

Child Maltreatment Solutions Network

Series Editor

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Innovative Methods in Child Maltreatment Research and Practice

Acknowledgements

This book is the culmination of activities that occurred during the Annual Conference on Child Maltreatment at Penn State held on September 2-3, 2021. The theme of the 2021 Annual Conference was Innovative Methods in Child Maltreatment Research and Practice. Despite the disruption of a global pandemic, scientists, providers, educators, caseworkers, students, and more attended the conference and heard professional presentations on the innovative methods being applied to address the current challenges created by child maltreatment. Those presentations serve as the foundation for the chapters that make up this book. I want to thank all the attendees, including those in-person and virtually, for making the 2021 conference such a success. I particularly want to thank each of the authors for their hard work and dedication in translating their presentations into chapters for this book. This is a long and arduous process that took numerous hours and revisions to carefully create the chapters included below. Thank you for your patience during this process as well as your commitment to advancing innovation for the field in this way.

I also want to thank Cheri McConnell and Sandee Kyler for their hard work in organizing the conference and supporting the efforts behind this book. I also want to thank the Centers, Departments, and Institutes at Penn State that supported the conference and the larger book series for which this book will belong: The Center for Safe and Healthy Children, The Child Study Center, The Prevention Research Center, The Center for the Protection of Children, The Child Maltreatment Solutions Network, and the Department of Human Development and Family Studies.

Finally, I want to thank my family - Virginia Shenk, Barry Shenk, Kimberly Von Dohren, Shaun Shenk, Jennie Noll, Margaret Noll, and Lydia Noll - and professional mentors - Alan Fruzzetti and Steven Hayes - for providing me the space, time, and

privilege for approaching a topic as important as child maltreatment with the compassion and scientific rigor it requires.

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Preface

Child maltreatment is an act of commission or omission by a caregiver that results in harm or risk for harm toward a person under the age of eighteen, including acts of physical abuse, sexual abuse, psychological abuse, and neglect (Gilbert et al., 2009). In the U.S., child maltreatment affects 12%-35% of the pediatric population (Kim et al., 2017; Wildeman et al., 2014) with annual incidences approaching nearly one million children (Sedlak et al., 2010; U.S. Department of Health and Human Services, 2022). The total lifelong economic impact of child maltreatment is now estimated at \$2 trillion dollars (Peterson et al., 2018). Clearly, reducing the incidence of child maltreatment and the impact it has across an individual's lifespan is an important societal and public health concern. Unfortunately, trends on the incidence of child maltreatment have remained largely stable across the last two decades (Gilbert et al., 2012), including potential increases in child fatalities resulting from maltreatment (U.S. Department of Health and Human Services, 2022), reflecting a lack of effective policies and interventions for reducing actual rates of child maltreatment (Curry et al., 2018). Furthermore, basic science research suggests a global risk for many adverse health conditions following child maltreatment (Noll & Shenk, 2010) yet the reproducibility of such research, and the mechanistic processes explaining such risk, remain elusive. For example, psychopathology is the leading cause of personal burden and disability worldwide (Global Burden of Disease Injury Incidence and Prevalence Collaborators, 2017; Patel et al., 2018) and child maltreatment creates a sustained risk for many, heterogeneous psychiatric disorders from childhood to adulthood (Baldwin et al., 2023). Yet, the significance and magnitude of this risk varies widely across individual studies and the transdiagnostic mechanisms explaining such risk, which would serve

as putative targets for preventive and clinical intervention, remain largely unknown. Being able to reach more children before and after maltreatment, and delivering interventions earlier and with novel intervention targets, holds considerable promise for improved screening, prevention, and treatment. The current book brings together recent innovations from national and international experts examining child maltreatment from both the research and practice perspectives to address these challenges and improve our collective responses to child maltreatment.

On the research perspective, Coleman and Baldwin (2023) demonstrate how the selection of prospective vs. retrospective methods have a differential impact on risk estimates generated from basic science research on the physical and mental health effects of child maltreatment. This work shines a light on the limitations of current methods, namely that they identify different people within the child maltreatment population, while providing a way forward for generating risk estimates that can be widely accepted by the larger scientific community. Shenk and colleagues (2023) address a methodological phenomenon, contamination, that occurs in control conditions when researchers rely on only one method of determining child maltreatment in basic science research. The bias that results from contamination can have dramatic effects on the significance and magnitude of risk estimates yet can be addressed by using innovative approaches for detection and statistical modeling. Noll and Roitman (2023) describe recent methodological advancements in the naturalistic measurement of internet behaviors and subsequent health risks following child sexual abuse. Using software tracking to quantify keyword searches, website traffic, and screen time, these researchers demonstrate for the first time how new methods can objectively measure internet behaviors following substantiated maltreatment and inform risk modeling for offline, real-person

encounters. Beal and colleagues (2023) report on innovative ways for linking information recorded in electronic child protective services records with information gathered in a child's electronic health record. This methodological advance has the potential to retain critical medical information for children and families as they navigate different placements and providers while offering direct evidence for how to advance substance use screening and prevention for the child welfare population. Addressing the gap on identifying mechanisms of adverse health following child maltreatment, Lamp and colleagues (2023) provide an in-depth description of the latest statistical methods for testing mediational processes affecting health outcomes following child maltreatment. This chapter contains a valuable conceptual overview easily accessible to those unfamiliar with statistical methods while containing the depth needed to excite quantitative experts studying these processes. Rounding out the research section, Guastaferrro (2023) provides a detailed tutorial on the Multiphase Optimization Strategy (MOST), a novel conceptual approach for developing and testing biobehavioral interventions with the aim of enhancing the efficiency, effectiveness, and scalability of these interventions. This chapter not only provides an introduction to MOST but lays out a vision for enhancing child maltreatment prevention, therefore aiding research on reducing actual rates of child maltreatment.

On the practice perspective, Hymel (2023) describes a program of translational research for enhancing the screening and detection of abusive head trauma in emergency departments and pediatric intensive care units. This program of research has systematically developed and refined an innovative screening tool that is evidence-based, easily accessible, and can be readily adopted by physicians, as demonstrated in randomized trials research. Valentino and colleagues (2023)

describe an innovative intervention, Reminiscing and Emotion Training (RET), delivered to mothers with a history of maltreating a child and designed to strengthen the dyadic relationship and child health outcomes. This intervention is applied following an investigation of child maltreatment with reported results offering strong implications for the prevention of future incidences of child maltreatment as well as adverse child health. Shaffer and colleagues (2023) review prior developmental research to justify the need for addressing novel intervention targets following psychological abuse. Once these targets are identified, the chapter outlines recent advancements in specific interventions addressing these targets and reporting on changes in clinical outcomes. Gruen and colleagues (2023) describe an innovative application of the Unified Protocols for treating psychiatric disorders following child maltreatment. Adapting the UP protocols developed for children and adolescents to the residential context, these authors provide detailed information to support implementation, lessons learned, and the preliminary effectiveness of the UP for addressing transdiagnostic targets with children exposed to maltreatment. Jurman (2023) describes the recent history and progress in making the State of Pennsylvania a “trauma-informed” state. Focusing on scalability at the State-wide level, this chapter reviews the initial development of this approach and current recommendations and strategies for making state agencies - from schools, the justice system, licensed healthcare providers, and more - aware of the need to screen and respond to trauma, including child maltreatment. Wandalowski and Vaithianathan (2023) describe a recent innovation for determining the risk for maltreatment at the County level, where reports of child maltreatment are investigated. They describe an evidence-based detection algorithm being implemented in Northampton County, PA, and designed to aid caseworkers in their

decision-making on whether to initiate a formal investigation of child maltreatment based on multiple risk indicators. Finally, Jackson and colleagues (2023) describe an NIH-supported educational program for graduate students and postdoctoral fellows seeing advanced training in the field of child maltreatment. This chapter describes the content of this training and the programmatic goal of preparing future scientists and practitioners to address the challenges of child maltreatment from a transdisciplinary perspective.

Innovative methods are the bridge between what we have been able to accomplish to help children and families affected by maltreatment and what challenges remain to further benefit children and families in the future. These methods are the tangible, pragmatic means for improving the lives of children now and into the foreseeable future, when inevitably newer innovations and methods will be needed to address the remaining gaps for fully ending child maltreatment as we know it. This book serves as one influential way to advance this progress and speed knowledge, aid, protection, and resilience to those children and families at risk for or affected by maltreatment.

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About the Editor

Chad Shenk, Ph.D., is an Associate Professor in the Department of Human Development & Family Studies and the Department of Pediatrics at Penn State. He is also a licensed clinical psychologist with specialty training in trauma exposure and pediatric psychology. Dr. Shenk's basic science research improves methods for risk estimation and target identification in prospective cohort studies of child maltreatment and adverse health across the lifespan. This work identifies biomarkers and putative mechanisms of adverse health conditions in the child maltreatment population using a multiple levels of analysis approach (e.g., biological, behavioral, environmental). His clinical trials and translational research therefore center on the optimization of behavioral interventions following exposure to child maltreatment by engaging identified targets and mechanisms more effectively. As Principal Investigator, Dr. Shenk's research has been funded by multiple institutes at the National Institutes of Health, the National Science Foundation, the American Psychological Association, as well as several Universities and Foundations.

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Ulziimaa Chimed-Ochir, M.A., is a doctoral student in the Department of Human Development and Family Studies at PSU. Ulziimaa's research interest revolves around parenting and parent-child relationships in the context of child maltreatment and complex trauma. Informed by the developmental perspective, she is interested in studying the negative effects of trauma on stage salient tasks (e.g., formation of attachment relationships, development of autonomy, social-emotional development) during the early childhood period. She is also interested in examining the effects of trauma-focused parent-child relational treatment programs across early- to mid-childhood, to understand the developmental processes in the aftermath of trauma experience, and the ways in which negative effects of complex trauma unraveled.

Oonagh Coleman, MSc., is a second year PhD student at the Social, Genetic and Developmental Psychiatry Centre at King's College London. Oonagh undertook her undergraduate degree at the University of Cambridge before completing a Masters in Psychological Sciences at University College London. Her Ph.D. aims to understand why retrospective and prospective measures of maltreatment identify different individuals, and how that might inform understanding of pathways of risk and resilience to psychopathology after childhood trauma. Her research focuses on the

role of memory and the subjective experience of trauma in the development of trauma-related psychopathology.

Christian Connell, Ph.D., is an Associate Professor of Human Development and Family Studies and Associate Director of the Child Maltreatment Solutions Network at the Pennsylvania State University. He completed graduate training in clinical-community psychology at the University of South Carolina and pre- and postdoctoral training in clinical-community psychology at Yale School of Medicine. His research examines the effects of maltreatment and other adverse experiences on child and adolescent mental health and wellbeing, their system involvement trajectories, and the effects of interventions to reduce negative outcomes of these experiences. He also conducts research on system-change initiatives to improve organizational capacity to meet the needs of children and families affected by maltreatment and other potentially traumatic events.

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Zachary Fisher, Ph.D., is an Assistant Professor in the Department of Human Development & Family at Penn State and member of the Quantitative Developmental Systems Methodology Core (QuantDev). His research interests lie at the intersection of developmental science, time-dependent processes, and statistical computing. Broadly, his research activities are focused on methods development in service of health and human development research and fall into three main areas:

the modeling of complex time-dependent systems, measurement issues commonly encountered in behavioral applications, and the synthesis of multi-way data (e.g. cross-sectional and time-series). While the primary focus of his work is methodological in nature, Dr. Fisher is heavily involved in research on the bio-psycho-social consequences of childhood trauma and extreme stress.

Mary V. Greiner, M.D., M.S., is a child abuse pediatrician and Professor within the Department of Pediatrics at the University of Cincinnati College of Medicine and Cincinnati Children's Hospital Medical Center. She is the medical director for the CHECK Center, which provides multidisciplinary and comprehensive healthcare to children with child welfare involvement. Her research aims to understand the health risks of children with child welfare involvement and evaluate innovative healthcare delivery approaches for children in or at risk of entering foster care. Her work, funded by multiple foundations and the Substance Abuse and Mental Health Services Administration, has led to improved health outcomes in the areas of medical, dental, developmental and mental health, from birth to transition to adulthood, in partnership with the community, including Hamilton County Job and Family Services.

Rinatte Gruen, M.S., is a graduate student under the mentorship of Dr. Jill Ehrenreich-May in the University of Miami's Clinical Psychology Ph.D. program. She graduated summa cum laude with honors in Psychology from Boston University and completed a research fellowship at the Yale Child Study Center through the Yale Fellowship in Translational Developmental Neuroscience. Her current work focuses on the implementation of transdiagnostic treatment for mood and anxiety disorders in children and adolescents and is driven by a passion for ensuring that high quality

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Kate Guastaferro, Ph.D., M.P.H., is an Assistant Professor in the Department of Social and Behavioral Sciences in the School of Global Public Health at New York University. She is an intervention scientist by training with expertise in prevention science, implementation science, and innovative methods for intervention optimization. Specifically, she is an expert in the multiphase optimization strategy (MOST) and is the Associate Director of the Center for Advancement and Dissemination of Intervention Optimization at New York University. Dr. Guastaferro's program of research is devoted to the development, optimization, implementation, and evaluation of effective, efficient, affordable and scalable interventions with high public health impact. In recognition of her work to prevent child sexual abuse, she was awarded the 2020 Victoria S. Levin Award for Early Career Success in Young Children's Mental Health Research from the Society for Research in Child Development. Her research has been funded by the National Institute of Child Health and Human Development.

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Children, Youth and Families for APA and as Director of the Multicultural Scholars Program at the University of Kansas. She further oversaw the development of trainee competency evaluation for all students in the Clinical Child Psychology Program at the University of Kansas for over 10 years (for 50+ trainees), ensuring that pre- and postdoc students were trained to meet the needs of the field at a high standard.

Karen Jacques, M.A., is a Ph.D. candidate in Clinical Psychology at the University of Notre Dame. Her research interests focus broadly on understanding how childhood adversities, such as maltreatment, may lead to or exacerbate psychopathologies. Further, she is interested in interventions and protective factors that can help lead to more positive developmental outcomes.

Daniel Jurman, D.Min., got his start working at a summer camp for at-risk youth in places like Camden, Newark and Atlantic City over 30 years ago. He went on to run programming and lead overnight and day camps for children with intellectual and physical disabilities and became a nonprofit leader whose career has focused on people whose circumstances have made them vulnerable. He has a bachelor's degree from Rowan University and master's and doctoral degrees from Lancaster Theological Seminary. His career has included working with people with intellectual disabilities, fundraising for healthcare services at rural and urban Federally Qualified Health Centers, and doing community organizing and anti-poverty work in Tampa, Florida and Lancaster, Pennsylvania. In December 2019, Dan began serving as the first Executive Director of Governor Wolf's new Office of Advocacy and Reform where his focus was to create better outcomes for all people whose circumstances have made them vulnerable. While there he wrote the state's Trauma-Informed PA

Plan, led Diversity, Equity, and Inclusion efforts, and worked to protect the state's most vulnerable residents from the impacts of Covid-19. He left that role in February 2022 to return to his roots and his first vocational love, camp, as the President and CEO of Camp Boggy Creek, a free, year-round camp for children diagnosed with serious illnesses. In addition to many volunteer roles in the community over the years, Dr. Jurman was also an adjunct professor/guest lecturer at the Penn State Hershey Department of Public Health Sciences and was an adjunct professor at Lancaster Theological Seminary where he co-taught a course on the intersection between Theology and Poverty. Dan currently lives in Winter Park, Florida with his wife and their three children.

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David Lindenbach, Ph.D., is a Research Associate in the Mathison Centre for Mental Health Research & Education at the University of Calgary. He is an interdisciplinary researcher who uses quantitative and qualitative methods to blend the fields of social services, psychology and neuroscience. He has a keen interest in

identifying how to implement and adapt evidence-based programs for community and specialized settings. He has done research in multiple areas related to child maltreatment, including how frontline providers recognize and respond to maltreatment, how maltreatment impacts development and how targeted interventions can mitigate the long-term impact of childhood trauma.

Linda Luecken, Ph.D., is a Professor of Psychology at Arizona State University (ASU). She received an M.A. in Experimental Psychology from the University of North Carolina, Chapel Hill, and a Ph.D. in Clinical Psychology from Duke University, and has been on faculty at ASU since 2000. Professor Luecken's program of research addresses the biological embedding of early life adversity and sociocultural risk and protective factors that promote resilience in the context of risk. She studies perinatal health in low-income and ethnic minority women and risk and protective influences on the emergence of biological, behavioral, and emotion self-regulation in low income and ethnic minority infants and children.

Erika Lunkenheimer, Ph.D., is a Professor of Psychology, Coordinator of the Developmental Psychology area, and an Associate Director of the Child Maltreatment Solutions Network in the Social Science Research Institute at Penn State. She is an Associate Editor of the APA flagship journal *Developmental Psychology* and an editorial board member of the *Journal of Family Psychology*. Her research has been funded by the National Institutes of Health (NIH) and the Institute for Education Sciences (IES), including K01 and R01 funding from the National Institute for Child Health and Human Development (NICHD). Her work has been published in many scientific journals, including *Developmental Psychology*, *Development and Psychopathology*, *Developmental Psychobiology*, *Journal of Child*

Psychology and Psychiatry, and the *Journal of Family Psychology*. Dr.

Lunkenheimer's research program revolves around risk and protective processes in the parent-child relationship, with special attention to the role of physiological, emotional, cognitive, and behavioral regulatory processes in the development of psychopathology. Her work involves the application of dynamic systems theory and analytic methods to address how mother, father, and child dyadic and individual regulatory patterns contribute to children's developmental outcomes especially in the context of harsh parenting and child maltreatment risk.

David P. MacKinnon, Ph.D., is a Regents' Professor of quantitative psychology at Arizona State University. He earned the Ph.D. degree in measurement and psychometrics from UCLA in 1986. He is fellow of the Society for Prevention Research, American Psychological Association Division 5, and the Association for Psychological Science. His applied interests are in human memory, health psychology, and prevention research. He has wide-ranging interests in statistics and methodology but his primary interest is in the area of statistical methods to assess how prevention and treatment programs achieve their effects.

Katie Nause, B.S., is a certified Clinical Research Coordinator IV at Cincinnati Children's Hospital. She completed her Bachelor of Science in psychology at Northern Kentucky University in 2013 and has worked in the CHECK Center since 2014. She provides study oversight, data management, and analyses for all CHECK Center research projects.

Jennie Noll, Ph.D., is the Ken Young Family Professor for Healthy Children in the Human Development and Family Studies (HDFS) Department in the College of Health and Human Development at Penn State University. She directs Penn State's

Center for Safe and Healthy Children and is the PI of the NICHD P50 Capstone Center for Excellence, *The Translational Center for Child Maltreatment Studies* (TCCMS; P50HD089922) and MPI of the T32 training grant *Creating the Next Generation of Scholars in CM Science* (CMT32; T32HD101390). For 3 decades, Dr. Noll has been conducting research to strengthen causal inference regarding the developmental and biologic impacts of child maltreatment (CM) through longitudinal, prospective research and contiguous NIH funding. She has been the PI on NIH grants aimed at discovering mechanisms that explain teen pregnancy and risky sexual behaviors in CM survivors (R01HD052533), risk for sex trafficking through adolescent internet and social media behaviors (R01HD073130), the biological embedding of CM across development (R03HD045346), and premature cognitive aging for adults who experienced CM (R01AG04879). She is also the PI on the longest ongoing prospective study of the developmental and intergenerational impacts of child sexual abuse spanning 3 decades and 4 generations (R01HD072468). She has Fellow status in the American Psychological Society (APS), the American Psychological Association (APA), and the Academy of Behavioral Medicine Research (ABMR). Published results from several of Dr. Noll's longitudinal studies have informed public policy recommendations for child abuse prevention and treatment by Pennsylvania's Joint State Government Commission, the Institute of Medicine (IOM), the World Health Summit, the NSPCC Scotland, and for several Federal Congressional briefings and hearings. The thrust and aims of Dr. Noll's research, centers, and infrastructure grants leverage translational messaging from cutting-edge science to aid evidence-informed policymaking focused on imploring a larger public investment in the primary prevention of CM and in improving the lives of survivors.

Anneke Olson, M.S., is a doctoral student in the Department of Human Development & Family Studies at Penn State. Anneke's research interests are in the effects of child maltreatment, specifically in identifying mediators and moderators in the association between child maltreatment and later behavioral and psychiatric outcomes. She is particularly interested in individual characteristics (e.g., emotion regulation), and family relationships (e.g., the parent-child relationship) and the ways in which these factors confer risk and resilience for youth who have been maltreated. Ultimately, she is interested in the development and evaluation of prevention and intervention programs for children and families who have been impacted by child maltreatment.

Nilam Ram, Ph.D., is Professor of Communication and Psychology at Stanford University. He studies the dynamic interplay of psychological and media processes and how they change from moment-to-moment and across the life span. Nilam's research grows out of a history of studying change. After completing his undergraduate study of economics, he worked as a currency trader, frantically tracking and trying to predict the movement of world markets as they jerked up, down and sideways. Later, he moved on to the study of human movement, kinesiology, and eventually psychological processes - with a specialization in longitudinal research methodology. Generally, Nilam studies how short-term changes (e.g., learning, information processing, emotion regulation, etc.) develop across the life span and how longitudinal study designs contribute to generation of new knowledge. He is developing a variety of study paradigms that use recent developments in data science and the intensive data streams arriving from social media, mobile sensors, and smartphones to study change at multiple time scales.

Margalit Roitman is a fourth-year undergraduate student at the Pennsylvania State University and a Schreyer Honors College scholar. She majors in Human Development and Family Studies with a minor in Child Maltreatment & Advocacy Studies and Deafness & Hearing Studies. She is the President of Pennsylvania State's Sign Language Organization and works directly with the deaf community. She also serves students with intellectual or developmental disabilities through volunteering with the *For Good Troupe and Harmony* society. Ms. Roitman regularly interacts with young children through an assistant teaching volunteer at the Goddard School daycare center.

Hannah Schreier, Ph.D., is an Associate Professor of Biobehavioral Health at The Pennsylvania State University. Her research examines the physiological consequences (primarily youth metabolic and inflammatory outcomes relevant to long-term chronic disease risk) of being exposed to adverse events (e.g., child maltreatment) or growing up in adverse environments (e.g., low socioeconomic status) and explores the use of social interventions to actively improve these same outcomes. To this end, she currently leads two R01 awards from the National Heart, Lung, and Blood Institute and is an MPI of the Child Health Study, a large, prospective cohort study aiming to understand the biological embedding processes connecting experiences of child maltreatment with later life health as part of Penn State's Translational Center for Child Maltreatment Studies.

Anne Shaffer, Ph.D., is a Professor of Psychology at the University of Georgia, where she also serves as Associate Dean of the Graduate School. Her research has addressed processes of risk and protection in the family context, with a specific focus on emotion-related factors such as emotional maltreatment and emotion

communication. As a licensed clinical psychologist, this research has extended to the development and evaluation of parenting interventions. A secondary interest focuses on the refinement and innovation of the measurement and assessment of parenting, including parental emotion regulation and emotion socialization. This research has been supported by the National Institute of Mental Health and the Eunice Kennedy Shriver National Institute of Child Health and Human Development.

Kenneth A. Shores, Ph.D., is an Assistant Professor specializing in education policy in the School of Education at the University of Delaware, and he is affiliated with the University of Delaware Center for Research in Education and Social Policy, the Biden School of Public Policy and Administration, and the Data Science Institute. His research is focused on educational inequality and encompasses both descriptive and causal inference. To this end, his work addresses racial/ethnic and socioeconomic inequality in test scores, school disciplinary policy, classification systems, and school resources. In addition, he has examined how improvements to school finance systems can reduce educational inequality and how vulnerabilities in school finance systems can contribute to it.

Jacqueline Unkrich, M.S.W., is a licensed social worker who completed her Bachelor of Arts from Mount Saint Joseph and her master's degree in Social Work from the University of Cincinnati. Before joining the CHECK Center in 2021, she was director for a regional intensive family services program working directly with families with child welfare involvement. In the CHECK Center, she delivers brief interventions for young people who endorse substance use and is trained in nicotine reduction strategies.

Rhema Vaithianathan, Ph.D., is a Professor of Economics at Auckland University of Technology, New Zealand where she founded the Centre for Social Data Analytics and leads a multidisciplinary team that works closely with health and human services agencies, predominantly in the United States, to develop and deploy research-led machine learning tools. Rhema is recognized internationally for translational research that uses data analytics for social impact. A cornerstone project has been the development of the world-first Allegheny Family Screening Tool, a decision support tool for child welfare hotline screening tool implemented in 2016 and profiled in The New York Times Magazine and Nature News. Rhema has held numerous research positions in Australia, Singapore and the United States, including a Harkness Fellowship at Harvard University.

Kristin Valentino, Ph.D., is Professor of Psychology and the Director of the William J. Shaw Center for Children of Families at the University of Notre Dame. She is also a licensed clinical psychologist. Dr. Valentino's program of research addresses how adversity affects child development with a focus on the caregiving behaviors that may promote risk and/or resilience among families with a maltreatment history. She evaluates how interventions may be designed to improve caregiving and, in turn, to improve developmental outcomes for children who have been maltreated. Guiding her research is a developmental psychopathology perspective which emphasizes the interface between normal and atypical development and employs a multiple-levels-of-analysis approach towards the study of child development and child psychopathology. Her research has been funded by NICHD, NIMH, and NIMHD. Dr. Valentino is the President-Elect for the American Psychological Association Division 37 Section on Child Maltreatment. She serves as an Associate Editor for the journal

Child Maltreatment and is a standing member of the National Institute of Health's Psychosocial Development, Risk, and Prevention Study Section.

Susan Wandalowski, M.S.Ed., is the Director of Human Services for Northampton County in Pennsylvania, where she oversees Children, Youth and Families, Drug & Alcohol, Mental Health, Early Intervention, Developmental Programs, Aging, Health Choices, Veteran's Affairs, Information Referral and Emergency Services, and the county nursing home. Having graduated from St. Joseph's University with a B.S. in Psychology and the University of Pennsylvania with an M.S.Ed., Sue has over twenty years of experience in child welfare. She began her career managing a transitional living program for homeless youth, followed by work in the foster care and permanency fields. As a member of the executive team for Resilient Lehigh Valley, Sue is a champion for trauma informed care across all sectors. Sue has a keen interest in leveraging data to support decision making.

Miriam Zegarac, M.S., is a clinical psychology doctoral student at the University of Georgia. Her research interests involve understanding parental emotion regulation and individual, family, and societal factors that help parents support children's emotional development, especially in key developmental windows. In particular, Miriam has investigated co-parenting, emotion regulation, and parental involvement during the transition to parenthood and adolescence. She has been a member of the Family Relationships, Emotions, Stress, and Health Lab directed by Dr. Anne Shaffer at The University of Georgia since 2019. Clinically, she is interested in the implementation of accessible, culturally sensitive, and evidence-based intervention and prevention programs for children and parents who have experienced trauma and/or maltreatment or are at-risk of maltreatment.

Part I: Innovative Methods in Research

Prospective Versus Retrospective Measures of Child Maltreatment and Their Relationships with Health

Oonagh Coleman, MSc. & Jessie R. Baldwin, Ph.D.

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Abstract

Childhood maltreatment is a well-established risk factor for mental and physical health problems. Researchers, clinicians, and public health professionals assess childhood maltreatment through prospective or retrospective measures, with the assumption that both measures are interchangeable. In this chapter, we critically evaluate this assumption by reviewing evidence examining whether prospective and retrospective measures of child maltreatment: (i) identify the same individuals, and (ii) differentially predict health outcomes. The evidence to date suggests three takeaway findings. First, prospective and retrospective measures of child maltreatment identify largely different groups of individuals and therefore cannot be used interchangeably. Second, retrospective self-reports of child maltreatment are more strongly associated with self-reported mental and physical health problems, in comparison to prospective measures. Third, prospective measures of child maltreatment are more strongly associated with objectively measured health problems compared to retrospective measures. Further research is needed to replicate these findings, and understand whether individuals with prospective or retrospective measures of child maltreatment have different risk mechanisms for poor health.

Keywords: child maltreatment; ACEs, mental health; physical health; prospective measures; retrospective measures

1 Introduction

Child maltreatment has been identified as a key risk factor for poor mental and physical health outcomes throughout the life course (Anda et al., 2006; Arseneault et al., 2011; Baldwin & Danese, 2019; Brown et al., 1999; Danese & Tan, 2014; Felitti et al., 1998; Scott et al., 2011; Widom, 1989). However, recent research has suggested that the relationship between child maltreatment and poor mental and physical health may differ depending on how maltreatment is measured (e.g., Danese & Widom, 2020; Reuben et al., 2016). Crucially, this could have implications for understanding the mechanisms through which poor health outcomes develop after childhood maltreatment, and for identifying the individuals who are at greatest risk of developing certain outcomes.

In this chapter, we review evidence examining whether different measures of maltreatment, namely, *prospective* versus *retrospective* measures, identify the same individuals and differentially predict health outcomes. We begin by outlining the differences between prospective and retrospective measures before discussing research that has examined the agreement between prospective and retrospective reports of maltreatment. Next, we review studies that have examined the associations between prospective and retrospective measures of maltreatment with mental and physical health outcomes. Last, we provide conclusions based on the evidence to date, and highlight recommendations for future research.

2 Prospective vs Retrospective Measurement of Child Maltreatment

Child maltreatment can be measured in two ways: through prospective measures collected while the child is growing up, or through retrospective measures collected in adulthood, years after the potential exposure (Baldwin et al., 2019).

These measures differ in a number of ways. First, prospective measures are usually

based on parent reports or official records, for example from Child Protection Services, whilst retrospective measures typically involve self-reports by adults. It is less common for prospective measures to involve self-reports from children as there are several ethical and practical challenges in collecting information on maltreatment from children. Second, prospective measures are used in longitudinal studies to examine relationships between maltreatment and later health outcomes, whereas retrospective measures tend to be used in cross-sectional studies, whereby health outcomes are assessed concurrently with retrospective reports of childhood maltreatment. Such concurrent assessment of health outcomes with reports of maltreatment means that retrospective measures might be subject to recall bias – in which current symptoms affect the likelihood of recalling or reporting negative experiences (Hardt & Rutter, 2004). Third, because prospective measures tend to be collected in longitudinal designs, they involve greater time and financial investment than retrospective measures.

2.1 The Assumption of Equivalence

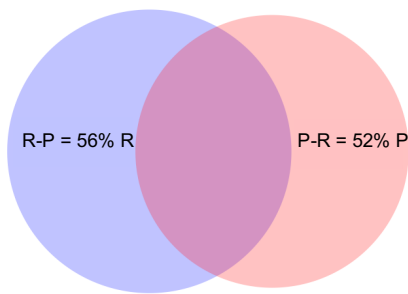
Much of our understanding about the links between childhood maltreatment and later life health outcomes has come from studies using retrospective reports of maltreatment (e.g., Hughes et al., 2021; Susser & Widom, 2012; Teicher et al., 2016), likely because such studies are cheaper and quicker than prospective studies. Importantly, use of retrospective measures has relied on the assumption that they *identify the same individuals as prospective measures* – the assumption of equivalence (Danese, 2020). If this assumption is true, then health outcomes associated with retrospective measures of maltreatment will also apply to children identified prospectively as having been maltreated. However, if retrospective and prospective measures identify different groups of individuals, then the health

outcomes linked to each measure might differ. Given that much of the research linking child maltreatment to later adult life health outcomes is based on retrospective measures, these outcomes might not generalize to children who have prospective reports of maltreatment.

2.2 Agreement between Prospective and Retrospective Measures

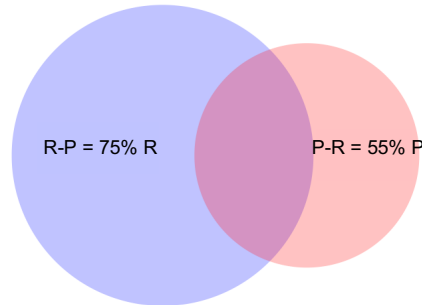
To test this assumption of equivalence, Baldwin et al. (2019) conducted a meta-analysis of the agreement between prospective and retrospective measures of child maltreatment. Across 16 cohorts with 25,471 individuals, the meta-analysis found that prospective and retrospective measures of maltreatment identified largely different groups of individuals. For example, 56% of people who retrospectively reported maltreatment didn't have concordant prospective evidence of maltreatment, and likewise, 52% of people with prospective measures of maltreatment didn't retrospectively report in adulthood. Similar results were found when focusing on specific subtypes of maltreatment, such as physical abuse, emotional abuse, sexual abuse, or neglect (Figure 1).

Retrospective recall Prospective measure



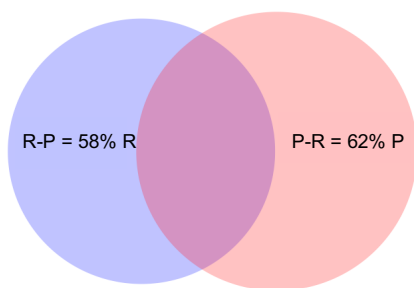
Child maltreatment (k=7)

Retrospective recall Prospective measure



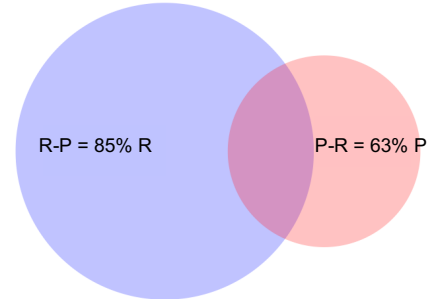
Child sexual abuse (k=8)

Retrospective recall Prospective measure



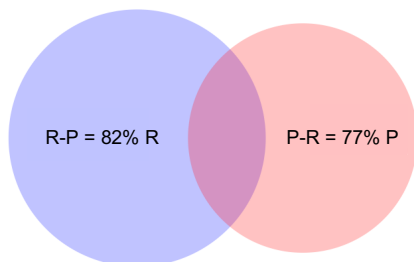
Child physical abuse (k=9)

Retrospective recall Prospective measure



Child emotional abuse (k=4)

Retrospective recall Prospective measure



Child neglect (k=4)

Figure 1. Overlap between individuals identified by virtue of prospective or retrospective measures of childhood maltreatment. In the Venn diagrams, the blue circles indicate retrospective recall, whereas the pink circles indicate prospectively identified childhood maltreatment. The blue nonoverlapping section (R-P) shows the proportion of individuals who retrospectively reported a history of childhood

maltreatment but were not prospectively identified as experiencing maltreatment in childhood. The pink nonoverlapping section (P-R) shows the proportion of individuals who were prospectively identified as experiencing maltreatment in childhood but did not retrospectively report a history of childhood maltreatment. The overlap between the 2 circles shows the proportion of individuals who were prospectively identified as experiencing maltreatment in childhood and retrospectively reported a history of child maltreatment. The figure is reproduced from Baldwin et al. (2019), JAMA Psychiatry.

The agreement between prospective and retrospective measures of maltreatment was also poor when measured through Cohen's Kappa, which accounts for chance agreement ($\kappa=0.19$, 95% CI=0.14-0.24 - Figure 2).

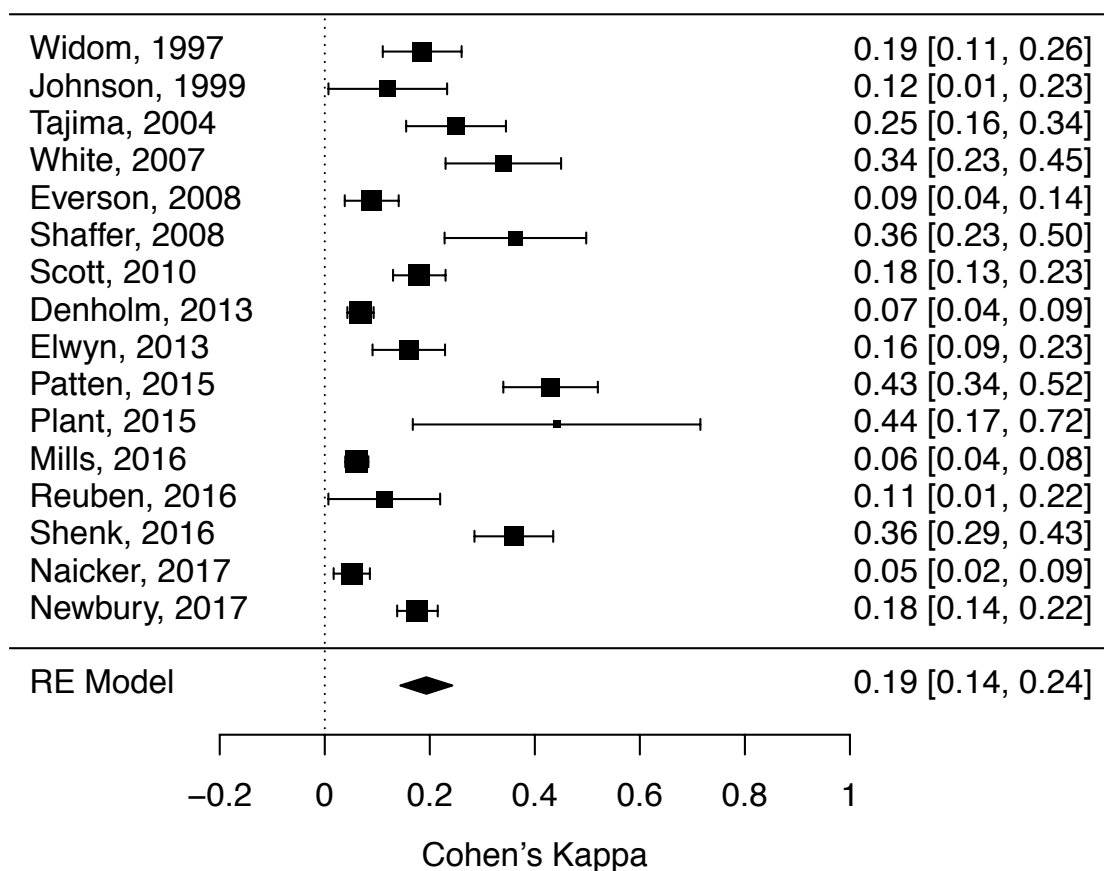


Figure 2. Forest plot depicting the results of a random-effects meta-analysis for the agreement between prospective and retrospective measures of child maltreatment. Results are presented as Cohen's kappa values for the agreement between prospective and retrospective measures of child maltreatment. The figure is reproduced from Baldwin et al. (2019), JAMA Psychiatry.

The study also examined whether heterogeneity in the agreement between prospective and retrospective measures of child maltreatment was influenced by various measurement characteristics. First, they found that agreement between prospective and retrospective measures was greater when studies assessed retrospective recall through interviews relative to questionnaires (Figure 3).

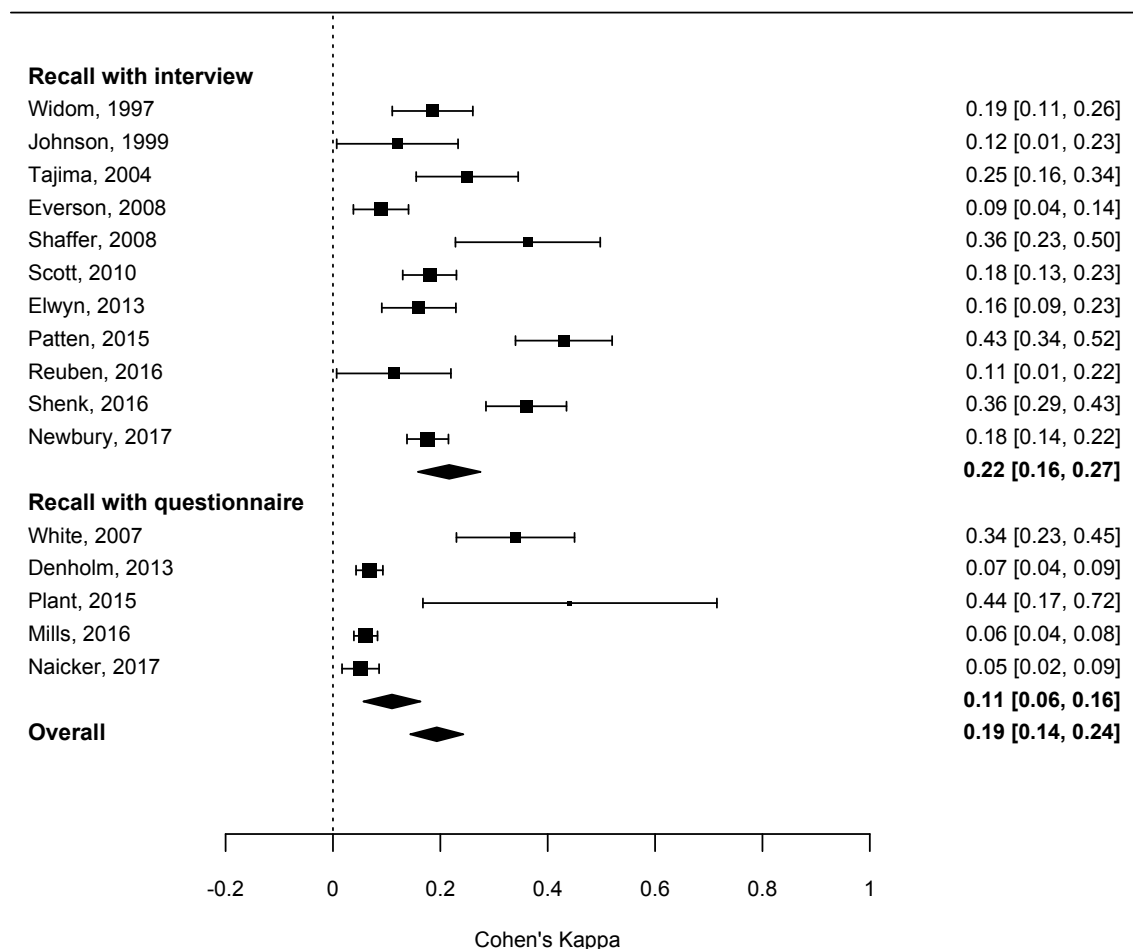


Figure 3. Forest plot depicting the results of a random-effects meta-analysis stratified by the type of retrospective measure used. Results are presented as Cohen's kappa values for the agreement between prospective and retrospective measures of child maltreatment. The figure is reproduced from Baldwin et al. (2019), *JAMA Psychiatry*.

A possible explanation for this is that people feel more comfortable disclosing information about maltreatment in the context of an interview where they have built up a rapport with the interviewer. Interviews also offer the possibility to clarify definitions of maltreatment and understand more precisely what is actually being assessed relative to more impersonal questionnaires. Second, greater agreement between prospective and retrospective measures was found in studies with smaller sample sizes. One explanation for this result is that in studies with smaller samples, more detailed interviews are possible relative to larger samples where detailed assessments might not be feasible due to time or financial constraints. In contrast, the type of prospective measure used, the age at retrospective reports, the sex distribution, and the quality of the study, did not affect heterogeneity in the agreement between prospective and retrospective measures of child maltreatment.

2.3 Reasons for Low Agreement between Prospective and Retrospective Measures

Low agreement between prospective and retrospective measures of child maltreatment might be due to a number of factors. Firstly, the motivation of the reporter could affect agreement (Baldwin et al., 2019; Della Femina et al., 1990). For example, in the context of prospective parent reports, information might be intentionally withheld due to fear that reporting maltreatment might lead to the

parents being reported to the authorities (Kalichman, 1999). Individuals might also withhold information if they prefer to avoid discussing upsetting experiences, or don't feel comfortable with the interviewer. On the other hand, it is also possible (although less likely) that people might intentionally fabricate information about maltreatment, for example in the context of a family dispute (Goodyear-Smith, 2016).

Secondly, poor agreement between retrospective and prospective measures of maltreatment might be explained by systematic differences between measures, such as measurement type (e.g., interview, questionnaire, or official record), period of observation, or reporter. Also, measurement sensitivity varies depending on the type of measure used. For example, prospective measures using official records might have lower rates of false positives due to the rigorous process of substantiation involved; however, because only a small proportion of maltreated children come to the attention of professionals, less severe cases might be left undetected (Gilbert et al., 2009). While retrospective measures may identify cases that might have been missed by official records, they are also more open to differences between people in the interpretation of past experiences (Kendall-Tackett & Becker-Blease, 2004).

Finally, deficits in memory across all stages, from encoding to retrieval, could reduce the accuracy of reports of maltreatment and contribute to lower levels of agreement (Baldwin et al., 2019; Goodman et al., 2010; Susser & Widom, 2012). For example, factors that limit the formation or retrieval of memories of childhood experiences, or that bias or distort existing memories, might lead to discrepant reports.

2.4. Implications of Low Agreement between Prospective and Retrospective Measures

Importantly, disagreement between prospective and retrospective measures does not imply that retrospective reports of childhood maltreatment are not valid. Indeed, there are also potential limitations with prospective measures that may limit the agreement with retrospective reports, such as low measurement sensitivity (Gilbert et al., 2009; Sedlak & Broadhurst, 1996). However, these findings do indicate that prospective and retrospective measures of maltreatment identify largely different groups of individuals, and therefore cannot be used interchangeably (Baldwin et al., 2019). Because of this, it is inaccurate to assume that prospective and retrospective measures of maltreatment will be associated with the same health outcomes and underlying risk mechanisms. This is particularly important given that much of the research linking maltreatment to later life health outcomes is derived from studies using retrospective measures (e.g., Baldwin, 2021; Hughes et al., 2021; Susser & Widom, 2012; Teicher et al., 2016). It is therefore important to understand whether prospective and retrospective measures of child maltreatment differentially predict health outcomes.

3 Associations between Prospective and Retrospective Measures of Child Maltreatment and Health Outcomes

In this section, we review studies that have examined the independent associations between prospective and retrospective measures of child maltreatment with health outcomes. We focus first on mental health outcomes before turning to physical health outcomes.

3.1 Mental Health Outcomes

A number of studies have examined the associations between prospective and retrospective measures of maltreatment with mental health outcomes. One of

the earliest studies to address the question of the association between prospective and retrospective measures and mental health outcomes used data from the US-based Minnesota Longitudinal Study of parents and children, established in 1975 (Shaffer et al., 2008). The study recruited pregnant mothers from low socio-economic backgrounds and followed their 170 children for several decades.

Prospective measures of maltreatment were collected across multiple assessments from birth to age 17, taken from interviews with caregivers, children, and teachers, reviews of CPS records, and observations of parents and children. At age 19, participants retrospectively reported on their experiences of maltreatment. In addition, emotional and behavioural problems were assessed through parent, teacher, and self-reports at age 16 and psychiatric diagnoses were self-reported by participants at age 17.5.

Shaffer et al (2008) found that levels of emotional and behavioural problems at age 16 were highest in those who had both prospective and retrospective measures of maltreatment, whilst those with only prospective or only retrospective measures of maltreatment didn't differ significantly from those with neither prospective nor retrospective measures. These results were generally consistent when emotional and behavioural problems were reported by parents, teachers, or via self-reports. However, for psychiatric outcomes at age 17.5, individuals with retrospective reports of maltreatment only (and no prospective measures) had a higher number of psychiatric diagnoses than non-maltreated individuals, whereas those with prospective measures only (and no retrospective reports) didn't differ from the non-maltreated group.

More recently, Newbury and colleagues (2018) examined the independent associations between prospective and retrospective measures of child maltreatment

and mental health problems in a large cohort of young adults. Data were from the E-Risk Longitudinal Twin Study, which includes 2,232 twins born between 1995 and 1996 in the UK and followed up to age 18. Prospective measures of maltreatment were assessed between birth and age 12 across repeated home visits, through parent interviews, and through research worker observations of the parent and child and the home environment. At age 18, participants retrospectively reported on maltreatment occurring between birth and age 12 and they were also assessed for psychiatric disorders through a self-reported clinical interview.

Newbury and colleagues (2018) found that prospective and retrospective measures of child maltreatment were independently associated with a range of psychiatric disorders at age 18, including internalising disorders (e.g., depression, self-injury) and externalising disorders (e.g., alcohol/cannabis disorder, conduct disorder). Notably though, retrospective measures often showed stronger associations with psychiatric disorders compared to prospective measures. This suggested that the link between childhood maltreatment and psychopathology in adulthood might at least partly be driven by whether the person with a history of psychopathology retrospectively recalls experiencing maltreatment.

This hypothesis was supported by research examining the role of prospective and retrospective measures of maltreatment in mental health problems in adulthood using a unique sample from the U.S. (Danese & Widom, 2020). Children with court records of abuse and neglect were prospectively identified from a metropolitan area of Midwest between 1967 and 1971 and were matched to a non-maltreated sample of controls with similar age, ethnicity, and socio-economic status. Both the maltreated children and controls were then followed up at age 29 and assessed for retrospective reports of maltreatment and psychiatric disorders.

Among individuals with *only* prospective court records of maltreatment, the prevalence of lifetime psychiatric disorders did not differ from the non-maltreated control group (Danese & Widom, 2020). However, among those with both prospective and retrospective measures of maltreatment, the prevalence of lifetime psychiatric disorders was significantly higher than the non-maltreated group. Interestingly, those with a retrospective report of maltreatment that wasn't prospectively documented in the court records had a similarly elevated prevalence of psychiatric disorders compared to those with both prospective and retrospective measures. These findings were consistent across both internalizing and externalizing disorders and specific diagnoses. This suggests that the risk of psychopathology linked to maltreatment in adulthood might be driven by those who have retrospective reports of maltreatment, given that no association was observed in those with prospective measures only. Notably, this could not be explained by recall bias, as the results were consistent when restricting the analyses to participants without current psychopathology at the time of retrospective recall.

Lastly, similar findings were observed in a sample of 1,037 adults from New Zealand, followed from birth to midlife as part of the Dunedin Study (Reuben et al., 2016). In this study, ACEs were prospectively measured between birth and age 16 from repeated assessments involving reviews of social service contacts, interview notes from interviews with parents, and observations of the parents and child's relationship. At age 38, participants retrospectively self-reported on their histories of ACEs, and between age 18 and 38, psychiatric symptoms were assessed through self-reported clinical interviews.

After adjusting for retrospective measures of ACEs, Reuben and colleagues (2016) found that the prospective ACEs measure was not significantly associated

with psychopathology. In contrast the retrospective measure remained strongly associated with psychopathology after adjusting for the prospective measure. Taken alongside the findings from Newbury et al. (2018), Danese and Widom (2020), and to some extent, Schaffer et al. (2008), these results suggest that memories and perceptions of childhood adversities may drive psychopathology risk in individuals retrospectively self-reporting a history of exposure.

3.2 Physical Health Outcomes

In the next section, we review evidence on whether prospective and retrospective measures of child adversities differentially predict physical health outcomes. Because physical health problems can be assessed through objective measures (e.g., biomarkers or anthropometric measures) as well as subjective self-reports, we differentiate between outcomes assessed through these different types of measures.

3.2.1 Self-reported Physical Health

Two studies have examined the associations between prospective and retrospective measures of maltreatment with self-reported physical health. First, in the Dunedin Study from New Zealand (discussed above), participants were asked to self-rate their health at age 38 in addition to retrospectively reporting exposure to ACEs (Reuben et al., 2016). The study found that the prospective measure of ACEs was not significantly associated with self-reported poor physical health after adjusting for the retrospective measure. In contrast, retrospective reports of ACEs were independently associated with self-reported poor health after adjusting for prospectively measured ACEs.

A second study using data from the Family and Community Health Study from the US observed similar findings (Berg et al., 2020). The study included over 8,000 African American children from Iowa and Georgia who were prospectively assessed for ACEs through a self-report interview at age 10. At age 29, the participants retrospectively reported on ACEs and self-reported physical illness symptoms. Similar to the Dunedin study, the prospective measure of ACEs was not significantly associated with self-reported physical illness after controlling for the retrospective measure. In contrast, the retrospective report of ACEs was independently associated with self-reported physical illness after controlling for the prospective measure. Notably, this pattern of results mirrors that observed for self-reported mental health outcomes, suggesting that the association between childhood adversities and perceived poor mental and physical health is driven by retrospective, but not prospective, measures of ACEs.

3.2.2 Objectively Assessed Physical Health

While self-reports of health problems can be affected by reporters' personality styles (e.g., neuroticism; Watson & Pennebaker, 1989) or cognitive biases, objective measures of health (e.g., biomarkers) are not affected by reporting characteristics. Therefore, it is important to understand whether the differential associations between prospective and retrospective measures of child maltreatment and self-reported health problems are observed when health problems are assessed through objective measures.

A handful of studies testing this question have generally shown the opposite pattern of results to those based on self-reported outcomes – namely, that *prospective* measures show stronger associations with objectively measured physical health outcomes, relative to retrospective measures. For example, in the

Dunedin Study, Reuben et al (2016) found that prospective measures of ACEs were associated with poorer biomarker-indexed health at age 38, including 9 indicators of metabolic abnormalities, cardiorespiratory fitness, pulmonary function, periodontal disease, and systemic inflammation, independent of retrospective reports. In contrast, retrospective reports were not associated with biomarker indexes of poor health, independent of prospective measures. Other studies have found similar results for the association between prospective and retrospective reports of child maltreatment and chronic inflammation, indicated through high levels of C-reactive protein (CRP). For example, Osborn and Widom (2019) found that individuals with prospectively ascertained official reports of maltreatment had significantly elevated CRP levels at age 23, while retrospective self-reports of childhood maltreatment were not associated with elevated levels of CRP (Osborn & Widom, 2020). These findings were also replicated by Kraav and colleagues (2020) in a Finnish sample of middle-aged men, which found that documented records of ACEs were associated with higher levels of CRP, while retrospective self-reports did not show a similar association. However, in contrast to these results, Berg et al (2020) found that in the Family and Community Health Study, both prospective and retrospective measures of maltreatment were independently associated with a slightly higher odds for biomarker-indexed cardiovascular risk at age 29.

In addition to biomarkers, researchers have also examined the associations between prospective and retrospective measures of ACEs with brain structural outcomes (Gehred et al., 2021). In the Dunedin Study, participants underwent MRI scans at age 45 to assess for brain cortical thickness and grey matter volume. Gehred and colleagues (2021) found that prospective measures of ACEs were associated with a lower cortical surface area after controlling for retrospective

measures. In contrast, retrospective reports of ACEs were not associated with differences in brain surface area after controlling for prospective measures. The results were very similar when examining average cortical thickness: prospective measures of ACEs were independently associated with lower cortical thickness, whereas retrospective measures were not. These results were also consistent when the analysis was limited to specific brain regions.

4 Discussion

This chapter reviewed evidence examining whether prospective and retrospective measures of child maltreatment identify the same individuals and differentially predict health outcomes. We highlight three key takeaway messages.

First, prospective and retrospective measures of child maltreatment identify largely non-overlapping groups of individuals (Baldwin et al., 2019). Evidence shows that over half of individuals with prospective measures of maltreatment do not report it retrospectively in adulthood. Likewise, over half of individuals retrospectively reporting maltreatment do not have concordant prospective measures. This suggests that prospective and retrospective measures of maltreatment are not interchangeable. Future research is needed to understand the reasons for low agreement between prospective and retrospective measures of maltreatment, for example by examining factors that might influence the subjective experience and interpretation of an event and the likelihood that an individual perceives their environment to be threatening or dangerous (e.g., personality, temperament, or psychopathology). Likewise, exploring factors that predict memory encoding and consolidation (e.g., age at which an experience occurs) and ways in which individuals avoid or block memory retrieval as a cognitive coping strategy might lead

to greater understanding of reasons for disagreement between prospective and retrospective reports of maltreatment.

Second, evidence suggests that retrospective measures of child maltreatment are more strongly associated with self-reported mental and physical health problems relative to prospective measures of maltreatment. One explanation for this is that memories and perceptions of maltreatment might lead to cognitive difficulties (e.g., poor self-esteem, emotional dysregulation, processing biases) that in turn result in mental health problems and perceived physical health problems (Baldwin & Esposti, 2021; Danese & Widom, 2021). In contrast, individuals who don't recall maltreatment that was prospectively documented seem to be protected from developing poor mental health and perceived physical health, perhaps because of adaptive cognitive functioning. Given that retrospective recall of maltreatment is closely tied to mental health, future research investigating why some individuals might not recall or perceive themselves as having been maltreated might give us insight into resilience against mental health problems among those with experiences of adversity. However, an alternative hypothesis is that the association between retrospective measures of maltreatment and self-reported health outcomes is driven by recall bias, as people who have perceived mental or physical health problems might be more likely to report maltreatment than those who are in good health (Hardt & Rutter, 2004). Future research is needed to test this, for example by examining whether within-individual changes in mental health predict within-individual changes in reports of maltreatment over time (e.g., Goltermann et al., 2021).

Third, in contrast to self-reported health outcomes, prospective measures of child maltreatment seem to be more strongly associated with objectively measured health problems compared to retrospective measures. This hypothesis suggests that

exposure to child maltreatment assessed through prospective measures might lead to neurobiological differences, regardless of whether maltreatment is recalled and reported retrospectively. This is intriguing, given that individuals with prospective, but not retrospective, measures of maltreatment do not perceive themselves to be in poor health. However, because only a small number of studies have tested the independent associations between prospective and retrospective measures of maltreatment and objectively measured health outcomes, future research is needed to clarify these findings.

In summary, the differential association of prospective and retrospective measures of maltreatment with health outcomes could indicate the existence of different mechanisms linking prospective versus retrospective measures of child maltreatment to poor health. Recalled or perceived maltreatment might lead to disrupted cognitive processes that increase risk for psychopathology, whereas prospectively reported maltreatment might lead to neurobiological differences that increase risk for later health problems. Future research on these potential mechanisms has the potential to inform therapeutic techniques. For example, understanding the role of perceptions and memories of maltreatment in psychopathology could lead to more effective interventions to prevent mental health problems in survivors of child maltreatment.

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**Addressing Contamination Bias in Child Maltreatment Research: Innovative
Methods for Enhancing the Accuracy of Causal Estimates**

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Abstract

Contamination occurs when members of a control condition receive or are exposed to the treatment under scientific investigation. The presence of contamination violates assumptions within counterfactual models of causal inference and results in two systematic and sequential problems: 1) measurement error in the form of misclassification of units in a control condition, and 2) bias in statistical modeling that affects the direction, magnitude, and significance of causal estimates. Contamination has the potential to underestimate the true causal effect within an individual study while creating variation in causal estimates across studies based on different degrees of contamination present. Originally examined in experimental research, this paper introduces the concept of contamination as applied to observational research and uses the substantive area of child maltreatment as an illustrative example. The paper also offers methodological solutions to improve the detection of contamination while describing statistical approaches that demonstrate the impact of contamination bias and estimate causal effects in observational research after it is controlled. The goal of this chapter is to orient child maltreatment scientists conducting observational research to the issue of contamination bias and current approaches for addressing it.

Keywords: child maltreatment; contamination; counterfactual; observational research; dual measurement strategy; propensity score; synthetic controls; augmented synthetic controls; quasi-experimental; non-randomized; official case records; self-report; LONGSCAN; NSCAW-II

1 Background

The counterfactual model of causal inference serves as the foundation of modern scientific knowledge. The empiricist philosopher David Hume is generally credited with being the first to establish counterfactual reasoning in the case of causal inference: “We may define a cause to be an object followed by another, and where all the objects, similar to the first, are followed by objects similar to the second. Or, in other words, where if the first object had not been, the second never had existed (Hume, 1748/2007, p.56).” This reasoning has been formally developed and refined since Hume proposed it (Neyman, 1923/1990; Pearl, 2000) with the counterfactual model now endemic across scientific disciplines examining cause and effect relations, including the psychological (Shadish et al., 2002), statistical (Rubin, 2005), and public health sciences (Höfler, 2005). The counterfactual model has also produced seminal experimental and observational research designs for promoting causal inference, including the randomized experiment in agriculture and biology, the natural experiment in physics and economics, the prospective cohort design in epidemiology, the case-control design in medicine, and the single-subjects design in behavioral analysis. Indeed, much of what is known about the relations among natural phenomena is the direct result of the counterfactual model of causal inference and the methods it has engendered.

A foundational assumption of the counterfactual model of causal inference is that different levels or conditions of a causal variable, such as treatment vs. control or exposure vs. comparison, are and remain mutually exclusive throughout data collection on an outcome of interest. That is, no one unit (e.g. cell, plant, person, state) assigned to one level of a causal variable participates in or receives another level of that same causal variable. While this assumption exists in multiple

counterfactual frameworks (Cook & Campbell, 1979; Morgan et al., 2009), it is stated explicitly as part of the stable unit treatment value assumption (SUTVA) in the potential outcomes framework (West & Thoemmes, 2010). In this framework, it is assumed that each unit does not receive multiple levels, or different versions, of the causal variable of interest (see Imbens & Rubin, 2015, p.10). Adherence to the general mutual exclusivity assumption, and SUTVA specifically, ensures that inferences about the direction, significance, and magnitude of the causal effect are unbiased, promoting replication and reproducibility that ultimately strengthen causal inferences.

In reality, there are many occasions when SUTVA is violated in both experimental and observational research. For example, wind during an evaluation of a new, genetically-modified strain of corn designed to improve crop-yields or resistance to pest infestations may introduce cross-pollination with a non-modified strain in a nearby field (Quist & Chapela, 2001). The effects of a de-worming treatment to improve attendance in select African schools can indirectly benefit attendance in nearby control schools through a geographic reduction in overall infection rates (Davey et al., 2015; Hicks et al., 2015; Miguel & Kremer, 2004). An educational intervention for improving self-concept for certain students within a classroom can benefit other students in the same classroom who did not directly receive the intervention but who interacted with students that did about the intervention (Craven et al., 2001). Failure to detect and correct these commonly occurring SUTVA violations can have serious scientific consequences. Specifically, SUTVA violations can introduce bias into resulting causal estimates, namely, where the direction, magnitude, or statistical significance of between-level differences is attenuated because some proportion of the units in a control condition have actually

received the treatment under investigation (Jo, 2002; Marfo & Okyere, 2019). This can have wide spread implications for causal estimates within and across scientific disciplines regardless of the research design or cause-effect relation under examination.

This chapter describes a specific and commonly occurring SUTVA violation, contamination, that has the potential to bias causal estimates across studies and health outcomes. While contamination has been examined extensively in experimental research, where known methodological and statistical solutions exist, it has not, to our knowledge, been directly applied to observational research when random assignment to treatment condition is impossible or unethical. This means that not only is the presence and impact of contamination in observational research relatively unknown but few options exist for controlling any resulting bias in causal estimates. As a result, this chapter aims to: 1) orient child maltreatment researchers to the presence and impact of contamination, 2) identify innovative methods for detecting and controlling contamination bias in observational research, and 3) describe the application of advanced statistical models for estimating causal effects that address other, known biases in observational research (e.g. covariate imbalance) after contamination is controlled. We define what contamination is, how it occurs in child maltreatment research, the overall prevalence of contamination, the bias it creates in causal estimates, the current approaches for controlling it, and the modeling of causal effects in its absence. We use the terms “treatment” and “control” throughout the chapter to refer to two different levels of a single causal variable of interest (e.g. child maltreatment and non-child maltreatment conditions) and to maintain consistency across terms used in experimental and observational research. We see other commonly used terms, such as “exposure” and “comparison”

conditions, as equivalent for our purposes here. Also, we use the term “observational research” throughout but see other terms, such as “non-randomized” and “quasi-experimental”, as interchangeable in the current context. Our hope is that a greater awareness to the issue of contamination, and the current methods for addressing it, will provide child maltreatment researchers with the tools they need to enhance the accuracy of causal estimates and restore the benefits of the counterfactual model of causal inference in the observational case.

2 What is Contamination?

Contamination is “the use of the treatment by individuals in a control arm” (Cuzick et al., 1997, p. 1017) or “when intervention-like activities find their way into the control group” (Delgado-Rodríguez & Llorca, 2004, p. 640). Historically, the presence and impact of contamination on causal estimates has been examined in randomized controlled trials (RCT) research. For example, an RCT examining the benefits of prostate-specific antigen (PSA) screening found that a certain number of individuals assigned to a no-screening control condition ultimately received PSA screening from an independent physician (Roobol et al., 2009). Such contamination is a SUTVA violation and has the effect of creating bias in casual estimates via misclassification, where units originally assigned to the control condition, but who subsequently received PSA screening, are now misclassified as control units when in fact they received the treatment. This bias minimizes the direction, significance, and magnitude of between-group differences because the values of the outcome of interest, prostate-specific morbidity or mortality, for those misclassified units will be closer to the values observed for units in the treatment condition rather than other units of the control condition (Hirano et al., 2000; Jo, 2002; Kerkhof et al., 2010; Marfo & Okyere, 2019).

Contamination, while specific to a control condition, is similar to two other phenomena observed in RCTs: 1) non-compliance, where units assigned to a treatment or control condition fail to adhere to the prescribed protocol, including members of a control condition receiving the treatment under investigation (Angrist et al., 1996), and 2) spill-over, when units assigned to a treatment condition interfere with or disseminate information about the treatment to units in a control condition (Vanderweele et al., 2013). Because these phenomena have been well-studied in the RCT context, there are now well-known solutions available to RCT researchers. For example, treatment fidelity and adherence monitoring (Conn & Ruppar, 2017) are prospective, methodological strategies for detecting instances of contamination, non-compliance, and spill-over when they occur in an RCT. Similarly, statistical solutions that use the randomization process as an instrumental variable can estimate the complier's (Little & Rubin, 2000) or local average treatment effect (Angrist et al., 1996) that generates unbiased estimates of the causal effect.

Contamination can also occur and ultimately affect the construction and maintenance of control conditions in non-randomized, observational research. To illustrate, say a hypothetical team of investigators conducted a 10-year prospective cohort study of the effects of pediatric lead exposure on the cognitive functioning of children immigrating to the U.S. Because random assignment to lead exposure is unethical, the investigators used a confirmatory venous sample blood lead level (BLL) test with a reference value $> 3.5 \mu\text{g/dL}$ to create the treatment condition. They also required the BLL test show no detectable levels of lead to create the control condition, thereby establishing a mutually-exclusive counterfactual condition at study entry. Then say, a subset of the children in the control condition relocate to an area of the U.S. that contains lead in water used for drinking, bathing, and cooking –

something that is unknown or undetected by the investigative team. Such an occurrence would constitute a SUTVA violation within the prospective cohort design, as it does in an RCT when members of a control condition seek out or receive the treatment under investigation. Children in the control condition being inadvertently exposed to lead results in a misclassification of those children as controls when in fact they have received the treatment. This has the potential to create bias in causal estimates generated in observational research, like with RCTs, where the direction, significance, and magnitude of the causal estimate for lead exposure is attenuated because observed values of cognitive function for certain units in the control condition more closely approximate observed values in the treatment condition. Thus, regardless of the aims of a particular study, or whether randomization is used or not, contamination can exist in almost any research design using counterfactual conditions and constitutes a SUTVA violation that warrants correction when it occurs. Unfortunately, unlike with RCT research, there is less awareness of this issue and fewer known solutions for detecting contamination or addressing resulting bias in the observational case.

Below, we highlight how contamination occurs in observational research on child maltreatment, demonstrate the prevalence of contamination and the impact of resulting bias in causal effect estimates, and apply existing statistical methods for estimating causal effects in observational research after controlling contamination. This is an important task, as the vast majority of causal effects generated in research on child maltreatment likely contain some degree of bias due to contamination.

3 How Does Contamination Occur?

There are many potential sources of contamination in child maltreatment research and the following list is not intended to be exhaustive. Instead, we highlight

what we see as three sources of contamination in child maltreatment research to raise awareness on how it occurs in this area of research and to generate potential solutions for controlling its presence and impact in a given study.

3.1 Planned Matching of Control Units

Random assignment to a treatment or control condition is, on average, an effective strategy for achieving balance on a large set of confounding variables that in turn promotes causal inferences about the effects of the treatment under investigation. However, different research design strategies are needed to address concerns about balance and confounding when random assignment is not possible or is unethical. Matching, where a unit is assigned to a control condition because they did not receive the treatment and because they represent the same background strata as one or more units in the treatment condition, is one research design strategy that can control extraneous variability due to confounding and allows for a more accurate determination of the treatment effect (Rubin, 1973). For example, matching a unit in the control condition who is 10-12 years of age, female, Hispanic, has an annual family income of \$60,000, and lives in a dual-caregiver home to one or more units in the treatment condition who has this same demographic background, strengthens conclusions that observed between-group differences on an outcome are due to the treatment and not these demographic confounds. Matching on a set of identified variables is a long-standing practice in child maltreatment research (Widom, 1988), as it is in a variety of cohort studies outside the substantive area of child maltreatment (Cheng et al., 2020), that attempts to mimic random assignment by balancing relevant confounders across treatment and control conditions and therefore controlling their potential impact on causal estimates.

However, the benefits of planned matching at the outset of a study should be considered along with some potential limitations of this approach. For example, several demographic variables commonly used for matching in studies of child maltreatment effects, such as age, race, income, and single-parent household, are also established risk factors for the occurrence of child maltreatment (Institute of Medicine, 2011). This means that by imposing a matching procedure based on these demographic variables, some units in a control condition may have already experienced child maltreatment or might experience maltreatment during longitudinal follow-up. If so, matching on these demographic variables has the potential to introduce contamination in a study due to the increased risk of child maltreatment occurring for units assigned to a control condition. As we illustrate below, statistically adjusting causal estimates by including matching variables into causal models does not mitigate bias attributable to contamination in these estimates (see Section 4). This requires that precise measurement of child maltreatment be employed early and repeatedly throughout a study to detect contamination when it occurs while using alternative means to control resulting bias.

3.2 Imprecision in the Measurement of Child Maltreatment

There are two primary methods for measuring child maltreatment: 1) official case records, such as the report generated from a Child Protective Services (CPS) investigation of a formal allegation of child maltreatment, and 2) self-report, including questionnaires, surveys, and interviews that determine the subjective experience of child maltreatment. Each method has unique strengths and weaknesses for measuring child maltreatment in a given study. Official case records are advantageous because they are used by the Federal government to track the incidence of child maltreatment in the U.S. They are also generated by trained

professionals who are independent from a given research project and masked with respect to the research hypotheses, minimizing experimenter bias. However, an allegation of child maltreatment made to CPS is required for a record to be generated and it is very likely that not all instances of child maltreatment are reported to CPS. For example, the current incidence of child maltreatment in the U.S. ranges from 8.4 to 42.9 per 1000 children (U.S. Department of Health and Human Services, 2022), an estimate considerably lower than 152 per 1000 children estimate generated by self-report methods (Finkelhor et al., 2015). This means that official case records likely reflect “true” cases of child maltreatment when they are substantiated but miss a certain number of “true” cases of child maltreatment when they are not substantiated or reported to CPS. Hence, using only official case records to establish and maintain child maltreatment and control conditions can introduce contamination in that a certain number of units in the control condition, who do not have an official record of child maltreatment, have actually been exposed to maltreatment with this experience going unknown to investigators.

Self-report methods are often selected given their widespread availability, efficiency in determining child maltreatment status, and potential sensitivity to detecting cases of child maltreatment relative to official case records. These features are particularly advantageous for large-scale, epidemiological studies or studies employing a cross-sectional or retrospective assessment of child maltreatment. However, self-report assessments of child maltreatment rely on the content validity of the items in those assessments, something that is highly variable across different instruments and with respect to official definitions and legal standards of child maltreatment (Mathews et al., 2020). Self-report methods are also subject to recall and memory biases that can affect the reporting of child maltreatment (Baldwin et al.,

2019; Hardt & Rutter, 2004), something that can be compounded by mono-method bias when a self-reported health outcome is assessed simultaneously with self-reported child maltreatment status (Green et al., 2010; Newbury et al., 2018). Finally, nearly 50% of people with an official record of child maltreatment fail to report this history during a self-report assessment (Everson et al., 2008; Widom & Shepard, 1996), suggesting that a substantial number of units in a control condition established using only a self-report assessment will actually have a history of child maltreatment that is unknown to investigators.

Unfortunately, there is no gold-standard measurement of child maltreatment and the most commonly used methods are each likely to miss cases when used in isolation, resulting in certain units within an established control condition reporting or experiencing child maltreatment at some point during a given study timeline (e.g. contamination). This problem in imprecision is made worse when one of these methods is used only once at study entry to classify individuals into treatment and control conditions. Even if a particular research project was successful in correctly classifying all cases of child maltreatment into treatment and control conditions at study entry, the risk for contamination continues should the research design be longitudinal in nature.

3.3 Cross-Sectional Assessment of a Time-Varying Phenomenon

Child maltreatment most often occurs from pregnancy throughout childhood, however, children continue to experience maltreatment up to age eighteen (Sedlak et al., 2010; U.S. Department of Health and Human Services, 2022). This means that the integrity of an established control condition needs to be continually monitored for the presence of contamination so long as data collection continues. For example, many researchers are interested in studying exposure to child maltreatment in early

childhood as a sensitive period that may have lasting effects on subsequent pediatric and adulthood health (Juster et al., 2011). This type of research requires continual monitoring of contamination, as individuals who were not exposed to maltreatment in early childhood may be subsequently exposed during later childhood or adolescence, potentially biasing resulting causal estimates.

Repeatedly assessing exposure to child maltreatment is similar to treatment fidelity and adherence monitoring in RCT research, where units are continually assessed throughout data collection to ensure that those assigned to either treatment or control conditions received only the treatment to which they were assigned. In child maltreatment research, this means continually tracking whether units assigned to the control condition at study entry remain unexposed to child maltreatment for the duration of a study. The continuing risk for child maltreatment up to adulthood, particularly for those who are already at increased risk due to other demographic variables, can therefore introduce contamination into a study implementing a longitudinal, repeated measures assessment.

4 Does Contamination Bias Causal Estimates in Observational Research?

Contamination is measurement error in the form of a misclassification of units assigned to a control condition. Like in RCT's, this misclassification has the potential to produce bias that affects the direction, statistical significance, and magnitude of the treatment effect in observational research. The major concern when contamination occurs is that it is either unknown to or uncontrolled by investigators, ultimately leading to biased estimates of the causal effect of interest (see Figure 1). Below is a brief review of existing empirical studies that have demonstrated the impact of contamination bias on the significance and magnitude of causal estimates

and the bias reduction that occurs in those same estimates when contamination is controlled.

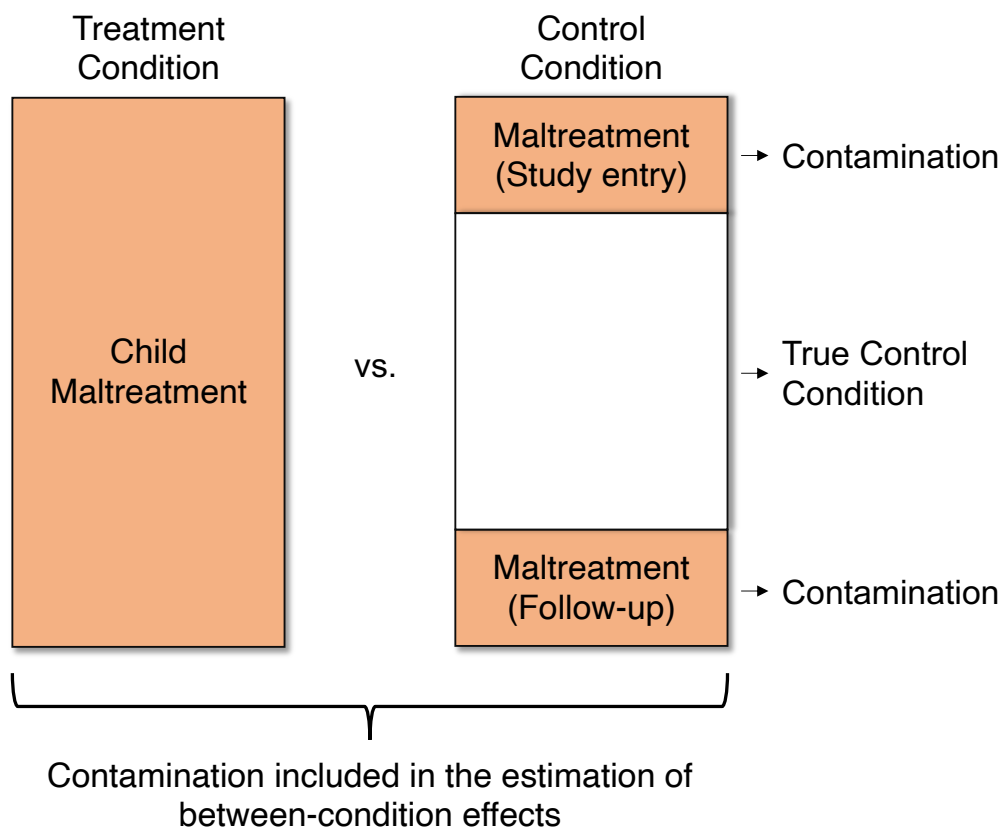


Figure 1. Traditional Modeling of Child Maltreatment Effects

Scott and colleagues (2010) examined the risk for psychiatric disorders in young adulthood following exposure to child maltreatment in a nationally-representative cohort in New Zealand (N = 2144). In this study, the investigators established child maltreatment and control conditions using official case records, where child maltreatment status was determined by an allegation of child maltreatment that was reported to and investigated by CPS. Interestingly, the investigators administered a self-report assessment of child maltreatment in this study, which indicated that 15.4% of units in the control condition reported exposure to child maltreatment. Using traditional estimation procedures that retained

contamination in the statistical model, results indicated that child maltreatment significantly increased the risk for past year (OR = 2.32) and lifetime (OR = 2.12) occurrence of a psychiatric disorder. However, when contamination was controlled by removing the 15.4% of control units who self-reported child maltreatment from the model and re-estimating risks for these same outcomes, the effect size magnitudes for both past-year (OR = 2.83) and lifetime (OR = 2.80) risk of a psychiatric disorder increased by 22%-32%, respectively. Similar trends in effect size magnitude were observed for individual psychiatric disorders, including several that achieved statistical significance only after contamination was controlled.

In a multi-wave, prospective cohort study in the U.S. (N = 514), Shenk and colleagues (2016) attempted to replicate prior research establishing child maltreatment effects on several indicators of female health at the transition to adulthood: teenage births, past-month cigarette use, obesity status, and clinical levels of major depressive disorder symptoms. Child maltreatment status was determined using official case records, where an allegation of child maltreatment was made, investigated, and substantiated by CPS. Control units were demographically-matched to units in the maltreatment condition on age, race, family income, and single-parent household. Using traditional estimation procedures that adjusted estimates based on the inclusion of matched demographic variables, this study failed to replicate statistically significant child maltreatment effects for obesity and major depressive disorder symptoms. However, Shenk and colleagues then screened for contamination at each wave of data collection using both official case records and self-reports of child maltreatment. This multi-method screen identified 44.8% of control units who experienced child maltreatment. When this contamination was controlled by removing these units from the statistical model, child maltreatment

significantly predicted all four female adolescent health outcomes ($RR = 1.47-2.95$), replicating prior research (e.g. Danese & Tan, 2014; Widom et al., 2007). Moreover, effect size magnitudes for these four outcomes increased by 24%-130% once contamination was controlled, again providing an indication of the degree of contamination bias in the causal estimate.

Shenk and colleagues (2021) investigated the impact of contamination on causal estimates when examining the effect of child maltreatment on age-heterogeneous trajectories of internalizing and externalizing behaviors across childhood and adolescence. Using existing data from a national, multi-site, and multi-wave prospective cohort in the U.S. ($N = 1354$), this study established child maltreatment and control conditions using official case records where independent raters confirmed exposure to child maltreatment based on details obtained in the official records. Shenk and colleagues then screened the no confirmed child maltreatment control condition for contamination using a repeatedly administered self-report assessment of child maltreatment. The authors identified a contamination prevalence estimate of 65.1% in this sample, meaning nearly two-thirds of units assigned to a no confirmed child maltreatment control condition reported maltreatment and were ultimately misclassified. Traditional estimation of confirmed child maltreatment effects revealed statistically significant risks for both internalizing and externalizing behavior trajectories with effect size magnitudes ranging from d 's = .19-.40. Contamination was then controlled by modeling the 65.1% of individuals who were misclassified as control units as a third condition (self-reported maltreatment without a confirmed case record) and deriving contrasts between the confirmed child maltreatment condition and the resulting no confirmed, no self-reported child maltreatment control condition. When models were re-estimated,

statistically significant risks for internalizing and externalizing behavior trajectories were again observed for confirmed child maltreatment but with effect size magnitude increases of 27.5%-52.6% (d 's = .29-.51).

These three studies illustrate several important aspects pertaining to misclassification of control units in the form of contamination in child maltreatment research. One, contamination exists in child maltreatment research with current prevalence estimates ranging from 15.4% to 65.1%. The existence of contamination constitutes a SUTVA violation and requires detection and control to generate accurate estimates of child maltreatment effects. Two, failing to control contamination can bias the significance and magnitude of causal estimates toward the null, making it harder to detect an effect, as well as the precise degree of that effect, for child maltreatment when it exists. This has obvious implications for the replication and reproducibility of effects observed in child maltreatment research, particularly when contamination is more or less prevalent across independent studies. Finally, traditional modeling of child maltreatment effects likely contains some degree of contamination bias, an approach that can underestimate the true causal effect of child maltreatment. Identifying ways to detect and control contamination prior to modeling child maltreatment effects holds considerable promise for improving the accuracy of causal estimates in this area of research.

5 How to Detect and Control Contamination Bias?

Ways for detecting and controlling contamination bias is an ongoing area of research. So far, a dual measurement strategy (Brenner & Blettner, 1993; Marshall & Graham, 1984), one that capitalizes on the different strengths of existing methods for determining exposure to child maltreatment, offers some degree of control of contamination while also demonstrating the bias in causal effects that contamination

creates. For example, each of the three studies reviewed in Section 4 applied a dual measurement strategy that used official case records to establish treatment and control conditions and self-report methods to detect and control contamination. This approach appears advantageous for two reasons. One, an indication of child maltreatment using official case records is most likely to result in lower false positive rates, where if maltreatment is determined to have occurred it is most likely to be a true instance of child maltreatment. Two, it is not appropriate to conclude that a negative indication of child maltreatment based on official case records means that maltreatment did not occur, only that the investigation did not produce enough evidence to confirm, indicate, or substantiate the allegation. As a result, using a second measure that is likely more sensitive to detecting child maltreatment, such as self-reports of child maltreatment, can detect cases of child maltreatment in the control condition and offer one way to identify and control contamination.

This dual measurement strategy has proved effective in prior child maltreatment research that demonstrated enhanced sensitivity for detecting cases of child maltreatment (Swahn et al., 2006) as well as stronger effects for child maltreatment on subsequent psychiatric disorders (Shaffer et al., 2008).

Furthermore, unpublished results from a prior examination of contamination bias (Shenk et al., 2016) highlight the impact of using a dual measurement strategy to detect contamination on the significance and magnitude of resulting effect size estimates relative to any single measure making up that dual strategy (see Table 1). Thus, for now, a dual measurement strategy to detect and control contamination in observational child maltreatment research appears to be the best method for approximating the benefits of treatment fidelity and adherence monitoring used to detect contamination in RCT research.

	No Screening	Self-report Only	Case Records Only	Dual Measurement
Major Depression	1.28 (0.79-2.08)	1.70 (0.94-3.08)	1.79 (1.05-3.02)	2.95 (1.22-7.16)
Teen Births	1.66 (1.06-2.61)	1.27 (0.93-1.74)	1.29 (0.96-1.72)	2.21 (1.06-4.63)
Obesity	1.16 (0.90-1.50)	2.84 (1.24-6.51)	1.22 (0.72-2.05)	1.47 (1.03-2.08)
Cigarette Use	1.36 (1.06-1.74)	1.56 (1.14-2.14)	1.46 (1.13-1.87)	1.68 (1.21-2.35)

Table 1. Dual Measurement Strategy for Detecting Contamination. Effect size estimates are relative risks and corresponding 95% confidence intervals after accounting for demographic covariates. Bolded numbers are statistically significant estimates ($p < .05$).

However, once contamination is detected using this dual measurement strategy, it remains unclear whether completely removing identified control units from a statistical model (i.e. reduced overall sample size), examining a “contamination” condition as its own condition in a statistical model (i.e. retains overall sample size), or some other approach provides the most accurate estimator of child maltreatment effects. Two obvious implications for controlling contamination based on the existing research are the potential impact on: 1) statistical power via reductions in sample size combined with expected increases in effect magnitude, features that are likely to vary based on different degrees of contamination present across studies, and 2) the external validity of results based on how similar the analytic sample matches the overall sample and overall population (Degtiar & Rose, 2021). One study did demonstrate that a dual measurement strategy to control contamination by removing

units from the statistical model did result in a revised control condition that had prevalence estimates for all outcomes that more closely approximated U.S. population prevalence estimates, aiding generalizability (see Shenk et al., 2016; Figure 1). Future research evaluating these approaches to controlling contamination should also evaluate resulting implications on statistical power and generalizability, implications that are likely to offer child maltreatment researchers several empirically-driven strategies in which to approach the issue of detecting and controlling contamination bias.

Two other potential ways for addressing contamination in child maltreatment research have been suggested during peer review of our prior research, which we do not recommend at this point. The first is to move misclassified control units who were identified as experiencing maltreatment using one method (e.g. self-report) into a child maltreatment condition established using a second method (e.g. official case records). There are several reasons for not following this approach. One, there is low agreement between self-report and official case records as indicators of child maltreatment status (Baldwin et al., 2019; Everson et al., 2008), demonstrating that these two methods are not interchangeable. Two, prospective methods of assessing child maltreatment, typically represented by official case records, and retrospective methods of assessing child maltreatment, typically represented by self-report methods, are associated with differential risks for physical and behavioral health outcomes (Newbury et al., 2018) - particularly when those outcomes are also assessed using self-report methods (mono-method bias; see review by Coleman & Baldwin in this book). Identifying child maltreatment in a control condition using one method and then adding those units to a child maltreatment condition established using another method adds unnecessary heterogeneity into the treatment condition

and the evaluation of treatment effects that is attributable to the measurement of child maltreatment (see Figures 1 and 2 in Shenk et al., 2021). Three, detecting and controlling contamination using a dual measurement strategy means this – that identified control units are misclassified and should no longer be regarded as control units. It does not mean, at least given the differences in self-report and official case records for determining child maltreatment, that those misclassified units are now equivalent to those units in the treatment condition.

The second way is to capitalize on existing approaches for addressing misclassification bias that have been developed and examined in the epidemiological and econometric literatures (Keogh et al., 2020). In these approaches, the potential misclassification of units is examined not just in a control condition but also in the treatment condition. This examination then determines whether the misclassification is differential or non-differential across the treatment and control conditions, which ultimately determines how treatment effects will be estimated. We view contamination in child maltreatment research to be distinct from the application of the existing approaches to addressing misclassification bias for several reasons. One, as described above, there is no gold-standard measure of child maltreatment nor are the existing methods non-differential in their sensitivity and specificity for detecting maltreatment, assumptions that are often required when addressing misclassification bias in this framework (Flanders et al., 1995; Johnson et al., 2014). Two, contamination refers to a phenomenon that only affects a control condition, not a treatment condition, and examining differential or non-differential misclassification across both of these conditions does not fully address the issue of contamination in promoting the accuracy of causal estimates. Instead, a dual measurement strategy specific for a control condition capitalizes on the differential psychometric strengths

of both measures to add precision to the measurement of child maltreatment. Three, official case records yield low false positive rates, meaning that when an allegation of child maltreatment is made, investigated, and determined to have occurred, it is likely true. In other words, there is little chance that a unit in a treatment condition created using official case records can “not-comply” or “non-adhere” to this treatment condition or be misclassified. A positive indication of exposure to child maltreatment using official case records will also always be true regardless of whether or not an individual recalls it on a self-report instrument at a later date, something that could be affected by an individual simply not having a memory of the maltreatment event because it happened early in infancy or childhood. As noted earlier, child maltreatment most often occurs early in the life course and many child maltreatment researchers are interested in how this event early in life creates lasting neurobiological change that results in later health risks (Juster et al., 2011). This can be measured using official case records regardless of whether a person can or does recall this event on a self-report instrument or not.

Below are active projects in which we are evaluating different research design, measurement strategies, and statistical approaches that not only attempt to detect and control contamination but also generate causal estimates of the effect of child maltreatment on subsequent health. Each uses a unique dual measurement strategy for detecting and controlling contamination. The latter two, given data are already collected, are also applying advanced statistical methods for estimating causal effects in observational research and demonstrating the degree of bias in causal effect estimates due to contamination. We have been fortunate to receive two federally-funded grants, one from the National Institutes of Health (NIH; R03HD104739) and the other from the National Science Foundation (BCS-

2041333), allowing us to formally examine ways for evaluating the impact of contamination bias and generating causal estimates of the effects of child maltreatment on subsequent behavior problems once it is controlled.

5.1 The Translational Center for Child Maltreatment Studies (TCCMS)

A dual measurement strategy to detect and control contamination is designed to capitalize on the individual strengths of each method and is enhanced by an early, repeated, and prospective administration for determining exposure to child maltreatment. The [TCCMS at Penn State](#), the first NIH Capstone Center for research on child maltreatment, has implemented a dual measurement strategy for detecting contamination within a prospective cohort study of the long-term effects of child maltreatment on pediatric health. The two methods constituting the dual measurement strategy in this study are: 1) official case records, and 2) self-reported instances of child maltreated obtained from research interview. The TCCMS is applying several innovative methods for establishing exposure to child maltreatment from official case records. For example, eligibility for inclusion in the study requires that units in the child maltreatment condition were the subject of a child maltreatment report, that is, an allegation of child maltreatment that was investigated by CPS, within the year prior to study entry. This report could have been substantiated or not, providing the opportunity to examine three different child maltreatment conditions: investigated but not substantiated, investigated and substantiated, and neither investigated nor substantiated (e.g. control condition). This approach to characterizing child maltreatment status has shown to enhance the sensitivity of official case reports by increasing overall prevalence with few differences in health outcomes observed between investigated but not substantiated vs. investigated and substantiated conditions (Kugler et al., 2019). The TCCMS is also employing the

Maltreatment Classification System (MCS; Barnett et al., 1993) to review and code official case records for varying child maltreatment dimensions, including type, duration, age at onset, and severity, spanning the entire lifetime of units. MCS codes are determined by independent raters unaware of the research hypotheses who review the official case records generated by CPS to make their codes regarding various child maltreatment dimensions. The MCS has enhanced sensitivity to detecting child maltreatment (Runyan et al., 2005), a feature that can strengthen the assessment of maltreatment using information from official case records.

The second method used in the dual measurement strategy for the TCCMS is the Trauma History Profile (THP) of the UCLA PTSD Reaction Index for DSM-5 (RI-5; Pynoos & Steinberg, 2015), which is administered prospectively at each wave of data collection via a semi-structured interview with trained and reliable interviewers. The RI-5 is a psychometrically-sound instrument (Kaplow et al., 2020; Steinberg et al., 2013) that determines self-reported exposure to the most common types of child maltreatment, including physical abuse, sexual abuse, psychological abuse, and neglect. Once a control condition is established using official case records, information from the THP will be used to detect instances of self-reported child maltreatment in that control condition, that is, contamination. This allows for an estimation of the prevalence of contamination in the TCCMS study, identifying a subgroup of units that report experiencing child maltreatment but who have no official case record. It can also inform ways in which to control contamination based on the potential impact on statistical power and external validity as well as various statistical modeling strategies (see below). This innovation in research design via a dual measurement strategy for determining child maltreatment at study entry and at each subsequent wave of data collection is important because data generated from

the TCCMS study will be made available to scientists across the nation and world to study the public health impact of child maltreatment. Thus, a more accurate understanding of the effects of child maltreatment is likely to be gained from this study when contamination is detected and controlled in subsequent modeling.

5.2 The Longitudinal Studies of Child Abuse and Neglect (LONGSCAN)

[LONGSCAN](#) (Runyan et al., 1998) is a multi-wave, multi-site, prospective cohort study of child maltreatment in the U.S. occurring from birth through age eighteen. The LONGSCAN database provides a unique opportunity to examine the issue of contamination given the repeated measurement of child maltreatment and behavioral health outcomes throughout the entire pediatric period. The dual measurement strategy we are evaluating with the LONGSCAN cohort is: 1) official case records where a modified version of the MCS was developed, applied, and evaluated, and 2) self-report methods, where one set of measures was administered prospectively from 12-16 years of age and another set was administered retrospectively at age 18. This dual measurement strategy affords several opportunities to examine contamination. One, it capitalizes on the strengths of official case records and enhanced sensitivity of the MCS to flexibly characterize different child maltreatment and control conditions. Two, once a control condition is established using official case records, the dual measurement strategy then allows for an estimation of contamination prevalence and bias using both prospective and retrospective self-report methods – the most commonly used approaches for estimating the effects of child maltreatment. Examining contamination prevalence and bias in LONGSCAN across prospective and retrospective self-report measures can inform researchers on whether the bias stemming from contamination varies depending on which of these assessment methods are used. These efforts will

provide further insights into the prevalence and impact of contamination in the LONGSCAN cohort and the effectiveness of the proposed dual measurement strategy.

The nature of the LONGSCAN data also provides opportunities for innovative econometric modeling. For example, synthetic and augmented synthetic control modeling (SCM) approaches for estimating causal effects in observational research can be leveraged using the LONGSCAN cohort design. Briefly, SCMs estimate causal effects by matching a unit in the treatment condition to one or more units in the control condition who are similar in their weighted levels of an outcome measured prior to the treatment of interest occurring. For example, we are using repeated measurements of child behavior problems in LONGSCAN to find a matched control condition similar to the maltreatment condition in their pre-maltreatment observations of these behavior problems. Because LONGSCAN repeatedly measured child behavior problems at each wave of data collection from ages 4 to 16, we are able to use the observations on this outcome across ages 4 to 8 to identify control units who were never maltreated throughout LONGSCAN and match them to units who were not maltreated from 4 to 8 years of age but who were maltreated at age 10 or later. The research design and measurement strategy of LONGSCAN, coupled with the innovative application of SCMs to these data, will allow for the first ever causal estimation of child maltreatment effects on child behavior problems throughout adolescence once contamination bias is controlled.

5.3 The National Survey of Child and Adolescent Well-being - II (NSCAW-II)

[NSCAW-II](#) is a multi-wave, prospective cohort study of child maltreatment (N = 5872; Dolan et al., 2011) comprised of children between birth and 17.5 years of age at study enrollment who were recruited from 83 counties across 30 states in the

U.S. All participants were recruited from child welfare investigations closed between February 2008 and April 2009. The first wave of NSCAW-II data collection occurred between March 2008 and September 2009, following the closure of the NSCAW-II index case investigation. The second wave of data collection occurred approximately 18 months thereafter and the final or third wave occurred 18 months following the second wave or approximately 36 months from baseline data collection. Importantly, the NSCAW-II index case, that is the child welfare investigation closed just prior to baseline data collection, includes both substantiated and unsubstantiated cases. NSCAW-II also oversampled for infants, families receiving services, and children in out-of-home placements.

Similar to LONGSCAN, NSCAW-II utilized a multi-informant, dual measurement strategy that affords the opportunity to examine the impact of contamination on child maltreatment effect estimates. To assess contamination in NSCAW-II, we are utilizing: 1) an official substantiation indicator, provided by the NSCAW-II team, that designates whether the index child maltreatment investigation that brought participants into the NSCAW-II cohort was or was not substantiated, and 2) caregiver reports, administered at each of the three waves of NSCAW-II data collection via the Parent-Child Conflict Tactics Scale (Straus et al., 1998), which provides data on caregiver-reported psychological aggression, physical assault, child neglect, and sexual maltreatment. Thus, as described above with LONGSCAN, using a substantiation indicator based on official case records, we are able to establish initial treatment and control conditions. In turn, the prevalence of contamination and resulting bias can be estimated using the seemingly more sensitive caregiver-reports of child maltreatment.

Using NSCAW-II, we are applying propensity score methods as a means to examine the impact of contamination on causal estimates of child maltreatment effects. Propensity score methods are a well-established approach to achieving covariate balance in observational research when randomization to treatment condition is not feasible or is unethical, such as in the case of child maltreatment. Specifically, propensity score methods aim to reduce bias in the estimation of a treatment effect in observational research, that is, the difference between the treatment and control conditions, when it is possible that there are systematic differences between these conditions on confounding variables. A propensity score refers to “the conditional probability of assignment to a particular treatment given a vector of observed covariates” (Rosenbaum & Rubin, 1983, p. 41). In the case of child maltreatment, therefore, a propensity score refers to the conditional probability of experiencing child maltreatment given particular covariates (e.g., income, child gender, caregiver education, race, and ethnicity) and is typically calculated using logistic regression, wherein the treatment is the dependent variable and covariates are predictors. In turn, using this propensity score, different methods can be applied such as propensity score matching or inverse probability of treatment weighting (IPTW) to create covariate balance across treatment and control groups and ultimately more accurately estimate the effect of a given treatment (Austin, 2011). Furthermore, NSCAW-II not only provides dual-measurement of child maltreatment but also longitudinal assessments of child behavior problems and ample covariates related to child maltreatment status, lending itself to propensity score estimation. In sum, using NSCAW-II, we will apply propensity score methods to estimate the casual impact of child maltreatment on child behavior problems both when contamination is and is not controlled.

6 Conclusion

It is very likely the case that contamination is a feature, not a bug, of conducting child maltreatment research. Attention to this issue is important, as contamination results in a bias that minimizes the significance and magnitude of causal effects regardless of the outcome examined. One possible implication of this phenomenon is that existing causal estimates are likely underestimating the true public health impact of child maltreatment. This has the potential to affect scientific, policy, and provider decisions about how to inform a statistical power analysis for future research, whether to devote intervention resources to child welfare or another family serving agency, or whether to consider the potential etiological role of child maltreatment for a presenting complaint in a pediatrician's office. Furthermore, the prevalence of contamination is likely to vary across sampling strategies used in different observational designs within child maltreatment research (e.g. prospective vs. retrospective). This means that the degree of bias in causal estimates, and therefore their impact on the direction, significance, and magnitude of causal effects, is likely to vary across studies proportional to the degree of contamination present. Variation in contamination bias across studies, combined with a lack of control for this bias, could be one explanation for prior failures in replication and reproducibility within child maltreatment research. This is likely one contributor to the overall replication crisis in the behavioral sciences at large. The implications of addressing contamination bias in child maltreatment research, or failing to, are indeed considerable.

This chapter highlights a program of research that is applying innovative methods for addressing the presence of contamination and controlling resulting bias in casual estimates within the substantive area of child maltreatment. While the

implications for child maltreatment researchers are clear, we expect that contamination is a general methodological phenomenon in observational research even outside this substantive area. The methods and procedures identified here are likely highly relevant across scientific disciplines employing observational research to examine cause and effect relations between phenomena of interest. Our hope is that greater attention to addressing contamination will restore the benefits of the counterfactual model of causal inference for child maltreatment and other scientists so that statistical models can more readily produce accurate casual estimates.

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**Applying Innovative Methods to Advance the Study of Youth At-risk for
Internet-initiated Victimization**

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Abstract

Innovative methods were used to study the impact of internet use behaviors on female development. This innovation included a never-before used method for objectively recording and quantifying URL activity via specially engineered software installed on provided laptop computers. A novel machine-learning algorithm was engineered to judge whether URL activity was that of the participating adolescent. Child welfare agencies provided access to confirmed cases of childhood sexual abuse. One month of internet activity was observed in a sample of females aged 12 to 16 (N = 460; 156 with confirmed sexual abuse, 360 controls). Psychosocial interviews were also conducted and repeated annually at two follow-up assessments. Compared to their peers, females represented in a high-risk profile – characterized by high rates of overall online activity, consuming pornography, and engaging in high rates of online gaming – were more likely to be cyberbullied, receive upsetting online sexual solicitations, and engage in risky sexual behaviors two years later. Females in this profile were also characterized by relatively low self-esteem and greater substance use and depression symptoms. Females who were sexually abused were more likely to be represented in this high-risk profile and were more likely to agree to meet strangers offline than their non-abused peers.

Keywords:

Child Maltreatment, Child Sexual Abuse, Internet, Social Media, Pornography, Revictimization, Sexual Socialization, Adolescents, Adolescent Women, Children, Sexual Development, Cyberbullying, Longitudinal, Online Victimization, Sexually Explicit Materials, Adolescent Development, Internet Use, Latent Profile Analysis, Objective Observation

1 Why Study Children Who Have Been Maltreated?

Studying children who have been maltreated provides an opportunity to grow new science in areas of grave public health concern given that survivors are at high risk for a host of deleterious outcomes, including myriad mental health disorders (Noll, 2021), homelessness (Farrell et al., 2017), criminal justice involvement (Berger et al., 2016), poor educational attainment (Boden et al., 2007), teen parenthood (Noll, Shenk, & Putnam, 2009), chronic health conditions (Jaffee, 2017), intergenerational transmission of maltreatment (Assink et al., 2018), and mortality (Shalev et al., 2016). Testing intra-individual life-course risk models of those at high risk for developing problematic outcomes can illuminate pathways, mechanisms, and sensitive periods in which to intervene. Such is the power of observational research. Employing innovative and unassailable research methods increase the likelihood that results get published in high impact journals, that the research gets noticed by the public, and that findings have translatability, thus increasing the visibility of science and the attention of policymakers. As showcased in other chapters included in this volume, the use of sound, innovative and cutting-edge methods can elevate an entire substantive field in terms of our findings being increasingly more visible on the high-impact stage and in terms of the translatability of our findings for use in real-world settings where children and families can actually benefit from the work that we publish.

Although the Institute of Medicine's 2014 report made it clear that the child maltreatment field needs high quality, longitudinal, prospective research (Diaz & Petersen, 2014), actually conducting studies with this population can be quite challenging for many reasons. For example, state-of-the-art prospective methods, that go beyond the retrospective self-report of child maltreatment, include accessing

official child welfare records which can be difficult to obtain. Such access requires state and/or local level statutes and protective service laws that specifically allow for research utilizing child welfare data. Gaining access requires relationship-building with state and local government whereby child welfare leaders have some level of trust in the research methods, human subject's protections, data security, research integrity, and in the researchers themselves. The research question itself should have some relevance to the betterment of the population, including clinical utility, such that child welfare leaders can easily discern how participating in research can improve the lives of their clients or have some translatability for prevention and treatment.

Once enrolled, these families can be difficult to track longitudinally as they often change residences and can have complex and layered needs that preclude stability and reachability. Interviews can be challenging and taxing, resulting in secondary trauma of staff members and staff turnover. Staff therefore need to be highly trained, well-supported, and incentivized to achieve maximum retention. While there are several guidelines to aid researchers in conducting prospective, longitudinal work with child welfare populations (Mathews et al., 2022; Schreier et al., 2021; Trickett et al., 2011), the significant challenges inherent in working with this population cannot be overstated and the successful studies that have engaged long-term cohorts should be highly-lauded across the field.

So why try to accomplish these studies? Not only do these types of designs hold the best promise for strengthening causal inference regarding the true impact of child maltreatment on subsequent mental, behavioral, and physical health but they also contribute to a growing body of science that enhances innovation across multiple fields of study. It is exactly this type of innovative, rigorous research that will

be upheld by decision-makers as they engage in evidence-informed policymaking (Crowley, Scott, Long, Green, Israel, et al., 2021; Crowley, Scott, Long, Green, Giray, et al., 2021). Moreover, there are ethical issues inherent in refraining from conducting research with vulnerable populations merely because the research is difficult to accomplish. For example, as summarized in a recent UNICEF report (Berman et al., 2016), leaving children from difficult humanitarian contexts out of cutting-edge research could have far greater consequences for both the short- and long-term safety and well-being of these children and their communities. Not only will innovative methods elevate the prominence of our science, but they serve to heighten the impact of our work such that findings have the best chance to impact policies and practices that directly serve vulnerable youth and families.

2 Innovation in the Study of High-risk Internet Behaviors

There can be unintended and surprising developments when conducting longitudinal research from which innovation can emerge. For example, our work over the past three decades has been primarily focused on basic, observational research with prospective, longitudinal cohorts. Following samples longitudinally requires the tracking of participants over time. This means that you must find people. In the early 2000s, a new technique became available that had never before emerged as an option for finding, tracking, and engaging research participants – social media. We therefore gained IRB approval to utilize MySpace, the first social media platform widely used by teens and young adults as a retention tool to keep in touch with participants and as a means to search for participants who had been lost to follow-up. In doing so, we started noticing something quite peculiar; many of our participants were posting personal information (e.g., phone numbers, addresses, etc.) and revealing photos and other provocative content on their publicly-available

profile pages. For example, one teen female adopted a provocative profile name, posted a scantily clad picture of herself, provided her full name, the high school she attended, and her phone number with accompanying messages, “Call me, I’ll pick up” and “I’m 16 going on 21!”.

After observing this phenomenon over and over – and encountering emerging literature reporting that teens with a maltreatment history were more likely to visit chatrooms (Beebe et al., 2004), be solicited sexually online (Mitchell, Finkelhor, et al., 2007b), and experience re-victimization significantly more often than their peers (Barnes et al., 2009) – we began to be curious about whether the advent of the Internet, and specifically the proliferation of social media, might somehow be opening new avenues for exploitive individuals to gain access to youth. We were also curious as to whether children who were maltreated might be especially vulnerable to internet-initiated victimization, including being sexually harassed online, being cyberbullied, and/or being lured offline by strangers whom they first met online. Accordingly, we conducted two studies to test this hypothesis.

In the first study (Noll, Shenk, Barnes, et al., 2009), adolescent females with confirmed child maltreatment and matched comparison females attended a laboratory session where they were instructed to create an avatar representing themselves. Using preset criteria, resultant avatars were quantified, via automated software specially designed for the study, for provocative features including bust-to-hip ratios, skin-to-clothing ratios, body piercings, etc. Results showed that adolescents with a maltreatment history created avatars with more “provocative” features than adolescents without a maltreatment history. Provocative avatar scores were significantly correlated with a host of risk behaviors consistent with internet-initiated victimization, including receiving online sexual solicitations and meeting

strangers offline. These findings were illustrative of a phenomenon known as the “Proteus Effect” (Yee & Bailenson, 2007), the idea that self-presentations not only can affect the behavior of the perceiver (i.e. potential predators targeting vulnerable teens) but can also have an effect on the behaviors of the presenter. This was the first study to objectively quantify avatar choices and to show how provocative presentations can place adolescents at risk for subsequent internet-initiated victimization.

In a second study (Noll et al., 2013), online and offline behaviors were assessed in a laboratory setting from 251 adolescent females – 130 experienced substantiated maltreatment and 121 were demographically-matched comparisons. Participants logged on to their active social networking profiles (MySpace, Facebook) which were recorded via screenshots and then objectively coded for personal information and for provocative self-presentations. Via a semi-structured interview, participants also reported on their propensity to seek out sexual content online as well as incidences of online sexual solicitations. Approximately 1.5 years later, participants also reported on incidences of offline meetings with strangers. Over 30% of the entire sample reported having met strangers offline. Child maltreatment was uniquely associated with intentional exposures to sexual content, creating high-risk social networking profiles, and receiving online sexual solicitations; all of which were predictive of subsequent offline meetings with strangers.

These studies, which were an outgrowth of our longitudinal work with youth who have been maltreated, raised questions about the impact of the internet on today’s teens in general. In particular, how having the internet at their fingertips and social media as a chief source of social discourse might be impacting adolescent development. We know that today’s teens are the first generation to grow up in a

world where high-speed internet is the norm with 93% reporting daily usage (Anderson & Jiang, 2018) and wide availability across all socioeconomic strata (Robison & Crenshaw, 2010). Yet, despite its proliferation there is little consensus about the impact of the internet on adolescent socioemotional development (Orben, 2020; Orben & Przybylski, 2020; Twenge et al., 2019). Some studies have associated the amount of time teens spend on the internet to negative outcomes, including depression (van den Eijnden et al., 2008), loneliness (Hunt et al., 2018), internet addiction (Stavropoulos et al., 2018), school burnout and poor academic engagement (Salmela-Aro et al., 2017), and shorter sleep durations (Mazzer et al., 2018).

In contrast, other studies have shown negligible associations and even benefits to internet use such as friendship development (Borca et al., 2015), self-esteem (Best et al., 2014), identity exploration (Subrahmanyam et al., 2006), social capital (Ellison et al., 2011), social support (Best et al., 2014), and increased well-being among anxious (Thom et al., 2018) and distressed (Dolev-Cohen & Barak, 2013) teens. Recent reviews (Odgers & Jensen, 2020; Orben, 2020) concluded that aggregate associations between digital technology use and adverse adolescent development are small relative to other adolescent problems and thus do not warrant policy reform nor intensive prevention efforts. Missing from this group of studies, and likely fueling controversy and inconsistency, are longitudinal studies with innovative methods to objectively quantify teen internet behaviors which could significantly advance the field.

3 The Impact of Pornography

Despite the internet's obvious advantages – it enhances social contact, is now the chief way we get information, and is an essential tool for educators – several of

its features warrant genuine concern, such as access to pornography. Although many parents consider themselves to be the first line of defense in restricting access to adult-content (National CyberSecurity Alliance, 2017), the majority of parents report lacking knowledge about how to effectively monitor the internet activity of their own children (Caivano et al., 2020) and such monitoring has been shown to have minimal effects (Noll et al., 2013). Not surprisingly, more than 20% of adolescents report unwanted online exposures to sexually explicit content (Madigan et al., 2018) and as many as 59% report intentionally seeking online pornographic material (Peter & Valkenburg, 2006).

Sexual Socialization Theory (Aubrey et al., 2003; Wyatt et al., 1988) suggests that, by contributing to sexual “scripts” that mold subsequent behaviors and guide sociosexual interactions, frequent exposure to sexually explicit media can affect developing sexuality (Subrahmanyam et al., 2004). Research shows that exposure to sexually explicit media and pornography is associated with increased sexual activity, (Braun-Courville & Rojas, 2009; Brown et al., 2006; Nathan, 2007) particularly that which can place one at risk for sexually transmitted diseases, HIV infection, and unintended pregnancy (Ashby et al., 2006; Wingood et al., 2001). Attitudes about sex and sex partners also seem to be affected by pornography use including permissive attitudes (Nathan, 2007; Zillmann & Bryant, 1988), desensitization (Zillmann, 2000), and sexual deviance (Bryant & Brown, 1989). Sexual exposures have also been associated with the trivialization of sexual aggression and attitudes toward rape, which can increase the likelihood that females will be victims of sexual assault (Allen et al., 1995; Brown & L'Engle, 2009; Goodson et al., 2001; Maas et al., 2019).

Notably, the bulk of this research has been conducted with adults and college students, leaving much to learn about how exposure to sexual material might affect the adolescent period – arguably the most formative years of sexual exploration and development. Reports from the few studies focused on adolescents confirm speculations that exposure to sexually explicit media is deleterious with respect to sexual attitudes and activities such as earlier age at coital onset, multiple sex partners, and risky sexual behavior (Lo & Wei, 2005; Mesch, 2009; Peter & Valkenburg, 2006). These studies however derive from foreign samples and rely heavily on cross-sectional designs however these data largely derive from foreign samples. Even very recently the impact of exposure to sexual media on sexuality has been hotly debated, largely due to the lack of rigorous longitudinal research (Collins et al., 2011a; Collins et al., 2011b; Steinberg & Monahan, 2011). Jane Brown's work is some of the only longitudinal data showing that earlier exposure to sexual content predicted higher rates of subsequent sexual activity and greater acceptance of sexually permissive norms two years later (Brown & L'Engle, 2009). However, like all extant media safety studies, Brown's studies rely on adolescent self-reports.

Much of what we know about the impact of pornography comes from studies of traditional sexual media (television, music, movies, magazines), the majority of which offer evidence that exposure to sexual content has a detrimental impact on adolescent sexual development in terms of heightened sexual behaviors and endorsement of behaviors that can influence sexual health, risk-taking, objectification, and dysfunction (Collins et al., 2017). These associations have been largely upheld in studies of online pornography (Doornwaard et al., 2014; Kohut & Štulhofer, 2018; Owens et al., 2012), especially for girls (Cheng et al., 2014). To date

only a handful of studies have tracked adolescent online pornography use over time, showing that pornography consumption predicted poor mental health (Doornwaard et al., 2016), risky sexual attitudes (van Oosten, 2016), and increased sexual activities (Brown & L'Engle, 2009) with effects especially pronounced among girls (Kohut & Štulhofer, 2018). It is noteworthy that all extant studies of teen pornography have employed limited survey questions, most often using only a single item, and relied exclusively on self-reports. Given that self-reports of pornography consumption have the potential to be biased due to potential embarrassment associated with divulging such sensitive information, an objective assessment that tracks actual web surfing behaviors would yield a more meaningful test of potential effects.

4 Internet-initiated Victimization

The proliferation of the internet has also brought with it increasing concerns about online safety and internet-initiated victimization of children including being cyberbullied, experiencing online sexual exploitation in terms of being asked to share sexually explicit photos or engage in sexual chat and discourse, and being lured off-line by strangers whose identity had not been fully confirmed (Boyd & E., 2013; Noll et al., 2013). Cyberbullying in the form of online sexual (e.g., “slut-shaming”) and nonsexual (e.g., body-shaming, social exclusion) harassment occurs in about 23% of teens according to a review of 36 studies (Hamm et al., 2015) and is most common among teens who are high utilizers of social media (Garett et al., 2016). There are substantial co-occurrences between cyberbullying and offline bullying for both boys and girls (Modecki et al., 2014), however a survey of school-aged children in 21 countries showed that linear trends in this co-occurrence stagnated for boys from 2002-2014 but continued to be pronounced for girls (Cosma et al., 2019).

Internet use has also opened a multitude of avenues by which strangers can

gain access to children through social media and social networking websites – places where internet sex crimes often originate (Dowdell et al., 2011; Madigan et al., 2018; Malesky, 2007; McGhee et al., 2011). Up to 30% of teens report online sexual advances or other forms of sexual exploitation such as being lured to pornography sites or the texting of nude or sexual images (Mitchell, 2010; Noll et al., 2013). Although they are sometimes acquainted through offline contexts (Wolak et al., 2008), sexual predators use technology to seek out teens who are willing to engage in online sexual solicitations including titillating chat, expressing sexual interest, and the sharing of sexual images (McGhee et al., 2011; Whittle et al., 2013). Sexual predators 'groom' potential victims, first by building trust (Lorenzo-Dus et al., 2016) and then by using flattery (Black et al., 2015) and deception (Marcum, 2007) to lure victims into offline sexual encounters. Adolescent females are more likely to be targeted by online sexual predators (Mitchell, Wolak, et al., 2007; Tener et al., 2015) and are also more often lured into sex-trafficking than are males (Deshpande & Nour, 2013). While offline meetings with strangers can be benign (Livingstone & Helsper, 2013), agreeing to meet someone in person whose identity has not been fully confirmed is arguably dangerous for any adolescent. In a recent nationally representative prevalence study of online sexual offences against children (N = 2639), 16% reported online sexual abuse which included image-based offences, nonconsensual sexting, and online commercial sexual exploitation (Finkelhor, 2022). In other studies, up to 49% of teenagers reported offline meetings with someone first met online (Helweg-Larsen et al., 2012; Noll et al., 2013). Given these results it will be important to identify risk factors that increase child/adolescent vulnerability for internet-initiated victimization. Such knowledge will be instrumental in developing strategies that might protect teens from exploitation or victimization that originates

online.

In accordance with the World Health Organization's 2030 Sustainable Development Goals Agenda, preventing violence against children will necessarily involve holistic, evidence-based approaches that span multiple and intersecting aspects of the child's social ecology including at the individual, interpersonal/community, and structural/contextual levels (Hillis et al., 2016). Without simultaneously considering the conjoining risk and protective factors operating at multiple levels of the child's offline environment, efforts to address online risk behaviors such as sharing personal information, conversing with strangers about sexual topics (Mitchell, Wolak, et al., 2007), and having unknown people as online "friends" (de Santisteban & Gámez-Guadix, 2018), will thus be insufficient.

A 2020 review concluded that common youth internet safety education programs are largely misaligned with research on offline factors that are known contributors to online victimization (Finkelhor, Walsh, et al., 2020). These factors include individual adolescent characteristics, such as delinquency (Mitchell, Ybarra, et al., 2007), emotional problems and antisocial behaviors (Helweg-Larsen et al., 2012), substance use (Díaz & Fite, 2019; Mitchell, Ybarra, et al., 2007), low cognitive ability (Noll et al., 2013), depression (Mitchell, 2007), poor emotional control (Hemphill et al., 2015), and low self-esteem (Zych, 2019). As summarized in a review of 18 meta-analyses (Zych, 2019), positive parent-child relationships, school engagement and academic achievement, and taking advantage of prosocial opportunities such as sports and clubs proved to be protective against online problems. Several demographic and contextual factors also place some adolescents at higher risk than others, including being female (de Santisteban & Gámez-Guadix, 2018; Mitchell, Wolak, et al., 2007), ethnic/minority status (Mitchell, Wolak, et al.,

2007), living in lower income households (Livingstone & Helsper, 2009; Mitchell, Finkelhor, et al., 2007b), and experiencing childhood maltreatment (Maas et al., 2019; Mitchell, Finkelhor, et al., 2007a; Negri & Valente, 2018; Noll et al., 2013) particularly sexual abuse (Helweg-Larsen et al., 2012).

5 Child Sexual Abuse as a Key Risk Factor for Internet-initiated Victimization

There are several reasons why studying the impact of the internet on adolescent development is highly relevant for those with a sexual abuse history. Learning how to navigate the internet safely and appropriately has become a key task of adolescent development and the experience of sexual abuse likely brings unique challenges in doing so as evidenced by decades of research showing that sexual abuse is uniquely linked to disrupted sexual development and sexual revictimization (Noll, 2021; Noll et al., 2017). Those with a sexual abuse history are 2 to 3 times more likely than their peers to experience subsequent physical and sexual re-victimizations during adolescence (Barnes et al., 2009; Noll, 2021), a finding that could logically extend to internet-initiated victimization. According to the Traumatogenesis Dynamics model (Browne & Finkelhor, 1986) sexual abuse in particular has serious implications for female sexual development due to the severe boundary violations, betrayal, stigma, shame and powerlessness that characterize sexual traumatization.

In consort with others' research, our prospective, longitudinal research indicates that substantiated childhood sexual abuse is associated with a host of behaviors and attitudes consistent with aberrant sexual development, such as early coital initiations, more sexual partners, risky sexual behavior, and teen pregnancy (Noll, 2021; Noll, Shenk, & Putnam, 2009). Those adolescents with a sexual abuse

history also report being more preoccupied with sexual images and thoughts, experiencing considerable internal and external pressure to engage in sexual acts, and marked sexual ambivalence and confusion (Noll et al., 2003). Those exposed to sexual abuse often report low quality relationships with non-offending parents and their family constellations are largely characterized by single parent households (Kim et al., 2007). Hence, the ability for parents to monitor media use and effectively communicate about the risks associated with internet behaviors may be especially impaired in these households. Finally, females who have been sexually abused have been shown to engage in pornography consumption (Burton et al., 2010; Noll et al., 2003) and are more often victims of sex trafficking (Lederer & Wetzel, 2014) than their non-abused peers.

6 The Need for Innovation

There is clearly a need for innovation in the study of whether, how, and why internet and social media behaviors might be impacting youth development as well as which teens might be most vulnerable to internet-initiated victimization. Recent reviews (Odgers & Jensen, 2020; Orben, 2020), including one reanalysis of three large-scale international social datasets (Orben & Przybylski, 2020), point out major shortcomings in the extant research that should be remedied if the field is to move forward in meaningful ways: (1) internet activity has been exclusively assessed via adolescent self-reports, which show only moderate correlations with actual use (Boase & Ling, 2013; Gold et al., 2015; Mireku et al., 2017; Scharkow, 2016), (2) research designs are cross-sectional with no ability to model risks over time, (3) the majority of studies lack adequate control of potential confounds, and (4) research should focus on the types and characteristics of internet use, not simply the amount of time teens spend online. The TechnoTeens study is one such attempt.

7 The TechnoTeens Study

The methods and procedures of the TechnoTeens study are fully described in a recent paper published in *Nature Human Behaviour* (Noll et al., 2022). The TechnoTeens study was conceived as a result of our previous prospective, longitudinal studies with children who were maltreated and several pilot studies on risky internet and social media behaviors. It also represents a major investment (\$3,672,658) by the National Institutes of Health (NIH; R01HD073130, PI: Noll) to understand the impact of the internet and social media on youth development in general. The TechnoTeens Study also employed significant advances in methodological innovation in the study of youth internet behaviors including: (1) working directly with local child protective service agencies to enroll females with substantiated child sexual abuse within the previous year, (2) objective recording of up to four weeks of actual web behavior as opposed to reliance on youth self-report, (3) authentication of participant web activity via observed keystroke patterns, (4) objective classification of all URLs into relevant categories of teen internet activity via open source, international databases, (5) extraction and analysis of YouTube and Netflix keywords, and (6) a longitudinal design.

A major objective of this study was to track the actual URL activity of 460 adolescent females not only in terms of how much time they spend online in general, but where they go, what they do, and what they see on the web. A second objective was to test how this activity was related to serious consequences two years later, including subsequent cyberbullying, online sexual solicitations, offline meetings with strangers first met online, and risky sexual behaviors. To meet these objectives, teens were provided laptop computers capable of recording all URL activity. At the end of the initial lab session, which lasted approximately 2 hours and included

structured interviews and questionnaires administered to adolescent and participating caregivers, females were provided a password protected Apple 15-inch MacBook Pro laptop computer. The CDROM drives on these computers were replaced with a 4G LTE Verizon modem and an accompanying antenna that allowed continuous connectivity and unlimited data usage to ensure that every participant would have unlimited high-speed access to the internet anywhere within the catchment area.

All URL data were objectively quantified in real time against open sourced blacklist databases into commonly understood classification categories (i.e., entertainment, social media, gaming, pornography, and education). In recognition that a large swath of URLs categorized as 'entertainment' likely include video-sharing platforms, we drilled down to extract keywords associated with videos consumed through YouTube and Netflix given their wide popularity and ease of access. We therefore were able to tag and quantify videos deemed to be inappropriate for teenagers, such as those associated with illicit drug use and/or containing sexual or violent content. As a result, a wealth of data was amassed capable of providing an objective assessment of teen internet use patterns and profiles.

To ensure that online behaviors were specific to those enrolled in the study as opposed to others residing in the household or who may have access to the assigned laptop, an authentication algorithm was developed to provide assurances that the observed web activity was indeed attributable to the participating adolescent. Using machine-learning techniques, key stroke patterns observed by study staff during laboratory visits (training data) were compared to patterns obtained during login procedures outside the laboratory (field data). Using a 97% specificity cutoff,

roughly 26% of all URL data were discarded for being inconsistent with that of participating adolescent. Coupled with the longitudinal design, this innovation and level of precision not only heightened the rigor of this research but strengthened statistical inferences about the impact of the internet on female adolescent development over time.

7.1 Sample

Participants ranged in age from 12 to 16 (mean = 14.25, SD = 1.25) at the initial, Time 1 assessment (N = 460) with two additional follow-up assessments commencing annually at Time 2 (N = 434; 94% retention) and Time 3 (N = 421; 92% retention) when the sample was mean-aged 15.32 (SD = 1.25) and 16.42 (SD = 1.26) years, respectively. The focus on teenage girls was intentional for several reasons; cyberbullying continues to be on the rise for females (Hamm et al., 2015), females field the bulk of sexual solicitations and are more often targeted for exploitation (Mitchell, Finkelhor, et al., 2007a), and social media disproportionately impacts the well-being of girls (Twenge, 2019). Given that boys report qualitatively different internet use patterns as compared to girls (National CyberSecurity Alliance, 2017), the risk pathways to online victimization for boys, and likely gender minority teens who are also understudied, are likely quite distinct from girls and would require a much larger sample size and financial investment to adequately do justice to these key differences.

The sample was constructed to intentionally include subgroups of adolescents from varying socioeconomic and risk contexts; roughly equal subsamples of females who experienced recent childhood sexual abuse (CSA), demographically-matched control (DMC) females from similar neighborhoods, and census-matched control (CMC) females. Our partnership with child welfare agencies to recruit females whose

sexual abuse was substantiated within the previous 12 months allowed us to ensure that the sexual abuse was objectively confirmed and to establish some homogeneity with respect to the developmental timing of the abuse. The use of a DMC group was a strategy to rule out potential confounds when asserting the unique effects of sexual abuse. Enrolling the CMC group provided an opportunity to further tease out the effects of sociodemographic contexts while the broadening of generalizability of findings.

7.2 URL Activity

URL activity was assessed via active URL interaction in minutes. Active usage was defined as consistent or intermittent interaction with a webpage. Only active URL activity was quantified for content. Activity was aggregated within all user-initiated sessions. A session began each time the user logged on to the computer and lasted until the computer was shut down or if there was consistent nonuse for a period of 60 minutes. When laptops were in continuous use, a new session was delineated every 2 hours. A total of 32,323 sessions were available for analysis.

Resultant data was quantified as the number of minutes participants spent actively surfing each category type within a given session. URLs were matched in a commercial blacklist database to objectively classify each based on broad category types including "social media", "entertainment", "pornography", "education" and "gaming". Just over 93 percent of all URLs were classified in at least one of these categories. Overall activity was quantified as the average number of minutes per session spent in all active URL activity. URL activity classified as social media, entertainment, pornography, education, and gaming was similarly quantified as the average number of minutes per session spent in active URL activity on each website

classified by these categories. See Noll et al. (2022) for a more detailed description of URL classification.

7.3 Psychosocial Risk and Protective Factors

Sexual abuse status was quantified as 1 (enrolled into the CSA group as described above) or 0 (enrolled in either the DMC or CMC comparison groups). As thoroughly described in Noll et al. (2022), a host of risk and protective factors were assessed using standard measures of substance use (Johnston et al., 2005), depression (Radloff, 1977), impulse control (Patton et al., 1995), executive functioning (LeJeune et al., 2010), self-esteem (Harter, 1988), offline prosocial activities (Harter, 1988), and parental relationship quality (Armsden & Greenberg, 1987). School engagement was represented by teens' reports of their overall school performance via a rating of their current or most recent grades quantified as 0 = F's, 1 = D's and F's, 2 = D's, 3 = C's and D's, 4 = C's, 5 = B's and C's, 6 = B's, 7 = B's and A's, and 8 = A's.

7.4 Outcomes

Internet-initiated victimization was assessed at follow-up visits (Times 2, 3) via a detailed semi-structured interview, the Comprehensive Trauma Interview (CTI). The CTI is an instrument assessing a host of traumatic events and adverse child experiences that has been validated for use with adolescents (Barnes et al., 2009; Shenk et al., 2016). During the course of this structured interview participants endorsed specific events that could be potentially traumatizing. Trained interviewers then followed up with detailed questions including the age at occurrence, duration, who was involved, severity, and how upsetting the event was for the participant on a scale from 0 = "not upsetting at all" to 5 = "the most upset I have been". Events with

upset ratings of 0 were excluded from further analyses. For purposes of this analysis, victimization was coded using responses on the CTI at Times 2 or 3 to indicate: 1 = had upsetting (i.e., via upset ratings >0) victimization experience(s) during the past 12 months, or 0 = did not have any such experience(s) during the past 12 months. **Cyberbullied** was assessed by the question, "Were there times when you have been bullied, harassed or threatened by someone online?". **Online sexual advances** were assessed by the question, "Have you experienced sexual advances that went too far or were upsetting to you through a social networking site, chat room, text message or instant message?". **Meeting strangers offline** was assessed by the question, "Have you met someone in person that you first met online, where the off-line meeting turned out to be a bad experience?". **Sexual activity** was assessed at each time point via seven questions from the Sexual Attitudes and Activities Questionnaire (Noll et al., 2003).

8 Summary of Major Results from the TechnoTeens Study

The analytic plan for this study included using latent profile analysis (LPA: Dziak et al., 2016; Lanza, 2016) to identify groups of adolescents who showed similar patterns of Time 1 internet use coupled with Time 1 individual-level psychosocial risk variables (substance use, depression, impulse control, executive functioning, and self-esteem,) and Time 1 family/school/community-level protective factors (school engagement, offline prosocial activities, and parental relationship quality). Resultant profiles derived from Time 1 variables were then used in longitudinal models as predictors of subsequent internet-initiated victimization and sexual activity approximately two years later. All analyses controlled for demographic covariates (Time 1 age, income, minority status, and ethnicity) and adjusted for

experiment-wise error. See Noll et al. (2022) for details and additional results not presented here.

Figure 1 includes the results of the LPA that was conducted using the R (R Core Team, 2018) mclust package (version 5.4.5) (Scrucca et al., 2016). Profiles differed significantly on key variables which aided in interpretation of findings. For example, Profile 1 (yellow) consisted of 139 females at relatively low-risk in terms of less internet use across all categories coupled with relatively low psychosocial risk and high protective factors. Profile 2 (blue) consisted of 200 females at moderate risk characterized by increased overall internet use – relatively high social media, entertainment, and adult-content YouTube & Netflix videos – coupled with moderate psychosocial risk and lower protective factors. Profile 3 (red) consisted of 93 females at high risk in terms of being characterized by high internet use in terms of total time spent online and time spent viewing pornography and gaming. Females in this profile were also characterized by high psychosocial risk including substance use and depression symptoms and lower protective factors. See Noll et al. (2022) for full results from MANOVA tests comparing the latent profiles.

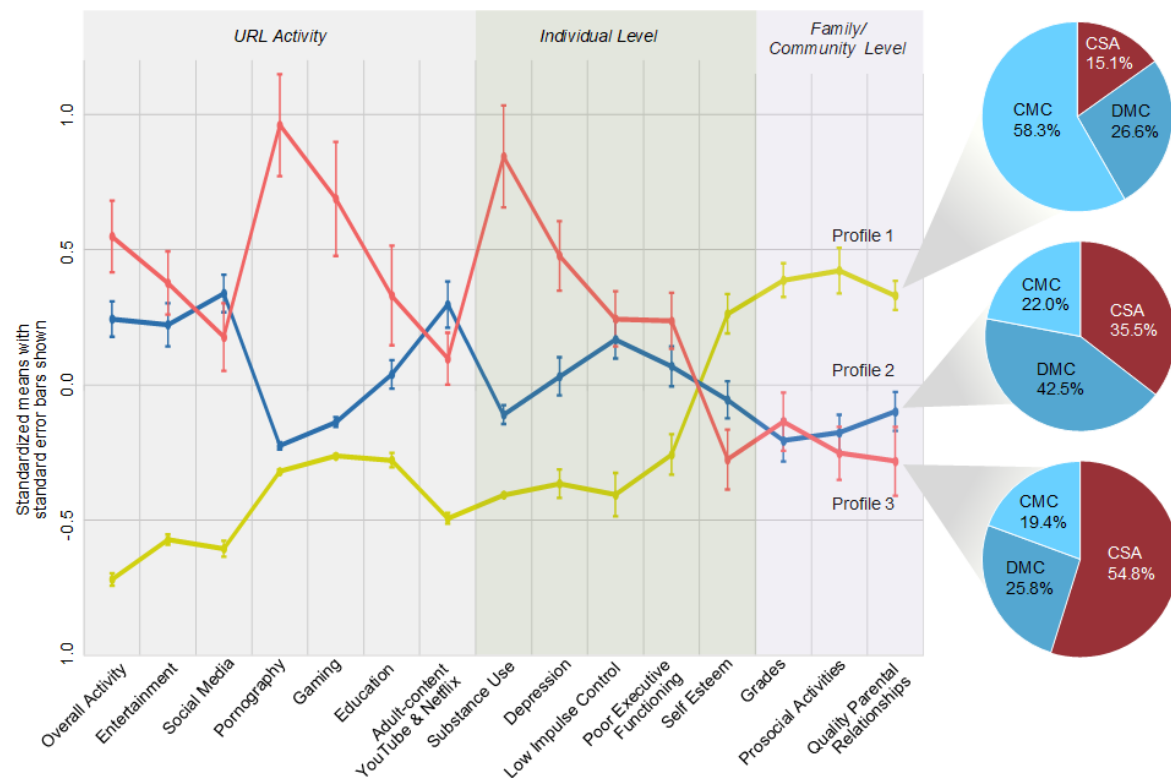


Figure 1. Unadjusted Standardized Means and Bootstrapped Standard Errors for All Variables Used in the Latent Profile Analysis (LPA). Reproduced from Noll et al. 2022 with permission.

Multinomial regressions were used to test how LPA group membership predicted subsequent internet-initiated victimization outcomes. Statistically significant results indicated that, as compared to Profile 1, the odds a female experiencing cyberbullying were 3.14 times greater for females in Profile 3 and 1.96 greater for females in Profile 2. The odds of a female receiving upsetting online solicitations were 2.63 and 2.64 times greater for females in Profile 3 than for females in Profile 2 and Profile 1, respectively. A final analysis of covariance (ANCOVA) model considered rates of sexual activity across profiles. Resulted indicated that females in Profile 3 endorsed significantly greater rates of risky sexual activities as compared to females in both Profile 2 and females in Profile 1.

Analyses testing differences in profile representation and in outcome prevalence for CSA females were also considered. Results indicated that the majority of those represented in Profile 3 were CSA females (54.8%). Additional statistically significant findings from a multinomial logistic regression where Profile 1 served as the reference group indicated that the odds of a CSA female being in Profile 3 were 5.72 times greater as compared to CMC females and 3.64 times greater as compared to DMC females. Additional logistic regression models indicated that the odds of a CSA female to be cyberbullied were 2.76 and 2.97 times greater than for DMC and CMC females, respectively. The odds of CSA females to have met strangers offline who they first met online were 4.97 greater than for CMC females.

9 Discussion

The TechnoTeens study is the first truly observational study of adolescent internet use to move beyond self-report data or methods. This study employed technology specifically developed to capture and quantify all URL activity of participating adolescents for roughly one month. We also developed a sophisticated keystroke authentication algorithm to ensure that the recorded activity was that of the participating adolescent as opposed to someone else in the home who might have access to the assigned laptop. The extraction and analysis of YouTube and Netflix keywords allowed us to drill down into the entertainment activities of teens in order to ascertain the extent of adult-content video consumption. Finally, the longitudinal design facilitated models of prediction, thus strengthening causal inference about how profiles of internet use coupled with psychosocial risk and protective factors accounted for unique variation in internet-initiated victimization and risky sexual behaviors roughly two years later.

Since a major design component of TechnoTeens was to understand the connection between sexual trauma and internet use patterns, an additional notable strength and innovation of this study was the inclusion of females with substantiated sexual abuse as opposed to relying on retrospective self-reports. To accomplish this, we partnered with local child welfare agencies to recruit eligible females and their caregivers. These partnerships were painstakingly cultivated over a number of years and across several research projects. We first approached these partnerships with a mutually beneficial, symbiotic relationship in mind. As researchers we offered to help agency directors think through aspects of their policies, practice, and consumer outcomes that would benefit from empirical study. We then offered our expertise in designing and conducting studies that would address these issues and thus directly benefit the agency. In return, agencies worked with us to gain access to families who would qualify for inclusion in our funded research studies.

Once all regulatory processes were mutually vetted and in place, agencies provided us with the names and addresses of eligible families for recruitment. Importantly, the recruitment procedures implemented were purposely designed to alleviate burden on child welfare staff. These procedures included research staff sending correspondence directly to eligible families from our research offices on behalf of the child welfare agency. These letters explained the study procedures, attested to the fact that the child welfare agency supported the study, made it clear that participation was voluntary and that child welfare services would not be interrupted if families chose not to participate, and offered specific procedures to opt out of any further contact by research staff. By allaying agency burden, building trust, and becoming a service to agencies, we found these partnerships and procedures to

be exceedingly effective in study recruitment and in a multitude of mutually beneficial community-based participatory research projects.

Results from this highly innovative study of objectively observed and quantified internet use demonstrate that there are indeed subgroups of adolescent girls whose internet use, along with co-occurring psychosocial risk-factors, can signal vulnerabilities for subsequent internet-initiated victimization and sexual risk-taking behaviors. In particular, females who, to a greater extent than their same-aged peers, spent more time online, consumed online pornography, and engaged in online gaming were more likely to be cyberbullied, receive upsetting online sexual solicitations, and engage in risky sexual behavior in their subsequent adolescent years. These teens were also those who reported lower self-esteem and greater substance use and depression symptoms than their peers. Results were also clear that CSA poses particular risk as these females were more much more likely to be represented in the highest risk profile group and were also more likely to agree to meet strangers offline than were non-abused females.

9.1. Complexities of Innovative Methods

The importance of sound, innovative methods in advancing science cannot not be lauded and extolled enough. Innovation is especially important in burgeoning fields such as the study of how technology impacts youth development. The over-reliance on self-reports of technology use, which characterizes the majority of published research in this field, has been touted as a key limitation due to the potential for social desirability and for reporting bias in terms of an inability to accurately recall use patterns (Verbeij et al., 2021). Although a dearth of studies exist that can illuminate the actual scope of this bias, one study compared computer log files to self-reports and showed that the accuracy of self-reported frequency and

duration of internet use was quite low and that survey data were only moderately correlated with log file data. Moreover, this study reported systematic patterns of misreporting both in terms of under- and over-reporting (Scharkow, 2016). The TechnoTeens study represents a significant advancement in innovation in terms of moving the field beyond adolescent self-reported online activity by being the first to actually record and quantify all URL activity. As described in the methods section above, the scientific rigor was also enhanced by a sophisticated authentication algorithm employed to ensure that the recorded URL activity was that of the participating adolescent.

Although highly innovative, capturing actual internet use of adolescents in the context of the TechnoTeens study proved quite tricky in a number of ways. First, it was necessary to demonstrate whether or not being observed might influence the behaviors of participants. In attempt to circumvent potentially truncated internet surfing behaviors due to being observed, it was made clear during the consent process that we wanted teens to use the assigned laptop as they would any computer. It was also stressed that we would not be divulging adolescents' URL activity to caregivers or others unless we observed behaviors consistent with participants being in danger or wanting to hurt themselves or someone else. In our pilot work prior to crafting the NIH proposal that ultimately funded this project, we demonstrated that, on average, URL activity appeared to be relatively light for the first few days of usage. After those few days, activity significantly increased. We surmised that adolescents likely "tested the waters" a bit to ascertain potential consequences prior to fully engaging in internet behaviors commensurate with typical browsing behavior. By recording activity for at least one month, we were

confident that we significantly increased the probability of capturing naturalistic behaviors.

Second, participant safety was a notable concern that required sensitivity and vigilance. For example, there were several instances when online activity warranted intervention. Although these data were not included in the present analyses, innovative data collection procedures recorded browser search terms and social media posts. Monitored daily by study staff, these data elements at times included details to suggest that the adolescent might have been victimized (e.g., “I think I was raped last night”). In such cases staff were trained to notify the participating caregiver and to report, or offer assistance in reporting, the incident to the appropriate agency.

We also encouraged participating caregivers to enact the parental control software feature that was included in the operating system options of the assigned laptops if they were concerned with the potential for their teen to consume inappropriate online content. After the first several months of the study, we noticed that caregivers were not using this option. To make this as simple as possible for caregivers we revised our protocol procedures to include a detailed lab demonstration on how to enact this feature at the time the laptops were assigned. We also included step-by-step instructions on how to enact parental controls in the form of a shortcut on the desktop. Despite attempts to encourage and empower caregivers, less than one percent opted to engage the parental control option.

Finally, considerable innovation was required to deal with a host of complexities regarding the software and laptops. Not only did we continually update our software to deal with the emergence of encrypted websites but we also adapted to new browsers and the ever-changing array of social media platforms. Continual

issues arose with regard to recovering and maintaining laptops and in keeping the machines in working order. On occasion, machines were returned stripped of internal features such as modems and memory cards. Some routinely sustained considerable damage to casings or screens. Others were returned with bedbugs, which required an innovative solution. We installed an oven in the lab and designed a specific protocol to ‘cook’ every returned laptop to ~180 degrees – hot enough to kill the bedbugs but not hot enough to damage the machine. Several laptops were stolen or sold. We thus installed innovative GPS tracking devices so that our team could pinpoint laptop locations which facilitated our ability to retrieve these ourselves or to work directly with law enforcement to recover stolen property.

9.2. Study Limitations

One major limitation of this research is that it focuses only on females and results cannot be generalized to males. As explained in section 7.1 above, we focused on females for several empirically-driven reasons. To include a sample large enough to adequately do justice to the potential uniqueness of boys versus girls would have been outside the scope of a single longitudinal study. Internet use and internet risk pathways for boys likely differ significantly from those of girls warranting larger studies where gender differences are specifically hypothesized and tested. Especially if online activity could be objectively observed, such research would significantly advance the field in ways that research limited to only females cannot. As discussed more fully in Noll et al. (2022), another potential limitation is that this study took place between 2012 and 2015 before smartphones became the preferred interface for teens surfing the internet and engaging social media. However, we assert that, by quantifying URLs into broad categories of behaviors which continue to

be relevant (social media, entertainment, pornography, gaming, education), results are generalizable even today.

9.3. Effect Sizes in Comparison to Studies of Self-reported Internet Use

The lack of methodological rigor employed in previous studies has fueled recent debate over whether the small yet statistically significant effect sizes reported in large-scale population-based datasets (Johnston et al., 2016; Kann et al., 2016; Joshi & Fitzsimons, 2016) are meaningful (Twenge, 2019) or whether they represent non-replicable results from hundreds of analysis options, each with little practical value (Orben, 2020). To support this claim, data from several population-based datasets were used in a re-analysis of the associations between technology use and various aspects of adolescent well-being. Results showed uncontrolled standardized R-squares to range from -.013 to -.068 (Orben & Przybylski, 2019).

For the purpose of comparing our results with these large-scale population-based social datasets, and to facilitate reproducibility, we generated a post-hoc, zero-order association matrix (Noll et al., 2022; Supplemental Table S1) as a means to contrast effect sizes obtained in self-report versus direct observation studies of internet use. Although not directly comparable, in general, effect sizes generated in the TechnoTeens study were 2 to 3 times larger than those reported in population-based, self-report studies of similar constructs. For example, zero-order Pearson's r associations with overall minutes per day of internet usage were equal to .179 for depression, -.150 for self-esteem, -.210 for grades, and -.220 for prosocial engagement. Moreover, these zero-order associations provide some level of construct validity (e.g., minutes spent on education websites correlates with good grades) and consistency within the extant literature (e.g., minutes spent on social media correlates with depression) (Orben & Przybylski, 2019). Results from the

TechnoTeens study, with its methodological rigor and relatively large effect sizes produced by longitudinal prediction models (ORs ranging from 2.97 to 4.97), thus reinforce conclusions that the impact of the internet on today's adolescent females is far from trivial. However, results also clearly demonstrate that there are many adolescents for whom the internet does not pose problems and that internet safety education, although warranted, would be most impactful if delivered at variable frequencies and at differing intensities depending on youth risk-profiles.

9.3. Implications for Internet Safety Efforts

Even as violence against children has become an international priority (World Health Organization, 2019) and global alliances now explicitly entreat the inclusion of online protections in prevention efforts (We Protect Global Alliance, 2015), extant online safety campaigns have been stymied by a lack of clarity regarding the scope and definitions of online violence as well as how to maximize reach and benefit (Kardefelt-Winther & Maternowska, 2020). Indeed, recent reviews of internet safety education programs currently operating in developed nations (Cosma et al., 2019; Finkelhor, Walsh, et al., 2020) – including those designed by technology companies (e.g. *Be Internet Awesome*; Google, 2019), child protection agencies (e.g. *NetSmart*; National Center for Missing & Exploited Children, 2019), and non-profits such as *Common Sense Media* (2019), and *PBS Kids* (2020) – detail the challenges that these programs currently face. These challenges include lacking rigorous empirical evaluation and failing to be aligned with the larger body of research on how online problems originate and which kids would benefit most from prevention efforts.

The three profiles of Figure 1 map on nicely to a three-tiered prevention approach consistent with definitions put forth by the Institute of Medicine (Springer & Phillips, 2007). At the first tier, a brief, low-cost internet safety campaign perhaps

delivered in a single session or via take-home flyers or community advertising would likely be sufficient for low-risk adolescents akin to those in Profile 1, or about 32% of the sample. These teens displayed few problematic URL behaviors, lacked individual psychosocial risk factors, and benefited from ample family and community-level protective factors.

At a second tier, and perhaps most beneficial to those in Profile 2 (46% of the sample), a more focused prevention program would be warranted that selectively targets individual-level risk factors. This could include integrating online safety curricula into other programs that are designed to prevent a larger array of violence and other offline problems, such as bullying prevention and bystander interventions, life-skills or relationship-skills training, and sex education. Integrating internet safety education into victimization prevention, life-skills training, and sex education programs would not only be in accordance with recent recommendations for increasing the efficacy of online safety education (Finkelhor, Walsh, et al., 2020) but would maximize the investment that schools are already devoting to prevention more broadly. Perhaps another extension of this work is the potential use of artificial intelligence and machine learning to automate the delivery of targeted prevention messaging over the internet. Akin to consumer marketing algorithms used to sell goods, such messaging could be strategically delivered when URL patterns are indicative of adolescent usage, but that are also simultaneously consistent with risk for online victimization and exploitation, such as surfing pornography websites and viewing adult-content videos. In such scenarios, algorithms engineered to routinely convey internet safety education and awareness could be additional avenues for tier-two prevention.

At a third tier, internet safety education could be integrated into prevention efforts for teens with indicated behavioral and/or mental health symptoms associated with risk for the deleterious impacts of the internet. Findings from the TechnoTeens study demonstrate that teens in Profile 3 (22% of the sample) spend large amounts of time online, including viewing pornography and gaming, but they also have remarkably high levels of substance use and depression suggesting that these psychosocial conditions may amplify the negative effects of risky web activity. For example, teens who are depressed likely spend more time surfing the internet simply as a means to cope with their depressed mood. These teens may also have few emotional and cognitive resources that would otherwise protect against the negative effects of excessive pornography use. Similarly, the same addictive tendencies that are associated with substance use might interfere with an ability to disengage from online activity such as pornography and gaming in favor of more healthy offline alternatives. However, since they were obtained simultaneously it is difficult to disentangle cause and effect and it is just as likely that higher rates of internet use may exacerbate depressive symptoms and substance use. What is clear, however, is that adolescents with this risk-profile were significantly more likely to be cyberbullied and to experience subsequent online sexual solicitations in longitudinal models – a finding that does indeed strengthen conclusions about specific indicated symptoms that could be intervened upon in a tier-three prevention strategy to protect teens from internet-initiated victimization.

9.4. Implications for Survivors of Sexual Abuse

Results suggest that sexual abuse is a salient risk factor for internet-initiated victimization. Not only did females with a sexual abuse history populate the highest risk profile group (Profile 3) in greater numbers than their demographic or census-

matched controls, they were also significantly more likely to engage in offline meetings with strangers that they first met online. There are several viable explanations for this elevated risk. First, the experience of sexual abuse has been shown to disrupt the normal course of development – in terms of early pubertal timing (Noll et al., 2013), deficits in cognitive development (Noll et al., 2010), dropping out of high-school (Trickett et al., 2011), and teenage childbearing (Noll et al., 2017) – thereby introducing unique challenges that can render adolescence a particularly difficult developmental period to navigate. Second, sexual development, in particular, can be disrupted by the betrayal, powerlessness, sexual boundary violations, and stigma associated with sexual abuse (Browne & Finkelhor, 1986) as evidenced by studies showing elevations in risky sexual behaviors (Negriff et al., 2015; Noll et al., 2019) and high rates of pornography consumption (Burton et al., 2010; Noll et al., 2003).

Finally, females who experience sexual abuse are susceptible to subsequent sexual re-victimization (Barnes et al., 2009) and sex trafficking (Lederer & Wetzel, 2014). The integration of internet safety education into programs designed to support victims who are struggling with indicated trauma symptoms – including evidence-based trauma treatments (Cohen et al., 2004) and those designed to target traumatic sexualization (Senn et al., 2017) – could be a viable third tier strategy. Such a strategy would likely have a substantial benefit to a large proportion of the population given that the sexual abuse of children is a persistent, international public health issue (Mathews, 2019) affecting 13% of girls worldwide (Barth et al., 2013) and showing recently rising trends in developed nations, including the U.S (Finkelhor, Saito, et al., 2020).

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**Understanding Variation in Health Risks across Development and Child
Welfare Involvement for Youth in Foster Care**

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Abstract

Children exposed to maltreatment and foster care (i.e., out-of-home care) experience disproportionately high healthcare utilization; however, the etiology of these differences is unclear. Health status, healthcare access, maltreatment histories, risk behaviors, and out-of-home placement likely all contribute. This chapter reviews empirical studies examining the health status and risk behaviors of children and adolescents in out-of-home care with the goal of identifying the unique contribution of experiences during out-of-home care to healthcare utilization, health characteristics, and risk behaviors. Further, we highlight where health disparities and risks are known and provide an example of where interventions can be applied to support health equity when children are in out-of-home care. Finally, opportunities to address policy and practice given the state of the current empirical literature, and areas where more research would enhance service provision, are discussed.

Keywords: child welfare, foster care, out-of-home care, protective custody, substance use, child abuse, maltreatment, adolescent, young adult, health care delivery, pediatrics, health services research, adolescent health, health disparities, health equity

1 Background

In the United States, children generally enter foster care (i.e., temporary or permanent assignment of physical and legal custody from a parent to a children's services agency, coinciding with the child's placement with new caregivers who are relatives, non-relatives, or staff supervising group homes, residential treatment, shelter care, or independent living; U.S. Department of Health and Human Services, 2020) when a children's services agency has determined that the child's legal custodian, generally a parent, was responsible for maltreatment or other imminent safety concerns either directly (e.g., as the perpetrator) or indirectly (e.g., failing to stop maltreatment). In 2020, approximately 394,700 children less than age 18 resided in foster care (U.S. Department of Health and Human Services, 2020). It has previously been estimated that on any given day, around 0.5% of the total U.S. population under the age of 18 years is in foster care (Wildeman & Emanuel, 2014). Further, placement in foster care is intended to be temporary and most children will only spend a portion of their childhood in foster care. As a result, the number of individuals experiencing foster care is much higher than the number of children in foster care on a given day or year. When considering all children in the U.S. who have spent at least 1 day in foster care prior to the age of 18, foster care involvement impacts close to 6% of the U.S. population (Wildeman & Emanuel, 2014). Attending to the needs of these young people and ensuring their health and well-being prior to, during, and after involvement in foster care is critical because the contexts in which services are provided (e.g., family and living arrangements, school, healthcare) change for children who have or will spend time in foster care.

While criteria for determining which children should enter foster care are described in federal, state, and local laws and statutes (Child Welfare Information

Gateway, 2022), in practice, the application of policy introduces variation that contributes to an unequal probability of entry into foster care by demographic characteristics including minoritized race and ethnicity, poverty, mental health, and intergenerational exposure to adversity (Wilson & Kastanis, 2015). Some of these mechanisms can appear causal - a parent with a substance use disorder who leaves their child unattended, for example, is neglecting their child due to their psychological disorder. However, contextual factors (e.g., not having resources or social support to secure an appropriate caregiver) modify the impact of a parent's behavior, contributing to similar mechanisms (e.g., a parent with a substance use disorder) having different outcomes (e.g., child enters foster care, child lives with another relative without children's services involvement). The complexity across these mechanisms results in minoritized children of color, for example, making up 56% of children in foster care in the U.S. (U.S. Department of Health and Human Services, 2020), despite representing only 50% of the U.S. population (United States Census Bureau, 2021). Likewise, children in foster care have a 29% higher odds of a history of living in poverty compared to children who live with a parent (Pac et al., 2017).

Acknowledging that contextual factors modify the interpersonal interactions between parents and children that contribute to foster care entry is important to this chapter for two reasons. First, both contextual and interpersonal interactions are known to contribute to children's health. As described by Bronfenbrenner, the family unit is embedded in a rich social and environmental context that shapes child and family development and well-being (Bronfenbrenner, 1986). Therefore, it is important to consider that children in foster care may experience health disparities that are not driven by their foster care involvement but rather by the multiple mechanisms that contribute to children entering foster care. Second, policies and systems designed

with an intentional or unintentional bias toward certain groups, including healthcare and children's services policies and practices, may further exacerbate risk. The reverberating impact of systemic racism that resulted in unsafe housing, inequity in education, limited employment, and disproportionate rates of incarceration for people of color (Murray, 2022) have also contributed to health concerns for children entering foster care. Both of these perspectives are important for considering the mechanisms that contribute to health disparities for children who are in foster care or will enter foster care.

2 Health Risks Prior to Foster Care Entry

There are multiple factors that contribute to poor health, development, and well-being that children may have been exposed to prior to their entering foster care. First, children of color and children exposed to poverty are disproportionately over-represented in foster care (Pac et al., 2017; Wildeman & Emanuel, 2014). Moreover, certain mechanisms, including institutional racism in healthcare (Yearby, 2018), contribute to disparities in healthcare access for publicly-insured children and families as well as reduced receipt of high-quality, preventive healthcare services for children and their families. As a result, children may be less likely to receive early intervention, home visiting, and other programs known to promote better health and enhance development and well-being (Alegria et al., 2010; Flores & Lin, 2013) in addition to missing out on preventive care like vaccinations, early detection of chronic disease, and resources to support positive parenting practices.

Second, children often enter foster care due to exposure to maltreatment (i.e., physical, sexual, or emotional abuse or neglect) and other adversity (e.g., parent mental health or substance use). Maltreatment and adversity are both known to contribute to children's health and development. With respect to maltreatment

exposure, studies have repeatedly demonstrated the harmful effects of maltreatment on physiology and development. Maltreatment sequelae contributes to altered stress and immune responses and increased inflammation and strain on physiology, which are associated with increased risk for autoimmune disorders, pain, and other chronic diseases (Ioannidis et al., 2020; Ramo-Fernández et al., 2019). Additionally, maltreatment is associated with psychological dysregulation (Crow et al., 2021) that, without intervention, can contribute to increased internalizing and externalizing behaviors, resulting in increased risk for PTSD and other behavioral health concerns. In addition, adversity (Belsky, 2019; Flaherty et al., 2006, 2013) and other social determinants of health, including parental mental health concerns and substance use (Viner et al., 2012; Viner & Taylor, 2005), have been linked to health and development in childhood and adolescence. The pathways linking adversity exposure to health are, in some ways, similar to those linking maltreatment and health, particularly when adversity exposure has been chronic. Further, the risks associated with adversity include a broad range of environmental and household factors, including exposure to environmental toxins, inconsistent or unresponsive parenting behaviors, and poor parent-child co-regulation that are linked to poor health and development, negatively impacting both physical health and social context, such as success in school (Low et al., 2005). In sum, the health and well-being of children who enter foster care is profoundly impacted by their experiences before removal from their families of origin, experiences that are multifactorial and multisystemic.

3 Health Risks while Children are in Foster Care

When children enter foster care, they are by definition separated from their primary caregivers; as a result, they are typically separated from the adult who has

the most knowledge and expertise about the child's history, preferences, and development. While children's services makes every effort to capture what is known about a child's health history and development when children enter foster care, information is often missing or incomplete (Greiner et al., 2015, 2022). In addition, the traumatic experience of parental separation negatively impacts child development and well-being (Greeson et al., 2011). New caregivers do not have the knowledge or history to fully ensure that children's health needs are being adequately met (Greiner et al., 2015), and often establish healthcare services with new healthcare and behavioral health providers who also do not have historic information to inform care (Greiner et al., 2019). As a result, healthcare and behavioral health services often start (or re-start) as children enter foster care and are again disrupted as children experience placement changes (Beal, Ammerman, et al., 2022), with potential to negatively impact health.

Within this context of disrupted caregiving and healthcare delivery, children's health needs when they enter foster care and while they remain in care are often higher than the general population (Simms et al., 2000), contributing to more healthcare use (Beal et al., 2021), and higher healthcare costs (Minnis et al., 2006) than other children who are publicly insured. While both physical healthcare utilization (Beal, Ammerman, et al., 2022) and behavioral healthcare service use (D. M. Rubin et al., 2004) decline as children remain stable in placement, both are known to increase when placement changes occur, suggesting that placement changes may, in some cases, be a driver of disrupted service delivery and therefore bidirectionally related to health problems for children in foster care. Communication and coordination among healthcare providers and caregivers, especially as services and placements transition, is lacking (Greiner et al., 2019), which is contributing to

more healthcare use (Beal, Ammerman, et al., 2022) and may also be contributing to poorer health and negatively impacting development and well-being. As a result of this discontinuity and poor communication, healthcare and behavioral health services run the risk of being episodic and in response to acute needs, rather than being delivered in a way that will ultimately lead to better health and well-being across the child's lifespan (Adler & Stewart, 2010).

4 The Promise of Better System Design to Improve Health

Multiple models of healthcare and behavioral health service delivery posit that healthcare and behavioral health service delivery will contribute to better health and development when it is coordinated, comprehensive, timely, efficient, and addresses the needs and priorities of the patient and family. For example, the Chronic Care Model proposes that healthcare systems and individual and community resources and practices improve health outcomes in the context of chronic disease; which has been applied to primary care and prevention as well (Hung et al., 2007). Likewise, the Medical Home Model suggests that healthcare systems that are designed to be comprehensive, coordinated, and committed to quality and safety must also account for patients' and communities' needs and preferences (e.g., supporting patients as primary decision-makers, ensuring accessibility and equity) in order to positively impact health (Aysola et al., 2011). Aligned with these ideals are concepts of both integrated behavioral health, where preventive and treatment behavioral health services are delivered (Kwan & Nease, 2013), and the healthcare transitions model, where transitions of responsibility for health management and service delivery are managed to ensure patients, caregivers, and providers are informed and supported (Andiman, 2011). These concepts highlight the importance of informed and integrated services that effectively communicate and collaborate with patients and

caregivers to ensure success in healthcare delivery and ultimately contribute to improved health and well-being. Studies have demonstrated improvements in completing primary and preventive care, better screening for preventable health conditions, and decreased cost when services are delivered in systems that align with these models (Starfield & Shi, 2004). These systems have the added benefit of being better positioned to connect their patients with other programs, including home visiting and early intervention, positive parenting programs, and behavioral health services associated with decreased internalizing and externalizing behaviors in children, reduced stress among parents, and enhancing parent-child relationships (Kazak et al., 2017).

For children who reside continuously with the same parent in the same community, it is easier to ensure a shared historical knowledge of a child's health with the parent and the healthcare provider, supporting access to early intervention programs known to promote health and well-being. When children enter foster care or experience changes in placement, the priorities and needs of the patient and their caregivers shift and educating new caregivers about children's health needs and history becomes important. Further, entry into foster care and changes of placement in foster care are often not coordinated with the comprehensive set of stakeholders (e.g., schools, community organizations, healthcare providers) that support the child to ensure that all other services, including healthcare, can be modified effectively to support the child's health, development, and well-being. In the absence of such coordination, healthcare systems are left unprepared to support transitions of care to new caregivers and may not have the historic health knowledge needed to educate the new caregiver on the child's needs. Instead, the healthcare provider and caregiver are both discovering a child's needs together, without the benefit of any

historical context. Further, in many communities, new caregivers choose the healthcare providers for the children placed with them, introducing additional mechanisms that can result in: a) children receiving healthcare from systems that prioritize access but are not designed to deliver integrated and comprehensive care (e.g., urgent care, retail healthcare providers), or b) children establishing care with a new healthcare provider who does not have access to the child's historical health information. In both instances, the potential benefits of a comprehensive, integrated medical care model that promotes health and well-being for children and their caregivers is sacrificed.

There are models of healthcare delivery that could help to stabilize children's healthcare services during their transitions into foster care, their time in care, and their transition into permanency (i.e., reunification, adoption, independent living) and policies are in place to better support these challenges and address concerns that arise from inconsistent and uncoordinated healthcare services for youth in foster care (Espeleta et al., 2020; Greiner & Beal, 2017). While a review of those models is beyond the scope of this chapter, multiple policies are in place to ensure that children are receiving healthcare services when they enter foster care and regularly thereafter (for review, see Allen, 2010). Recommendations and guidelines about what that care should include and when health information should be reviewed are already in place (e.g., Szilagyi et al., 2015). Unfortunately, evidence is missing to: a) demonstrate the long-term health impact of coordinated and comprehensive healthcare services delivered to young people in foster care, and b) provide tools to ensure that caseworkers, caregivers, and clinicians have the information necessary to access and deliver coordinated and comprehensive healthcare services when youth enter foster care, experience placement changes, and achieve permanency.

With respect to tools supporting healthcare delivery, a recent review highlighted strategies that healthcare and child welfare systems have taken to support information sharing and coordination around the health needs of children in foster care (Boyd & Scribano, 2022). On the whole, these tools were found to be generally useful but were often missing key pieces of information (e.g., upcoming appointments, treatment plans, discharge summaries) or required manual data entry, which was difficult to sustain. As a result, advocates, clinical leaders, and policymakers have called on healthcare and child welfare systems to support integrated, automated, real-time information sharing that would facilitate communication about historic and upcoming health needs for children, notify healthcare providers when children enter foster care or change placements to support continuity and care coordination, and allow child welfare to effectively audit children's health needs and ensure the overall health of the children in their care. Importantly, this work aligns with broader initiatives to leverage integrated data to support young people in foster care, including linked data across other settings (e.g., education and child welfare sectors; American Bar Association, 2022).

5 Innovative Methods to Improve Health for Youth in Foster Care

One solution developed and implemented within our healthcare system, IDENTITY, accomplishes many of those tasks (Greiner et al., 2019). IDENTITY, or Integrated Data Environment to Enhance Outcomes in Custody Youth, was designed in collaboration with child welfare, healthcare, and research stakeholders in Hamilton County, Ohio to address two key issues that prevented improvements in health for children in foster care: healthcare systems did not know when children were in foster care, and therefore could not deliver timely and coordinated healthcare services, and child welfare systems did not know what medical needs a child entering foster care

had, and therefore could not ensure children engaged with timely and coordinated healthcare services. This undermined many of the core principles of effective chronic condition and health management for healthcare (Hung et al., 2007) and prevented existing evidence-based innovations in healthcare, including concepts like the medical home and integrated behavioral health (Kwan & Nease, 2013) from being available to children while they were in foster care. Such system inequities would be expected to contribute to worse health outcomes over the life course and could explain why adults with a history of foster care involvement experience more health concerns than their peers (Ahrens et al., 2014). To address this gap, our multisystem and interdisciplinary team worked to identify key critical information that was essential for healthcare and child welfare systems to exchange and was permissible with existing federal and state laws and statutes (Beal et al., 2022; Greiner et al., 2019). We then established a data sharing agreement that allowed for bidirectional and ongoing data exchange, and developed a user-friendly and secure display for integrated information, which could be accessed by healthcare and child welfare staff at participating institutions. Updated daily, child welfare information is used to indicate whether a child is currently in foster care, so that records for children no longer in foster care are not visible in the IDENTITY web-based portal. Information is organized to maximize efficiency for healthcare and child welfare staff, and forms required for healthcare delivery or for semi-annual review hearings and case plans can be generated within IDENTITY to increase accuracy of information shared with other parties involved in the healthcare management of children in foster care (Beal et al., 2022).

A key component of IDENTITY's functioning is the ability to link a child's child welfare record with the same child's electronic health record, where no unique

shared identifier exists in both systems. To accomplish this, a set of algorithms was developed and evaluated that matches records using demographic information, including names, dates of birth, sex, race, ethnicity, family names, and address history (see Dexheimer et al., 2019 for a detailed description of the algorithms and their function). When all demographic information matches, records can be deterministically linked. When discrepancies exist, records are flagged as potential matches and are shared with a healthcare provider who has more detailed access to source records from the electronic health record for a more thorough chart review to decide whether the records should be linked. Importantly, due to the nature of healthcare data, where duplicate records were common, the child welfare record was considered the original source of identification for a child with one or more healthcare records potentially linking to a single child welfare record. For that reason, a more detailed review of the electronic health record was required for approval of potential matches, rather than a more in-depth review of the child welfare record data. Once records were linked, a report was generated to identify and resolve discrepant data (e.g., inconsistent dates of birth, names, gender, race).

In addition to determining how data should be linked, our team completed a collaborative and iterative process for determining what information should be displayed in the IDENTITY system, ensuring that only information that was necessary for the core function of healthcare and child welfare systems would be displayed, that data shared should be justified by existing policy or practice whenever possible, and that data would be pulled from fields that are commonly used and completed by the system from where the data originated. For example, the state of Ohio, where IDENTITY was developed, requires routine screening for communicable diseases when children enter foster care or experience a placement

change and best practice guidelines encourage testing for sexually transmitted infections when children have been exposed to sexual abuse (Szilagyi et al., 2015). For that reason, it was important for our healthcare system to have access to any substantiated or indicated allegations of sexual abuse of a child but knowing who the perpetrator was is less important for guiding care delivery. Likewise, child welfare staff assume the responsibility for ensuring the well-being of children while they are in foster care, which justifies the sharing of information related to diagnoses, medications, and upcoming appointments, and for those reasons pertinent information was included in IDENTITY. Information deemed less relevant or not consistently stored in either source record was not included in IDENTITY. This created an intuitive platform for focused information exchange, which caseworkers and healthcare providers both reported was easy to use. Finally, to ensure that clinicians and other healthcare staff used IDENTITY effectively, a flag was placed in the electronic health record to notify a clinician of a child's status in foster care and children's services created a workflow to review IDENTITY at the time a child's case opened, with each new placement or placement change, and during semi-annual reviews required by law. To facilitate use, forms required by state statute for the semi-annual review hearing and the case plan and court report that included child health information were recreated in IDENTITY so that a complete and accurate form could be automatically generated and saved.

Since implementation in 2019, IDENTITY has been well-received by providers and caseworkers with utilization remaining steady across both organizations. Studies examining information sharing with caseworkers has demonstrated improved awareness of children's health needs and ease of task completion for caseworkers (Greiner et al., 2022). Caseworkers repeatedly

highlighted how important the information contained within IDENTITY was for informing their case plans, holding caregivers accountable for following-through with health services, and ensuring that the children on their caseload were receiving appropriate preventative (e.g., well-child visits, immunizations) and acute (e.g., ill visits, ED visits, disease management) care. Children's services staff repeatedly highlighted the challenges of receiving out-of-date information through medical records requests and emphasized that automated information exchange, where they did not have to do any additional steps to maintain access to health information, was a critical component of the success of IDENTITY in reducing their work burden. In interviews with children's services staff who did not use IDENTITY, the only limiting factors for IDENTITY use identified were in password management creating barriers to log on, and a lack of awareness about what information IDENTITY provided.

Further, our team has demonstrated that IDENTITY is effective in saving time and resources for healthcare and child welfare systems and promoting access to healthcare services (Beal, Dynan, et al., 2022). Specifically, prior to IDENTITY implementation, healthcare and children's services staff reported spending up to 400 minutes gathering and sharing relevant health information for a single child over a one-month period. IDENTITY implementation allowed staff from both organizations to access the same health information in less than 5 minutes. Healthcare and children's services staff both reported that IDENTITY information was displayed in a manner that was easier to access, use, and understand than records they received outside of the IDENTITY system. Importantly, a significant increase in completion of mandated visits following placement changes was also observed, which was primarily due to the healthcare system being able to use IDENTITY to proactively contact new caregivers to do outreach and schedule appointments. As a result,

IDENTITY supported better healthcare service delivery without reliance on children's services staff to change their usual documentation practices. Finally, IDENTITY provided the healthcare system with updated Medicaid billing numbers and information about managed care plans, which change when children enter foster care in Ohio. As a result, the hospital was able to recoup a significant proportion of previously lost revenue for services delivered to young people in foster care, leading to a reduction in loss of \$385 for every child entering foster care over the fiscal year following IDENTITY implementation.

It is in this context of better awareness of children's foster care involvement and access to placement and caseworker information to support service delivery that our healthcare system has modified and evaluated healthcare delivery to young people in foster care to demonstrate long-term impact in one key area of adolescent health: substance use (see below). We use substance use as an example of how healthcare and child welfare systems can collaborate to implement sustainable solutions to promote long-term health outcomes because: a) there is clear evidence to suggest that young people with a history of foster care involvement use more substances (Braciszewski & Stout, 2012; Vaughn et al., 2007) and are at higher risk for substance use disorder than the general population (Aarons et al., 2008; e.g., Pilowsky & Wu, 2006); b) substance use in adolescence is preventable, including evidence supporting early intervention delivered in healthcare settings (Ozechowski et al., 2016); and c) adolescent substance use contributes to a myriad of other health concerns and social risks, including sexual risk behavior (Tapert et al., 2001), mental health concerns (Schwinn et al., 2010), disruptions in school (Breslau et al., 2011) and work performance (Shanahan et al., 2021), poor romantic relationship quality as young adults (LoBraico et al., 2022; Stormshak et al., 2019), and placement

disruptions (Cullen et al., 2020). To the extent that healthcare systems can effectively monitor substance use and deliver substance use interventions for adolescents in foster care, there is a clear opportunity to demonstrate the direct impact of coordinated and enhanced service delivery on the health and well-being of young people experiencing foster care.

6 Substance Use: An Exemplar

Substance use in adolescence is common, with 7.1% of 8th graders and 30.5% of 12th graders reporting use of marijuana in the past year and even higher rates of alcohol use (17.2% and 46.5%, respectively; Johnston et al., 2022). Further, young people who experience maltreatment (Yoon et al., 2017) and other social adversity (Wolitzky-Taylor et al., 2017), and young people with parents who use substances (Li et al., 2002), are all at significantly increased risk for substance use in adolescence. Given that the vast majority of young people who enter foster care have experienced maltreatment and social adversity (Rebbe et al., 2017), and a third of young people enter foster care in part because they have a parent who uses substances (Meinhofer & Angleró-Díaz, 2019), young people enter foster care at elevated risk for substance use or may have initiated substance use prior to their foster care entry.

Additional mechanisms are likely further exacerbating risk for substance use while young people are in foster care. Trauma and maltreatment exposure as children move through the child welfare system and experience further placement disruption and a lack of consistency with school and healthcare services undermines opportunities to receive substance use prevention (Skiba et al., 2004). Increased mental health symptoms without access to effective behavioral health services (Duong et al., 2021) may further increase risk for substance use. Importantly,

pediatric healthcare systems are encouraged to screen for substance use and identify children at risk for substance use disorder (Ozechowski et al., 2016), which should aid in identifying which young people would benefit from early intervention. However, a lack of resources in pediatric settings to deliver early intervention around substance use, primarily through standardized screening, brief intervention, and referral to treatment (SBIRT), means that healthcare providers and systems may identify young people who are using substances, but no action is taken to address substance use until more costly, problematic, and difficult to treat substance use disorders are identified (Compton et al., 2019).

At Cincinnati Children's Hospital's Comprehensive Health Evaluations for Cincinnati's Kids (CHECK) Center (Greiner & Beal, 2017), where IDENTITY is implemented (Greiner et al., 2019), we were able to use innovative methods that extracted clinical data for healthcare encounters for all children in foster care over a five-year period and compare them to clinical data for demographically-matched children with no history of foster care (Beal, Nause, et al., 2022). That work identified low rates of documented substance use screening in structured data (i.e., data fields where providers use point-and-click interfaces to ensure standardized documentation), however, rates of screening increased when unstructured clinical progress notes were evaluated such that approximately 70% of young people ages 10 years and older were screened for substances by a healthcare provider at least once during the five-year study period. The inconsistent manner in which substance use information was documented prevented healthcare providers from being able to identify patterns of substance use for young people over time or deliver brief intervention; as a result, even though 47% of young people in foster care were identified as having used substances, none received intervention. Motivated to close

this gap, the clinical team implemented the SBIRT model and moved to tablet-based, standardized substance use screening (Lange et al., 2018) followed by delivery of a brief negotiated interview for adolescents who endorsed substance use and referral to substance use treatment when substance use disorder is suspected (Levy et al., 2011). With these changes, 99.6% of young people in foster care who receive healthcare services in the CHECK Center are now screened, 44% of whom endorse substance use and receive a brief preventive intervention, and 1% of whom have been referred for treatment. Additionally, the clinic has observed a reduction in past 30-day substance use by an average of $M = 6.65$ days ($SD = 11.83$) since the brief intervention was implemented. While studies demonstrating the impact of this change in practice on longer-term outcomes is needed, this provides an example of how healthcare systems, when they are equipped to provide comprehensive, evidence-based care and are able to identify and effectively support young people in foster care, can address the health needs of children in foster care in a way that leads to improved health outcomes.

7 Implications for Healthcare Policy and Practice

There are multiple opportunities to leverage findings in the context of substance use and other aspects of health where screening and intervention are a focus (e.g., reproductive health, oral health, obesity; Berlan et al., 2021; Riter et al., 2008; Young et al., 2010) to demonstrate the impact of comprehensive, coordinated healthcare services for children in foster care and motivate the implementation of technology and practice change to support better service delivery. Research, especially when it is multisite and demonstrates effectiveness across a broad number of outcomes, can generate the evidence-base needed to justify directing healthcare services and resources to providing the types of interventions that will

benefit children in foster care the most, and simultaneously may reduce more costly healthcare services (e.g., emergency and urgent care; Beal et al., 2021) leading to long-term cost savings. With that evidence, healthcare advocacy organizations, such as the American Academy of Pediatrics, will be better positioned to advocate for healthcare delivery to young people in foster care that includes effective, early intervention components, as has occurred in other contexts, including screening for infectious and communicable diseases (Greiner et al., 2017; Szilagyi et al., 2015). Further, Medicaid and other payer systems can be leveraged to ensure resources are adequately directed to those healthcare systems that are putting technology and intervention services in place. Medicaid is ideally suited to promote these changes because, similar to findings demonstrated for other conditions (e.g., dental services; Lee et al., 2018), Medicaid will likely benefit the most from early intervention over the lifetime for children experiencing foster care (Bullinger & Meinhofer, 2021). Promotions may include incentives through rates of reimbursement for healthcare systems where comprehensive services are in place when children are in foster care, similar to Medicaid reimbursement practices for pediatric care via accountable care organizations (Gleeson et al., 2016).

8 Implications for Child Welfare Policy and Practice

As with the healthcare system, there are also multiple ways in which child welfare policy could be leveraged to ensure children in foster care are able to access healthcare services where evidence-based, early intervention for a variety of health needs are available. The first is through regulation. Similar to requirements for placement providers (e.g., foster homes, group homes) and other contracted services, child welfare could establish contracts for healthcare services with medical providers where a commitment to serving the needs of children in foster care and

delivering evidence-based care is made. As a result, the responsibility for monitoring and addressing health concerns (e.g., vaccinations, medication management, behavioral health) moves from the child welfare system to the healthcare system, similar to shifts in healthcare payment for publicly insured young people, where the healthcare system is now responsible for ensuring better health to the children they serve (Gleeson et al., 2016). Likewise, child welfare systems can partner with healthcare systems to ensure technology is in place to support effective monitoring, communication, and collaboration, where caseworkers can get up-to-date information on children's health status and health needs and healthcare providers have access to updated information about where children reside and who is responsible for their day-to-day care (Beal, Dynan, et al., 2022; Greiner et al., 2022). As a result, children would have better access to healthcare services, caregivers would understand where children should go to receive care and what health needs the child has, healthcare systems would be better positioned and motivated to be active agents in ensuring children's health, and child welfare systems would have the information they need to hold caregivers and healthcare providers accountable and assure the health needs of children while they are in their custody.

9 Conclusions

Opportunities to support the health, development, and well-being of children in foster care abound and research to identify effective interventions and practice changes is desperately needed. In the future, this research must focus on more than just the child welfare system, taking into account the multiple systems (e.g., family, community, healthcare, education, social safety net; Maschi et al., 2008; Murray, 2022) that form the foundation for child health and well-being. Further, our programs of research addressing health must consider early intervention and the promotion of

well-being, moving beyond a focus on negative outcomes and treatment for diagnoses, so that we can better capture and describe health and well-being. Our experience with substance use provides one example of where this is a challenge: few young people met criteria for a substance use disorder, which might suggest intervention services are not needed, but that fails to account for the benefits over a young person's lifetime if substance use disorder is prevented by targeting reductions in overall use and supporting abstinence (Compton et al., 2019).

Structured diagnostic data has been used for decades to understand the health needs of children in foster care (D. Rubin et al., 2012; Simms et al., 2000) precisely because it is structured and universal definitions of diagnoses are in place. Multisite, unified data collection of structured and unstructured fields that captures early prevention and indicators of well-being would help to strengthen the evidence base needed to justify changes in healthcare delivery and ensure better health for children in foster care. It is only with those studies that we will be able to advocate for changes in healthcare and child welfare practice to promote the health, development, and well-being of all children in foster care.

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**Methods for Studying Mediating Mechanisms in Developmental and
Intervention Studies of Child Maltreatment**

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Abstract

The identification of causal mechanisms is a key component in research studies examining the effects of maltreatment on child development, as well as for intervention studies aiming to reduce the frequency and severity of child maltreatment within a targeted population. Mediation analysis is a valuable tool in the discovery and evaluation of potential causal effects in developmental research, allowing researchers to identify which pieces of the predictor, or which mediating variables caused by the predictor, cause a change seen in the primary outcome of interest. This chapter outlines the conceptual and statistical foundation of mediation analysis and reviews its current application in a variety of research contexts, including longitudinal designs, structural equation modeling, group-based moderation effects, and the potential outcomes framework. Suggestions for best practices, such as sample size planning approaches and the consideration of statistical assumptions, are also described. Various examples drawn directly from the child maltreatment literature are provided to demonstrate how mediation analysis has been used in practice and to exhibit the wide breadth of questions this statistical approach can help researchers answer.

Keywords: mediation, third-variable effects, confounding, colliders, measurement, causal inference, potential outcomes, sensitivity analysis, moderation, sample size planning, longitudinal designs, research design, mechanisms, maltreatment, developmental research

1 Introduction

Questions about “how” and “why” children demonstrate different developmental and health outcomes are central to child maltreatment research. Answers to these questions improve the theoretical understanding of the mechanisms of child development in the context of adversity and provide practical information for designing and evaluating preventive interventions to reduce the impact of maltreatment on a child’s well-being. Mediation analysis is the statistical methodology used to investigate these causal mechanisms, allowing researchers to identify what specific components targeted by an intervention are most effective in producing the desired outcome. Mediation analysis is therefore a valuable tool for research in developmental psychology broadly, and child maltreatment specifically, as it allows for a deep exploration into how parenting behaviors, conflict, neglect, abuse, and other early life exposures affect mental, physical, and behavioral outcomes for children, beyond the simple bivariate relationships generated from correlational data and regression coefficients.

The goal of this chapter is to describe the mediation model and the motivations for investigating mediating mechanisms in child maltreatment research. We provide an overview of single-mediator models, longitudinal mediation models, causal inference, and subgroup analysis while emphasizing the importance of a program of research for identifying critical mediating mechanisms. The last few decades have witnessed substantial development of statistical approaches to analyzing mediating mechanisms, and although many of these newer methods have an extensive statistical background, our focus in this chapter is to present an approachable and digestible description of the most relevant methods for child maltreatment research. We also address some of the complications of performing

mediation analyses, such as obtaining adequate measurements of constructs, the feasibility for randomization to conditions, and securing baseline and follow-up measures, and we provide suggestions and resources for cases where these complications may concern researchers.

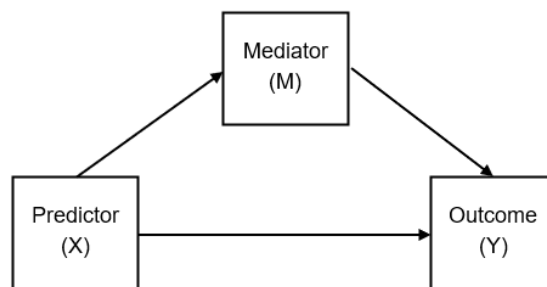


Figure 1. The Basics of Mediation - Path Diagram

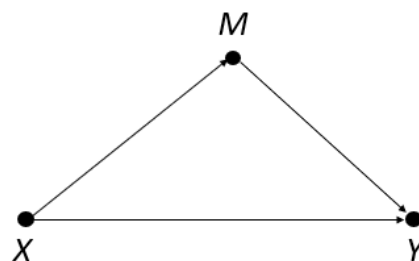


Figure 2. The Basics of Mediation - Directed Acyclic Graph

The general, single-mediator model is depicted in Figure 1 and Figure 2, where X represents the predictor/independent variable, M represents the mediating variable, and Y represents the outcome/dependent variable. Figure 1 represents the path diagram often used in the structural equation modeling framework. In contrast, Figure 2 depicts the mediation model as a directed acyclic graph (DAG) used in the causal inference literature. The direction of the arrows represents the causal relations between variables, where X causes a change in M , M causes a change in

Y , and X causes a change in Y both directly ($X \rightarrow Y$) and indirectly through the third variable M ($X \rightarrow M \rightarrow Y$). The latter effect is known as a mediation effect because M “mediates” the relationship between X and Y .

In formal terms, mediators help explain the causal mechanisms by which the predictor variable generates the observed changes in the outcome variable (MacKinnon et al., 2000). Mediation effects can be likened to a chain reaction, whereby the independent variable causes the mediator, which in turn causes the values observed in the outcome variable (Sobel, 1990). A mediator thus serves dual purposes in a model: a cause and an outcome, an independent and dependent variable, a source of variation and a cause of variation (Last, 1988). Analysis of mediation effects allows researchers to answer a wide range of theoretical and applied questions central to many fields, especially for studies focusing on prevention and treatment effects that require a strong basis of causality before implementation outside of the lab. In this way, mediation can be a crucial tool for identifying the central causes and consequences of child maltreatment, as well as the best preventive and treatment methods to improve short- and long-term outcomes for children at risk.

Information garnered from mediation analysis can be used to develop new treatment interventions and identify the key ingredients that make these interventions more effective. Mediation analysis can help provide answers to a plethora of developmental questions, such as:

- What are the mechanisms by which childhood maltreatment affects educational achievement, physical health, and mental well-being later in life?

- How do social, environmental, and economic factors buffer, or exacerbate, the effect of maltreatment on lifespan mental and physical health?
- How can predictors of developmental outcomes following exposure to maltreatment be used to design and refine interventions to reduce problem behaviors?

Mediation methods can be broken down into two primary applications: mediation for explanation and mediation by design (MacKinnon, 2008). Mediation for explanation is more exploratory, in that it seeks to further explain or analyze a relationship that has already been observed. For example, a researcher might identify a potentially causal relationship between interparental conflict and child mental health, then add relevant variables such as parent-child relationship quality to the causal pathway to test how the inclusion of those variables changes the original estimate of the observed relationship (also known as the elaboration method, described by Lazarsfeld, 1955). Conversely, in the mediation by design approach, mediators are selected during the research design stages that will be specifically targeted by the intervention. The goal of this approach is to demonstrate the causal steps from the intervention to the mediating variable, which then would change the primary outcome of interest. Thus, testing mediation is the goal, rather than testing for a potential mediating effect after the initial data analysis.

For studies designed to target mediating mechanisms, two types of theories are necessary to consider when constructing a theoretically strong model to test (Chen, 1990; Lipsey, 1993; MacKinnon, 2008). The first of these theories is known as “manipulation theory” which describes a researcher’s expectation for how the intervention will cause a change in the mediating variable and the actions they plan

to implement to cause that change. The second theory is known as “conceptual theory” which focuses specifically on how the mediating variable is causally related to the outcome, and by what mechanisms it will cause a change in that outcome for that particular study. Essentially, manipulation theory explains how we expect the intervention will affect the mediators, while conceptual theory focuses on how we expect the mediators will affect the primary outcome of interest. Consideration of these different theories can help improve the theoretical basis of a model, and reduce the costs and resources required of researchers to produce a more successful, more effective intervention (MacKinnon, 2008).

Targeting these specific, theoretically-based mediators can lead to the discovery of important—and potentially causal—effects in the child maltreatment literature and provide insight regarding the mechanisms of change that drive these effects. For example, Eckenrode et al. (2017) found that home visitations (X) focusing on life course variables such as the number of subsequent children born to mothers (first mediator, $M1$) and months receiving public assistance (second mediator, $M2$) led to fewer child maltreatment reports over a 15-year period (Y). Likewise, the Head Start program (Bierman et al., 2008) enhanced executive function as a mediator, which then demonstrated an improvement in cognitive and emotional skills. Similarly, Green et al. (2018) found that by targeting a child’s engagement and attention during play with his parent ($M1$) as well as that child’s cognitive development ($M2$), the Head Start intervention reduced the prevalence of child maltreatment (i.e., child welfare reports, including neglect, physical abuse, and sexual abuse reports).

When developing a mediation model, it is also important to consider how the presence of third-variable effects may disrupt the pathway estimation process. Mediation itself is a third-variable effect as it measures the effect a third variable (i.e., the mediator) imposes on a bivariate relationship; however, other third-variable effects, such as confounding and collision, are effects that can induce bias when estimating the predictor-outcome relation if they are not properly handled during statistical analysis (MacKinnon & Lamp, 2021).

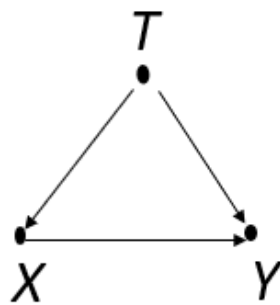


Figure 3. Third-Variable Confounder Effect

Confounder effects occur when a third variable, measured or unmeasured, serves as a common cause of both the predictor and the outcome variable (pictured in Figure 3, where T represents the third-variable confounder). When present, confounder effects can induce spurious relationships between the predictor (X) and the outcome (Y) that do not reflect true causal effects, biasing the sample estimate (Greenland & Morgenstern, 2001; MacKinnon et al., 2000); however, this bias can be removed by controlling for the confounder variables during statistical analysis, such as including them as covariates in a regression analysis. The adjustment for confounding effects in mediation models is one of the core assumptions made when performing a mediation analysis, so it is imperative researchers consider what

confounders may influence the various pathways between the primary variables of their mediation model.

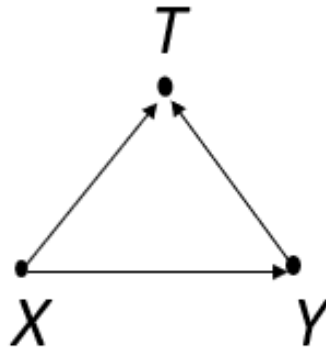


Figure 4. Third-Variable Collider Effect

Another third-variable effect that is less prevalent in statistical discussions is that of the collider effect (pictured in Figure 4, where T represents the third-variable collider). Collider variables function as a common outcome of both the predictor and the primary outcome in the model, similar to confounders but in the opposite direction (Greenland, 2003; Pearl, 2009). Unlike confounders, however, collider variables should not be adjusted for during statistical analysis as doing so introduces bias into the estimate of the X - Y relationship (Elwert & Winship, 2014; MacKinnon & Lamp, 2021). Because the collider variable is an outcome of Y (the true outcome of interest), adjusting the X - Y estimate for the collider variable essentially breaks the causal pathway, as it places the collider variable before outcome Y when it should come afterwards. Collider bias can be the result of adjusting for measured third-variable collider during statistical analysis, or can be the result of sample selection bias where participants are selected into a study based on the collider variable, thus inadvertently adjusting for the collider variable before statistical analysis has begun (MacKinnon & Lamp, 2021).

Mediation models can be made of more than just three variables, as well. Combinations of four, five, six variables, and beyond are possible, with the effects between each variable representing different possible variations of mediation, confounding, and collision depending on the theoretical causal pathways. It is important to consider how many variables may be pertinent to the research questions at hand and how those variables may affect or interact with each other to change the outcome of interest.

2 Performing Mediation Analysis

The pathways included within the single-mediator model are represented by three regression equations, as demonstrated in Equations 1 to 3 (MacKinnon, 2008).

$$Y = i_1 + c X + e_1 \quad (1)$$

$$Y = i_2 + c' X + b M + e_2 \quad (2)$$

$$M = i_3 + a X + e_3 \quad (3)$$

Information gleaned from these equations provides the coefficient estimates necessary to calculate the individual pathways between each variable, where X represents the independent/predictor variable, M represents the mediator variable, and Y represents the dependent/outcome variable. Equation 1 provides an estimate of the effect from X to Y without adjustment for the mediating variable (denoted by coefficient c). Equation 2 provides an estimate of the effect from X to Y after adjusting for the mediating variable (denoted by coefficient c') and the effect from M to Y after adjusting for the predictor (denoted by coefficient b). Equation 3 provides an estimate of the effect from X to M (denoted by a); i_1 , i_2 , and i_3 represent the model intercepts and e_1 , e_2 , and e_3 represent the residuals.

The coefficients observed from each of these equations can then be used to interpret various effects of research interest (MacKinnon, 2008). The direct effect and total effect of X on Y are fairly simple to obtain, as the value of these effects are represented by coefficients c' and c , respectively. The direct effect, c' , is an estimate of the effect of X on Y after the influence of the mediator has been adjusted for, and the total effect, c , is an estimate of the entire, all-encompassing effect of X on Y with all external influences included.

The mediated effect, or the indirect effect from X to Y through M , can be calculated in two different ways. The first and most common approach is known as the product-of-coefficients method, where the estimate of the indirect effect is represented by the product of the a and b coefficients (the pathway from X to M , and the pathway from M to Y adjusted for X , respectively). The second method, known as the difference-in-coefficients method, can provide an additional estimate of the mediated effect by subtracting the value of the direct effect out of the total effect ($c - c'$), leaving only the effect of the mediator remaining. When X , M , and Y are all continuous, the product and difference methods produce the same estimate of the indirect effect; however, in more complex models, such as logistic mediation where Y is a binary variable, the results can differ because of the scaling of the error term in categorical data analysis (MacKinnon & Dwyer, 1993).

As an aside, it is often reasonable to include a third term in Equation 2 to account for the XM interaction (MacKinnon, 2008; Pearl, 2001; Valeri & VanderWeele, 2013), the value of which is often represented by coefficient h (as shown in Equation 4). The XM interaction tests whether the effect of the mediator on the outcome (i.e., the b coefficient) differs across levels of X . For treatment and

intervention studies, a significant XM interaction would indicate that the relationship between the mediator and the outcome differs between the treatment and control groups. The XM interaction helps bridge the gap between traditional mediation analysis and causal estimation methods by allowing the effect of the mediator to vary by group (MacKinnon et al., 2020). In traditional mediation analysis, the XM interaction is often assumed to be zero, which means it is expected that the mediation effect will be consistent for all participants regardless of their assigned group or the value of the predictor.

$$Y = i_4 + c'X + bM + hXM + e_4 \quad (4)$$

As with most parameter estimates, it is also possible to test the significance of a mediated effect estimate (MacKinnon & Dwyer, 1993). One method is to divide the mediated effect estimate by its standard error to produce a z-score (Equation 5). The z-score can then be compared to the normal distribution to determine its significance. If the z-score is greater than the critical value of 1.96 on the normal distribution, then that indicates evidence of significance where $p < .05$.

$$z' = \frac{\widehat{ab}}{\sqrt{(\widehat{a})^2(\widehat{se}_b)^2 + (\widehat{b})^2(\widehat{se}_a)^2}} \quad (5)$$

However, this approach to significance testing for mediation is not ideal because the sampling distribution of the mediated effect does not follow a normal distribution (MacKinnon et al., 2002). Instead, it is recommended that researchers use other forms of significance testing that allow for non-normal distributions, such as joint significance tests, the distribution of the product, and bootstrapped confidence limit estimation (MacKinnon et al., 2004). These methods have been

shown to provide more accurate results and higher power for detecting significant mediated effects (Fritz & MacKinnon, 2007; MacKinnon et al., 2002).

Certain assumptions must be met for all of these methods before any causal statements can be made from any statistically significant results (MacKinnon, 2008; MacKinnon et al., 2020; VanderWeele & Vansteelandt, 2009). First, the study must have reliable and valid measures for each variable. Second, all of the coefficients obtained from the regression analyses are assumed to reflect true causal relations present in the population that are linear (i.e., the coefficients have the “correct functional form” in the sample model). Third, the chain of mediation is assumed to be accurate with an established temporal ordering, where X comes before M , which comes before Y . Fourth, we assume the relations from X to M and from M to Y are homogenous across subgroups in the study for cases where the equations are not modeling moderation or the XM interaction. Fifth, it is assumed that no unmeasured confounders influence the estimation of the pathways. If all of these assumptions are met, a researcher can interpret their mediated effect through the lens of causality; if they are not met, then the interpretation of the mediation effect is limited.

3 Inconsistent Mediation Models

Another important aspect of mediation analysis is that a statistically significant mediated effect between X and Y can be present in a given model even in cases where the total effect between X and Y is non-significant (O’Rourke & MacKinnon, 2015). The mediating variable transmits the effect of the independent variable to the dependent variable through a pathway separate from the direct and total effects, so it is possible that X only causes a change in Y when M is present. This type of mediation model is known as an inconsistent mediation model because the indirect

effect is “inconsistent” with the sign and, potentially, the significance of the direct effect (MacKinnon et al., 2000).

Inconsistent mediation models, which are also sometimes referred to as “suppression models,” have at least one mediated effect with a different sign than the direct effect or other mediated effects (MacKinnon et al., 2000). This difference in sign can manifest as two effects with opposing directions (e.g., the direct effect is negative while the indirect effect is positive) or in cases where the total effect (captured by coefficient c) is non-significant and near-zero. For intervention studies, inconsistent mediation could indicate that at least one of the mediating variables is acting in a counterproductive manner or producing the opposite effect desired compared to the intent of the overall intervention.

For example, an intervention designed by Goldberg et al. (1996) to reduce the intention to use anabolic steroids among high school football players was found to instead indirectly *increase* intentions to use steroids through one of the intervention components; specifically, lectures that focused on the reasons why athletes take anabolic steroids (e.g., increasing muscle mass, quickly improving athletic ability, etc.) led to an increase in the intention to use steroids. This outcome was inconsistent with the rest of the model, where the effect of participation in the program on intention to use steroids was negative. Breaking down these different effects via a mediation model provided very useful insights into how the program affected the study’s participants and which components needed to be changed in future implementations of the intervention. See Figure 5 for a visual depiction of this example.

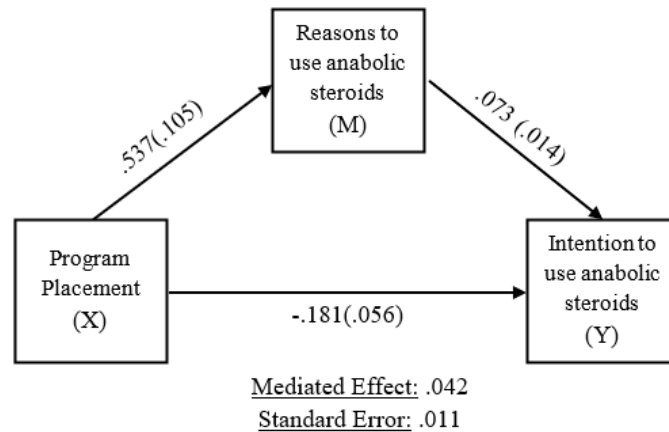


Figure 5. Example of an Inconsistent Mediation Model - Steroid Use

Another example comes from Jewell et al. (2017), where researchers modeled the effect of acculturation to the United States on postpartum weight gain among low-income Mexican-origin mothers (Figure 6). The authors found two opposing mediation effects: the first was a negative effect of family support on weight gain, and the second was a positive effect of family negativity on weight gain. Acculturation was positively related to both mediators, but because each mediator demonstrated opposing effects on the weight outcome, the overall effect between acculturation to the weight outcome appeared to be zero. Without mediation, it may have appeared that acculturation of the mother had no effect on her postpartum weight. However, examination of the different mediation pathways tells a different, more complex story.

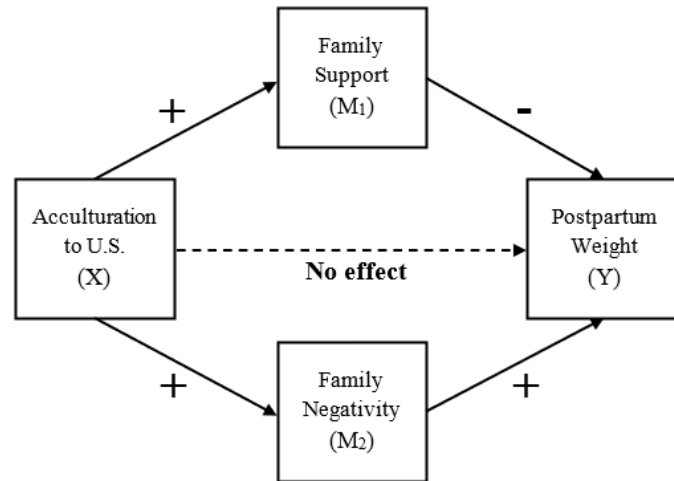


Figure 6. Example of an Inconsistent Mediation Model - Postpartum Weight

4 Longitudinal Mediation Analysis

Mediation analysis is, in theory, a longitudinal model, as the mediation model relies on the assumption of a particular temporal ordering. First, it assumes that X precedes M and M precedes Y . Second, it assumes that relations among X , M , and Y variables are at equilibrium. This means that the observed relations among the variables in the data are not solely due to the specific time point at which they are measured; for instance, the same model would apply if the variables were measured one hour later. Third, it assumes the correct timing and spacing of measurement periods to detect the effects. This assumption requires theoretical work to determine at what point X begins to affect M , and when M begins to affect Y . Researchers need to take into consideration that there may be different timing processes regarding how X , M , and Y relate to each other, such as triggering and cascading processes, each of which may have a different effect on the X to M path compared to the M to Y path (Howe et al., 2002; Tang & DeRubeis, 1999). With longitudinal data, the timing of

these measurements is crucial for capturing when these important changes occur (Collins & Graham, 2002).

The statistical models used to analyze repeated measures of X , M , and Y with two-time points include difference score models, analysis of covariance (ANCOVA), and residualized change score models (Valente & MacKinnon, 2017). There are even more models to choose from to analyze measures of X , M , and Y at three or more time points: autoregressive models, latent growth models, latent change score models, and survival models. For intervention research, X is usually measured once, and these issues about timing are pertinent primarily to the M and Y variables. However, in an observational study, extensive theoretical work is necessary before conducting the mediation analysis to model how the X , M , and Y variables change over time.

Figure 7 shows an example of an autoregressive model with time-ordered mediation (Cole & Maxwell, 2003; MacKinnon, 1994; 2008), where X_1 represents random assignment to treatment or control groups. This model has a time effect from M_1 to M_2 to M_3 (s_2). There is also a time effect from Y_1 to Y_2 to Y_3 (s_3). Finally, there is mediated effect in which X_1 affects M_2 , and M_2 affects Y_3 ($a_1 * b_2$), which is a longitudinal mediated effect because X_1 precedes M_2 , and M_2 precedes Y_3 .

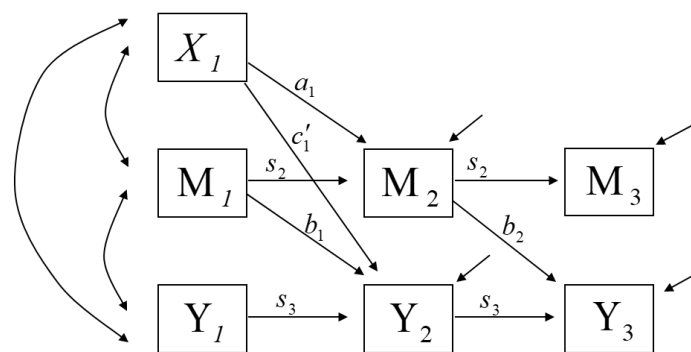


Figure 7. Autoregressive Model with Time-Ordered Mediation

Note: All residuals are correlated

5 Measurement

Accurate measurement of constructs is a prerequisite to perform a mediation analysis. In order to obtain unbiased, accurate information about mediating processes, the variables in the model must be measured correctly. The search for mediating mechanisms can be viewed as a measurement challenge where the understanding of a mediating process improves with better measurement of the mediating variable (Gonzalez & MacKinnon, 2021). This refinement involves the identification of the most critical facet of a more general construct. If the critical ingredient of the construct is identified, an intervention can target that particular facet instead of targeting the more general construct. For example, similar to other mediation constructs, parental style is multidimensional (Sandler et al., 2011). It could be that the facet of parental warmth is the critical mediator, instead of the more general measure of parenting style. For this reason, an important task in applied research is to evaluate intervention effects through facets.

Figure 8 shows a simplified path diagram of a bifactor mediation model originally published by Gonzalez and Mackinnon (2018) and exemplifies the case when a single facet of a construct is the critical mediator. The general construct (η_{g1}) has two facets (η_{s1} and η_{s2}). However, the core mediating process from X to Y occurs only through the first facet (η_{s1}), demonstrating the importance of specific identification of mediators that exist under the umbrella of a larger, multifaceted general construct when designing mediation models.

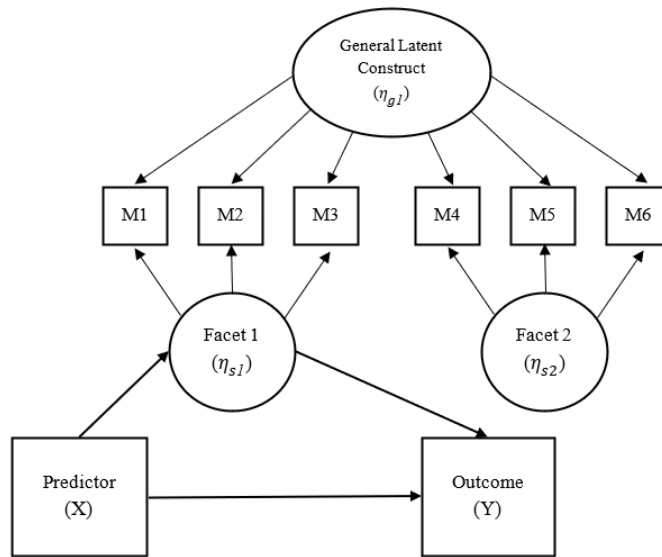


Figure 8. Bifactor Mediation Model with a Single Critical Mediator

6 Causal Inference and Mediation Analysis

The methods previously described assume true causal relations and no omitted variables in the analysis. If the idea is to estimate causal effects, researchers should try to measure all of the variables related to the model. The issue, however, is that it can be difficult– often impossible – to measure all the variables that are involved in a particular phenomenon (e.g., child maltreatment). Blalock (1969) estimated that there are about 50 variables involved for accurate modeling of any given sociological phenomenon, which is likely the case for most types of complex outcomes related to child maltreatment.

Another issue regarding causal inference in mediation analysis is that the mediator is not randomly assigned to individuals (Lynch et al., 2008; MacKinnon, 2008; Holland, 1988). In an intervention study, researchers can randomly assign participants on the independent variable (X) to receive a particular treatment (e.g.,

either the treatment or control group). However, randomization of X does not guarantee the causal interpretation of the M to Y effect because the value of the mediator is determined by the participant's response to X rather than something assigned or controlled by the researcher.

Most modern approaches to causal inference use the potential outcomes framework (Holland, 1986; Rubin, 1974), also known as a “counterfactual” approach. This method considers all the possible conditions of an experiment, both factual (conditions that were observed) and counterfactual (conditions that were not observed, but *could have been* observed), then builds a statistical model based on these potential conditions. For instance, in a two-group study, researchers would need to not only consider the outcome a participant would get if assigned to the control group, but also consider the same participant's expected outcome if they were to be assigned to the treatment group instead. The difference between the participant's results in the treatment vs. the control group would then represent the causal effect of the treatment.

Table 1 demonstrates an example of counterfactuals in a hypothetical intervention study for teenagers where the goal is to prevent the participants from becoming smokers. The second column shows the group assignment for each participant, where four participants were assigned to the control group ($x=0$), and four participants were assigned to the treatment group ($x=1$). The third column lists the observed binary scores for each participant, where a 0 indicates the person did not start smoking and a 1 indicates the person started smoking. The last two columns show the potential outcomes of the control group ($Y(0)$) and the potential outcomes of the treatment group ($Y(1)$).

Each row in Table 1 features at least one question mark instead of a binary outcome indicator in one of the potential outcomes columns. These question marks represent an outcome that was not observed in the final study. For example, Julie has a potential outcome for $Y(0)$ because she was assigned to the control group; thus, her outcome for the control group was observed and recorded. However, she has a question mark for the $Y(1)$ column because she was never assigned to the treatment group, meaning her expected score within the treatment group is unknown. Suppose we were somehow able to reverse time, reassign Julie to the treatment group, and see whether or not Julie becomes a smoker. In that case, we could then compare these two outcomes to determine the causal effect of the intervention on smoker status for Julie.

Participant	Assignment	Observed Y	Potential Outcome $Y(0)$	Potential Outcome $Y(1)$
Juan	0	0	0	?
Julie	0	1	1	?
Alandra	0	1	1	?
Antonio	0	1	1	?
Kim	1	1	?	1
Derrick	1	0	?	0
Reginald	1	0	?	0

Shar	1	0	?	0

Table 1. Potential Outcomes

Unfortunately, such a feat is impossible. To estimate the causal effect at the individual level, we need to observe the same participant in both the treatment and control conditions simultaneously, but we only have access to one potential outcome per participant. This is often referred to as the fundamental problem of causal inference (Holland, 1986). In a two-group study, we will have data for a person who serves in the control group $Y_i(0)$, but we will not have data for the same person in the treatment group $Y_i(1)$. Similarly, for a person in the treatment group $Y_i(1)$, we will not have data for that person in the control group $Y_i(0)$ —the potential outcomes that cannot be directly observed are represented in bold. However, it is possible to approximate these unobserved potential outcomes on a group level by comparing the aggregated averages of the outcomes observed in each group. The estimator of a causal effect reflects the difference of these averages, referred to in the causal inference literature as the average causal effect: $ACE = E(Y(0)) - E(Y(1))$.

The extension of the potential outcomes framework to mediation analysis requires adding a third variable, the mediator (M), which expands the possible potential outcomes to four:

1. The expected value for Y in the control group at their mediator value in the control group: $E(Y(0, M(0)))$
2. The expected value for Y in the treatment group at their mediator value in the treatment group: $E(Y(1, M(1)))$

3. The expected value for Y in the treatment group at their mediator value in the control group: **$E(Y(1, M(0)))$**
4. The expected value for Y in the control group at their mediator value in the treatment group: **$E(Y(0, M(1)))$**

As was the case for the two-group scenario, two of these potential outcomes are not directly observable in sample data (represented in bold lettering). However, the observed sample data can be used to gain insight into all unknown potential outcomes and approximate causal mediated effects.

Causal effects for mediation analysis are defined as a comparison of potential outcomes. The first causal mediated effect is called the Total Natural Indirect Effect, $TNIE = E[Y(1, M(1)) - \mathbf{Y(1, M(0))}]$, and equals $a*b + a*h^1$ using the notation from Equations 1-4. The TNIE represents the mediated effect in the treatment group. The second mediated effect is the Pure Natural Indirect Effect, $PNIE = E[\mathbf{Y(0, M(1))} - Y(0, M(0))]$. It equals $a*b$, which is the same estimator used in the traditional framework of mediation analysis (where b is estimated from Equation 4 with the inclusion of the XM interaction). The PNIE represents the mediated effect in the control group. There is a direct correspondence between the traditional framework in mediation analysis and causal mediation analysis when both M and Y are continuous. In other cases, such as when M and Y are categorical or have some other non-normal distribution, these new causal methods will be more accurate because they have precise definitions of effects and a clear specification of the assumptions.

¹ h is the interaction effect of X and M on Y , as seen in Equation 4 of this chapter. See MacKinnon et al. (2020) for links between traditional and causal mediation.

One major advantage of these modern causal inference approaches over the traditional mediation approach is the clear articulation of the assumptions about confounding. There are four assumptions about confounders in mediation analysis (VanderWeele & Vansteelandt, 2009):

1. no unmeasured X to Y confounders given covariates
2. no unmeasured M to Y confounders given covariates
3. no unmeasured X to M confounders given covariates
4. no measured or unmeasured confounders of M to Y that have been affected by X

If X is randomized, assumptions 1 and 3 are satisfied; conversely, assumptions 2 and 4 are not guaranteed because the mediator variable, M , is almost never randomized. For that reason, in any mediation analysis, additional steps need to be performed to address the assumption that there are no unmeasured M to Y confounders and that there are no measured or unmeasured confounders between M to Y affected by X .

Figure 9 shows a path diagram of the single-mediator model using the traditional approach, but it also includes the presence of confounders on the X - M and M - Y relations, U_1 and U_2 , respectively. These confounders can bias the mediation analysis results. If X is randomized, there should not be any confounders of the X to M relation (U_1); thus, the central issue is to deal with potential confounders of the M to Y relation (U_2).

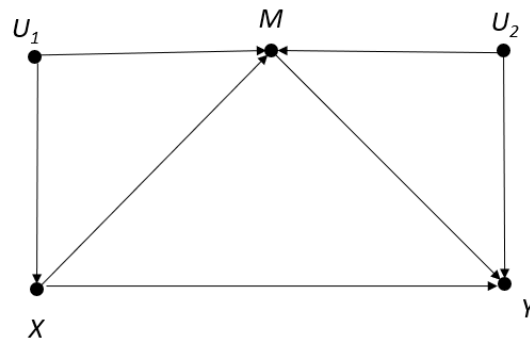


Figure 9. Single-Mediator Model with Confounders

There are a few methods that can help mitigate problems with confounders. One approach is to perform a sensitivity analysis to evaluate how the mediation analysis results would change if there were a confounder on the M to Y relation. This method can be applied to both interventional (i.e., X is randomized) and observational studies. However, the latter would need to evaluate possible confounders for both the X to M and the M to Y relations, as observational studies often do not have a randomized X variable.

Cox et al. (2013) provide a review of the most common sensitivity analyses for mediation analysis, as well as adapt the Left Out Variables Error method (L.O.V.E), originally developed by Mauro (1990), as a method to assess confounding on the M to Y relation. This method considers the correlation of a confounder with Y (r_{uy}) and the correlation of a confounder with M (r_{um}) which would make the mediated effect zero or non-significant. The binary confounder method (VanderWeele, 2010) looks at the confounder effect on Y and the difference in proportions of that confounder between the two groups. The sensitivity parameter in this method is referred to as the E-value. The correlated residuals method (Imai et al., 2010) looks at the correlation between the error term in Y and the error term in M (r_{e2e3}) because a confounder between M and Y would induce a correlation between the error in M and

Y. In order to assess confounding, researchers can evaluate how big the correlation between residuals would need to be to make the mediated effect zero or to make the mediated effect non-significant. Recent investigations of confounder bias also include methods to assess measurement error bias—the extent to which results would change if the mediator was measured with more or less error (Fritz et al., 2016).

Besides performing sensitivity analysis to improve causal inference in mediation analysis, there are also statistical and design approaches to help with this endeavor in a mediation study (see MacKinnon & Pirlott, 2015 and Pirlott & MacKinnon, 2016). One relatively well-known method used to address confounder bias is the instrumental variable method, in which a variable that has a strong relationship with the mediator, but is not related to the outcome, is included as an informal predictor in the model to help emulate random assignment (Angrist et al., 1996; Angrist & Krueger, 2001; MacKinnon, 2008). Another approach is principal stratification, a method that helps identify the types of people that are present in a study (such as latent classes) and predicts how they might change over time (Angrist et al., 1996; Frangakis & Rubin, 2002; Jo, 2008). One widely used method is inverse probability weighting, a method that weights each person's observation to determine how much they as individuals would be affected by confounding effects, producing a confounder-free estimate if all confounders were measured by the researcher (Robins et al., 2000). A similar method, known as sequential G-estimation, is also designed to adjust the estimate of the mediated effect for confounder effects (Goetgeluk et al., 2008; Vansteelandt, 2009).

Design approaches to improve causal inference can address the consistency and specificity of mediation effects. For example, the former would address the consistency of a mediation relation across different contexts and groups such as SES background, family structure, and exposure to maltreatment. The specificity of mediation relations would assess the specific situations or circumstances where a mediator works or situations where only one of the mediators is active. That idea of testing facets with measurement would be an example of a method to look at the specificity of mediation relations.

One specific analysis that has shown promise in the causal inference literature is the structural causal model (SCM). The SCM is a general method to specify causal relations with the causal inference framework, combining the structural equation modeling (SEM) framework—an approach commonly used in the social sciences—with modern causal inference and the potential outcomes model. These models are based on probabilistic graphs representing dependencies among random variables through graphical models, such as DAGs. The models originated in the area of computer science and were extended into causal inference by Pearl (2001; 2009), and have been useful in bridging the gap between the causal inference framework and the more familiar statistical methods seen in child developmental studies. For examples of the application of SCM in the area of child maltreatment and neglect, see the models constructed by Austin et al. (2019) and Bellani and Bia (2018).

7 Moderation in Mediation Analysis

Moderation describes a situation in which two or more different groups of people from the population of interest (e.g., men and women, people of different

racial backgrounds, different age groups, etc.) demonstrate unique effects on an outcome of interest (Fairchild & MacKinnon, 2009; Hayes, 2017). For example, a child exhibiting high levels of resilience may demonstrate different health outcomes than a child with low levels of resilience despite experiencing similar negative life events as they grow and develop. Moderation can help generalize statistical analyses to the greater population by modeling the different complexities present among subgroups.

Moderation can influence any pathway in a mediation model. There may be a moderation effect on the X - M pathway, the M - Y pathway, or the direct X - Y pathway (Hayes, 2017). Moderators are distinct from mediators in that they are not intermediaries in the causal sequence between X and Y ; rather, they induce interaction effects that change how the effect pathways function overall for a person depending on their group membership (MacKinnon, 2008). For cases where the moderator is binary or categorical (e.g., gender, smoker status, SES, etc.), one way to analyze interaction effects is to run the mediation model separately based on group membership and compare the pathway coefficients of each model, as is shown in Figure 10. Each model produces a separate indirect effect that can be compared across groups.

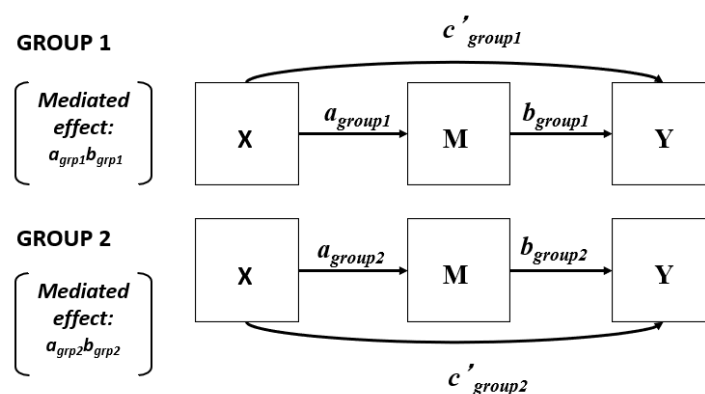


Figure 10. Example of Examining a Moderator in a Mediation Model

Moderators can also be incorporated directly into the regression equations used to estimate pathway coefficients. For example, suppose a researcher believes gender moderates how their treatment affects the measured mediator variable. In that case, the researcher can add gender as a separate term in Equation 3 (often denoted as Z) as well as an interaction term to measure the moderation effect (often denoted as XZ). This approach is more flexible than the former, as it allows for researchers to evaluate the effect of continuous moderator variables on the pathway of interest (MacKinnon, 2008). An example of the updated equation is presented in Equation 6 below, where a_1 represents the effect of X on M , a_2 represents the effect of the moderator on M , and a_3 represents the interaction of the moderator and the predictor on the mediator. If the a_3 interaction estimate is significant, then there would be evidence that the predictor affects the mediator differently depending on the value of the moderator variable.

$$M = i_3 + a_1 X + a_2 Z + a_3 XZ + e_3 \quad (6)$$

8 Sample Size Planning for Mediated Effects

Because the mediated effect is a product term of two regression coefficients (or a difference term of two coefficients), the mediated effect estimate does not follow a normal distribution (MacKinnon et al., 2002). This property of mediated effects can make sample size planning tricky, as most of the available software for sample size planning are not built to handle non-normal, complex parameter estimates. Researchers must either perform a simulation study attuned to their expected population parameters and desired level of power in order to determine what sample size would be adequate to capture a significant mediated effect for their

model, or consult previously published simulation studies that have explored what sample sizes are necessary to detect mediated effects under a large variety of conditions.

For example, Fritz and MacKinnon (2007) provide a table of suggested sample sizes for a wide range of coefficient effect sizes within the single-mediator model, separated by mediation analysis method (e.g., Baron and Kenny's causal steps method, joint significance testing, percentile bootstrap confidence intervals, etc.). Other resources, such as Thoemmes et al. (2010) and Liu and Wang (2019) extend this sample size research to more complex mediation models, including models with multiple mediators, moderated mediation models, and longitudinal mediation models, while incorporating other considerations such as uncertainty in the expected population effect values. These more complex models often require much greater sample sizes in order to reliably detect a significant effect when compared to the sample sizes needed for simpler mediation analyses, so it is important that researcher plan their models well in advance.

9 Summary

Mediation analysis is important for experimental and observational studies because it provides insight into how effects occur, which can then be used to develop and evaluate interventions. The single-mediator model, which has been a focus of decades of methodological and applied work, is now being extended to more complicated situations. There are models for more complex designs, like multiple mediator models, models with moderation and mediation, and longitudinal mediation models. There are challenging assumptions for accurate conclusions from mediation analysis—even when X is randomized, there will be challenges in

interpreting the *M* to *Y* relationship as a causal effect. An important recent development for mediation analysis is the incorporation of principles of causal inference. Contributions of this active research area include the clear articulation of causal assumptions and methods to assess the sensitivity to violations of these assumptions, including methods to investigate confounder bias and measurement error bias. We expect continued growth in methods to investigate mediating mechanisms which guide the study of how and why effects occur in child maltreatment research.

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**Applying the Multiphase Optimization Strategy (MOST) to the Prevention of
Child Maltreatment: A Vision for Future Multicomponent Interventions**

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Abstract

The prevailing strategy in the prevention of child maltreatment is early childhood home visiting. However, the effects of these programs vary among populations, there are high rates of attrition over time, and, in general, it is likely that families at greatest risk do not receive these services. To realize the full public health impact of this federally supported prevention strategy, home visiting models must consider ways to improve the effectiveness, parental engagement, and implementation of the program. This chapter introduces the engineering-inspired Multiphase Optimization Strategy (MOST) to the field of child maltreatment prevention. The objective of the MOST framework is to arrive at an intervention that strategically balances effectiveness against qualities of affordability, scalability and efficiency. An overview of MOST is provided and then highlighted through three applied examples of how MOST may be used to improve the effectiveness, engagement, and implementation of home visiting programs. It is no longer sufficient to merely demonstrate effectiveness of home visiting programs – we must ensure these programs benefit and reach those who need it most.

Keywords: intervention optimization, MOST, intervention science, child maltreatment, prevention, engagement, implementation science, factorial experiment, home visiting, parenting, behavioral science, translational science, public health, clinical trial, resource constraints

1 Interventions related to the Prevention of Child Maltreatment

Estimated to affect 40% of youth before 18 in the United States (Kim et al., 2017), child maltreatment is associated with myriad life-long biopsychosocial consequences (Chapman et al., 2007; Cicchetti & Handley, 2019; Gilbert et al., 2009; Toth & Manly, 2019) and confers a lifetime economic burden estimated to exceed \$428 billion (Peterson et al., 2018). In 2020, approximately 618,000 children were determined to be victims of maltreatment by child protection systems (U.S. Department of Health & Human Services, 2022). We know however that reports to these systems vastly underestimate the true prevalence of child maltreatment. Research suggests incidence rates of 39.5 per 1000 children, roughly four times higher than CPS reports (Sedlak et al., 2010) and retrospective surveys suggest 1 in 7 children experience maltreatment per year (Finkelhor et al., 2005). Preventing child maltreatment before it occurs, thereby preventing lifelong sequelae, is an urgent public health priority (Herrenkohl et al., 2015; Klevens & Whitaker, 2007; Merrick & Latzman, 2014; Whitaker et al., 2005).

The prevailing prevention strategy is early childhood home visiting, an umbrella term for a method of delivery used by many evidence-based programs.² At the broadest level, home visiting programs are designed to foster parent knowledge and skills, provide social support, develop coping and problem-solving, and increase access to community referrals. Programs vary with regard to the type of families they serve (e.g., first time mothers vs. multiple children in a family), target child ages, duration and frequency of the sessions, educational background of providers, and

² Henceforth, this chapter will use the term ‘home visiting’ to refer to the swath of programs (and models) that use this delivery strategy. It should be noted that there has been some discussion about referring to these programs as ‘parent support programs’ in response to feedback from participating parents. This change has not been widely adopted, so as to be consistent with the current literature base, this chapter will use home visiting.

the types of behaviors targeted. Variations notwithstanding, there has long been agreement that home visiting is an effective strategy for helping families (Diaz & Petersen, 2014; Peacock et al., 2013; Selph et al., 2013; Sweet & Appelbaum, 2004). Indeed, a number of home visiting programs have reached designation as evidence-based, demonstrating an empirical reduction in risk for child maltreatment (Duffee et al., 2017; Filene et al., 2013; U.S. Department of Health & Human Services, 2021). Efforts to identify common elements of home visiting programs (Kaminski et al., 2008; Kaye et al., 2018) have identified components including problem solving strategies, efforts to increase the quantity and quality of parent-child communication and interactions, and practicing taught skills with the child during sessions. Often delivered in concert with child protective service systems, home visiting programs are delivered across a variety of prevention strategies, including to the general population, to families at risk for maltreatment, and those who have already experienced maltreatment (Chaffin et al., 2001; MacMillan et al., 2005).

The promise of home visiting for preventing child maltreatment was recognized as early as 1993 (Chaffin et al., 2001). Nearly \$2 billion of federal support has been invested in home visiting since 2010, the majority supporting the Maternal, Infant, and Early Childhood Home Visiting (MIECHV) program administered by Health Resources and Services Administration (HRSA). MIECHV focuses on home visiting programs targeting parents of children 0-5. In 2021, over 3 million home visits reaching 277,852 families and 312,579 children were provided by 15 models funded by MIECHV (National Home Visiting Resource Center, 2022). Investment in home visiting programs at the community-level has demonstrated a direct impact on rates of child maltreatment reports. For example, Kim et al. (2022) examined the association between home visiting programs and child maltreatment report rates in

Illinois. County-level data from 2011-2018, indicated higher rates of home visiting programs in communities was significantly associated with decreased child maltreatment report rates. The reach and effect of home visiting programs is not inconsequential. However, there is evidence to indicate the majority of those at greatest risk (e.g., low income families, preterm infants, and low birthweight infants) do not receive home visiting services (Lanier et al., 2015). Further, there are still a high number of children determined to be victims of maltreatment each year (Finkelhor et al., 2022).

1.1 Room for Improvement

If home visiting is to remain the prevailing prevention strategy in the field of child maltreatment, then we collectively have more work to do to ensure the public health impact of this strategy is realized. For example, despite the considerable federal financial investment in home visiting programs in the U.S., not all children and families are benefitting from these services and hundreds of thousands of children experience maltreatment each year (Lanier et al., 2015). Home visiting models must consider ways in which to improve the effectiveness of the program, parental engagement in the program, and factors related to the program's implementation. This section is not meant to be an all-encompassing, comprehensive critique of the state of the science, rather the purpose is to set up hypothetical examples in subsequent sections. Let us explore these three areas for improvement in turn.

1.1.1 Effectiveness

The varied effectiveness across home visiting programs has long been documented (Avellar & Supplee, 2013; Goyal et al., 2013; Peacock et al., 2013;

Raikes et al., 2006; Roggman et al., 2008; Sweet & Appelbaum, 2004). Using meta-analytic techniques, Filene et al. (2013) sought to describe the effect of universal and selective home visiting programs on birth outcomes, parenting behavior, maternal life course, child cognitive outcomes, child physical health, and child maltreatment. Across the studies ($N = 51$), the mean effect size (ES) was 0.20 (range -0.68 - 3.95), but was only significant and positive in maternal life course, child cognitive, and parent behaviors and skills outcomes. Importantly, the mean ES for the child maltreatment outcome was -0.08 (Filene et al., 2013). In a meta-analysis of 37 randomized controlled trials of parenting programs, Chen and Chan (2016) reported a total ES of 0.21 for the reduction of official child maltreatment rates. However, upon further examination, the ES of the studies ($n = 14$) focused on families involved in the child protective service system, and which involved a home visitor, ranged from -0.17 to 1.48. Among the home visiting models supported by MIECHV, the Maternal Infant Home Visiting Evaluation (MIHOPE) study indicated the average reduction in the frequency of minor physical assault was $ES = 0.08$ and $ES = 0.11$ for psychological aggression (Michalopoulos et al., 2019). Focused specifically on the first two years of a child's life, the average ES for home visiting programs ranged from 0.09 to 0.11 in improving parenting and -0.02 to -0.03 in the reduction of child maltreatment (Supplee & Duggan, 2019). In sum, these multiple meta-analyses and evaluations highlight the wide variation in effectiveness of home visiting programs.

Leveraging another metric useful in the estimation of effectiveness, Han and Oh (2022) conducted a systematic review and meta-analysis focused on recidivism. Among parents who had maltreated their children, the recurrence rate among intervention groups was reported to be between 10-57%, whereas the rate of recurrence among control groups was 21-67%. The recurrence rate was still lower

among the intervention group but any recurrence suggests room for improvement.

1.1.2 Engagement

Home visiting programs eliminate common barriers associated with clinic-based services (e.g., transportation, child care; Damashek et al., 2012) and stigma. Yet, a conservative estimate suggests only 60% of invited families choose to enroll in home visiting services (C. N. Baker et al., 2011; Garvey et al., 2006; Gomby, 2007). Further, of those who enroll, fewer than 80% receive the number of intended visits and as many as 50% leave the program before the designated conclusion (Daro et al., 2012; Gomby, 2007). The attrition rate among home visiting programs ranges from 20-67% (Damashek et al., 2011). The impact, and therefore the effect, of home visiting programs is diminished if families do not enroll and if they do enroll, if they do not receive the program as designed. The MIHOPE evaluation indicated that families participated for less time and received fewer visits than prescribed by four of the most widely implemented home visiting programs (Michalopoulos et al., 2019). Engagement is a more complex phenomenon than a simple count of completed visits or retention (Ingoldsby et al., 2013). For the purposes of this chapter, we will adopt a broad definition of engagement, spanning a continuum from recruitment to enrollment to participation to maintenance and to acceptability/social norms (Guastaferro et al., 2020).

Factors influencing engagement, specifically the activities of enrollment and participation, include family characteristics, provider characteristics, program factors (e.g., frequency of visits), and community variables (e.g., community violence, economic status; Daro et al., 2003; Filene et al., 2013; Korfmacher et al., 2008; Latimore et al., 2017; McCurdy & Daro, 2001). The majority of research has focused on the effect of parent- and family-level characteristics, though findings have been

mixed (Bower et al., 2020). For example, some studies indicate that families of higher risk were more likely to enroll in home visiting (Daro et al., 2003; Duggan et al., 2000), whereas other studies have demonstrated the opposite - families of high risk are less likely to enroll (Ammerman et al., 2006). The strength of the relationship between provider and parents is a consistent predictor of a family's sustained participation in a home visiting program (Barton et al., 2020; Korfmacher et al., 2008). On the other hand, inconsistent attendance early in services has been demonstrated to be the strongest predictor of attrition (Janczewski et al., 2019). In relation to the role of program characteristics on engagement, a meta-analysis of 29 studies ($N = 6,543$ families) indicated that programs with a higher frequency of visitation (i.e., at least three per month) had higher success rates (Nievar et al., 2010). Engagement is a model-agnostic phenomenon that directly impacts the impact of home visiting programs.

1.1.3 Implementation

Real world complexities almost immediately threaten the dissemination and implementation of home visiting programs. So much so that effect sizes of home visiting programs are often diminished when implemented at scale (Michalopoulos et al., 2019). Multiple contextual factors may contribute to these implementation barriers. Competing demands on a family's time - work, appointments, other services - may lead to missed visits. Home visits may eliminate some important barriers (e.g., transportation, child care) but because they take place in a clients' home, the client is the 'gatekeeper' with control when the visits occur, length of the visit, and the agenda to some degree (Kitzman et al., 1997). Of course, in 2020 the social distancing and isolation strategies enacted to mitigate the spread of the COVID-19 pandemic upended the implementation of home visiting programs. Unable to visit homes in-

person, the majority of home visiting models transitioned to virtual visits (Roben et al., 2022; Traube, Gozalians, et al., 2022). The use of virtual visits, however, offers the ability to visit families that live remotely or who may be resistant to inviting someone into their home (Traube, Taylor, et al., 2022) - an answer to some implementation barriers beyond the COVID-19 context. The high rate of staff turnover - a problem that spans all home visiting programs (Wasik, 1993) - is not only a barrier to parent engagement (Bower et al., 2020) but also a driver of cost.

The cost of home visiting is considerable. An early cost analysis of the Nurse Family Partnership, a home visiting program with three decades of research and implementation (Olds, 2012), indicated an average cost was \$4,970 per family, however, the cost for enrolling a new family in the program was \$7,835 (Boulatoff & Jump, 2007). A different study of 9 evidence-based home visiting models indicated that the annual cost per family was \$8,497 but costs varied across local implementing agencies from \$1,970 to \$39,770 (Yarnoff et al., 2019). MIHOPE indicated the cost of providing home visiting services to a family during the first year ranged from \$1,304 to \$5,788 per year (Corso et al., 2022). Cost is driven by the number of home visits delivered in the study period, salary of the home visitor (i.e., labor expenditure), and program expenditures by the administering agency (e.g., provider training, facilities, etc.). Costs are a function of the number of families served by an agency - the more families served, the lower the per family cost.

1.2 What is the Reason for Variation of Effectiveness, Engagement, and Implementation?

It is likely that there is not one reason for the varied effectiveness, engagement, and implementation of home visiting programs. The differences across programs' research methodologies, populations of interest, pedagogical approaches

and other characteristics preclude a conclusive analysis. However, we might speculate one reason for the variability in effectiveness is the approach to development of these interventions. Home visiting interventions, and for that matter, the vast majority of general behavioral interventions, were developed using what is often called the *classic treatment package approach* (Guastaferro & Collins, 2019). Following this approach, a scientist developing an intervention designed to prevent child maltreatment would use theory, empirical literature, and clinical practice to identify components - including anything that they think might possibly be important in preventing child maltreatment. These components then would be packaged together and empirically tested using a two-arm randomized controlled trial (RCT), or another design in which the package is tested against a control or placebo. If the results of the trial indicate that the outcome of interest is affected in the desired direction, then the package would be determined to be effective. The vast majority of home visiting programs have been developed and evaluated following the treatment package approach. However, though the RCT remains the gold standard in determining efficacy, the design leaves many unanswered questions critical to program development.

The treatment package approach does not tell us, for example, the manner and degree to which each of the identified components produces an effect on the outcome. It is also unknown if or how the inclusion of one component may affect the performance - positively or negatively - of another component. In other words, the traditional two-arm RCT design does not allow for the estimation of interactions between components. It is also unknown if the inclusion of a component offsets its cost - does the component impact the outcome enough to justify the cost of inclusion? In the treatment package approach, it is unclear whether all of the

components are needed to produce the effect in the outcome. Could the same effect be achieved with fewer components? Moreover, the RCT is an incredibly resource intensive design. The amount of time, money, and energy expended in the design and conduct of an RCT is not inconsequential. And, at the end of an RCT it is possible the results will be null, not as expected, or not replicable. Then what? The information produced by the RCT does not provide a clear way forward or a direction in which to proceed to improve the effectiveness or other qualities of the intervention.

The time has come for the field of home visiting to seek a different, novel approach for intervention development. Supplee and Duggan (2019) suggest “the field needs a radically different approach if we are to achieve outcomes for the most vulnerable families” (p. 174). In order to do so, this approach must answer a broader spectrum of research questions thereby incrementally improving the effectiveness of home visiting models as well as other obstacles faced by programs such as parental engagement and implementation.

1.3 An Innovative Approach

This chapter focuses on one approach for intervention development, the multiphase optimization strategy (MOST). Inspired by the fields of engineering, behavioral science, public health, economics, and decision science, MOST is a framework for the development, optimization, and evaluation of multicomponent behavioral interventions (Collins, 2018). In contrast to the classic treatment package approach, MOST introduces a phase of experimentation, known as an *optimization trial*, designed to answer questions about the performance of individual components on the outcome of interest, alone and in combination. Results of an optimization trial may be used to decide what components should be retained and subsequently tested in an RCT or what components may need to be discarded or further refined to

improve impact. The overall objective of MOST is to arrive at an intervention that achieves intervention *EASE* by strategically balancing Effectiveness against Affordability, Scalability, and Efficiency (Figure 1).

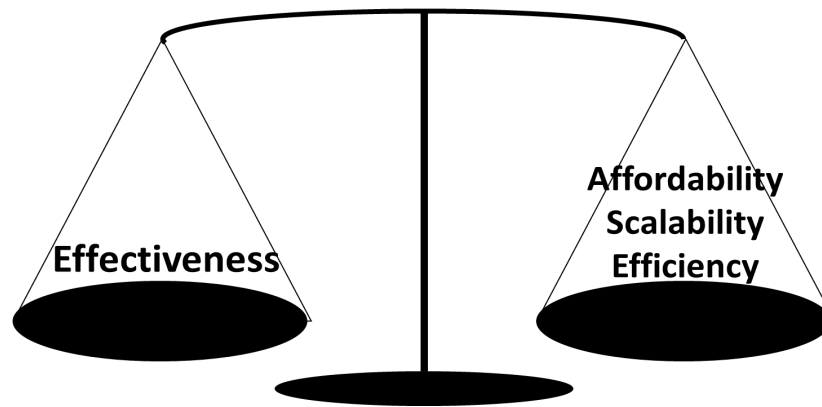


Figure 1. Intervention *EASE*: The Balance of Effectiveness against Affordability, Scalability, and Efficiency

MOST has been applied across a number of public health issues including but not limited to smoking cessation (T. B. Baker et al., 2015; Cook et al., 2016; Piper et al., 2016), weight loss (Pfammatter et al., 2020; Spring et al., 2020), fidelity of school-based drug use and HIV prevention (Caldwell et al., 2012), prevention of sexually transmitted infections (Tanner et al., 2021; Wyrick et al., 2020), improvement in language skills among non-verbal school children (Kasari et al., 2014), and adherence to antiretroviral therapy to reduce HIV viral load (Gwadz et al., 2017). At the time of writing, more than 150 projects using MOST have been funded by the National Institutes of Health in the United States and other projects abroad. However, also at the time of writing, MOST has not yet been applied directly, specifically, and intentionally to the field of home visiting to prevent child maltreatment. MOST offers a solution to the urgent call of Supplee and Duggan

(2019) to better understand what works, for whom, and under what conditions.

The remainder of this chapter will provide an overview of MOST and three applied examples of how MOST may be used to improve the effectiveness, engagement, and implementation of home visiting programs. A word of caution for the intrepid reader: MOST is not an off the shelf procedure or method. This means that every application of MOST will vary and, as such, the hypothetical examples described herein should not be taken as a standard protocol. Instead, the intent of this chapter is to showcase only a small offering of what MOST can do for the field of home visiting and for inspiring the reader to integrate MOST into their program of research.

2 The Multiphase Optimization Strategy (MOST): An Overview

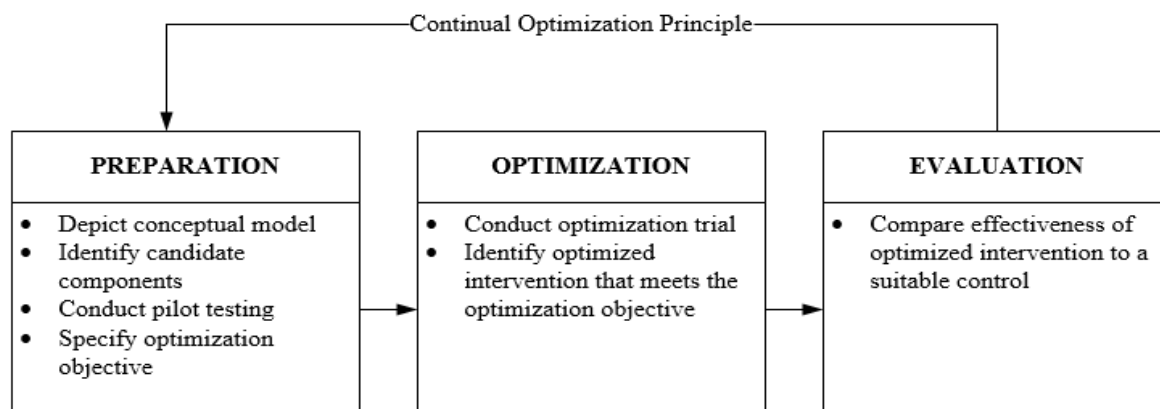
This section provides a high-level overview of MOST; interested readers should refer to Collins' 2018 book for a comprehensive overview as one chapter is nowhere near sufficient to explain all of MOST. In addition, the application of MOST to the field of child maltreatment has also been suggested previously. For example, Guastaferro, Shenk, and Collins (2019) demonstrated how MOST can be used to develop better interventions to reduce trauma symptoms among children who have experienced maltreatment. Additionally, Guastaferro, Strayhorn, and Collins (2021) also offered an introduction of MOST to the field of home visiting specifically. This chapter seeks to expand and extend elements of those discussions by addressing multiple threats to the field of home visiting – effectiveness, engagement, and implementation.

Aspects of the MOST framework will be familiar to those trained in the classic treatment package approach. For example, intervention components are still theoretically, empirically, and clinically justified. New to many will be the notion of

optimization. It is worth noting that this perspective of optimization is not synonymous with optimal. Optimization is a concept used across many disciplines but usually involves balancing competing considerations. In MOST, optimization is defined as “the process of identifying an intervention that provides the best expected outcome obtainable within key constraints” (Collins, 2018, p. 12). Optimization could be the best that we can afford. As a framework, MOST has the potential to hasten the translation of behavioral interventions into practice, thus maximizing the potential realization of public health impact (Guastaferro & Collins, 2019).

2.1 Phases of MOST

MOST is comprised of three phases: preparation, optimization, and evaluation (Figure 2). The phases are independent and, though conducted sequentially, do not always follow a straightforward process. For example, it may be necessary to return to the preparation phase after the optimization phase instead of moving onto the evaluation phase directly. Or, an investigator may be able to leverage previous work to complete activities of the preparation phase and ‘jump’ right in to the optimization phase. MOST is also not a finite process; rather, optimization is an iterative process of ongoing improvement. This falls under a core tenet of MOST, the *continual optimization principle*. This engineering-inspired principle holds that even an intervention that has demonstrated effectiveness through the Evaluation Phase can be further optimized. There will always be new science to justify consideration of a new component or different implementation constraints. This iterative and incremental process of achieving intervention *EASE* is how we can ensure our behavioral interventions continue to meet the needs of those served and the context in which the interventions are delivered.



Note: This figure has been adapted with permission from Collins 2018.

Figure 2. The Multiphase Optimization Strategy (MOST) Phases & Key Activities

2.1.1 Preparation Phase

The Preparation Phase lays the foundation for optimization. Key activities include: developing a conceptual model, identifying a candidate set of components, conducting pilot studies, and operationalizing an optimization objective. The conceptual model is a theoretical and empirically-derived depiction of the intervention and the process to be intervened upon. It is highly-detailed and explicit, depicting: (a) the outcome that the intervention is designed to impact, (b) mediators that will be targeted to produce a change in the outcome, and (c) components that are designed to affect mediators. As such, the conceptual model helps to identify the components that will be candidates for inclusion in the optimized intervention. Unlike a logic model, the conceptual model articulates exactly the way in which an intervention is designed to intervene upon a causal process by identifying what mediators are targeted by which specific component. It is recommended that one component targets one mediator to aid with interpretation of results from the optimization trial. Also, unlike a structural equation model, the conceptual model will not contain every expected nonzero regression path.

In MOST, a component is defined as anything that may be separated out for

study. A component might be a specific activity, such as a group session focused on enhancing perceived social support. A component could also be designed to enhance adherence (e.g., homework between home visit sessions) or fidelity (e.g., supervision of home visitor). As in the treatment package approach, any number of methods may be used in the development of candidate intervention content including human-centered design (O'Hara et al., 2022) and community-based participatory research (Windsor et al., 2021). Should a component need to be developed, adapted, or refined, the investigator would conduct pilot studies under the scope of the Preparation Phase. Adhering to the definition provided by Leon and colleagues (2011), pilot studies are designed to determine or ascertain the acceptability and feasibility of a component. A pilot study is not designed to estimate the efficacy of a component and for that reason are not powered to estimate effect sizes. A pilot study could use any suitable experimental design (e.g., single-case design, pre-post) and often includes qualitative data.

The final activity in the Preparation Phase is to specify the *optimization objective*. This is a description of how intervention *EASE* will be achieved. Specifically, the way in which Effectiveness will be balanced with other desired qualities of Affordability, Scalability, and Efficiency (Figure 1). The optimization objective considers constraints on implementation, for example, time or money. The applied examples presented later in the chapter will highlight a variety of optimization objectives. For the sake of illustration at this point, let us suppose you are interested in developing an intervention designed to enroll new mothers in a home visiting program during a well-child visit at the pediatrician's office. There is a finite window during which this intervention may be delivered to the mother and, for sake of argument here, suppose you know that window to be only 10 minutes. If you

designed an intervention that actually takes 20 minutes, or even 12 minutes, to deliver, then the intervention would not be implementable in the context for which it was developed. In contrast, if you were following the MOST framework, you would specify an optimization objective as follows: *the intervention that produces the best expected outcome when delivered in 10 minutes or less*. The optimized intervention that you select at the end of the Optimization Phase would meet this objective and, thus, will be immediately implementable. There is no singularly correct optimization objective. Two investigative teams working with the same components may identify two unique optimization objectives to match their respective contexts.

Many of these activities are familiar to intervention scientists trained in the treatment package approach. So then how are they different in MOST? The answer is: it is really not that different! However, as the reader will soon see, these activities are critical to the success of later phases of MOST. Recently, there has been a call to standardize reporting elements of the Preparation Phase activities using the MOST PREParation REPorting (PREP-REP) Checklist to enhance rigor and reproducibility between studies in this iterative process of intervention development (Landoll et al., 2022). Resources devoted to activities in the Preparation Phase may be better leveraged across studies when there is consistent, high-level reporting.

2.1.2 Optimization Phase

Unique to MOST, the Optimization Phase will be the least familiar to intervention scientists trained in the classical treatment package approach. In this phase, the optimized intervention is built. The key activity is the optimization trial, a rigorous, randomized experimental trial designed to examine the effect of intervention components - alone and in combination - on the outcome of interest. The purpose of the optimization trial is to estimate the contribution of each

component and their interactions on the outcome of interest. The results of this trial will be used to identify the optimized intervention or the intervention that satisfies the optimization objective specified in the Preparation Phase.

The selection of an experimental design for an optimization trial is driven by: (1) the research question, (2) the type of intervention being developed (i.e., fixed or adaptive³), and (3) the resource management principle. The resource management principle holds that the investigator will make efficient use of available resources (or those that are reasonably obtainable) when obtaining scientific information (Collins et al., 2009). A wide array of experimental designs may be considered for the optimization trial. For a number of reasons, the most common experimental design for an optimization trial is some variation of the factorial experiment due to the efficient and economical use of subjects. A full tutorial of the factorial experimental design is beyond the scope of this chapter; interested readers are referred to Collins et al. (2009, 2014) and Dziak et al. (2012).

Moving from the intervention development phase to the experimental phase, a component is now referred to as a factor. The complete factorial experiment produces estimates of main effects for each factor and the all component interactions. For example, if there were 4 components identified in the Preparation Phase, the optimization trial would be designed to test the main effects of the 4 factors and all possible combinations, up to the 4-way interaction. Extending this scenario, suppose the research team: (a) sought to identify only the components that produced a clinically significant improvement on the outcome (via the mediator(s) as

³ A fixed intervention is one in which everyone receives the same level of intervention. In contrast, the adaptive intervention is one in which the level of intervention (i.e., treatment type, duration, frequency, dose) will vary by an individuals' performance at critical decision points during intervention.

depicted in the conceptual model); (b) developed a fixed intervention in which everyone received the same level of treatment; and (c) had obtained grant money to support the research. A 2^k factorial experiment would be a suitable selection for the optimization trial design, in which there would be 4 factors each with 2 levels (on/off, or low/high). The resulting design is a 2^4 factorial experiment or $(2 \times 2 \times 2 \times 2)$ yielding 16 experimental conditions. Before you say “Whoa, 16 experimental conditions?! No way I could ever have enough subjects to power that study!” – be assured you can. This is because the factorial experiment does not compare one condition to another head-to-head; rather, the main effect of a factor is estimated using means of conditions, averaged across the levels of the other factors. Subjects thereby are efficiently used in the estimation of each main effect and their interactions - actually resulting in often fewer subjects than one would need in an RCT. Space precludes a full tutorial of the power and sample size calculations for a factorial experiment; readers are referred to Collins et al. (2009) and Dziak et al. (2012). Resources are also available to assist in these calculations from the Center for Advancement and Dissemination of Intervention Optimization (cadio) at New York University.

At the conclusion of the optimization trial, the research team has answered the research question - what is the effect of each component on the outcome of interest - as well as the empirical information to identify and decide upon the optimized intervention. First, the research team would be able to estimate the main effects and all possible interactions using a factorial analysis of variance (ANOVA). Should any of the main effects not meet the specified criterion (clinical significance in this case), then any experimental condition that includes this component would likely not be considered in the selection of the optimized intervention. Recall that the

optimized intervention is the one that satisfies the optimization objective. Let us return to the scenario in which there is a 10-minute window to deliver an intervention in the clinic to enroll new mothers into a home visiting program. Data from the factorial experiment would depict the intention to enroll among the mothers in each of the experimental conditions (representing all combinations of components) and the time to deliver the content of each condition. Only the experimental conditions with the components that met clinical significance and that were delivered in 10 minutes or less would be considered.

Admittedly, the decision-making process in the Optimization Phase is an open research area. At the time of writing, active research is integrating the use of Bayesian statistics in the decision-making process. It is worth briefly mentioning that data from optimization trials can be used for secondary analyses. For example, factorial mediation analyses can be used to test hypotheses about causal mechanisms underlying individual and combined effects of components (Strayhorn et al., 2022).

2.1.3 Evaluation Phase

The objective of the Evaluation Phase is to *confirm* the effectiveness of the optimized intervention. As a point of contrast, the purpose of the Optimization Phase was to *decide* upon the optimized intervention. To confirm effectiveness, the most suitable experimental design is the RCT in which the optimized intervention would be compared to a suitable control. Perhaps the control condition is the not-optimized version of the intervention. It could also be standard of care or a placebo. This is a good point to emphasize that MOST is not anti-RCT. However, following the MOST framework, by the time a research team gets to the RCT in the Evaluation Phase many more questions, including the way in which the intervention works, are better

understood. It is also not a requirement that the RCT be the experimental design used in the Evaluation Phase (see Tanner et al., 2021). Any experimental design may be selected so long as it: (a) answers the research question, (b) is matched to the type of intervention, and (c) adheres to the resource management principle.

3 Applied Examples

In this section, three case studies are presented to highlight the way in which MOST may be applied to address the areas for improvement, which were noted in the first part of this chapter: effectiveness, engagement, and implementation. The context for each case study is described first, followed by a high-level walk through of the Preparation and Optimization Phases of MOST. The case studies do not include the Evaluation Phase, in which the optimized intervention is compared to a suitable control, as that will be most familiar to the reader. The case studies are hypothetical and are not intended to be conclusive or suggestive of a particular solution. Rather, the case studies are designed to demonstrate the application of MOST in a variety of ways that inspire the reader to apply intervention optimization in their own research.

3.1 Case 1: Effectiveness

As noted, the effectiveness of home visiting programs to reduce the risk for child maltreatment is variable and one reason for that is that there is not empirical evidence to support the inclusion (or exclusion) of individual components. Indeed, many components are shared across home visiting models. In a common components analysis, Kaye et al. (2018) demonstrated that problem-solving strategies, home cleanliness, accident prevention, first aid, and social support were common across home visiting programs. Though these components are used across

home visiting programs, it is unknown what effect each of these components have on reducing the risk for child maltreatment. It is unknown if we need all or some of these components to reduce the risk for child maltreatment. It is unknown if the inclusion of one of these components offsets its cost. This is where MOST could be applied to answer these questions.

3.1.1 Preparation Phase

The first step will be to depict the conceptual model for the intervention designed to reduce risk for child maltreatment as measured by the Child Abuse Prevention Inventory (CAPI; Milner, 1994). Leveraging the empirical data from Kaye et al. (2018) and theories of behavior change, the relationship of mediators on the causal process and the components designed to affect those mediators are depicted in Figure 3. Theory of behavior change suggests that to see a reduction in risk of the potential for child maltreatment (Outcome), the parent must increase relevant knowledge and skills and address social norms around parenting. These elements are labeled as Distal Mediators in the conceptual model - these are part of the causal process leading to the outcome. Parents' knowledge and skills are needed in the areas of stress management, home cleanliness, and how to prevent unintentional injuries. To impact social norms, parents must have an increase in social support. These are labeled as Proximal Mediators on the conceptual model. Then, the components that are designed to affect each of the Proximal Mediators are operationalized. These are reflected on the left side of Figure 3 and are labeled as Candidate Components because they may or may not be included in the optimized intervention. The far left of the conceptual model has a vertical box labeled 'General Parenting.' This is what we call a constant component, that is a component provided to all subjects and is not experimentally manipulated. Including a constant

component is appropriate when there is a standard of care that all subjects should receive ethically or there is a base level of knowledge that all parents need to succeed in the components that will be experimentally manipulated. The trade off is that the research team will not be able to disentangle the effect of the constant component from the effect of other components.

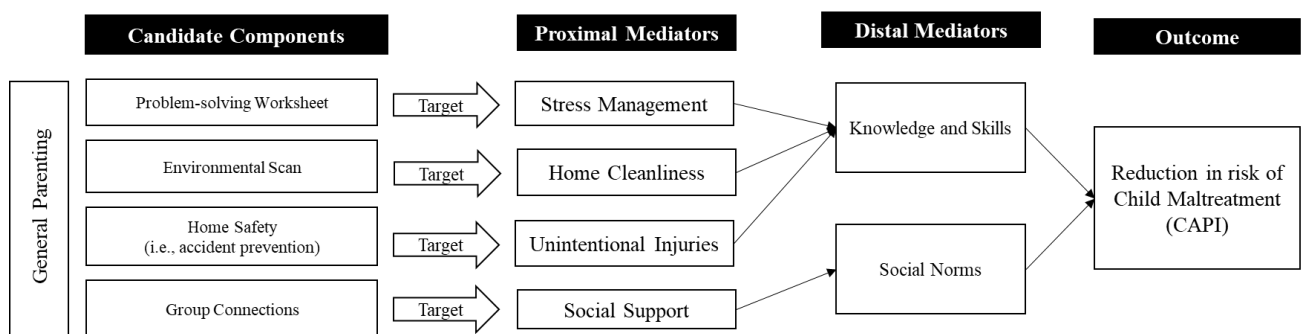


Figure 3. Conceptual Model for Intervention Designed to Improve the Effectiveness of an Intervention to Reduce the Potential for Child Maltreatment

If any of the candidate components identified in the conceptual need to be developed, adapted, or refined it is at this stage the research team would conduct pilot studies. A pilot is designed to ascertain acceptability and feasibility but also is a suitable occasion to refine protocol procedures. Not all home visiting programs have a group component, so it is likely the research team would need to develop this component and pilot test it. From a procedural and experimental design perspective, the pilot study offers an important opportunity to understand threats to validity, specifically contamination. In this case study, the risk for contamination is in the group setting. Participants from all experimental conditions - who have been receiving different components and/or component levels - would interact and potentially influence one another's knowledge or experience. The pilot study would

offer an ideal setting to refine the protocol to reduce the risk for those types of interactions - perhaps a script for the facilitator to use to redirect conversation or perhaps it becomes clear that groups should be comprised of those who received the same other components. If the pilot study was not conducted in the Preparation Phase, it may negatively impact the success of subsequent phases.

Lastly, the research team must identify the optimization objective. An operationalization of the goal of the intervention, the optimization objective could be to simply identify the most effective intervention comprised of components that have a positive effect on the outcome of interest. A simple objective, but an impactful one. If the research team selects this 'all active components' optimization objective, any inactive or insufficient components would be eliminated from the optimized intervention thereby increasing the efficiency of the intervention.

3.1.2 Optimization Phase

The research team is developing a fixed intervention and is interested in estimating the effect of each component, independently and in combination, on the outcome of interest. In the Preparation Phase, the team identified four candidate components, and one constant component; thus, the best suited experimental design for the optimization trial, aligned with the resource management principle, is the factorial experiment. There are four experimentally manipulated factors, each with two levels, leading to a 2^4 (or $2 \times 2 \times 2 \times 2$) experimental design (Table 1). In total, the factorial experiment will have 16 experimental conditions that reflect all possible combinations of the 4 factors.

Experimental Condition	General Parenting	Problem Solving	Environmental Scan	Home Safety	Group Connections
1	On	On	On	On	On
2	On	On	On	On	Off
3	On	On	On	Off	On
4	On	On	On	Off	Off
5	On	On	Off	On	On
6	On	On	Off	On	Off
7	On	On	Off	Off	On
8	On	On	Off	Off	Off
9	On	Off	On	On	On
10	On	Off	On	On	Off
11	On	Off	On	Off	On
12	On	Off	On	Off	Off
13	On	Off	Off	On	On
14	On	Off	Off	On	Off
15	On	Off	Off	Off	On
16	On	Off	Off	Off	Off

Table 1. Experimental Conditions for Case Study 1 Using a 2⁴ Factorial Design

Participants will be randomized to one of the 16 experimental conditions. A participant randomized to experimental condition 6 would receive General Parenting Skills, Problem Solving, and Home Safety, but not Environmental Scan or Group Connections. In contrast, a participant randomized to experimental condition 14 will only receive the General Parenting Skills and Home Safety components. It is not the case that experimental condition 16 is the control group – in a factorial experiment, there is no standard “control” group, like in an RCT. The “control” group for a given factor in the factorial experiment is estimated by comparing the two levels of the factor. For example, the main effect of Problem Solving is estimated by comparing the means of conditions 1-8 against the means of conditions 9-16 (Table 1; shading indicates comparison for all factors). It is not possible to estimate the effect of only General Parenting because it was not experimentally manipulated. Recall, this is

because unlike the RCT, the estimation of effects is a combination of conditions rather than a head-to-head comparison.

The research team then conducts the factorial experiment. At its conclusion, the team is able to estimate the main effect for each component (4) and then all possible combinations (11, up to the 4-way interaction). The team conducts a factorial ANOVA to first estimate the main effect for the four components. Any component that meets an a priori specified criterion of importance to the team (e.g., p value, effect size, mean difference) would be eligible for inclusion in the optimized intervention. Let us suppose that in this case study, the team wished to retain components that produced a main effect with a Cohen's $d \geq .25$ (ES) and only the Problem Solving and Home Safety factors met this criterion. Problem Solving and Home Safety are now tentatively designated for inclusion in the optimized intervention. Next, the team reviews the interactions from the factorial ANOVA output looking for interactions that meet the same criterion (Cohen's $d \geq .25$). Suppose the interaction of Home Safety and Environmental Scan met this criterion. A plot of marginal means indicates the interaction is synergistic, meaning the effect is more favorable than would be expected solely on the main effects. Home Safety had a main effect on the outcome, but Environmental Scan did not. Should the Environmental Scan be included in the optimized intervention? Maybe or maybe not. This is up to the discretion of the research team. If the contribution of this component produced a meaningful impact on the reduction of risk for child maltreatment, then it may be worth including despite the cost of including it. Suppose the team decides to retain the Environmental Scan. Now the optimized intervention has been identified: General Parenting, Problem Solving, Environmental Scan and Home Safety. The Group Connections component is eliminated (or set to the lowest level).

The optimized intervention produces a small effect as measured by Cohen's d , but is more efficient as it does not include a component that does not affect the outcome. The team may wish to move into the Evaluation Phase, or could return to the Preparation Phase to further refine the Group Connections component or develop a new component informed by emerging science and then test if that further improves the effect of the intervention. This is a step forward for the field of home visiting in improving the effectiveness of interventions because the inner workings of the components are better understood. Findings could be shared across and extended to other programs that include these components.

3.2 Case 2: Engagement

A lack of parental engagement in a home visiting program will impact the effect of the program, whether optimized or not. Let us suppose that the research team has previously optimized an intervention for effectiveness (Case 1) but still experience challenges in engagement, specifically in the participation and completion of the intervention. The team wishes to use MOST to develop an optimized intervention to increase the engagement of parents in their home visiting program (Case 1) to maximize the percentage of home visiting sessions that are completed (Outcome).

3.2.1 Preparation Phase

Informed by the Integrated Theory of Parent Involvement (ITPI) model (McCurdy & Daro, 2001), the research team seeks to improve completion via individual parent, program, and neighborhood mediators. Leveraging empirical literature and clinical practice, the team identifies strategies to affect parent, program, and neighborhood mediators. Suppose the home visiting program (Case 1)

targets mothers specifically. Maternal depression is a predictor of a lack of engagement (Ammerman et al., 2006, 2010; Damashek et al., 2011), so a component is designed to screen mothers for depression and align auxiliary services as appropriate. A study by McGinnis et al. (2019) indicated that when fathers were included in home visits, the family's retention was four times higher than families in which the father was not included. To ensure cultural sensitivity of the intervention, the team decides to include a component which will include any co-parent (e.g., father, partner, grandparent) identified by the participating parent in the home visiting sessions to increase involvement in the program. To address program characteristics, the team chooses to look at program duration and pedagogical approach. A meta-analysis of 121 independent studies on home visiting programs indicated higher effect sizes when the program was of short duration (0-6 months; van der Put et al., 2018). A meta-analysis of 77 studies conducted by Gubbels et al. (2021) indicated that programs that used video-feedback yielded larger effect sizes. Therefore, the investigators will examine a 3-month and 6-month version of the intervention and include video-feedback in the training approach. Home visitors will record parents engaging in parent-child interactions allowing the parent to reflect on their interactions alone and with the home visitor. Finally, to improve the sense of community among participants, the program will offer a weekly play group held in a safe, community-based location, such as a faith-based organization or a youth serving organization.

The conceptual model is depicted in Figure 4. The reader will note that in this model, two components (program duration and video feedback) target one mediator (program satisfaction). This is possible but will make interpreting the findings of the optimization trial and identifying the optimized intervention challenging. For example, if program duration had a significant main effect on percent of completed visits but video feedback did not, it would be more difficult to parse out the effect of program satisfaction on the outcome. A solution to this is to modify the granularity of the components (e.g., combine) or to refine the components such that they uniquely affect proximal mediators leading to program satisfaction. For the sake of argument, assume that pilot testing of the components is complete.

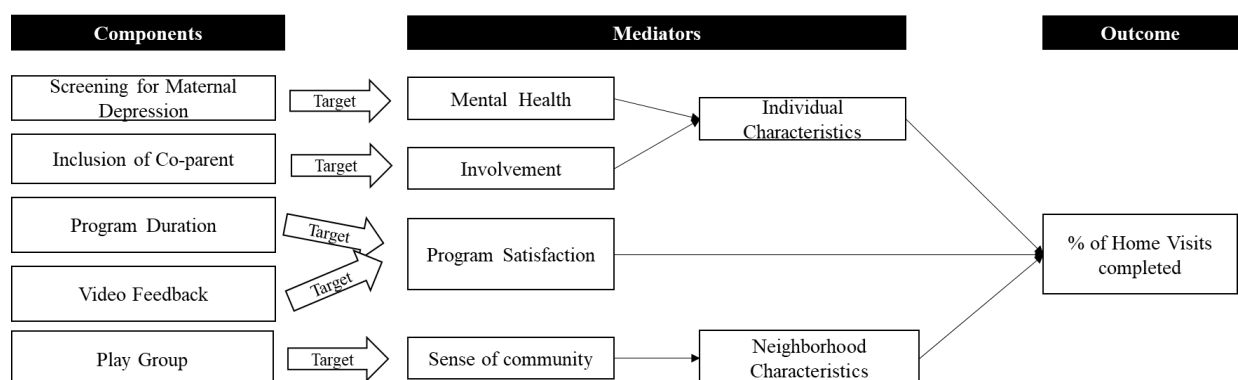


Figure 4. Conceptual Model for Intervention Designed to Increase Percent of Completed Home Visits

The team is concerned about the time that these components will add to the home visitors' delivery of the intervention for each family on their caseload. There are limits on funds to pay for provider time and the number of families that can be served by one home visitor. Qualitative input from key stakeholders, such as home visitors and funders, indicate that the added engagement intervention cannot add more than 10 contact hours with each family over the course of service. The

optimized objective, thus, is to identify the most effective intervention comprised of components that add no more than 10 hours of time to the service each family receives.

3.2.2 Optimization Phase

The intervention specified in the Preparation Phase has five candidate components, translating to five components, each with two levels. The research team has two options for the experimental design of their optimization trial: the complete factorial or the fractional factorial. The complete factorial would be a 2^5 including all 32 experimental conditions. Space precludes a full treatment of the fractional factorial design but briefly the design includes a carefully chosen subset (fraction) of the experimental conditions in the complete factorial (see Collins et al., 2009). In a fractional factorial, main effects are aliased with higher-order interactions, thereby eliminating the ability to estimate the higher-order effects but reducing the number of experimental conditions. Included experimental conditions are identified on statistical grounds using software (e.g., Proc FacTex in SAS). One fractional factorial design could be the half-fractional design (2^{5-1}) which produces 16 experimental conditions. Importantly, choosing a fractional factorial design does not reduce the number of participants needed to adequately power the experiment. A fractional factorial is an option when the team does not have the capacity or resources to implement 32 experimental conditions and expects the contribution of higher-order interactions to be negligible. A fractional factorial is not a solution to a lack of sufficient subjects to power a factorial study. Readers interested in how fractional factorial experiments may be implemented in applied projects using MOST are referred to Gwadz et al. (2017), Strecher et al. (2009), or Watkins et al (2016).

Let us suppose for this case study, the team is able to manage 32

experimental conditions and, thus, selects the complete 2^5 factorial experiment for the optimization trial (Table 2). The team would conduct the optimization trial as done in Case 1 and analyze using factorial ANOVA. In addition, the team will consider the number of added hours per family. The time to implement a component throughout the program is known and summed for each experimental condition (see far right column in Table 2). For simplicity, let us ignore interactions and assume all components meet the main effect criteria for inclusion. Only experimental conditions that added 10 hours or less would be considered for the optimized intervention. The condition that produced the greatest percentage of completed sessions and added ≤ 10 hours would be identified as the optimized intervention. This ensures it is effective but also immediately scalable within the constraint of time.

<i>Experimental Condition</i>	<i>Depression Screen</i>	<i>Co-Parent</i>	<i>Program Duration</i>	<i>Video Feedback</i>	<i>Play Group</i>	<i>+ Hrs/Family</i>
1	Yes	Yes	3-months	Yes	Yes	18
2	Yes	Yes	3-months	Yes	No	12
3	Yes	Yes	3-months	No	Yes	16
4	Yes	Yes	3-months	No	No	10
5	Yes	Yes	6-months	Yes	Yes	9
6	Yes	Yes	6-months	Yes	No	6
7	Yes	Yes	6-months	No	Yes	7
8	Yes	Yes	6-months	No	No	4
9	Yes	No	3-months	Yes	Yes	15
10	Yes	No	3-months	Yes	No	9
11	Yes	No	3-months	No	Yes	13
12	Yes	No	3-months	No	No	7
13	Yes	No	6-months	Yes	Yes	6
14	Yes	No	6-months	Yes	No	3
15	Yes	No	6-months	No	Yes	4
16	Yes	No	6-months	No	No	1
17	No	Yes	3-months	Yes	Yes	17
18	No	Yes	3-months	Yes	No	11
19	No	Yes	3-months	No	Yes	15
20	No	Yes	3-months	No	No	9
21	No	Yes	6-months	Yes	Yes	8
22	No	Yes	6-months	Yes	No	5
23	No	Yes	6-months	No	Yes	6
24	No	Yes	6-months	No	No	3
25	No	No	3-months	Yes	Yes	14
26	No	No	3-months	Yes	No	8
27	No	No	3-months	No	Yes	12
28	No	No	3-months	No	No	6
29	No	No	6-months	Yes	Yes	5
30	No	No	6-months	Yes	No	2
31	No	No	6-months	No	Yes	3
32	No	No	6-months	No	No	0

Table 2. Experimental Conditions for Case 2 Using a 2⁵ Factorial Design

3.3 Case 3: Implementation

As reviewed above, a number of contextual factors may threaten the implementation of a home visiting program. A team of researchers is interested in designing an intervention that increases the implementation fidelity of home visitors trained to deliver the home visiting program. This program must be cost effective, so

the optimization objective is to identify the training approach that produces the highest degree of implementation fidelity for the least amount of money spent on training. This case study will not belabor the exercise of developing a conceptual model, depicted in Figure 5. Incorporating common training elements for home visitors, the candidate components include: training format (online vs. in-person), certification process (one time vs. annual), supervision (weekly vs. monthly), and networking (access to networking or not).

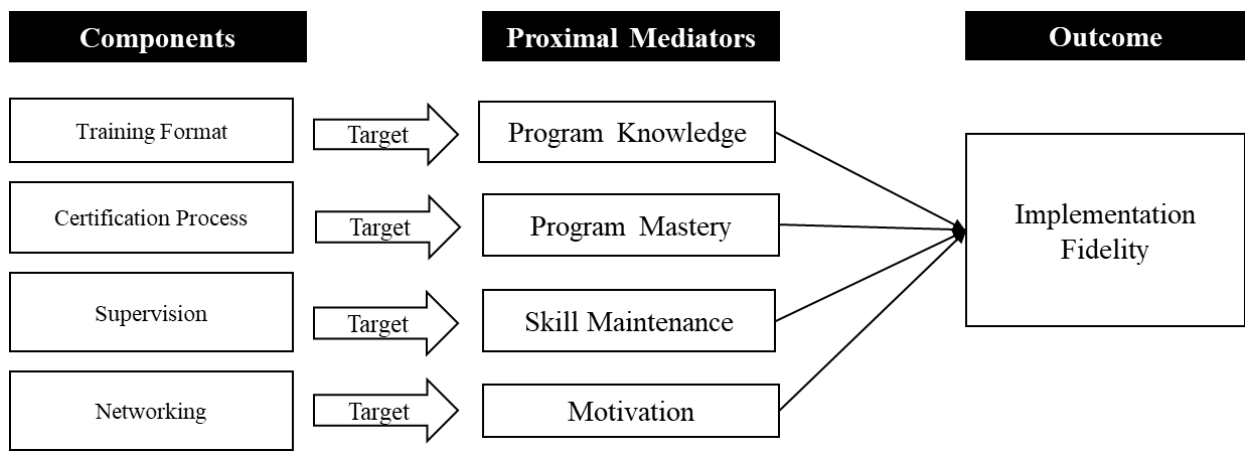


Figure 5. Conceptual Model for Intervention Designed to Increase Implementation Fidelity

The appropriate experimental design for the optimization trial is the 2⁴ factorial experiment, yielding 16 experimental conditions depicted in Table 3. The design of the optimization trial in this case, however, must account for the organizational structure in which home visitors exist. Agencies that implement home visiting programs use teams of home visitors who are able to substitute for each other as needed and problem-solve with one another. Thus, it would not be feasible to randomize home visitors at the individual level given the threat for contamination and impracticality. Randomization must occur at the agency, or site, level. The

experimentally-induced clustering necessitates the use of specialized data analysis models and power planning resources (see Nahum-Shani et al., 2018).

<i>Experimental Condition</i>	<i>Training</i>	<i>Certification Process</i>	<i>Supervision</i>	<i>Networking</i>
1	Online	1-time	Weekly	Yes
2	Online	1-time	Weekly	No
3	Online	1-time	Monthly	Yes
4	Online	1-time	Monthly	No
5	Online	Annual	Weekly	Yes
6	Online	Annual	Weekly	No
7	Online	Annual	Monthly	Yes
8	Online	Annual	Monthly	No
9	In-person	1-time	Weekly	Yes
10	In-person	1-time	Weekly	No
11	In-person	1-time	Monthly	Yes
12	In-person	1-time	Monthly	No
13	In-person	Annual	Weekly	Yes
14	In-person	Annual	Weekly	No
15	In-person	Annual	Monthly	Yes
16	In-person	Annual	Monthly	No

Table 3. Experimental Conditions for Case 3 Using a 2⁴ Factorial Design with Clustering

Case 3 was designed to showcase the way in which clustering will most likely need to be considered in implementation focused optimization efforts. It is not always the case however and is dependent upon the research question, target of the intervention, and unit of analysis. This is a growing area of research that requires intentional integration of the principles of intervention optimization and implementation science (Guastaferro & Collins, 2021).

4 A Vision for the Future of Child Maltreatment Prevention Efforts

The significant investment in federal support for home visiting creates the opportunity to improve the lives of many children and families in need. As a field we

have a duty to ensure the home visiting programs delivered are maximally effective and sufficiently reach those the program is designed to impact. The problem of reach is not specific to child maltreatment; indeed, “many efficacious behavioral interventions do not make their way down the pipeline through implementation” (Onken et al., 2014, p. 23). The ongoing COVID-19 pandemic and its effect on parent and child mental health has heightened the need for home visiting services (Williams et al., 2021). It is no longer acceptable to maintain the status quo. The time has come for the field of home visiting to adopt an innovative approach.

MOST can be used to develop a new home visiting intervention or applied to existing home visiting interventions. The model developers and purveyors, however, must be willing to possibly eliminate one or more components that are not meaningfully contributing to the outcome. Policy makers and funders, especially those who have already invested heavily in home visiting, must also support this scientific endeavor. A home visiting program, even one rated as evidence-based, is only as good as its ability to be delivered with fidelity to a high number of families in need. In other words, it is not sufficient to merely demonstrate the effectiveness of a home visiting program. The dissemination and implementation of that home visiting program is paramount.

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Part II: Innovative Methods in Practice

**Reducing “Missed” Cases of Pediatric Abusive Head Trauma: From Index
Case to Clinical Trial**

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Abstract

Young victims of abusive head trauma whose abuse was “missed” have suffered repetitive trauma and death when returned to their abusive caregivers. To minimize missed cases, the Pediatric Brain Injury Research Network (PediBIRN) conducted sequential multicenter studies to derive, validate, and implement simple, effective, evidence-based screening tools for pediatric abusive head trauma. Applied as a directive clinical decision rule, the 4-variable “PediBIRN-4” screening tool “screens in” 96% of cases. The simplified “PediBIRN-3” detects 93% of cases with fewer false positives. Applied instead as evidence-based prediction tools, the PediBIRN-3 and PediBIRN-4 facilitate calculation of patient-specific estimates of abuse probability that are highly predictive of the positive results of patients’ subsequent, completed, abuse evaluations. In this chapter we present the science and the story of PediBIRN investigators’ journey to reduce missed cases of pediatric abusive head trauma - from index case to clinical trial.

Keywords: abuse, child physical abuse, abusive head trauma, evidence-based, medical screening, medical diagnosis, clinical decision rule, clinical prediction rule, probability, likelihood ratio, Bayes’ theorem, derivation, validation, implementation, impact analysis, cluster randomized trial

1 Abusive Head Trauma

Abusive head trauma (AHT) is a leading cause of traumatic death and disability in early childhood, with an estimated annual incidence is 20-30 cases per 100,000 children under 2 years of age (e.g., Barlow and Minns 2000; Eisele et al 2006; Ellingson et al 2008; Keenan et al 2003; Minns et al 2008). Survivors of AHT are frequently burdened with lifelong physical and cognitive deficits (e.g., Barlow et al 2005; Chevignard and Lind 2014; Duhaime et al 1998; Eismann et al 2020; Fanconi and Lips 2010; Lind et al 2016; Makoroff and Putnam 2003; Nuño et al 2018). Unfortunately, physicians continue to miss this diagnosis, putting their patients at risk for repetitive abuse and even death when they are returned to their abusive caregivers (e.g., Jenny et al 1999; Letson et al 2016). In this chapter, I describe a journey - spanning 13 years, 18 participating sites, and 3 multicenter studies - to derive, validate, and implement evidence-based screening for pediatric AHT. Our goal? To reduce missed cases.

1.1 The Index Case

In March of 1995, Dr. Carole Jenny examined a 14 month-old boy who had sustained AHT 4 months previously. Over his subsequent 4 months, the child was examined by 7 physicians and underwent 2 head imaging studies. At each visit, the diagnosis of AHT was not recognized. When Dr. Jenny evaluated him, he was found to have multiple old and new skeletal fractures and healing brain injuries.

1.2 Dr. Jenny's Landmark Study of Missed AHT

Dr. Jenny's experience triggered her immediate conviction to analyze missed cases of AHT and she invited me to join the effort. Our subsequent, retrospective, single institutional study (e.g., Jenny et al 1999) found that AHT was "missed" in 54

(31%) of 173 patients when they first presented for medical evaluation of clinical symptoms ultimately attributable to their AHT. Of the 54 patients with missed or unrecognized AHT, 15 (28%) were reinjured after their missed diagnosis, 22 (41%) experienced medical complications, and 5 (9%) died. We determined that 4 of the 5 deaths might have been prevented if their abuse had been recognized. In a more recent multicenter study, Letson and colleagues (e.g., Letson et al 2016) reported that -17 years later - physicians were still “missing” 31% of cases.

2 Evidence-Based Approaches to Medical Diagnosis and Screening

For simple and/or common conditions, medical diagnosis results from pattern recognition. For example, we examine our patient’s rash, recognize impetigo, and initiate appropriate treatment. For more challenging or less familiar conditions, when pattern recognition fails, physicians adopt a probabilistic approach for medical diagnosis. We conduct an initial assessment, generate a list of possible diagnoses (a “differential diagnosis”), and estimate the probability associated with each candidate diagnosis. Thereafter, we conduct additional diagnostic investigations (e.g., we capture additional history, complete a more focused physical examination, order laboratory tests, and/or complete radiological studies). Finally, we interpret the results of these additional diagnostic investigations to increase or decrease the diagnostic probabilities, until we are sufficiently confident in the diagnosis that we initiate appropriate treatment.

An “evidence-based” approach to medical screening and diagnosis applies data from clinical research to guide our reasoning from differential diagnosis to treatment (e.g. Jaeschke et al 2002). My PediBIRN colleagues and I launched our 13-year journey - from index case to clinical trial - based on a foundational commitment that we would apply the principles of evidence-based screening and

diagnosis to address the challenge of “missed” or unrecognized AHT. That’s where we will begin our discussion.

2.1 Pre- and Post-Test Probability

Doctors’ preliminary estimates of diagnostic probability have been labelled estimates of “pre-test probability.” Our subsequent, refined estimates of probability, adjusted upwards or downwards based on the results of our additional diagnostic investigations, have been labelled estimates of “post-test probability.” Let’s explore these concepts further, in a fictitious patient, using the scale in Figure 1.

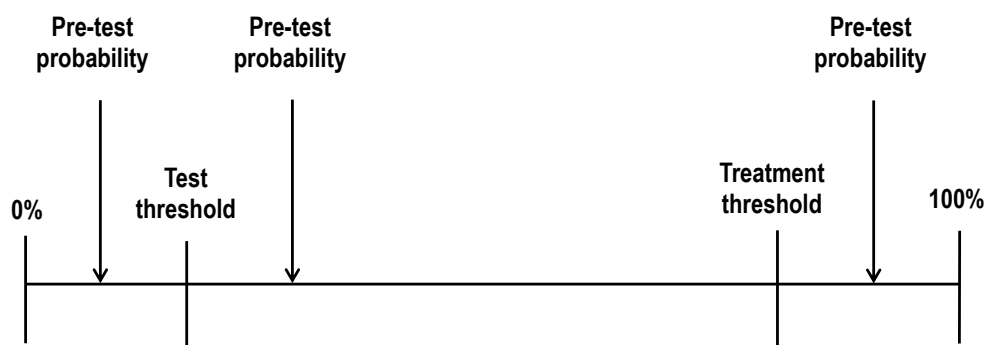


Figure 1. The Diagnostic Probability Scale

The “diagnostic probability” scale runs from 0% to 100% and reflects the estimated probability of each diagnosis in our fictitious patient’s “differential diagnosis.” Of course, the actual probability of each candidate diagnosis is either 0% or 100%. The problem is that we don’t know which it is. Along this scale of diagnostic probability are two theoretical thresholds, the “test threshold” and the “treatment threshold.” (NOTE: Reflect on these theoretical thresholds for a while, and you’ll understand why they vary from patient to patient, from disease to disease, and from doctor to doctor.) Now let’s place a pre-test estimate of the probability of a candidate diagnosis at various locations along the scale and observe the

consequences. Three outcomes are possible: (1) Pre-test probability falls below the test threshold, the diagnosis is effectively excluded, and no further testing or medical investigations are warranted; (2) Pre-test probability falls between the test and treatment thresholds, the diagnosis is neither confirmed nor excluded, and further testing and/or medical investigation are warranted; or (3) Pre-test probability falls above the treatment threshold, the diagnosis is effectively confirmed, no further testing or medical investigation is warranted, and treatment commences. (NOTE: In the absence of patient-specific information, disease prevalence in the local patient population is a reasonable estimate of pre-test probability.)

2.2 Sensitivity and Specificity

Some clinical findings or test results, when positive, shift probability upwards greatly, but may reduce it little when negative. Other findings are more useful when negative, because some negative findings virtually exclude a diagnosis, whereas the positive finding may increase probability only slightly. The two specific qualities of a clinical finding or test that best describe their effect on probability are “sensitivity” and “specificity.” To understand these concepts, let’s pretend that we have conducted a research study to assess the frequency of a specific clinical finding in patients with and without a specific medical condition, and we have used our data to complete the following “2x2 contingency table”.

	Condition	Condition	TOTALS
	Present	Absent	
Finding Present	A	B	A+B
Finding Absent	C	D	C+D
TOTALS	A+C	B+D	A+B+C+D

Table 1. A 2x2 Contingency Table

Sensitivity is defined as the proportion of patients with the condition who have the clinical finding (or positive test result). In Table 1, it would be calculated as $(A) \div (A+C)$. A finding or test with high sensitivity is useful to help exclude a diagnosis when negative because a highly sensitive test will render few results that are falsely negative. Highly sensitive findings or tests make good screening tests. They cast a wide net. Specificity is defined as the proportion of patients without the condition who don't have the clinical finding (or positive test result). In Table 1, it would be calculated as $(D) \div (B+D)$. A finding or test with high specificity is useful to help confirm a diagnosis when positive because a highly specific test will render few results that are falsely positive. Highly specific findings or tests make good confirmatory tests. (NOTE: In Table 1, disease prevalence - useful for estimating pre-test probability - would be calculated as $(A+C) \div (A+B+C+D)$.)

2.3 Likelihood Ratios

A "likelihood ratio" incorporates both sensitivity and specificity to describe the overall discriminatory power of clinical finding or test result. The positive likelihood

ratio, symbolized as (LR+) and calculated as $(\text{Sensitivity}) \div (1 - \text{Specificity})$, describes the positive or negative changes in the probability of a diagnosis if the clinical finding is present or the test is positive. The negative likelihood ratio, symbolized as (LR-) and calculated as $(1 - \text{Sensitivity}) \div (\text{Specificity})$, describes the positive or negative changes in the probability of a diagnosis if the clinical finding is absent or test is negative. The advantage of likelihood ratios is how simply they can be used to estimate the post-test probability of a diagnosis. For example, likelihood ratios of 2, 5, and 10 increase probability approximately 15%, 30%, and 45% respectively. Conversely, likelihood ratios of 0.5, 0.2, and 0.1 decrease probability approximately 15%, 30%, and 45%, respectively. (NOTE: A likelihood ratio of 1 neither increases nor decreases the probability of a diagnosis.)

2.4 Applying Bayes' Theorem

Having introduced several new terms, concepts, and equations, it's time to explain how we can apply them to actualize medical diagnosis and screening that is "evidence-based". The simple answer is: we apply Thomas Bayes' famous theorem. Thomas Bayes' was an 18th century English mathematician and Presbyterian minister. Late in life, he became interested in probability. A year after his death in 1761, his friend Richard Price arranged for a public reading of a paper written by Bayes, in which he proposed what would become known as Bayes' theorem. The formula described how we can update beliefs about the probability of an event using data. Bayes' theorem is now used in a wide variety of real world applications, including criminal investigation, marketing, environmental science, social science, and medical decision making. Interestingly, historians believe that Bayes' never imagined the usefulness of the theorem that now bears his name.

Returning to our discussion: How do we actualize medical diagnosis and decision making that is evidence-based? The more complete answer is that we conduct clinical research, create a 2x2 contingency table, calculate disease prevalence, calculate the sensitivity and specificity of the clinical finding or test of interest, calculate its positive and negative likelihood ratios, and apply Bayes' theorem. The process, and the theorem, are presented in Figure 2. (NOTE: We can convert "odds" to "probabilities" and vice versa with simple math).

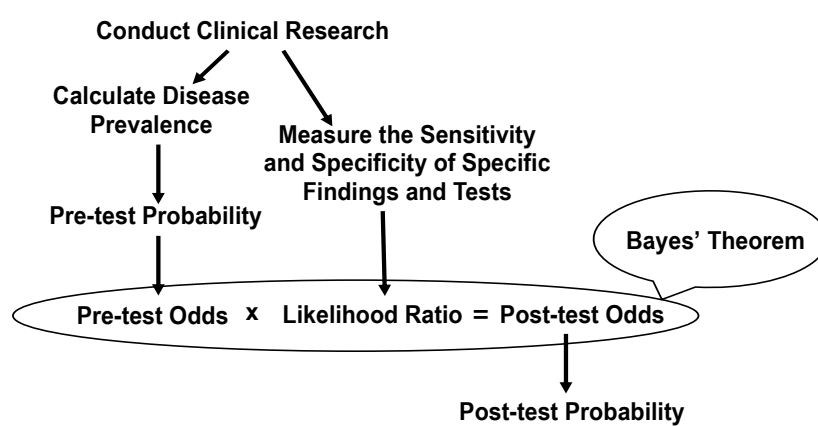


Figure 2. Applying Bayes' Theorem

2.5 Returning to the Diagnostic Probability Scale

To apply and visualize what we've learned about pre- and post-test probabilities, likelihood ratios, and Bayes' theorem, let's return to our diagnostic probability scale. For this illustration, we will presume that the pre-test probability of the candidate diagnosis falls between the theoretical test and treatment thresholds, and we've added vectors for LR+ and LR- that reflect their impact on post-test probability. In this example, the negative finding or test result decreases probability to a point below the test threshold, effectively excluding the diagnosis. On the other hand, even though the magnitude of its impact on probability is greater, the positive finding or test results in a post-test probability that still falls between the test and treatment thresholds. The diagnosis is neither confirmed nor excluded and further

medical investigation is warranted. (NOTE: This example illustrates how and why initial estimation of pre-test probability affects the need for additional testing.)

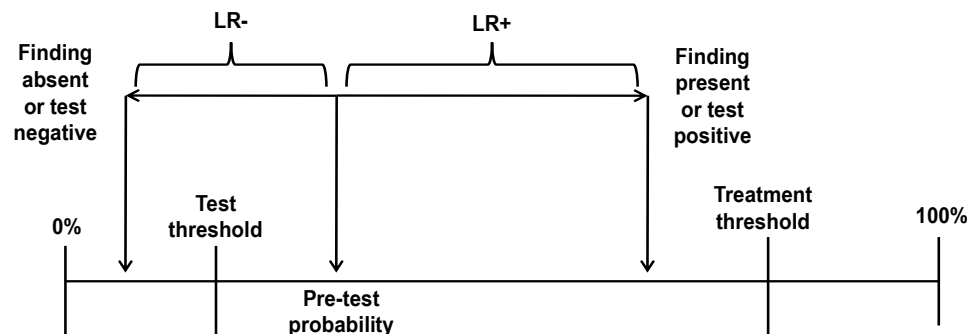


Figure 3. The Diagnostic Probability Scale Revisited

3 Clinical Prediction and Decision Rules

A clinical prediction rule (CPR) is an evidence-based tool that measures and then combines the predictive contributions of multiple clinical findings or test results to estimate or predict the probability of a diagnosis, prognosis, or response to therapy for an individual patient (e.g., Jaeschke et al 2002; McGinn et al 2002; Stiell & Wells 1999). A CPR that is used to direct a specific, difficult, clinical decision is frequently referred to as a clinical decision rule (CDR). To clarify the distinction, clinical prediction rules are developed to inform a specific, difficult, clinical decision. They typically provide an estimate of probability. Clinical decision rules are developed to direct a specific, difficult, clinical decision. They usually recommend or direct a specific clinical action.

If our primary reason for developing a CPR is to avoid over-diagnosis, then we would develop a rule that performs with maximum specificity, to help confirm the diagnosis when positive. Our goal would be to identify some combination of discriminating and reliable clinical findings or tests that - in combination - will

increase probability above the theoretical treatment threshold, when positive or present. Such a CPR would function as an effective confirmatory test. If, on the other hand, our primary reason for developing a CPR is to avoid missing a diagnosis, then we would develop a rule that performs with maximum sensitivity, to cast as wide a net as possible, to help miss fewer cases, and to help exclude the diagnosis, when negative or absent. Such a CPR would function as an effective screening test.

4 The Birth of PediBIRN

With these concepts firmly in mind, my collaborators and I began our journey to develop a CDR that would function as an effective AHT screening tool. We called our new research network the “Pediatric Brain Injury Research Network” or “PediBIRN” for short. We committed ourselves to the development of an effective AHT screening test, not a confirmatory test. We wanted our future AHT screening test to miss as few cases as possible. Therefore, as illustrated in Figure 4, our challenge would be to identify a cluster of simple, objective, and reliable clinical findings or tests, readily available at or near the time of hospital admission, that will predictably decrease the probability of AHT to the lowest possible level when negative or absent. To cast the widest possible net, our future CDR would then direct physicians to conduct thorough abuse evaluations on any and all patients who present with any one or more of its “predictor variables”.

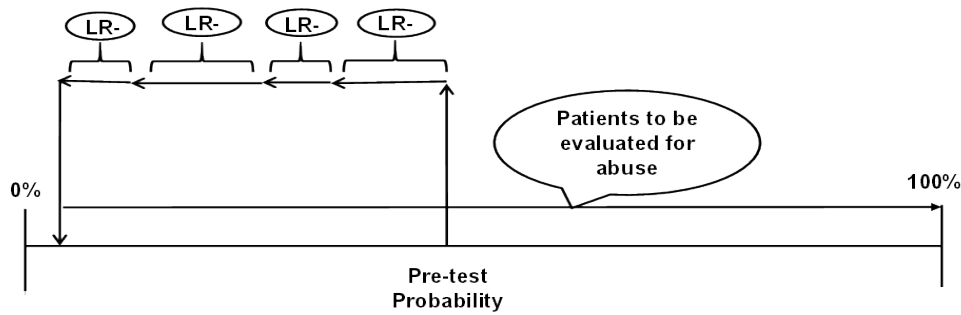


Figure 4. The Diagnostic Probability Scale Revisited Yet Again

4.1 Our Network Research Objective

Stated more explicitly, our network's goals were to derive, validate, implement, and disseminate a CDR for pediatric AHT that: (1) is simple and reliable; (2) can be applied at or near the time of hospital admission; (3) will function as an effective AHT screening tool; (4) is highly sensitive to help clinicians miss fewer cases and exclude AHT when negative; (5) can also be applied as a prediction tool, to facilitate calculation of evidence-based, patient-specific estimates of abuse probability; (6) can inform or direct clinicians' early decisions to launch or forgo an evaluation for abuse; and (7) reduces cases of missed AHT.

4.2 Our Path Forward

By established convention, the development of any clinical prediction or decision rule proceeds in three sequential phases: (1) the creation or derivation of the rule; (2) the validation of the rule's screening performance in a second, equivalent, patient population; and (3) the implementation of the rule in active clinical settings to assess its actual impact on relevant health outcomes - the impact analysis (e.g., Laupacis et al 2009; Reilly & Evans 2006; Stiell & Wells 1999). Each phase requires a multicenter study.

5 The PediBIRN CDR Derivation Study

Focusing exclusively on the pediatric intensive care unit (PICU) setting we: (1) conducted a prospective, strictly observational, multicenter, cross-sectional study (e.g., Hymel et al 2013) across 14 U.S. academic medical centers; (2) captured extensive, uniform, clinical, radiological, and historical data regarding 209 acutely head-injured children under 3 years of age hospitalized for intensive care (excluding victims of motor vehicle accidents and pre-existing brain abnormalities); and (3) applied a prior AHT definitional criteria (see Table 2) to sort patients into comparative groups of abusive (AHT) vs. other head trauma (non-AHT).

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- Primary caregiver¹ admission of abusive acts
 - Abusive acts by the primary caregiver that were witnessed by an unbiased, independent observer
 - Specific primary caregiver denial of any head trauma even though the pre-ambulatory child in his or her care became acutely, clearly and persistently ill with clinical signs subsequently linked to traumatic cranial injuries visible on CT or MRI
 - Primary caregiver account of the child's head injury event was clearly historically inconsistent with repetition over time
 - Primary caregiver account of the child's head injury event that was clearly developmentally inconsistent with the child's known (or expected) gross motor skills
 - Two or more categories of extracranial injuries considered moderately or highly suspicious for abuse²

¹ The person responsible for the child when he or she was acutely head injured or first became clearly and persistently ill with clinical signs subsequently linked to

traumatic cranial injuries visible on CT or MRI.² Including classic metaphyseal lesion fractures or epiphyseal separations; rib fractures; fractures of the scapula or sternum; fractures of digits; vertebral body fractures, dislocations or fractures of spinous processes; skin bruising, abrasions, or lacerations in two or more distinct locations other than knees, shins, or elbows; patterned skin bruising or dry contact burns; scalding burns with uniform depth, clear lines of demarcation, and paucity of splash marks; confirmed intraabdominal injuries; retinoschisis confirmed by an ophthalmologist; retinal hemorrhages described by an ophthalmologist as dense, extensive, covering a large surface area, or extending to the ora serrata.

Table 2. The PediBIRN Network's Definitional Criteria for AHT

Next, from a list of 45 candidate variables, we identified 13 “early” variables - available at or near the time of PICU admission - that were both discriminating ($p < .05$) and reliable (Kappa $> .60$), and calculated each variable's predictive qualities (sensitivity, specificity, LRs). Finally, we applied recursive partitioning and identified 4 candidate clusters of these early, discriminating, and reliable variables that - alone or in combination - demonstrated high sensitivity ($> 92\%$) to detect AHT in PICU settings (e.g., Hymel et al 2013). Ultimately, we decided that a 4-variable CDR demonstrated the optimal qualities that define an effective screening tool, including high sensitivity, low false negatives, high true negatives, low LR-, simplicity, high inter-rater reliability, and acceptability to physicians. We called our new CDR the “PediBIRN-4.”

5.1 The PediBIRN-4 Clinical Decision Rule for AHT

To minimize missed cases, every acutely head-injured infant or young child hospitalized for intensive care who presents with one or more of these 4 predictor

variables should be considered to be at “higher risk” and thoroughly evaluated for abuse: (1) any clinically significant respiratory compromise at the scene of injury, during transport, in the Emergency Department, or prior to admission, (2) any bruising involving the child’s ear(s), neck, or torso, (3) any subdural hemorrhage(s) or fluid collection(s) that are bilateral OR involve the interhemispheric space, and (4) any skull fracture(s) other than an isolated, unilateral, non-diastatic, linear, parietal skull fracture. (NOTE: The PediBIRN-4 makes no recommendations regarding abuse evaluations in the remaining “lower risk” patients who present with none of its 4 predictor variables.)

5.2 The PediBIRN-4 CDR’s AHT Screening Performance in Our Derivation Study

Lacking a gold standard for AHT, we ultimately defined AHT in 3 ways: (1) applying our AHT definitional criteria (see Table 2), (2) using physicians’ final diagnoses, and (3) as a positive partial or complete abuse evaluation. The PediBIRN-4’s AHT screening performance in the derivation study, measured against these 3 outcome measures for AHT, is presented in Figure 5. Applied accurately and consistently, the PediBIRN-4 would have sorted $\geq 96\%$ of AHT patients as higher risk - no matter how we defined AHT.

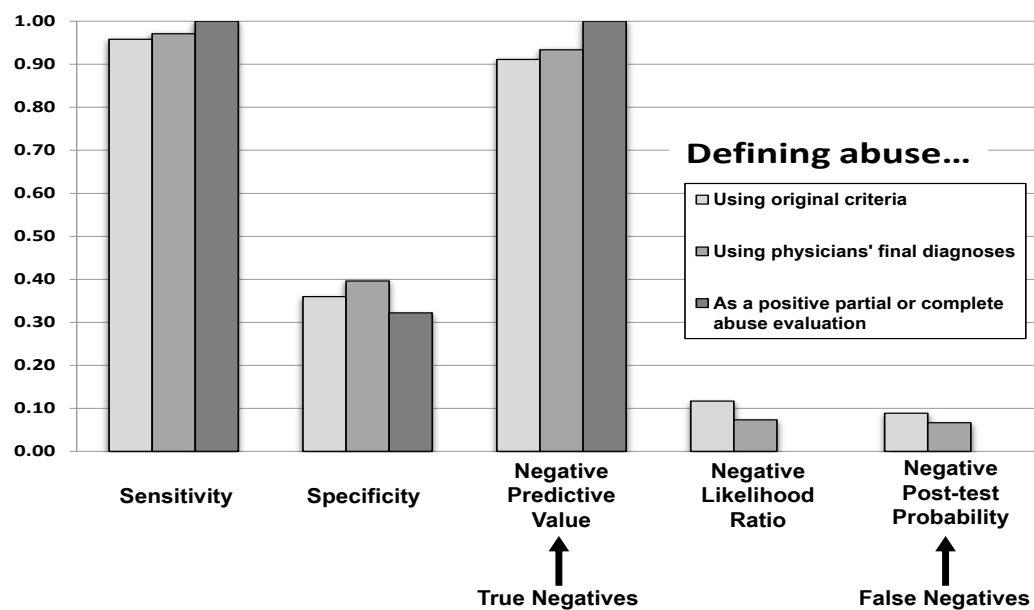


Figure 5. The PediBIRN-4 CDR's AHT Screening Performance in the Derivation Study (N=209)

6 The PediBIRN CDR Validation Study

Applying precisely the same inclusion/exclusion criteria and methods, we conducted an equivalent study in a new, larger population of 291 young, acutely head-injured patients hospitalized for intensive care across 14 PICU sites (e.g., Hymel et al 2014). In this validation study, the PediBIRN-4 CDR demonstrated AHT screening performance equal to - or higher than - its screening performance in the derivation study (see Figure 6.) Applied accurately and consistently, the PediBIRN-4 would again have sorted $\geq 96\%$ of AHT patients as higher risk no matter how we defined AHT.

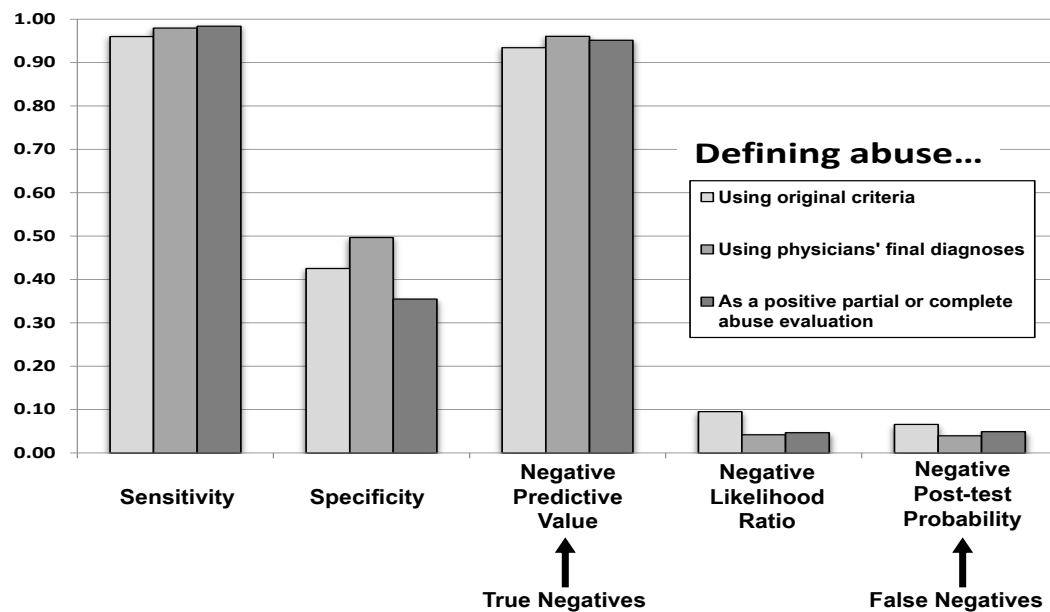


Figure 6. The PediBIRN-4 CDR's AHT Screening Performance in its Validation Study (N=291)

7 The PediBIRN CDR Implementation Study - The Impact Analysis

Applied accurately and consistently, the PediBIRN-4 CDR performs with sensitivity $\geq 96\%$. Though promising, some physicians will reject the CDR's application as an AHT screening tool and/or its recommendations. Thus, the CDR's actual impact on relevant health outcomes will very likely be less than its potential impact.

7.1 Study Objective

The objective of our CDR implementation study (e.g., Hymel et al 2021) was to apply the rigor of a stratified cluster randomized trial (CRT) to assess the PediBIRN-4 CDR's actual impact on missed AHT when applied in active PICU settings.

7.2 Trial Participants

Trial participants were 8 PICUs in U.S. academic medical centers, divided into 2 clusters (4 intervention, 4 control); their licensed and credentialed PICU and child abuse pediatric (CAP) physicians; and their consecutive, acutely head-injured patients under 3 years of age admitted for intensive care. Victims of motor vehicle accidents and patients with pre-existing intracranial abnormalities were again excluded.

7.3 Randomization and Stratification

Participating PICUs were drawn from our prior CDR derivation and validation studies and matched into 4 pairs based on projected patient volumes. A senior biostatistician randomized 1 PICU from each pair to the intervention arm.

Randomization sequences were concealed from a second biostatistician responsible for data analysis.

7.4 CDR Implementation Supports

Interventions designed to support and encourage application of the CDR as an AHT screening tool were targeted toward physician participants at the cluster (PICU) level. They included: (1) an initial, online, 15 minute training that provided an overview regarding AHT; missed AHT; and the CDR's derivation, validation, application, and potential impact; (2) CDR badge cards; (3) prompts by local research coordinators to apply the CDR; (4) monthly "booster training" emails; (5) access to an online "AHT probability calculator" that applied the PediBIRN-4 as an prediction tool (rather than a directive decision rule, see Section 10 below); (6) progress reports (every 6-8 months over the course of the CRT) that compared PICU-specific measures of CRT progress, provider engagement, and adherence to the CDR's recommendations; and (7) local "information sharing sessions" (every 6-8

months) to review site-specific progress reports and to discuss local barriers to CDR acceptance and utilization. Strict compliance with the CDR's recommendations was not required.

7.5 Primary Outcome Measures and Hypotheses

We hypothesized that application of the PediBIRN-4 CDR as an AHT screening tool would trigger: (1) more frequent thorough abuse evaluations of higher risk patients (with skeletal survey AND retinal examination); (2) less frequent abuse evaluations of lower risk patients (with skeletal survey OR retinal exam); (3) fewer potential cases of missed AHT (patients lacking 1 or both abuse evaluations); and (4) a lower estimated rate of missed AHT (among potential cases) - at intervention vs. control sites. All outcomes were measured at the individual patient participant level.

Our selection of these outcome measures was based on four assumptions adopted to facilitate estimation of missed AHT in the absence of a gold standard: (1) patients who underwent both skeletal survey and retinal exam had been thoroughly evaluated for abuse; (2) the discovery of moderately or highly specific findings of abuse on either abuse evaluation corroborated a patient's head trauma as abusive; (3) patients lacking skeletal survey and/or retinal exam represented potential cases of missed AHT; and (4) actual cases of missed AHT - among potential cases - could be estimated as (potential cases of missed abusive head trauma) x (their mean estimate of abuse probability). (NOTE: Prior to CRT launch, we demonstrated that the PediBIRN-4's patient-specific estimates of abuse probability were good predictors of the overall positive yield of PediBIRN patients' subsequent, completed, skeletal surveys and retinal examinations (e.g., Hymel et al 2015). For more

information about the PediBIRN-4's application as a prediction tool, see Section 10 below.)

7.6 Trial Execution

Prospective data capture began 1 August 2017 and ended 31 March 2020. Intervention costs were modest - only minutes per month. The trial was monitored by a Data Safety Monitoring Board. No harms or adverse events were reported. Ninety (90) of 91 PICU and CAP physicians at intervention PICUs consented to participate and completed the initial online training. Over the course of the 32 month trial: (1) Site coordinators facilitated 333 physician prompts to apply the CDR, (2) 1979 (76%) of 2594 monthly "booster training" emails were opened or acknowledged, (3) 50 (56%) of 90 consented physicians accessed the AHT probability calculator at least once, (4) 38 (42%) of 90 attended at least 3 of 4 information sharing sessions, and (5) 66 (73%) of 90 intervention physicians had an opportunity to apply the CDR. Over the course of the CRT, 631 acutely head-injured patients were hospitalized at a participating PICU. Of these, 211 were excluded. Of the remaining eligible patient participants (n=420), 183 (44%) were admitted to an intervention PICU; 237 (66%) to a control PICU. At the 4 intervention PICUs, CDR implementation supports actively promoted CDR application as an AHT screening tool. At control PICUs, the trial was strictly observational. At intervention PICUs, investigators applying the PediBIRN-4 CDR correctly categorized 158 patients as higher risk and 25 as lower risk. At control PICUs, the CDR would have categorized 175 as higher risk and 62 as lower risk.

7.7 Primary Outcomes

Our overall results were as follows: (1) physician-directed CDR implementation supports facilitated CDR application as an AHT screening tool; (2)

CDR application effected changes in AHT evaluation practices; (3) these changes reduced potential and estimated cases of missed AHT; (4) the reduction in potential cases of missed AHT (from 40% → 21%) at intervention sites was statistically significant ($p < .001$); and (5) the reduction in the estimated rate of missed AHT (from 15% → 7%) at intervention PICUs fell short of the potential reduction (to 4%) associated with full adherence to the CDR's recommendations.

7.8 Our Embedded “Pre-Post” Analysis

Using equivalent methods and data, we calculated equivalent results - at the same 8 PICUs, in comparable patient cohorts - from prior PediBIRN studies. Our findings suggest that CDR application as an AHT screening tool triggered a reduction from baseline in prior studies to the CRT in the estimated rate of missed AHT from 15% to 7% at intervention PICUs, while at control PICUs, the estimated rate of missed AHT increased from 11% to 13%.

7.9 Additional Considerations

The PediBIRN-4 CDR's screening recommendations must be interpreted in the context of other relevant information, including: (1) the presenting history, (2) the head-injured patient's past and family medical history, (3) an assessment of psychosocial risks, (4) the results of tests to confirm or exclude medical mimics of AHT, and (5) input from child protection caseworkers and police investigators. We hypothesized incorrectly that abuse evaluations of lower risk patients would be lower at intervention PICUs. It is worth noting, however, that over time and across trial arms, the positive yield of completed abuse evaluations in lower risk patients was only 3% (3 of 99). It follows that some, perhaps many, evaluations of lower risk

patients were unnecessary. To the best of our knowledge, the CRT was the first randomized trial of a validated medical screening tool for child physical abuse.

8 External Validation Studies of the PediBIRN-4 CDR's AHT Screening Performance

The PediBIRN-4 CDR's AHT screening performance has been validated externally - in pediatric emergency department (ED) and other inpatient settings (e.g., Hymel, Pierce et al 2022; Pfeiffer et al 2018), applying diverse criteria or methods to define AHT, through analysis of prospective data captured by three independent research networks; and in populations with divergent AHT prevalence.

9 Are Three Variables Enough?

In the external validation study of the PediBIRN-4 CDR's AHT screening performance in pediatric ED settings (e.g., Hymel, Pierce et al 2022), the PediBIRN-4 again demonstrated sensitivity of 0.96, correctly categorizing 75 (96%) of 78 AHT patients as higher risk. However, specificity in the ED setting was lower than predicted - only 0.29. (NOTE: Specificity in the PediBIRN-4 CDR's validation study was 0.43.) Sensitivity analysis of the external ED data set (N=116) revealed that application of a simplified CDR - based solely on the PediBIRN-4's first three predictor variables - would have increased specificity to 0.84 without compromising sensitivity.

To help confirm or exclude a relative advantage in CDR simplification for application in PICU settings, we conducted a retrospective secondary analysis of our combined derivation, validation, and implementation study data sets (N=973) (e.g., Hymel, Karst et al 2022). Our objective was to measure and compare the PICU-based AHT screening performances of the original 4-variable CDR to that of a

simplified 3-variable CDR (the “PediBIRN-3”) based solely on the PediBIRN-4’s first three predictor variables (see Table 1). Our results were surprising. Applied accurately and consistently as directive decision rules, both CDR’s would have performed with sensitivity $\geq 93\%$ and negative predictive value $\geq 91\%$. Eliminating the PediBIRN-4’s fourth predictor variable regarding complex skull fractures increased overall AHT screening accuracy. Specifically, the PediBIRN-3 CDR performed with significantly higher specificity ($\Delta \geq 19\%$), positive predictive value ($\Delta \geq 8\%$), and area under the receiver operating curve ($\Delta \geq 6\%$). This improvement in AHT screening accuracy exacted only a 3% reduction in sensitivity (e.g., Hymel, Karst et al 2022). These results support the following impressions: (1) both PediBIRN CDRs screen effectively for AHT, (2) the PediBIRN-4 CDR casts a broad net to detect 96% of cases, and (3) the PediBIRN-3 CDR detects 93% of cases with fewer false positives.

10 Applying the PediBIRN 3- and 4-variable CDRs as Prediction Tools

To measure and compare the PediBIRN 3- and 4-variable CDRs’ performances as clinical prediction rules (“AHT probability calculators”), we: (1) combined our CDR derivation, validation, and implementation study datasets; (2) divided the patient population into subpopulations that presented for intensive care with unique combinations of each CPR’s predictor variables ($n=16$ for the PediBIRN-4 and $n=8$ for the PediBIRN-3); (3) applied our network’s longstanding AHT definitional criteria (see Table 2) to sort patients into abusive vs. other head trauma cohorts; (4) calculated the percentage of patients sorted as AHT within each subpopulation; (5) assigned that same value, expressed as an estimate of abuse probability, to every patient within that specific subpopulation; (6) calculated the percentage of patients within each subpopulation who revealed findings moderately or highly specific for abuse on their completed skeletal surveys and/or retinal exams;

and (7) measured the correlation between each CPR's patient-specific estimates of abuse probability and the overall positive yield of patients' subsequent, completed, skeletal surveys and retinal examinations.

Our results were highly favorable (e.g., Hymel, Karst et al 2022). Applying AHT definitional criteria to sort AHT vs. other head trauma, the PediBIRN CDRs' patient-specific estimates of abuse probability correlated positively and strongly with the overall positive yield of patients' subsequent, completed, skeletal surveys and retinal examinations (Pearson's $r = .91$ and $.95$, respectively). Stated more simply, applied at or near the time of PICU admission as prediction tools, the PediBIRN 3- and 4-variable "AHT probability calculators" each facilitated patient-specific estimation of abuse probability highly predictive of the positive yield of PediBIRN patients' subsequent, completed, abuse evaluations.

11 Secondary Analyses of PediBIRN Data

Multiple secondary analyses of aggregate PediBIRN data have been completed. In 2015, we published a retrospective, theoretical comparison of actual PICU screening for AHT vs. screening guided by the PediBIRN-4 (e.g., Hymel et al 2015). Our results suggested that, applied accurately and consistently as an AHT screening tool, the PediBIRN-4 could increase AHT detection and the overall yield of completed abuse evaluations, while targeting slightly fewer children for abuse evaluation. Published in 2018, our preliminary cost analysis of the PediBIRN-4 CDR predicted that its PICU-based application as an AHT screening tool could reduce the cost per correctly identified child with AHT by 15.1%, and reduce health system costs resulting from missed AHT by 72.4% (e.g., Cohrs et al 2018). Focusing on patient race and ethnicity, PediBIRN investigators reported evidence of disparity and bias in physicians' decisions to evaluate and report suspected AHT (e.g., Hymel et

al, 2018). The race/ethnicity-based disparities were observed almost exclusively in patients that the PediBIRN-4 CDR sorted as lower risk, and, extreme disparities occurred at only two of 18 PediBIRN sites. In 2019, we derived a 7-variable CPR for AHT that incorporated the (positive or negative) predictive contributions of the head-injured child's completed abuse evaluations (e.g., Hymel et al, 2019). The "PediBIRN-7" CPR's patient-specific estimates of abuse probability for 72 observed combinations of its seven predictor variables ranged from 0.04 to 0.98. In 2020, PediBIRN investigators conducted a secondary analysis designed to estimate the diagnostic relevance of specific historical "red flags" presumed highly specific for abuse (Hymel et al, 2020). Our results provided evidence that a caregiver's specific denial of any head trauma, changing history of accidental trauma, or history of accidental trauma inconsistent with the child's gross motor skills are each highly specific ($>.90$) and predictive (0.81) of AHT, but may provide weaker support than previously reported for a diagnosis of AHT in patients with persistent neurologic abnormalities. Our results led us to speculate that some caregivers falsify the history in cases of non-abusive head trauma, particularly if/when their inattention, imprudent behavior, or lapse in judgement resulted in head trauma with neurologic compromise.

Most recently, PediBIRN investigators completed two secondary analyses designed to investigate physicians' diagnostic reasoning regarding AHT (e.g., Boos et al 2022; Hymel, Boos et al 2022). In the first study, we demonstrated that three, purely mathematical, "cluster algorithms" - devoid of references to predetermined AHT criteria and physicians' diagnostic impressions - partitioned the PediBIRN patient population into "clusters" (cohorts) highly predictive of physician diagnosis. The second study yielded two important results: (1) The clinical, historical, and

radiological differences observed in PediBIRN patients with witnessed/admitted AHT vs. witnessed non-AHT confirmed prior published reports; and (2) The complete absence of differences in patients with witnessed/admitted AHT vs. physician-diagnosed AHT that was not witnessed/admitted supported an impression that PediBIRN physicians applied diagnostic reasoning informed by knowledge of previously reported injury patterns with reasonable and expected rigor and consistency.

12 Summary

AHT is a leading cause of traumatic death and disability in early childhood (e.g., Barlow et al 2005; Chevignard and Lind 2014; Duhaime et al 1998; Eismann et al 2020; Fanconi and Lips 2010; Lind et al 2016; Makoroff and Putnam 2003; Nuño et al 2018). Some victims of AHT whose abuse was missed or unrecognized have been re-injured and killed when returned to their abusive caregivers (e.g., Jenny et al 1999). To lessen missed cases of AHT, PediBIRN investigators developed screening tools for AHT (e.g., Hymel et al 2013; Hymel et al 2014; Hymel et al 2021). The PediBIRN-3 and PediBIRN-4 CDRs are simple, evidence-based, and effective (e.g., Hymel, Karst et al 2022). Applied accurately and consistently as directive decision rules, they cast a wide net, missing $\leq 7\%$ of cases. Applied instead as prediction tools (“AHT probability calculators”), they each facilitate patient-specific estimation of abuse probability highly predictive of the overall positive yield of patients’ subsequent, completed, abuse evaluations. (NOTE: To learn more, or to “test drive” the PediBIRN AHT probability calculators, visit www.pedibirn.com.)

The AHT screening performances of the PediBIRN 3- and 4-variable CDRs have been validated externally, in pediatric intensive care and ED settings (e.g., Pfeiffer et al 2018; Hymel, Pierce et al 2022), applying diverse criteria or methods to

define AHT, through analysis of prospective data captured by three independent research networks, and in populations with divergent AHT prevalence. Prospective application of the PediBIRN-4 CDR in active PICU settings has been shown to reduce potential cases of missed AHT (e.g., Hymel et al 2021). Secondary analyses of the aggregate PediBIRN data set have yielded additional, relevant, clinical insights. PediBIRN investigators welcome future effectiveness studies that assess CDR performance in diverse clinical settings and under less controlled conditions.

As stated so clearly and succinctly by G. Guyatt and the other members of the original evidence-based medicine (EBM) working group: “In contrast to the traditional paradigm of medical practice, EBM acknowledges that intuition, unsystematic clinical experience, and pathophysiologic rationale are insufficient grounds for clinical decision making, and it stresses the examination of evidence from clinical research” (e.g. Guyatt et al, 2002).

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**Reminiscing and Emotion Training: A Relational Intervention Approach for
Preschool-Aged Children with a History of Child Maltreatment and Their
Mothers**

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Abstract

Child maltreatment is considered a pathogenic relational experience, typically occurring in the parent child relationship. Relational interventions focus on improving the parent-child relationship as the key mechanism of change to support adaptive development of children who have been maltreated. This chapter presents the theoretical rationale and empirical evidence for Reminiscing and Emotion Training (RET), a brief, relational intervention designed for preschool-aged children who have been maltreated and their mothers. Results from the randomized clinical trial of RET demonstrated that mothers who received the intervention improved in their parenting and emotion socialization skills, which, in turn, is associated with improvements in child emotion knowledge, memory, emotion regulation, emotional adjustment, and stress physiology. Limitations and future directions for research and dissemination of RET are discussed.

Keywords: Child maltreatment, child abuse, neglect, interventions, parenting, home-visiting, relational interventions, parent-child relationships, reminiscing, emotion socialization

1 Child Maltreatment

In 2020 alone, there were 3.1 million children who were investigated for child abuse or neglect in the United States (USDHHS, 2022). Of these 3.1 million children, 618,000 were deemed victims of substantiated maltreatment. By now, it is well documented that maltreatment is a transdiagnostic risk factor for the development of psychopathology (Cicchetti & Toth, 2016) as well as other negative physical health outcomes (e.g., Springer et al., 2007). Moreover, risk for adverse outcomes extends beyond just those whose maltreatment is substantiated; nearly 50% of children who are investigated for child maltreatment demonstrate clinically significant mental health symptoms and many more experience psychological distress (Burns et al., 2004).

Given the negative sequelae associated with child maltreatment, there is an urgent need for effective interventions for children who have experienced abuse and neglect. Toward this goal, a critical consideration is that child maltreatment tends to be perpetrated by caregivers. In 2020, for example, nearly 80% of child maltreatment victims were victimized by one or both of their parents (USDHHS, 2022). Indeed, caregivers who maltreat their children often subject those children to severe and destructive failures in the caregiving environment (Cicchetti & Valentino, 2006). Thus, child maltreatment may be best conceptualized as a problem in the parent-child relationship or a pathogenic relational experience (Cicchetti & Valentino, 2006; Valentino, 2017). These caregiving deficiencies are a central risk process for the development of psychopathology among children who have been maltreated (Valentino, 2017).

2 The Prevention of Child Maltreatment

Numerous strategies have been proposed and implemented to prevent child maltreatment, including preventive and curative prevention strategies (Van der Put et al., 2018). Preventive interventions aim to either target the general population or families at risk for child maltreatment to prevent the onset of maltreatment (Chen & Chan, 2016), whereas curative interventions target families where maltreatment has already occurred and aim to reduce recurrence (Van der Put et al., 2018). Home-visiting programs, typically provided to mothers during the postnatal period, have become one of the most well-researched and widely disseminated preventive interventions (e.g., Donelan-McCall et al., 2009). While home visiting programs such as the Nurse Family Partnership Program (NFP) and the SafeCare Program have documented evidence of effectiveness (Guastaferro, et al., 2012; Olds, et al., 1997; Olds, et al., 1986), they have primarily been targeted towards families who are deemed to be at risk for child maltreatment. Scaling up primary prevention models to the population level is challenging, however, because it requires significant public expenditures and investment to expand the resources available in a community to foster greater collaboration among local service providers and to sustain accessibility for the whole community (Daro & Dodge, 2009). As such, the population impact of these programs may be limited until these issues are resolved (Alonso-Marsden et al., 2013).

Curative prevention efforts offer another important approach to the prevention and/or reduction of child maltreatment and are a way of intervening to support the development of a child who has been maltreated. Curative prevention refers to intervening and providing services to families after maltreatment has already occurred with the goal of preventing the long-term outcomes associated with child maltreatment and to prevent its recurrence (van der Put et al., 2018). The risk

for recurrence is high -over five years, more than half of families who have committed an act of maltreatment have another recurrence of child abuse or neglect (DePanfilis & Curavin, 1998). Risk for reinvolvement is highest in the first year after families become involved with the child protective services unit. Given this, curative prevention for families with a history of committing maltreatment may be most effective when they occur early in families' involvement in the child protective services system. Moreover, it is important for these interventions to be delivered early in children's development.

3 Relational Intervention Approaches

From a developmental psychopathology perspective, development is conceptualized as hierarchically organized where the achievement of each developmental task facilitates the ability to resolve future stage-salient issues. Unsuccessful resolution of early stage-salient tasks, however, may result in disruptions in subsequent functioning throughout the lifespan (Cicchetti & Valentino, 2006). As such, interventions for child maltreatment should seek to decrease future incidents of maltreatment as well as to promote the resolution of early stage-salient developmental tasks and positive developmental trajectories among children who have been maltreated. Given that child maltreatment is primarily a pathogenic relationship between the parent and the child, one promising way of intervening to support the healthy development of a child who has been maltreated and to prevent the recurrence of maltreatment is to treat the parent-child relationship. Indeed, positive parenting is central for scaffolding young children's development and in providing external regulation for the child in cognitive, emotional, and physiological domains (e.g., Bowlby, 1969; Spangler et al., 1994). Positive aspects of the parent-child relationship have a significant buffering effect in the association between

adversity and maltreatment with child emotional, behavioral, and physical health (i.e., Miller & Chen, 2013; Toth et al., 2002). Relational interventions, therefore, focus on improving the parent-child relationship, and, in turn, enhancing children's success at resolving stage salient developmental tasks as the key mechanism of change to support adaptive development for children who have been maltreated.

4 Maternal Sensitivity and Relational Interventions for Infancy and Toddlerhood

Maternal sensitivity and attachment organization are central components of the parent-child relationship that are targeted for improvement by relationally-based interventions for children who have been maltreated. Sensitive caregiving is central for the development of secure attachment relationships and for providing an external scaffold for children's developing stress regulatory system (Bowlby, 1969, Spangler et al., 1994). Thus, sensitivity may be considered a more proximal parenting mechanism to enhance during relational interventions relative to the more distal mechanism of attachment organization. Because the formation of secure attachment organization is a key stage salient developmental task during the first two years of life, most relational interventions for child maltreatment focus on enhancing caregiver sensitivity during infancy and toddlerhood (see Toth et al., 2013; Valentino, 2017 for reviews). For example, Attachment and Biobehavioral Catch-Up (ABC; Dozier et al., 2008), Promoting First Relationships (PFR; Kelly et al., 2008), and a brief attachment-based intervention (Moss et al., 2011) are all brief relational models that are associated with improvements in maternal sensitivity among families with a maltreatment history. Additionally, more intensive, long-term relational interventions such as Child-Parent Psychotherapy (CPP; Lieberman & Van Horn, 2008), which focuses more broadly on attachment security, are associated with enhanced

attachment security among mothers who maltreated their infants (e.g., Cicchetti et al., 2006; Stronach et al., 2013).

Overall, it is clear that intervening to enhance components of the mother-child relationship, including maternal sensitivity and attachment security, is critical for interrupting negative developmental cascades and for promoting resilience among children who have been maltreated (Toth et al., 2013). However, despite the strengths of the relational models noted above for supporting healthy child development, they were all designed for infants and toddlers, primarily, limiting their use for older children such as preschoolers. Interventions for children aged 0-2 are important, as more than a quarter of child maltreatment victims are 0-2 years old; however, children aged 3-6 years represent 35.8% of children with substantiated maltreatment reports (USDHHS, 2022). Thus, relational interventions that are developmentally tailored for delivery during early childhood are needed.

5 Maternal Sensitivity and Early Childhood

During early childhood, sensitive parenting behavior shifts towards increasing reliance on verbal behavior, including supportive guidance during discussion of children's emotion (Thompson & Meyer, 2007). Parents' abilities to co-construct elaborative and emotionally supportive narratives about children's emotional experiences become critical in shaping children's representational models of self and others and in supporting their development (Fivush et al., 2006; Thompson, 2006). As such, enhancing maternal communication may be a relevant focus for relational interventions aimed at improving parent-child relationships among families with a maltreatment history and preschool-aged children.

5.1 Maternal Elaboration

There are important individual differences among parents with respect to their ability to provide elaboration and sensitive guidance during reminiscing or discussions of children's past experiences (Fivush et al., 2006; Koren-Karie et al., 2003a; McCabe & Peterson, 1991). Parents who are high in *elaboration* during reminiscing frequently ask their children open-ended questions. For example, this includes questions such as who was there and what happened during a past event. Moreover, an elaborative parent will contribute additional details to the conversation and confirm or validate their child's contributions (Fivush, 2011; Nelson & Fivush, 2004). High maternal elaboration is positively associated with children's memory development over time, both within and outside the context of mother-child discourse (e.g., Leichtman et al., 2000; Salmon & Reese, 2015), as well as with children's language, literacy development, and autobiographical memory specificity during early childhood (e.g., Melzi & Caspe, 2017; Peterson et al., 1999; Reese et al., 1993; Valentino et al., 2013a). Indeed, reminiscing conversations may provide children opportunities to practice their language, rehearse memories, create narratives, and organize those memories within their autobiography.

Importantly, there is evidence that maternal elaboration is quite malleable following brief training. Randomized controlled studies of maternal elaboration training indicate that children of trained mothers display richer memories than did children of untrained mothers (Peterson et al., 1999; Reese et al., 1993, Reese & Newcombe, 2007; Salmon et al., 2009). Moreover, when reminiscing training has included an emphasis on discussion of children's past emotional events, children in the training group demonstrate enhanced emotion knowledge compared to children whose mothers did not receive training (Van Bergen et al., 2009). As such, reminiscing-based interventions that teach communication skills are promising for

enhancing child memory and emotion knowledge, as well as other domains of functioning following brief training (Salmon & Reese, 2015; Wareham & Salmon, 2006).

5.2 Maternal Sensitive Guidance

Another important dimension of maternal communication, and of reminiscing specifically, is the affective quality of maternal input and emotional support during discussions of children's past emotional events. Indeed, the quality of reminiscing about past emotional experiences is an important form of emotion socialization. Parents shape their children's emotional development through their reactions to their children's emotions, their own emotional expressiveness, and their conversations with their children about emotions (Eisenberg et al., 1998). Through reminiscing conversations about children's past emotional experiences, parents can teach children about how to identify their feelings, how to express their emotions appropriately, and how to cope with emotions. In particular, the extent to which parents are able to provide *sensitive guidance* during discussions of past emotional events (Cleveland & Morris, 2014; Cleveland & Reese, 2005; Koren-Karie et al., 2003b) is important for children's emotional development. Specifically, sensitive guidance refers to the overall affective tone, quality, support, and organization of emotion dialogues across positive and negative emotion discussions (Koren-Karie et al., 2003a; Hsiao et al., 2015). Sensitive guidance is linked with children's understanding of emotions. Moreover, parents' ability to provide support and guidance regarding positive and negative emotion discussions, including validation of children's feelings, explanation of emotions, and discussion of emotion resolution, is positively associated with children's self-representations, self-esteem, and attachment security (Bohanek et al., 2008; Fivush et al., 2006; Laible, 2011). Thus, a

focus on enhancing maternal sensitive guidance during emotion dialogues is relevant for relational interventions that seek to enhance the mother-child relationship during early childhood.

6 Child Maltreatment and Maternal Reminiscing

Our lab hypothesized that providing training in elaborative reminiscing and sensitive guidance to mothers who have committed an act of maltreatment may be an effective intervention strategy to promote a more positive parent-child relationship and to address the developmental sequelae associated with maltreatment across several domains of functioning (Valentino et al., 2013b); however, no prior research had evaluated differences in reminiscing among mothers who previously maltreated a child and mothers that did not. Nonetheless, there were many reasons to believe that mothers who maltreated a child may have difficulty in elaborative and sensitive reminiscing. For example, during infancy and the preschool years, mothers who previously maltreated a child have been shown to engage in fewer verbal interactions with their children (Alessandri, 1992; Valentino et al., 2006). In research with school aged-children, mothers who previously maltreated a child have been shown to engage in more emotion invalidation and were less likely to talk about the causes and consequences of emotion with their children, which is associated with poor emotional understanding (Shipman & Zeman, 1999). Thus, we expected that mothers who previously maltreated a child would have difficulties with reminiscing about past emotional events. Specifically, we hypothesized that mothers with maltreatment perpetration histories would demonstrate lower elaboration and sensitive guidance compared to demographically similar mothers who did not previously maltreat a child. Subsequently, we found support for this idea - maltreatment was related to poor reminiscing in terms of both elaboration and

sensitive guidance (Valentino et al., 2015, 2019; Speidel et al., 2019). Moreover, we found preliminary evidence that maternal reminiscing may be a mechanism explaining, in part, how maltreatment is related to poor cognitive and emotional outcomes for children. Specifically, in cross-sectional analyses with the same sample, we identified significant indirect effects between maltreatment and children's emotion knowledge, receptive language, and physiological regulation through maternal elaboration (Valentino et al., 2015) and indirect effects with children's emotion regulation through maternal sensitive guidance (Speidel et al., 2019). Building on this basic research, we then hypothesized that by improving maternal elaboration and sensitive guidance, we could improve outcomes for children who have been maltreated across multiple developmental domains (see Figure 1). This key hypothesis led to the development of the Reminiscing and Emotion Training (RET) intervention.

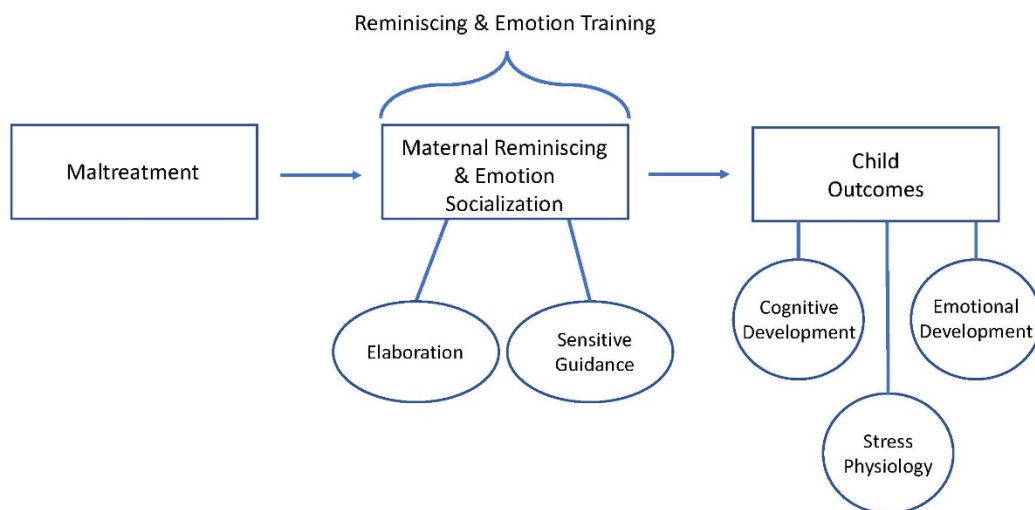


Figure 1. Conceptual Model of the Reminiscing and Emotion Training Intervention

7 The Reminiscing and Emotional Training Intervention

RET was first evaluated in a pilot sample with a waitlist control design (Valentino et al., 2013b) and then in a full, randomized controlled trial with 248

mothers and their 3- to 6-year-old children. We recruited families who had a substantiated maltreatment case from the Department of Child Services (DCS). Two-thirds of our sample were mother-child dyads with a history of maltreatment and then one-third of the sample were mother-child dyads without such a history but demographically similar (see Valentino et al., 2019 for details). We accessed all mothers' DCS records and coded these records using the Maltreatment Classification System (MCS; Barnett et al., 1994) to determine the presence or absence of maltreatment. Dyads with a maltreatment history were eligible for inclusion if they were named the perpetrator of at least one substantiated instance of maltreatment and dyads without a history of maltreatment were eligible if their records corroborated their histories of no maltreatment perpetration. For inclusion, children had to be living at home with their mothers because we aimed to improve the parent-child relationship and we taught skills that we wanted them to practice every day. At the time of writing, we have not evaluated RET in situations where children are placed in foster care. But, for our randomized controlled trial, children were eligible if they had previously been in foster care as long as they were presently living at home.

After completing a baseline assessment (T1), dyads with a child maltreatment history were randomly assigned to receive either RET or enhanced community standard (CS) control group. Both conditions were led by family coaches, who were trained bachelors-level staff with experience working with vulnerable families. As part of the CS condition, mothers were connected with resources in the community and provided written parenting materials. Families in both RET and CS groups were provided with cell phones; families in the RET condition were texted about things relevant to what we were doing in the context of the intervention (e.g.,

family coaches reminded mothers to practice the skill(s) they had learned during that week's session). To control for attention, research staff sent an equivalent number of texts to CS families about resources in the community. For example, CS mothers were notified about free events at the library. Families without a maltreatment history participated only in assessments and were recruited as an additional control group (NC). The sample was diverse in terms of race and ethnicity, primarily low income, and also low in educational attainment. Across all three groups, the majority of mothers did not have more than a high school diploma and most were receiving welfare assistance (see Table 1).

	RET (n = 83)	CS (n = 82)	NC (n = 83)
Variable	M(SD) or %	M(SD) or %	M(SD) or %
Maternal age	29.87 (5.31)	29.30 (5.41)	30.37 (6.85)
Child age	4.97 (1.11)	4.88 (1.20)	4.86 (1.13)
Child gender			
Male	47.0	53.7	50.6
Maternal race/ethnicity			
African-American	32.5	50.0	41.0
Caucasian	50.6	36.6	32.5
Hispanic/Other	16.9	13.4	26.5
Family income			
≤\$12,000/year	54.2	61.0	54.2
Marital status***			
Married	13.3	11.0	33.7

Maternal education

Some high school	28.9	39.0	21.7
High school/GED	37.3	29.3	30.1
Some trade/college	22.9	23.2	31.3
Completed trade/college	10.8	7.3	14.5
Master's degree	0.0	1.2	2.4

Language (PPVT-4)

Maternal*	86.59 (13.20)	81.99 (11.92)	86.22 (12.64)
Child***	87.28 (14.56)	86.81 (16.71)	97.02 (14.53)

Note. RET = Reminiscing and Emotion Training. CS = Community Standard. NC = No Maltreatment Comparison. PPVT-4 = Peabody Picture Vocabulary Test Version 4. * $p < .05$; ** $p < .01$; *** $p < .001$

Table 1. Sample Characteristics by Intervention Group

Informed by prior reminiscing training programs (Salmon et al., 2009; Van Bergen et al., 2009), the content of RET focuses on teaching three basic communication skills, which are presented as the ‘ABCs’ of communicating with children. The A stands for Asking more open-ended questions. This means mothers were encouraged to ask Wh- questions about the past emotional event such as (who, what, where, etc.). The B stands for Building on their child’s responses and being responsive to what their child says. Here, mothers are taught to respond to children’s contributions to the conversation positively and to build on their responses with additional information or details. For example, if the child contributes a new detail, the mother could affirm, “Yes, that’s it! I also remember that ...”. Lastly, the C

refers to Communicating feelings. The intervention included emphasis on teaching mothers to identify and explain their children's feelings, and, when discussing negative emotions, to include discussion about how negative feelings were resolved. Mothers were taught these three primary skills with an initial training video. Family coaches then led mothers through a practice guide which summarizes each of the key skills. Mothers were given a copy of this guide to keep and to use as a reference for practicing. Then, mothers received six weekly in-home sessions that were approximately an hour in length.

In each intervention session, mothers were provided video feedback. Specifically, mothers were asked to practice reminiscing with their child. The family coaches videotaped the reminiscing on a tablet and then immediately played the reminiscing back for the mothers and reviewed it with the family coach. This video-feedback technique has been associated with larger effect sizes in parenting interventions (Kaminski et al., 2008) and has been used successfully to increase sensitivity among mothers who previously maltreated a child (Moss et al., 2011). The goal of this video feedback was for the family coach to highlight the positive moments where the mother was engaged with her child and using the ABC skills well. Mothers were also asked for their input regarding what they thought went well and what they thought could go better. In addition, the family coach provided examples if mothers asked for them. Importantly, family coaches were taught to teach the core reminiscing skills through praise and positive reinforcement to enhance mothers' engagement.

Finally, because of our goal of enhancing emotion socialization through sensitive guidance, we incorporated activities aimed at improving emotional identification and coping into three sessions. We felt that it was important for mothers

who previously maltreated a child and children to practice some foundational emotion skills together to support the dyad's ability to jointly discuss past emotional events. As such, prior to the live reminiscing practice, Sessions 2-4 included one activity each to focus on emotion identification, emotion causes, and emotion regulation, respectively. The first emotion activity focused on emotion identification; mother-child dyads played a mirror game with each other where mothers and children practiced showing each emotion. In this way, we provided opportunities for mothers and children to talk about what emotions look like and how mothers can tell when children are feeling different ways. The second emotion activity included talking about antecedents of emotions, or emotion causes; for this activity the dyad read books about feelings and discussed what makes the child feel sad, scared, etc. The third emotion activity focused on ways to cope with and resolve negative emotions. This session included the turtle technique from Promoting Alternative Thinking Strategies (Greenberg et al., 1995), which teaches children to stop (or go inside their shell), take a few deep breaths, and problem-solve before reacting when they feel angry.

At the conclusion of each session, mothers were asked to practice the reminiscing skills with their child one time every day and to record one practice session on the cell phone provided to them per week. To facilitate the mother-child conversations, families also received a blank scrapbook containing several activity pages with conversation starters and prompts (e.g., "One time I felt sad was ____," with space to illustrate the event). Families were encouraged to use the scrapbook throughout the intervention.

Approximately eight weeks after the baseline assessment (T1), following the completion of the intervention for families in the RET condition, all families

participated in a post-assessment at the laboratory (T2). Families were also invited to participate in assessments six months (T3) and one year (T4) after T1. There was some attrition throughout the course of the study. Of the 232 dyads who participated in the T1 assessment, $n = 217$ (93.5%) participated at T2, $n = 210$ (90.5%) participated at T3, and $n = 208$ (89.7%) participated at T4 (Valentino et al., 2021b; Figure 2). There were no differences by intervention group regarding whether families were lost to attrition.

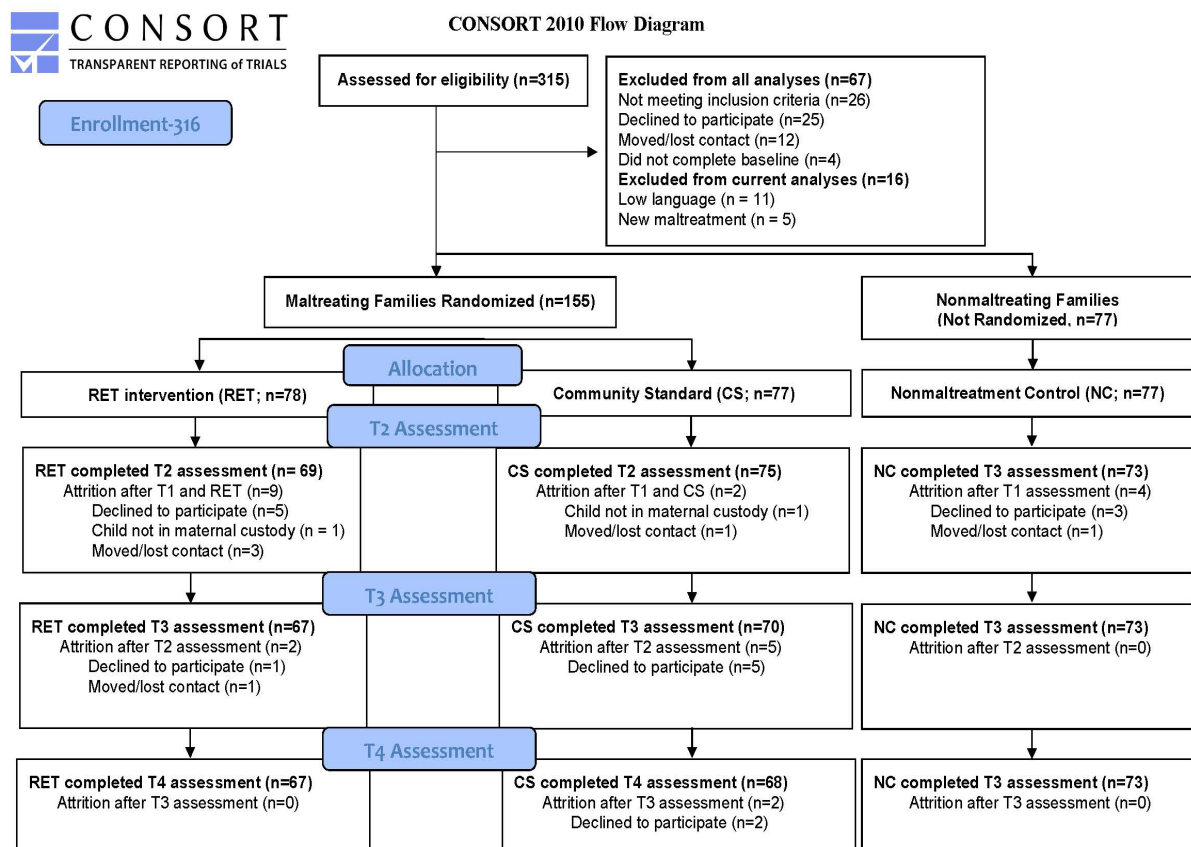


Figure 2. Chart of Participant Flow Across the Study

Every time the families came in for assessments, they completed a repeated measures battery of assessments including a mother-child reminiscing task. At each visit, mothers would pick four past emotional events where their child

felt happy, sad, scared, and angry; negative emotion words were counterbalanced across the sample to account for the possibility of order effects. Mothers were instructed to talk about these times with their children as they normally would at home. The reminiscing task was videotaped and transcribed.

Maternal elaboration was coded from the transcriptions of the mother-child dialogues. Following established coding schemes (Cleveland & Morris, 2014; Haden et al., 2009; Jobson et al., 2018; Reese & Newcombe, 2007), statements were partitioned into utterances, defined as subject-verb propositions, and coded for the presence of: (a) maternal elaborations (i.e., statements or questions that add new information about the event), (b) maternal confirmations of child contributions (i.e., positive affirmations of the child's memory), (c) maternal Wh- questions (i.e., open-ended questions), and (d) maternal yes/no questions (i.e., closed-ended questions). The composite score used in subsequent analyses was calculated by summing the transformed variables across the four emotion events. Interrater reliability was assessed by double coding 20% of the transcripts, with intraclass correlation coefficients for individual categories ranging from .74 to .99.

Maternal sensitive guidance was coded following the Autobiographical Emotional Events Dialogue (AEED; Koren-Karie et al., 2003a) coding manual. The sensitive guidance and narrative quality of reminiscing were coded on seven dimensions: (a) shift of focus (i.e., how focused the mother was on completing the task), (b) acceptance and tolerance (i.e., how accepting and encouraging or impatient and critical the mother was of her child's contributions to the conversation), (c) involvement and reciprocity (i.e., how engaged the mother was throughout the conversation), (d) closure of negative feelings (i.e., how the mother handled negative emotions, emphasizing negative aspects or working to resolve the story and end it

on a positive note), (e) structuring (i.e., how well the mother guided the process of creating the four stories), (f) overall adequacy of the stories (i.e., how accurately the stories matched the emotion cue), and (g) overall coherence of the stories (i.e., how clear the stories were). A composite score was created by averaging the seven criteria, each of which was coded on a 9-point Likert scale with higher scores indicating more of the given behavior. Interrater reliability was assessed by double coding 20% of the videotapes, with intraclass correlation coefficients for individual subscales ranging from .71 to .93.

8 Efficacy of RET

8.1 Immediate Effects

We first examined how RET was associated with change in maternal elaboration and sensitive guidance during reminiscing immediately following the intervention (Valentino et al., 2019). Controlling for mothers' elaboration at T1, as well as mothers' language skills, marital status, and children's age, there was a significant effect of group (RET, CS, NC) on maternal elaboration at T2. As hypothesized, RET mothers used more elaborative statements, confirmations, Wh-questions, and yes/no questions than both CS and NC mothers at T2, with medium to large effect sizes. Similarly, there was a significant effect of group on maternal sensitive guidance at T2, controlling for maternal sensitive guidance at T1, maternal language, marital status, and children's age. RET mothers engaged in more involvement and reciprocity, closure of negative feelings, and structuring than CS mothers with medium to large effects. In addition, RET mothers engaged in more disclosure of negative feelings than NC mothers.

Group (RET, CS, NC) also was significantly associated with children's unique memory contributions to the reminiscing conversations, such that children in the RET group contributed significantly more unique memories than children in the CS and NC groups at T2, controlling for mothers' marital status, children's language skills, children's age, and children's contributions at T1 (Valentino et al., 2019). A parallel effect was observed for children's emotion knowledge at T2. Controlling for the effects of mothers' marital status, children's language skills, children's age, and children's emotion knowledge at T1, RET children had significantly more emotion knowledge at T2 than children in the CS group (Valentino et al., 2019).

We conducted hierarchical regressions predicting children's unique memory contributions and emotion knowledge to determine if changes in maternal elaboration and sensitive guidance from T1 to T2 were associated with children's unique memory contributions and emotion knowledge at T2. Maternal elaboration and sensitive guidance explained variance in children's T2 unique memory contributions, but not children's T2 emotion knowledge, over and above children's pre-test performances, age, and language skills (Valentino et al., 2019).

8.2 Longitudinal Outcomes

As mentioned above, families participated in two additional follow-up assessments 6 and 12 months following the conclusion of the intervention. These visits provided an opportunity to evaluate the endurance of intervention-related effects on maternal reminiscing, as well as to determine whether improvements in maternal reminiscing, in turn, led to hypothesized improvements in child emotional, cognitive, and physiological domains. Indeed, we found evidence that mothers who previously maltreated a child can sustain gains made in elaborative reminiscing over time (Valentino et al., 2021a). Univariate latent growth curve models, run separately

for the RET, CS, and NC groups, suggested that latent basis change models fit best for all three groups. The RET group showed significant increase in maternal elaboration from T1 to T2, and then a leveling off from T2-T3, whereas the CS and NC groups both showed a pattern of significant decrease and then leveling off in maternal elaboration from T1 to T3. As such, it appears that the RET intervention is associated with significant improvement in maternal elaborative reminiscing, which is then maintained over time. Similarly, we have observed sustained RET-related improvements in maternal sensitive guidance. For example, in an analysis that considered both maternal elaboration and maternal sensitive guidance, RET was significantly associated with maternal sensitive guidance at T3 and maternal elaboration at T3, in that mothers in the RET condition showed higher sensitive guidance and elaboration at T3 than mothers who were not in the RET condition, controlling for maltreatment, sensitive guidance, and elaboration at T1 (Valentino et al. 2021a). Similarly, RET is positively associated with change in sensitive guidance from T1 to T3, such that mothers in the RET showed steeper improvement over time than CS mothers (Valentino et al., 2022). Thus, when assessed six months post intervention, we continued to see a positive association between RET and both key reminiscing skills (elaboration and sensitive guidance). Given our hypothesis, then, that improving reminiscing should be related to subsequent improvements in child functioning in cognitive, emotional, and physiological domains, we pursued addressing these questions with our longitudinal data.

8.2.1 Cognitive Development

With regard to cognitive outcomes, we examined the extent to which improvements in maternal elaboration and sensitive guidance were related to children's autobiographical memory specificity (AMS). AMS refers to the ability to

generate and recall specific event memories in response to emotional cue words. This is an important memory phenomenon because AMS, or its inverse—overgeneral memory—is significantly associated with psychopathology among youth and adults (Hitchcock et al., 2014). In particular, reduced AMS has been associated with the onset and severity of depression and elevated depressive symptoms (e.g., Gibbs & Rude, 2004; Gutenbrunner et al., 2018; Stange et al., 2013). In our own research, we identified indirect effects of maltreatment on children's reduced AMS through reduced elaboration but only when mothers were also low in sensitive guidance (Lawson et al., 2018). Therefore, we hypothesized that improvements in elaboration and/or sensitive guidance would be associated with improvements in AMS over time. Using data through the one-year follow-up (T4), we found a statistically significant indirect effect of RET on child AMS at T4 through maternal sensitive guidance at T3 (Valentino et al., 2021).

8.2.2 Emotional Development

Across several papers, we have assessed whether maternal sensitive guidance during reminiscing is a mechanism of change supporting improvement in the emotional development of children who have been maltreated (Behrens et al., 2022; Speidel et al., 2020; Valentino et al., 2022). For example, when considering children's emotion regulation and negativity/lability, children of mothers who received the RET intervention had steeper positive linear change in emotion regulation from T1 to T3 compared with children in both the CS and NC groups (Speidel et al., 2020). In addition, there were significant indirect effects of RET on both children's emotion regulation at T3 and change in emotion regulation from T1 to T3 through change in maternal sensitive guidance from T1 to T3. In contrast, maltreatment (CS group) was negatively associated with both children's emotion regulation at T3 and

change in emotion regulation from T1 to T3 through maternal sensitive guidance at T1, and positively associated with children's emotional lability/negativity through sensitive guidance at T1 (Speidel et al., 2020), highlighting the importance of maternal sensitive guidance for children's adjustment following maltreatment.

Moreover, sensitive guidance emerged as a mediator of an intervention-related effect on children's maladjustment (a composite of internalizing and externalizing symptoms) at T4 through maternal sensitive guidance at T3, such that maternal sensitive guidance was negatively associated with child maladjustment (Valentino et al., 2022). We followed up on these findings with the families in our sample during the early months of the COVID-19 pandemic and invited mothers to report on their children's internalizing symptoms and their family resources. The average time between the T4 assessment and our COVID-19 follow-up questionnaire was 3.31 years ($SD = 1.40$). Evidence suggested that RET had a significant indirect effect on children's internalizing symptoms during the COVID-19 pandemic sequentially through maternal sensitive guidance at T2 and children's maladjustment at T4 (Behrens et al., 2022). This effect was significant while controlling for other relevant factors, such as maltreatment, children's age, race, time between T4 and the COVID-19 follow-up, and family resources assessed both at T1 and during the COVID-19 pandemic.

8.2.3 Physiological Development

Finally, we aimed to evaluate whether RET may be associated with improvements in children's stress physiology. Dysregulation in children's physiological stress systems is a key process linking early adversity to poor health and psychopathology (Essex et al., 2011; McEwen, 1998). Thus, interventions that improve children's stress physiology are especially promising for helping to prevent

deleterious health outcomes. In prior cross-sectional work, we identified poor maternal elaboration as a mechanism linking child maltreatment to flat diurnal cortisol slopes (Valentino et al., 2015). As such, we anticipated that improvements in maternal elaboration may be related to improvements in children's stress physiology. Indeed, we found that mothers' elaboration immediately after the intervention (T2) was as a significant mediator of RET's positive effects on children's diurnal cortisol regulation across the year following treatment. More specifically, we observed indirect effects of the intervention on latent change in children's cortisol slopes, such that diurnal slopes became steeper/more negative over time (Valentino et al. 2021). Likewise, children in the CS group exhibited a blunting in their diurnal rhythms across the study period. This suggests that our intervention is facilitating children's stress regulation following maltreatment by preventing dysregulation and promoting healthier regulatory capabilities.

9 Summary and Future Directions

Overall, the randomized clinical trial of the RET intervention adds to accumulating evidence that relational interventions and improvements in positive caregiving behaviors can have significant positive effects on remediating the negative sequelae associated with maltreatment in multiple developmental domains. Our results further underscore elaborative reminiscing and sensitive guidance as important parenting processes that support child development during the preschool-years and beyond, adding to the literature that has been more focused on infancy/toddlerhood and on improving maternal sensitivity and nurturance or attachment security (Bernard et al., 2012; Cicchetti et al., 2006). This brief relational intervention holds much promise given evidence that mothers are able to learn positive reminiscing skills in just six sessions, and subsequently maintain these skills

over time. Moreover, this model has high potential for scalability because it is time-limited and can be delivered by family coaches without professional clinical degrees.

Looking towards the future there are a number of possible ways that RET could be implemented to benefit mothers and children. For example, RET has potential to serve as an adjunct module that could be provided alongside other parent-child treatments, such as those with more of a behavioral, rather than emotion-related, focused. Alternately, to serve the greatest number of families who have a history of committing maltreatment with the limited funding available, a tiered service delivery model may be useful wherein families may first receive brief relational models that target maternal sensitivity, such as RET, and well as assistance with basic needs (Valentino, 2017). Subsequently, additional intensive relational services could be offered on a more targeted basis. Finally, RET has potential for use in a primary prevention framework, and could be implemented alone or alongside other evidence-based primary prevention strategies to prevent the incidence of maltreatment. Our analyses examining potential effects of RET in child welfare system re-involvement are ongoing and will be critical in determining the extent to which RET may relate to reductions in revictimization.

In considering potential treatments to offer in conjunction with RET, one important consideration is that while RET specifically targeted the parent-child relationship, it did not address other important relationships and experiences that affect child development, such as inter-adult relationships and intimate partner violence (IPV). Interventions that focus on the prevention and/or reduction of IPV and/or are geared toward improving parents' romantic relationships may also prove beneficial as an adjunct to the RET intervention to best support adaptive development among children who have been maltreated. Similarly, interventions that

aim to support maternal needs, and to address maternal psychopathology, such as depression, may be useful to offer before, during, or after the implementation of RET. Indeed, results from our analyses indicated direct negative effects of baseline maternal depression and IPV on children's long-term emotional maladjustment and stress physiology, respectively, that was not mediated by maternal reminiscing skills (Valentino et al., 2020; 2021a). An effectiveness trial of RET, whether implemented alone or in conjunction with another treatment approach, is an essential next step towards the dissemination of this approach.

Overall, the results of the first randomized clinical trial of the RET intervention are promising in demonstrating efficacy across multiple domains of child development. There are limits, however, to what data can show about the efficacy of an intervention. In many ways, the success of an intervention is measured by the impact it has among real people. As such, we conclude with the words of a mother who participated in RET, describing what she learned and the influence this intervention had on her family, in an interview following her completion of the program.

10 Testimonial - (*Name changed to maintain confidentiality*)

Q. How did you feel or what did you feel about the project?

A. I'm glad I've participated. I feel like because I had better communication with my children, and I'm able to kind of get what they feel out of it a little bit better. And I'm glad to kind of realize that I have to -- I never really thought about the fact that I have to give them the language to be able to communicate how they feel. I just, you know, I never -- it never occurred to me that I had to kind of show them and guide them how to communicate their feelings. Yeah.

Q. Did you feel it was too much? How about the project as far as being involved in the project, how did you feel your involvement, was it too many visits? Or, did you feel --

A. No. I didn't feel like -- it flew by really fast. The schedule was really -- you know, it worked really well with my schedule and everything like that. Me having all the kids here, when I felt like I needed help -- felt like it went really well.

Q. And do you think this is a skill that you'll probably be able to use with your children continue using?

A. Oh, yeah, definitely. Yeah, I actually use it with all my children, not just Jonathan, I'm using it with all my kids to try to get them to label their feelings because especially my three-year-old, he had a lot of rage and he will fight a lot. And I, through this program, I figured out a lot of it was basically him not being able to communicate what his problem was or what kind of situation it is. And now, I see him opening up and kind of last-minute telling me, OK, she did this, this makes me mad. And him saying things like this is frustrating at three years old is like really, really amazing to me. And we use the pictures even to identify exactly what kind of face they might have. They don't really identify like angry or sad or something like that, but at least they do identify.*

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**Leveraging Emotion Socialization Research: Innovative Prevention and
Treatment Programming for Vulnerable Families**

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Abstract

This chapter summarizes recent innovations in emotion-focused parenting interventions that have leveraged developmentally-informed research and theory on emotion socialization to address aspects of parenting that have historically been overlooked in existing parenting interventions. Parents who themselves experienced harsh parenting, limited supportive emotion socialization, or emotional maltreatment in childhood tend to be at elevated risk for difficulties with providing supportive, varied emotion socialization experiences with their own children. As such, we have three primary objectives in this chapter: 1) to provide an overview of parent emotion socialization, and its relations to youth emotional development; 2) to discuss applications of developmental research on emotion communication to clinical interventions; and 3) review emerging data from multiple studies illustrating feasibility and effectiveness of emotion coaching interventions with applicability to families with a maltreatment history or those at risk of maltreatment. Specific emotion-related challenges (e.g., identification, regulation, supportive expression) faced by parents who maltreat their children or are at risk of maltreatment are discussed. Additionally, relevant themes in emotion-focused parenting interventions (e.g., emotion-coaching, validation, emotion labeling) are connected to current literature in emotional development and parenting.

Keywords: emotion socialization, emotional development, emotion-focused intervention, parenting, emotional maltreatment, parenting intervention

1 Development of Emotion Competence and Emotion Regulation

Healthy emotion development in youth comprises a broad spectrum of skills generally referred to as emotion competence (Saarni, 2000). These skills include the ability to express emotions accurately and flexibly, to understand one's own and other's emotions (i.e., accurately label emotions, identify causes of emotions), and manage emotions adaptively (Camras & Halberstadt, 2017). Many of the processes involved in managing emotions are collectively referred to as "emotion regulation," a broad term that encompasses a variety of processes both voluntary and involuntary.

For the purposes of this review, we take a functionalist approach (Barrett & Campos, 1987; Walle & Dahl, 2020) to defining emotions and emotion regulation. That is, healthy emotion regulation comprises the modulation of emotional responses (i.e., up-regulation, down-regulation, sustaining) in order to promote adaptive goals. In contrast, difficulties with emotion regulation are a correlate and outcome of childhood maltreatment. Furthermore, impaired emotion regulation is a primary and transdiagnostic correlate and predictor of mental disorders for youth and adults. As such, it is important to understand developmental predictors of emotion regulation, particularly those predictors that can be intervened upon.

2 Parental Emotion Socialization

The developmental predictors of emotion competence and emotion regulation exemplify the dynamic interactions and joint influence of "nature" and "nurture." Many aspects of emotion regulation are influenced and constrained by "nature," in terms of individual differences in temperament (Rothbart & Sheese, 2007). Children are also influenced by "nurture" in both indirect and direct ways (Morris et al., 2017). In terms of indirect processes, children's own emotion competence and emotion regulation abilities are informed by the general family emotional climate in which they are

raised, which encompasses family-level differences in the intensity and valence of emotional expressiveness within families and observational learning from how others (particularly parents) express their emotions (Camras & Halberstadt, 2017; Halberstadt & Eaton, 2002). In addition to the indirect ways in which the family context influences a child's emotional development, parents also engage in direct influences on children's emotional development via processes of emotion socialization, which comprise the myriad ways in which parents respond to, and teach about, emotions.

Through emotion socialization, children receive messages from their parents and caregivers about the appropriateness of experiencing and expressing different emotions, how to interpret their and others' emotions, and how to understand the causes and consequences of emotions (Eisenberg, 2020; Eisenberg et al., 1998). While emotion socialization occurs in many contexts (e.g., through peers, teachers), the predominant focus has been on emotion socialization as a parenting process. In addition, while emotion socialization can occur in many modalities (e.g., reminiscing about emotional experiences; Valentino et al., 2019), most research to date has focused on parental communication about emotions, especially in response to children's negative emotions (e.g., fear, anger, sadness). Generally, this aspect of emotion socialization is understood to comprise supportive and unsupportive responses to children's emotions. Supportive emotion socialization skills include actions or expressions that serve to validate or normalize a child's emotions, such as explaining to them that their feelings make sense or other children might feel that way in the same situation. In addition, emotion coaching skills can involve more explicit teaching to help a child understand what emotions they're experiencing, why they may be experiencing them, and what to do to manage those emotions. Emotion

coaching can serve to promote children's emotion awareness (i.e., ability to accurately identify/label emotions), extend a child's understanding of the causes and consequence of their emotions, as well as coping and problem-solving support.

As an example, a parent might observe a child crumpling a paper and sighing heavily while doing homework. A response to this could start with asking the child to label their emotion: "I noticed you just crumpled up that piece of paper. How are you feeling?" Once the child has identified that they are feeling frustrated and angry, a further response could include validation combined with emotion coaching to identify the likely cause of the emotion (e.g., "It makes sense that you feel angry and frustrated when you're not sure how to do the assignment"). Emotion coaching might also include suggesting a coping strategy, such as taking a few deep breaths or engaging in positive self-talk. In contrast, emotion socialization responses broadly defined as unsupportive can include things such as invalidation or criticism. In the example above, this may involve a parent directly criticizing the child for "overreacting" or "acting like a baby" for their homework struggles or engaging in a punitive response that implies that the child is wrong to experience anger or frustration in challenging academic situations.

2.1 Predictors of Parental Emotion Socialization

Of course, parents will vary in their own emotional competence, which will necessarily constrain their ability to interpret and respond to the emotions of their children. Furthermore, parents will have differing beliefs about the acceptability of certain emotions in their children. Sometimes referred to as an implicit "meta-emotion philosophy" (Katz et al., 2012), these beliefs influence how parents may encourage or discourage the expression of specific emotions and are often informed by sociocultural beliefs (e.g., gender-specific beliefs about the appropriateness of

expressing anger or culture-specific beliefs about the appropriateness of expressing pride). In addition, parents will experience varying levels of comfort with their child's discomfort or negative emotions. For example, some parents may be able to extend a high degree of patience in the context of their child's anger and wait out angry reactions when setting a disciplinary limit, but may not be as tolerant of a child's fear and rush to mitigate or "rescue" a child from situations in which they feel afraid.

2.2 Outcomes of Emotion Socialization for Youth

Evidence from a broad range of research (e.g., Cunningham et al., 2009; Ellis et al., 2014; Godleski et al., 2020; Lunkenheimer et al., 2007) shows that parents who engage in more supportive socialization strategies usually have children with better psychological adjustment, broadly speaking, physical health, social and academic competence. In contrast, unsupportive emotion socialization is consistently associated with poorer psychosocial outcomes for youth (e.g., Buckholdt et al., 2014; Krause et al., 2003; Shipman et al., 2007; Yap et al., 2008). Given the implications of emotion socialization for youth emotional development, it is incumbent on researchers and clinicians to identify predictors of supportive and unsupportive emotion socialization practices that can help elucidate why some parents may engage in more unsupportive and less supportive responses to children's emotions.

2.3 Emotion Socialization in the Context of Childhood Maltreatment

As with many aspects of parenting behavior, these challenges are especially salient among parents with a history of maltreating their children or those at risk for maltreatment. Emotion socialization is implicated in the contexts and sequelae of childhood maltreatment in many ways. For example, multiple researchers have demonstrated that parents who have maltreated their children engage in less

supportive and more unsupportive emotion socialization than parents who do not maltreat their children (Edwards et al., 2005; Shipman et al., 2005; Shipman et al., 2007). Various subtypes of maltreatment typically occur in combination with other types, yet each type disrupts the process of emotion socialization via high levels of distress combined with limited support (English et al., 2015; Wolfe & Mclsaac, 2011; Marques-Feixa, 2021). Within a context of maltreatment, children are also more likely to experience chaotic and unpredictable emotional contexts, making it difficult to consistently learn how to notice, interpret, and respond to emotions most effectively (Kim & Cicchetti, 2010). For example, children who are maltreated may be exposed to an excess of negative emotional stimuli, such as shouting, controlling, belittling, and physical violence. A child who has been maltreated may become exceptionally sensitive, habituated, or attuned to negative and dangerous stimuli but this may come at the cost of missing or misinterpreting other types of emotional cues (McLaughlin et al., 2015; Jenness et al., 2020; Pollak et al., 2000; Pollak et al., 2009).

The definition and context of intrafamilial maltreatment is inconsistent with supportive emotion socialization. Despite the possibility for parents who have maltreated their children to demonstrate some supportive emotion socialization behaviors, there remains an imbalance of negative emotions, lack of support, or harsh parenting behaviors that significantly disrupt a child's healthy development or cause harm (Ness et al., 2022; Wolfe & Mclsaac, 2011; Glaser, 2011; White et al., 2016). The limited range of emotional stimuli and inadequate parental emotional support prevents healthy emotional development and inhibits emotional flexibility. Long-lasting impacts of maltreatment and risks to inflexible or inadequate self-regulation are prevalent among youth who have been maltreated (Burns et al., 2010;

Fay-Stammbach et al., 2017; Kim-Spoon et al., 2013). The early stages of self-regulation processes that cue and inform individuals of next steps in the regulatory process, such as emotional reactivity, awareness, and labeling, may be disturbed when exposed to maltreatment (Güleç et al., 2013; Aust et al., 2013; Bailey et al., 2012; Bérubé et al., 2021). Behaviorally, individuals who experience maltreatment are more likely to engage in risky activities, which is likely linked to these internal challenges with self-regulation and maladaptive attempts at managing emotions (English et al., 2015; Angelakis et al., 2019; Miller et al., 2017).

Unsupportive emotional parenting behaviors may be especially prevalent among families with a history of emotional maltreatment. While not all expressions of unsupportive emotion parenting, such as invalidation and criticism, are severe enough to rise to the level of emotional maltreatment, there are significant conceptual and practical overlaps. Emotional maltreatment (EM) comprises a chronic and pervasive lack of developmentally appropriate emotional support (i.e., emotional neglect) and/or a high intensity and chronicity of harsh, critical, and belittling behaviors (i.e., emotional abuse). The active behaviors that comprise emotional abuse (e.g., invalidation, hostile criticism) can create excess exposure to negative emotions, while the “acts of omission” that define emotional neglect may deprive children of adequate emotional support and socialization (Glaser, 2011). A combination of both unsupportive acts of omission and active emotionally abusive behaviors creates an environment in which a child is not guided to learn appropriate ways to detect, express, manage, and regulate emotions. EM occurs when dysfunctional or harsh parenting becomes chronic, intense, escalating, or conveys that a child is worthless, flawed, or unloved (Hart et al., 2002). Parenting behaviors that may rise to the level of EM include extreme instances of hostility, criticism,

psychological control, emotional unavailability, or withholding of affection or support (Hart et al., 2002; Kairys et al., 2002; Shaffer et al., 2009; McCullough et al., 2014). In addition, positive emotion socialization can be undermined in families with a history of maltreatment through failure to provide emotion coaching and validation of the child's emotional experience and instead engaging in invalidating or neglectful emotion parenting behaviors (Shipman et al., 2007). Researchers point to several factors that distinguish unsupportive parenting from maltreatment (McCullough et al., 2015; Backhaus et al., 2022). Whereas unsupportive parenting may cause confusion and distress, maltreatment is likely to result in fear, intimidation, and feeling unsafe. Maltreatment is also distinct from unsupportive parenting in its impact; maltreatment is more likely to cause direct harm whereas the impact of unsupportive emotion parenting is more variable (Wolfe & Mclsaac, 2011).

Emotionally invalidating messages from parents contribute to a family context containing a limited range of emotions, which can constrain children's ability to learn appropriate ways of flexibly detecting, expressing, and regulating a spectrum of emotions. These effects are seen for children who have been maltreated in research demonstrating difficulties detecting and attuning to emotional stimuli (McLaughlin et al., 2015; Kim et al., 2021; Gray et al., 2016), understanding and interpreting emotionally-relevant information (Pollak & Tolley-Schell, 2003; Brown et al., 2018), and utilizing adaptive emotion regulation strategies such as cognitive reappraisal (Carvalho Fernando et al., 2014; Gruhn & Compas, 2020; Buckholdt et al., 2014). Not surprisingly, these effects are intergenerational, as parents' own maltreatment histories and unsupportive emotion socialization predict their engagement in unsupportive emotion socialization practices with their own children (Leerkes et al., 2020; Milan et al., 2021; Assink et al., 2018; Savage et al., 2019). Children who

demonstrate difficulties with emotion-related skills stemming from experiences of maltreatment, unsupportive parenting, harsh interactions, and observing dysregulation in their own parents may grow up to develop similar parenting and emotion regulation difficulties in adulthood (Warmingham et al., 2020; Jaffee, 2017; Duprey et al., 2022) and if individuals have children (Green et al., 2020). Specifically in parenthood, individuals who experienced maltreatment and unsupportive emotion socialization demonstrate challenges with emotion recognition and labeling, which are integral in emotion regulation processes (Luke & Banerjee, 2013; Bérubé et al., 2020; Aust et al., 2013; Brown et al., 2018). When parents have difficulty recognizing their own emotions, they similarly have difficulty recognizing and sensitively responding to their children's emotions (Wang, 2022; Cabecinha-Alati et al., 2021; McCullough et al., 2015).

Aside from recognition and responsivity when faced with emotion cues, parents who grew up under conditions of maltreatment and/or unsupportive emotion socialization parenting practices may also demonstrate more challenges with regulating emotions in adaptive ways. They may implement emotion regulation strategies that are associated with maintenance of negative emotionality and development of psychopathology, such as greater use of suppression and avoidance and more challenges inhibiting impulsive emotional responses and tolerating distress (Ehrensaft et al., 2015; Infurna et al., 2016; Osborne et al., 2021). A review by Lavi and colleagues (2021) found that parents who maltreat their children or are at-risk of doing so were more likely to demonstrate significantly greater emotional reactivity and dysregulation. Parents who were maltreated as children are more likely to use less effective parenting strategies in response to emotions, such as physical aggression (Rodriguez et al., 2021), intrusiveness, and harsh criticism and

punishment (Edwards et al., 2005; Shipman et al., 2005; Shipman et al., 2007). Further, parents tend to broadly develop beliefs about parenting and implement parenting strategies based on experiences of being parented, even those that were unsupportive, invalidating, or violent (Simons et al., 1991; Conger et al., 2012). In reflecting on emotion regulation as a process of employing strategies to achieve adaptive goals, internal struggles with emotion recognition and regulation can interfere with meeting the demands of parenting situations. Parenting requires the use of many cognitive, emotional, and physical resources. For example, a parent may need to tolerate distress (e.g., tantrums, fear reactions), identify and predict emotional triggers, assist a child in regulating emotions (e.g., physical touch, verbalization, providing distractions), or suppress their own emotions to achieve broader goals (e.g., suppress frustration at a toddler's slow eating pace so child can learn to eat independently). A parent who was not adequately guided in building skills surrounding emotion recognition, expression, responsivity, and regulation may be at risk for difficulties in providing supportive emotion socialization experiences for their children via modeling, teaching, and sensitive support.

3 Review of Current Emotion-Focused Parenting Interventions

Generally speaking, existing parenting interventions have not explicitly targeted the emotion-focused processes that developmental researchers have found important in socializing emotion and building regulatory capacity following maltreatment. The following section reviews the burgeoning evidence that novel emotion-focused parenting interventions can leverage developmental research findings that the way parents talk to their children about emotions is a vital component of the parent-child relationship with long-term implications for child functioning in multiple domains.

Across different emotion-focused parenting interventions, common treatment content is found. In their review of extant emotion-focused parenting interventions, Havighurst and colleagues (2020) identified four primary domains: “(1) Parents’ histories with emotions and attachment/relational experiences with emotion stemming from their family of origin/past experiences; (2) Parent emotion competence (emotion awareness, understanding and regulation); (3) Parents’ responses to and communication with their children when emotions occur; (4) Parents’ skills to guide their children in emotional competence (p. 587).” The first two listed themes underscore the importance of focusing on parents’ own emotional competence before teaching parents how to support their children. The safety instructions at the beginning of airline flights, to “put on your own oxygen mask before assisting others,” has become a frequently invoked metaphor to illustrate this concept - in order for parents to be effective emotion coaches for their children, they have to first cultivate self-awareness and self-care and self-regulation. The second two themes highlight parents’ labeling and validation of children’s emotions, as well as the teaching and scaffolding of appropriate and effective coping strategies.

Intervention strategies intended to address domains (1) and (2) above often focus on bolstering parents’ own emotional awareness and regulation. This may include practices of mindfulness to increase awareness of mental and physical emotion-related cues. Parents may also be encouraged to reflect on their own emotional experiences, both currently and in their personal histories. Finally, parents are frequently taught emotion regulation strategies (i.e., coping with negative emotions, building up positive emotions through pleasant activities). Domains (3) and (4) are typically addressed by teaching parents emotion coaching strategies that can be useful in supporting youth with their emotions, particularly when they are

experiencing intense or challenging emotions. These practices typically include engaging in active listening (i.e., positive body language, use of reflection) and maintaining a focus on the child's experience (i.e., asking open-ended questions to understand rather than interrogate or redirect). Also common in emotion coaching interventions is a focus on emotional support or validation, with statements or actions that communicate to a child that their emotional reactions make sense (e.g., "I understand that you feel sad," or "Lots of kids would feel angry in that situation.") Domain (4) in particular is often addressed by parents engaging in more direct teaching about emotions, such as labeling the emotion a child may be feeling, helping them understand what might be causing that emotion and how that emotion is associated with their behavioral reactions, and teaching or scaffolding effective coping strategies that a child can use. Parent emotion coaching interventions also often focusing on raising parents' awareness about emotion-related parenting behaviors that can be unsupportive, in order to avoid engaging in those behaviors. These include behaviors consistent with the invalidating parental responses to children's emotions described above, such as disbelieving or dismissing a child's emotional experience, criticizing or punishing a child's emotional expression, or focusing on the parent's perspective at the expense of the child's experience.

To date, emotion-focused parenting interventions have included both stand-alone interventions and those that have been explicitly developed as adjuncts or enhancements to existing interventions for parenting and youth psychopathology. Promising and evidence-based examples are each reviewed below.

3.1 Stand-alone Emotion Coaching Parenting Interventions

3.1.1 Tuning in to Kids

The Tuning in to Kids (TIK) program, developed by Havighurst and colleagues, is supported by robust evidence with parents of young and school-aged children. The TIK intervention content is typically delivered in six two-hour sessions, utilizing a group format and emphasizes building parents' own emotional awareness and regulation so that they can respond sensitively and empathically to their children via emotion coaching skills (i.e., emotion labeling, emotion exploration/discussion). Initial reports demonstrated significant improvements in parents' own emotion competence as well as their child-directed emotion coaching (Havighurst et al., 2010; Wilson et al., 2012). Subsequent follow-up research indicated that TIK was effective, relative to control conditions, in reducing child problem behavior (Havighurst et al., 2013).

TIK has also received developmental adaptations to extended age groups. Tuning in to Teens provides for greater autonomy with adolescents and less directive teaching on parents' parts; this adapted intervention has been shown to reduce parents' emotionally dismissing behaviors as well as both parents' and adolescents' reports of emotional distress (Kehoe et al., 2014). Subsequent research with Tuning in to Teens indicated that changes in parents' emotion coaching behaviors mediated the effects of treatment on reductions in adolescents' internalizing behavior (Kehoe et al., 2020). A developmental adaptation for parents of children ages 18-36 months, Tuning in to Toddlers, emphasizes the developmental needs and emotion regulation abilities of toddlers, and has evidenced positive changes in emotion coaching behaviors via self-report and observations (Lauw et al., 2014).

3.1.2 Parenting Your Hyperactive Preschooler Program

This novel intervention was designed by Herbert and colleagues (2013) for parents of hyperactive toddlers who display challenges in behavioral and emotional

regulation. The program is delivered via 14 sessions, incorporating traditional parenting principles (i.e., setting limits, using effective comments) with emotion-focused content (i.e., labeling child emotions, strategies for managing negative emotions and amplifying positive emotions, parent modeling of appropriate emotional expression). In an initial study of 31 families, parents demonstrated reduced engagement in unsupportive parenting behaviors, and children demonstrated less emotional lability post-treatment (Herbert et al., 2013).

3.1.3 Emotion Coaching for Families Exposed to Intimate Partner Violence

Katz and colleagues (2020) developed an emotion coaching intervention designed specifically to meet the needs of youth who have been exposed to intimate partner violence (IPV), often considered a form of EM. Notably, the emotional context of IPV exposes youth to dysregulated and harmful expressions of emotions (e.g., anger) and causes youth personal distress and dysregulation. This emotion coaching intervention targeted non-perpetrating but IPV-exposed mothers and their children. Relative to mothers in the waitlist control group, mothers in the intervention group showed improvements in emotion awareness and emotion coaching, increased use of validation and decreased use of sermonizing/lecturing/scolding during parent–child interaction, and increased sense of parenting competence. Furthermore, both mothers and children in the intervention group experienced improvements in emotion regulation via self/parent-report as well as psychophysiological indicators (Katz et al., 2020).

3.1.4 Reminiscing and Emotion Training

Valentino and colleagues (2019; see chapter in this volume) have developed and tested a unique intervention program for parents of preschool-aged children who

have a history of maltreatment that focuses on processes of reminiscing about emotional situations in parent-child conversations. In addition to focusing on the role of reminiscing and elaborative narratives as relational techniques for strengthening parent-child relationships, the RET curriculum includes several of the commonly-identified components of emotion coaching interventions, including labeling emotions, identifying causes of emotions, and support for coping with intense emotions. Notably, this intervention incorporates video-mediated feedback, where the interventionist records a parent-child interaction and then reviews it together with the parent, which is a promising technique for promoting skill uptake.

3.1.5 Let's Connect

The Let's Connect intervention (formerly AFFECT; Shipman et al., 2013) addresses caregivers' own emotion competence and self-awareness, then teaching specific skills related to active listening and engagement (i.e., "Notice and Appreciate"), supportive presence and validation of children's emotions, and emotion coaching techniques such as emotion labeling, identifying and understanding mixed emotions, and supporting youth in identifying effective approaches to coping with intense emotions. Delivered in eight to twelve sessions in individual or group format, Let's Connect emphasizes skill training and uptake through live role plays and guided skills practice for caregivers of youth aged 5-15. Let's Connect has been identified by the National Child Traumatic Stress Network as a promising practice for youth who have experienced trauma, either as a stand-alone intervention or in addition to evidence-based interventions addressing traumatic stress (for more information, see letsconnect.org).

A pilot study of 34 families tested Let's Connect in a group-based format (Shaffer et al., 2019). In an open trial in a community sample, parents who

completed Let's Connect significantly increased their engagement in supportive emotion communication (e.g., labeling emotions, validation) and decreased their engagement in unsupportive emotion parenting practices (e.g., criticizing or minimizing child emotions); these changes were maintained at three-month follow-up.

3.2 Emotion Coaching Interventions as Adjuncts to Evidence-Based Parenting Interventions

Emotion coaching interventions have also been applied as adjunct interventions to existing parenting interventions for a variety of psychological disorders. Examples include modifications of Parent-Child Interaction Therapy (PCIT; Eyberg & Funderburk, 2011) to include emotion coaching content specifically for youth with attention deficit/hyperactivity disorder (ADHD; Chronis-Toscano et al., 2016) and depression (Luby et al., 2018; Luby et al., 2020). These studies have tested two add-on components to PCIT focused on emotional development and emotion coaching content relevant to parents of preschoolers. These adjuncts to PCIT teach parents how to serve as effective emotion coaches for young children as they learn to adaptively regulate intense emotions. Another parenting intervention, Triple P, has been tested with an adjunctive emotion-focused component (Salmon et al., 2014); in this study, while parents did engage in significantly more emotion coaching relative to those in traditional Triple P, this adjunct treatment was not associated with fewer post-treatment behavioral concerns.

As a more specific example, we have recently developed an augmentation of family-based treatment (FBT; Lock & Le Grange, 2015) for adolescents with anorexia nervosa to include an emotion coaching parent group intervention known as FEED (Families Ending Eating Disorders; Shaffer & Aarnio-Peterson, 2020). FBT

is a well-established intervention for adolescents with anorexia nervosa that focuses on empowering parents to normalize adolescent weight and eating behaviors through re-nourishment. While FBT is efficacious and a first-line treatment for adolescents with anorexia nervosa (Couturier et al., 2013; Keel & Haedt, 2008), problems with unsupportive emotion communication (i.e., high parental criticism/hostility and low warmth) are predictors of poor treatment outcome in this population (e.g., poor weight restoration; Allan et al., 2018). Given the serious risks of anorexia nervosa, including comparatively high rates of mortality, it is necessary to target these predictors of poor outcomes.

FBT focuses on the practical factors related to the re-nourishment process but does not explicitly attend to emotion communication between adolescents and parents during this process. However, the nature of FBT can create conflict between parents and adolescents by charging parents with the task of managing their adolescent's intake (e.g., plating, serving, supervising meals). It is necessary for parents to assume this role to ensure life-saving re-nourishment that the adolescent is unable to do for themselves due to the effects of acute malnutrition, but this level of oversight on their adolescent's eating is inconsistent with what is developmentally typical and can create tension. Often, in addition to having emotional responses (e.g., fear, anger, guilt) related to having to re-nourish their bodies and subsequent weight gain, adolescents are frustrated with their parent's management of their eating.

The FEED emotion coaching intervention was designed to reduce unsupportive parenting behaviors and improve treatment outcomes for adolescents with anorexia nervosa engaged in FBT. In our pilot study, we recruited families of adolescents with newly diagnosed anorexia nervosa (age 12-17) and their parents

who were high in criticism/low in warmth. Since high criticism/low warmth parents are more likely to fail traditional FBT (Rienecke et al., 2016), we specifically recruited these families for more targeted intervention. Parents and their adolescents with anorexia nervosa all received FBT and were randomly assigned to receive either the FEED emotion coaching intervention (parent group format) or attention control condition (parent psychoeducation group).

Our preliminary results suggest acceptability of the intervention by both parents and interventionists. One FEED group participant noted “employing a lot of those tactics...active listening and scaffolding and just being able to label emotions has been extremely helpful for him, and we can work through the anxiety a lot better.” Compared to parents in the attention control condition, parents in the emotion coaching intervention increased parental warmth ($d = 1.58$) directed towards their adolescent and decreased criticism ($d = 0.28$). Further, adolescents of parents in the emotion coaching intervention experienced greater weight gain across the intervention compared to the attention control group ($d = .58$). Finally, 40% of adolescents in our FEED group fully remitted from anorexia nervosa, compared to just 25% in the attention control condition, suggesting a promising positive impact of this adjunct intervention on adolescent treatment outcomes for a serious and often intractable mental disorder (Aarnio-Peterson et al., 2023).

6 Lessons Learned and Future Directions

The state of the literature on emotion-focused parenting interventions highlights a number of innovative programs with high potential to serve parents who have maltreated a child or those parents at risk of committing maltreatment. Current research, as well as our clinical experiences implementing emotion-focused

parenting interventions, point to some important lessons as well as directions for future research.

6.1 Lessons from Clinical Implementation

Our team has been engaged in the development and delivery of emotion-focused parenting interventions for over a decade. Based on our experiences and consultation with other experts, we have observed and learned the following lessons.

6.1.1 Prioritize Addressing Parents' Own Emotion Competence

Parents who engage in or seek out emotion coaching interventions are often understandably eager to get to the emotion coaching content. For a variety of reasons, they are motivated to understand and learn how to respond to their child's difficult emotions. In iterations of treatment development, we have considered and tried models in which we began directly with parental emotion coaching skills. Consistently, we found that we (as clinicians) and parents (as consumers) were challenged to learn and use emotion coaching skills when parents did not have a solid understanding of their own perspective on emotions. While we believe that intervention development should always be guided by principles of economy and simplicity, we found that skipping the early emphasis on parents' own skills in emotional self-awareness and regulation was not worth the time saved. In the future, clinical research with well-powered samples should address this issue empirically.

6.1.2 Timing is Everything in Emotion Coaching

Often times, when we teach parents about the importance of supportive presence and active listening, or of validating rather than minimizing a child's emotions, they feel overwhelmed or intimidated by the idea that they must practice this level of engagement in emotion coaching throughout all of their interactions with

their child. We strive to remind parents that these are skills to be used when the moment calls for them - when a child is struggling with intense emotions and needs support. By extension, not every moment in which a child is experiencing intense emotions is the right moment for emotion coaching. Sometimes parents will find that their bids to engage with their child by offering a supportive comment or question are rebuffed because the child is simply too upset to respond effectively. Sometimes, parents find that even their best efforts at emotion coaching do not immediately calm or redirect a child. In those situations, we strive to remind parents that sometimes emotion coaching can be as effective when it is done after the moment of intensity has settled (e.g., “You were really upset earlier today. I wonder if it’s because you were already feeling worried about your upcoming test when you heard that you need to watch your sister this weekend.”).

6.1.3 Parents Learn with Practice

Much of learning about emotion coaching is didactic, in terms of concepts and skills, but we have learned (and research bears out, e.g., Kaminski et al., 2008) the importance of *in vivo* practice for skills uptake by parents. Often times, emotion coaching skills make sense in the abstract, or when they are demonstrated by an interventionist, only to feel foreign or confusing when attempted by a parent for the first time. Talking to a child about their emotions, especially if it has not previously been a prominent part of the parent-child relationship, takes practice to be executed with confidence. In our clinical experiences implementing emotion-focused parenting interventions, we continually observe the importance of in-session live coaching/feedback and daily practice outside of session as parents adopt these communication skills. We regularly express to parents that through practice, they will learn to make the words and phrases sound authentic to them. We further note that

through role plays and other live practice, interventionists are able to identify strategies that parents feel more or less comfortable with, and provide feedback. As noted above, modalities such as live roleplays or video-mediated feedback can be effective tools for these purposes.

6.2 Needs for Future Research: More Fathers, More Diversity

The burgeoning area of emotion coaching interventions is highly promising but attention is needed to fill some gaps in the clinical literature. To date, intervention study samples primarily comprise mothers and female caregivers and fathers are underrepresented. While this is generally true in parenting research, it may warrant specific attention in the area of emotion parenting, which is historically considered to be a more feminized aspect of parenting. More research with fathers is needed to determine relevance of gender and socialization norms around emotion communication. Research findings are mixed in terms of potential differences between mothers and fathers in their approaches to emotion socialization (e.g., Sosa-Hernandez et al., 2020). It is worth noting that Herbert and colleagues (2013) invited fathers to participate and approximately half of the families in their study included fathers *and* mothers. Focus groups or qualitative approaches could further investigate how fathers receive, interpret, and engage with the content and goals of emotion coaching interventions.

Similarly, future clinical research and intervention development must consider the inclusion of racially, ethnically, and culturally diverse families. To date, the vast majority of families in emotion coaching intervention studies are White/European American. The need for more representative samples is true in the broader emotion socialization literature as well, which has begun to tackle empirical and culturally responsive questions about how to define supportive and unsupportive emotion

parenting – what is universal, what is context-dependent, and what is culturally-determined (e.g., Dunbar et al., 2017; Labella, 2018; Reaume et al., 2022). In a review of cultural differences in emotion socialization, Friedlmeier and colleagues (2011) note that cultural contexts vary in the prioritization of individualistic or relational goals that influence how emotional experiences and expressions are socialized; for example, minimizing expressions of anger when the cultural context prioritizes relational harmony vs. validating expressions of anger when the cultural context prioritizes individual goal pursuits. More diverse samples will serve the generalizability of emotion coaching interventions (see Qiu & Shum, 2022 for an example of adapting TIK to a Chinese sample) and will also point to needs for clinicians to be culturally responsive in adapting principles of emotion coaching to diverse emotion socialization values and goals.

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**A Trauma-Informed Approach to the Unified Protocol for Children with
Exposure to Child Maltreatment**

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Abstract

Youth who have experienced trauma or maltreatment often experience a range of comorbid mental health symptoms, and emotion regulation difficulties following such traumatic experiences may serve as a core risk factor for both short- and long-term challenges. Despite the frequent comorbidity of mental health symptoms with which youth who have experienced maltreatment present, limited work has examined the applications of transdiagnostic treatments for individuals following traumatic experiences. Using a mixed methods approach, our team adapted and studied the implementation of the Unified Protocols for Transdiagnostic Treatment of Emotional Disorders in Children and Adolescents within a group home program for children who had experienced maltreatment. We present core aspects of the Unified Protocols for Transdiagnostic Treatment of Emotional Disorders in Children and Adolescents and a review of the prior research on the use of transdiagnostic interventions with survivors of trauma and maltreatment. Then we share our process working in collaboration with stakeholders, modifications made to the original treatment manual, findings from our pilot study, and reflections from this work.

Keywords:

Transdiagnostic treatment; maltreatment; trauma; abuse; neglect; children and adolescents; Unified Protocols; UP-C; UP-A; cognitive behavioral therapy; treatment adaptation; implementation science; mixed-methods research; residential treatment; group home

1 Background

Youth who have experienced high rates of adverse childhood experiences including trauma and maltreatment face elevated risks for mental and physical health challenges, as well as academic, professional, and interpersonal difficulties throughout the lifespan (De Venter et al., 2013; Hardcastle et al., 2018; Kerker et al., 2015). Furthermore, exposure to childhood trauma or maltreatment can lead to the development of posttraumatic stress disorder (PTSD), though partial symptomatology of and comorbidity with other mood or anxiety disorders is also common (Daniels et al., 2013; Dvir et al., 2014; Dyregrov & Yule, 2006). Emotion regulation difficulties associated with early traumatic experiences may serve as a core risk factor for adverse long-term outcomes, as early experiences of trauma can impact cognitive and behavioral responses to perceived threat and brain development (Dvir et al., 2014; Herringa, 2017). Although some effective therapies exist to treat youth with PTSD (e.g., trauma-focused cognitive behavioral therapy) and can lead to improvements in comorbid symptoms (e.g., Jensen et al., 2017), limited work has examined the applications of transdiagnostic treatments for individuals experiencing PTSD or other trauma-related symptoms (Gutner et al., 2016).

To address this need, our team explored the potential application of the Unified Protocols for Transdiagnostic Treatment of Emotional Disorders in Children and Adolescents (UP-C and UP-A; Ehrenreich-May, Kennedy, et al., 2017), a psychotherapy model designed to target core emotion regulation concerns in youth with internalizing disorders, adapted for use within a group home program for children who had experienced maltreatment. In this chapter, we describe fundamental aspects of the UP-C and UP-A, provide an overview of the research on

the UP-C and UP-A, and discuss the limited findings that exist to date for using this approach for treating youth who have been maltreated. Then we share our team and collaborators' innovative efforts to adapt the intervention for youth exposed to trauma and/or maltreatment, including some of the modifications made incorporating stakeholder feedback to the UP-C, outcomes from that study, and knowledge we gathered through this process.

2 The Unified Protocols for Children and Adolescents

The UP-C and UP-A were developed as a treatment for youth with emotion regulation difficulties or emotional disorders. The UP-C and UP-A take a primarily cognitive-behavioral therapy (CBT) informed approach and were developed to address a number of challenges clinicians commonly face in their efforts to provide evidence-based care to youth. Despite the existence of many evidence-based treatments, many children with emotional disorders do not receive evidence-based care in any form (Becker et al., 2013; Whiteside et al., 2016). One challenge is the high rate of comorbidity among mood and emotional disorders in youth, with up to two-thirds of youth presenting with a primary anxiety disorder receiving at least one additional diagnosis (Angold et al., 1999) and rates up to 75% for comorbid depressive and anxiety disorders (Axelson & Birmaher, 2001; Garber & Weersing, 2010; Ollendick et al., 2008). Not only is there frequent concurrent comorbidity of symptoms (Angold et al., 1999; Kessler et al., 2012; Merikangas et al., 2010) but there is also sequential comorbidity of both internalizing and externalizing difficulties (i.e., a developmental trajectory connecting clinical problems; Beesdo et al., 2009; Boylan et al., 2007; Schleider et al., 2014). At the same time, many evidence-based treatment manuals were developed to target specific diagnoses or symptom clusters at one time point (e.g., anxiety [Kendall & Hedtke, 2006], obsessive-compulsive

disorder [Franklin et al., 2018], depression [McCauley et al., 2016], etc.). As a result, clinicians often experience challenges in selecting from the plethora of disorder- or problem-specific treatment manuals when working with youth who so often present with far more complexity than just one area of difficulty. Furthermore, it can be challenging and costly for clinicians to develop and maintain competency in multiple disorder-specific treatments. The utilization of a transdiagnostic treatment approach could help alleviate this burden and promote effective implementation of evidence-based practices (McHugh & Barlow, 2010).

The UP-C and UP-A utilize key transdiagnostic treatment components to provide a singular yet flexible approach to addressing the wide range of mood and anxiety concerns with which youth present. The Unified Protocol for adults (UP; Barlow et al., 2017), UP-C, and UP-A are theorized to be core dysfunction-focused transdiagnostic approaches, targeting the higher-order mechanism of neuroticism (Marchette & Weisz, 2017). From this perspective, individuals with mood and emotional disorders not only experience higher frequency and intensity of strong emotions but also often feel as if they cannot tolerate the discomfort associated with such feelings (Barlow et al., 2004; Barlow et al., 2014; Ehrenreich-May, Kennedy, et al., 2017; Sauer-Zavala et al., 2021; Wilamowska et al., 2010). As a result, these individuals often use emotionally-driven behaviors or emotional behaviors, such as avoidance or escape, to prevent or relieve themselves from the frequency or intensity of that emotion. While such behaviors may be adaptive in the face of true threats of harm, avoidance of strong emotions, for example, often perpetuates and exacerbates symptoms (Barlow et al., 2004; Barlow et al., 2014; Ehrenreich-May, Kennedy, et al., 2017; Sauer-Zavala et al., 2021; Wilamowska et al., 2010).

For the purpose of this chapter, we highlight the child version of the treatment (used with youth ages 6-12, typically), or the UP-C (Ehrenreich-May, Kennedy, et al., 2017), which our team and collaborators adapted for use with youth who had experienced maltreatment in the study we discuss below. Core components of the standard UP-C youth and caregiver sessions are described in Table 1. The UP-C aims to present core CBT components in a way that is fun, interactive, and engaging for children, emphasizing activity-focused learning and positive reinforcement throughout treatment. The UP-C originally was designed to be used in a group format, though the therapist guide provides instructions for how to utilize the treatment as a modular individual therapy as well. The UP-C uses a central metaphor of empowering children with skills to become “emotion detectives” and solve the mystery of their strong emotions. Throughout this behavioral intervention, children learn to collect “CLUES” skills (i.e., Consider how I feel, Look at my thoughts, Use detective thinking and problem solving, Experience my emotions, and Stay healthy and happy). These skills incorporate techniques such as psychoeducation, cognitive reappraisal, problem-solving, behavioral activation, and exposure techniques in a framework that can be applied across a range of mood and anxiety symptoms. Additionally, the UP-C provides a separate caregiver curriculum which highlights patterns of common emotional parenting behaviors (i.e., Overcontrol/Overprotection, Criticism, Inconsistency, and Excessive Modeling of Strong Emotions, and Avoidance) as well as skills to help caregivers support and maintain their children’s treatment progress. In standard group application of the UP-C, the group meets weekly with simultaneous child and caregiver groups; however, as discussed later in this chapter, the child and caregiver content can be utilized in a more personalized or individualized manner.

CLUES Skill	Session Number and Name	Core Content for Youth	Core Content for Caregivers
C Skill (<u>C</u>onsider how I feel)	1: Introduction to the Unified Protocol for the Transdiagnostic Treatment of Emotional Disorders in Children	- Introduction to treatment structure, Top Problem and treatment goal identification, and rapport building - Psychoeducation about emotions, including emotion identification and emotions as normal, natural, and harmless	- Introduction to treatment structure, Top Problem and treatment goal identification, and rapport building - Promoting caregiver understanding of children's emotional responding (i.e., the three parts of an emotion, the cycle of avoidance and other emotional behaviors)
	2: Getting to Know Your Emotions	- Continue normalizing emotional experiences - Psychoeducation including the three parts of an emotion and the cycle of avoidance and other emotional behaviors	- Learning to identify patterns of children's emotional responses and caregivers' emotional responses - Positive reinforcement as an opposite parenting behavior to criticism
	3: Using Science Experiments to Change Our Emotions and Behavior	- Connections between activities and emotions - Modifying behavioral action tendencies through opposite action and engaging in enjoyable activities	- Supporting children in modifying behavioral action tendencies - Continue practicing positive reinforcement as an opposite parenting behavior to criticism
	4: Our Body Clues	- Awareness and tolerance of physical sensations	- Caregiver awareness and tolerance of physical sensations - Encouraging empathy as an opposite parenting behavior to criticism
L Skill (<u>L</u>ook at my Thoughts)	5: Look at my Thoughts	- Recognition of thinking traps (cognitive distortions)	- Introduction to cognitive flexibility and thinking traps - Promoting consistent reinforcement and

			discipline as an opposite parenting behavior to inconsistency
U Skill (Use Detective Thinking and Problem Solving)	6: Use Detective Thinking	-Utilizing detective thinking (cognitive reappraisal)	-Increasing caregiver cognitive flexibility -Introducing healthy independence-granting as an opposite parenting behavior to
	7: Problem Solving and Conflict Management	-Problem-solving skills	-Promoting healthy independence-granting including opportunities for caregivers to encourage children to use detective thinking and problem solving as alternatives to reassurance-seeking and accommodation
E Skill (Experience my Emotions)	8: Awareness of Emotional Experiences	-Practicing mindfulness skills (i.e., present-moment awareness and nonjudgmental awareness) to promote awareness and tolerance of emotional experiences	-Practicing mindfulness skills (i.e., present-moment awareness and nonjudgmental awareness) to promote caregiver awareness and tolerance of emotional experiences -Planning for situational emotion exposures
	9: Introduction to Emotion Exposure	-Skill review -Exposure demonstration	-Promoting healthy and helpful caregiver modeling of emotions as an opposite parenting behavior for excessive modeling of strong emotions -Planning for situational emotion exposures
	10: Facing Our Emotions—Part 1	-Learning about safety behaviors and subtle avoidance behaviors -Engaging in group exposure	-Using opposite parenting behaviors to support children's exposures

	11-14: Facing Our Emotions—Part 2	-Personalized exposures	-Caregiver incorporation in situational emotion exposures as indicated
S Skill (Stay Healthy and Happy)	15: Wrap-up and Relapse Prevention	-Maintaining gains and preventing relapse	-Maintaining gains and preventing relapse

Table 1. Core Components of the UP-C for Youth and Caregivers

3 Prior Research on the UP-C and UP-A

The UP-C and UP-A are effective in treating a range of anxiety and depressive disorders, and studies on these protocols have generally demonstrated large effect sizes (e.g., Bilek & Ehrenreich-May, 2012; Carlucci et al., 2021; Kennedy et al., 2019). Prior to being manualized as a treatment for children with clinically elevated emotional disorder symptoms, the UP-C was originally developed as an anxiety and depression prevention program for children (“Emotion Detectives”), presented in a group summer camp setting (Ehrenreich-May & Bilek, 2011). The Emotion Detectives program yielded significant decreases in children’s symptoms of anxiety and depression (Ehrenreich-May & Bilek, 2011). In an open-trial study of the UP-C with children with a primary anxiety diagnosis, youth demonstrated significant improvements in anxiety and depressive symptoms with large effect sizes (Bilek & Ehrenreich-May, 2012). A randomized control trial conducted by Kennedy and colleagues (2019) comparing the UP-C to an evidence-based, anxiety-specific treatment (i.e., Cool Kids; Lyneham et al., 2003) in treating children with at least one primary anxiety disorder found equivalent efficacy in decreasing anxiety symptoms with UP-C as compared to the disorder-specific treatment. Furthermore, participants in the UP-C group demonstrated greater gains in use of reappraisal strategies as well as greater improvements in depression symptoms and emotion regulation for

sadness in the UP-C group compared to the other treatment condition. Additionally, the findings suggested the UP-C may be more robust to symptom recurrence at 6-month follow-up, highlighting potential benefits of this transdiagnostic approach (Kennedy et al., 2019). A large-scale randomized controlled trial in collaboration with the University of Coimbra and University of Lisbon in Portugal is ongoing (following a study demonstrating the feasibility and acceptability of the UP-C within a Portuguese population [Caiado et al., 2022]) and hopes to offer further the evidence-base on the UP-C.

A waitlist-controlled randomized trial of the UP-A with adolescents with primary diagnoses of anxiety or depression found that youth who received the UP-A had greater improvements in diagnostic severity and in global improvement compared to the waitlist condition. Improvements in the UP-A condition were identified at both mid- and post-treatment timepoints, and adolescents who received UP-A continued to demonstrate trajectories of further improvements - albeit slower progress than during treatment - following treatment completion (Ehrenreich-May, Rosenfield, et al., 2017). Queen and colleagues (2014) similarly found that adolescents continued to identify additional improvements in their anxiety symptoms at six-month follow-up after concluding treatment with the UP-A and that improvements in depressive symptoms were largely maintained at follow-up, though did not evidence significant additional improvements at that time point beyond gains during active treatment. In addition to published work, recently completed and ongoing randomized controlled studies of the UP-A are evaluating the effectiveness of the treatment within community mental health settings in two locations across the United States (Jensen-Doss et al., 2018) as well as in a separate study of the UP-A in community mental health settings in Australia. Additionally, the UP-A has been

adapted and is being assessed for use as a school-based universal prevention in Spain (García-Escalera et al., 2017).

In addition to evidence supporting the use of the UP-C and UP-A in treating anxiety and depressive symptoms, there is emerging evidence that these interventions may be beneficial in the treatment of other disorders and symptom clusters. The UP-C and UP-A have shown to significantly decrease obsessive-compulsive symptoms by both youth- and parent-report for children and adolescents presenting with a primary anxiety, depressive, or obsessive-compulsive disorder diagnosis (Shaw et al., 2021). Emerging evidence also indicates the utility of the Unified Protocols in treating eating disorders (Thompson-Brenner et al., 2018; Burton et al., 2021), borderline personality features and disorder (Sauer-Zavala et al., 2016; Tonarely, Sherman, et al., 2021), bipolar II disorder (Ellard et al., 2012), anger and irritability in youth (Hawks et al., 2020; Grossman & Ehrenreich-May, 2020), and early onset serious mental illness (Weintraub et al., 2020). Additionally, the UP-A has been adapted to help support youth coping with sexual minority stress, adding an emphasis on empowerment through positive LGBTQ+ role models and adapted examples (Ehrenreich-May & Kennedy, 2021).

The UP-C and UP-A also have been adapted for delivery in brief, stepped-care formats and for delivery via telehealth (Kennedy et al., 2021; Tonarely et al., 2022). Such adaptations may further promote accessibility of treatment and decrease treatment burden. The stepped-care adaptations of the UP-C (UPC-SC; Kennedy et al., 2021) and UP-A (UPA-SC; Tonarely et al., 2022) prioritize specific treatment components, including emotional/sensational awareness, exposure exercises, and opposite action strategies provided in an initial 6-7 session treatment phase with the option to “step-up” to receive additional subsequent treatment content

if warranted. The UPC-SC includes two parent-only sessions and emphasizes providing psychoeducation and guidance to caregivers to promote caregiver-led interventions to support the children (Kennedy et al., 2021). The UPA-SC does not include significant caregiver-directed content, rather focusing more exclusively on providing skills directly to the adolescent (Tonarely et al., 2022). Pilot studies offer preliminary support for the feasibility and acceptability of these stepped care adaptations as well as demonstrating significant mood and anxiety symptom improvements within the pilot samples (Kennedy et al., 2021; Tonarely et al., 2022).

Prior research has also examined the benefits of the UP-C and its caregiver-focused materials on caregivers themselves. Findings indicate the UP-C helps decrease parents' parenting distress, anxiety, depression, stress, and improve parents' cognitive reappraisal and distress tolerance (Tonarely, Kennedy, et al. 2021). Interestingly, parent changes in distress tolerance appear to be most highly associated with youth outcomes (Tonarely, Kennedy, et al. 2021). However, in applying the UP-C to youth who had experienced maltreatment, special considerations regarding the potentially limited role children's caregivers may be able to play in treatment were warranted given the likelihood of limited, strained, and/or potentially unsafe relationships between children and their biological parents.

4 Prior Research on the Application of the Unified Protocols for Survivors of Trauma

Given that childhood trauma is associated with increased risk for the development multiple forms of psychopathology throughout the lifespan, transdiagnostic interventions targeting key mechanisms associated with these risk factors may be especially valuable in promoting positive outcomes for youth who experienced trauma (Gutner et al., 2016; Gutner & Presseau, 2019; McLaughlin et

al., 2020). More specifically, transdiagnostic risk factors targeted by the UP (Barlow et al., 2017), including emotion regulation deficits, emotional avoidance, and anxiety sensitivity have been demonstrated to increase vulnerability and maintenance of PTSD (Gallagher et al., 2017; Paulus et al., 2018; McLaughlin et al., 2020) as well as anxiety and depressive disorders (Aldao et al., 2010; Sloan et al., 2017; Thompson et al., 2001). Furthermore, transdiagnostic treatments can address a number of obstacles to treatment for youth who have experienced trauma as they can be cost-effective, decrease training burden, and promote use of evidence-based practices, while also having the potential to address the diagnostic comorbidity that many trauma survivors experience (Gutner et al., 2016; Gutner & Presseau, 2019).

However, limited prior work has examined the use of the UP for treating PTSD, and these studies have mostly been conducted within adult rather than child populations. Varkovitzky and colleagues' (2018) piloted the use of the UP with 52 veterans and found significant posttreatment improvements not only in depressive symptom severity and emotion regulation skills but also in PTSD symptom severity. Improvements in emotion regulation over the course of treatment were predictive of lower PTSD and depressive symptoms following treatment, suggesting that emotion regulation was a core mechanism of change (Varkovitzky et al., 2018). Additionally, a randomized controlled trial in Australia comparing the UP to usual care for adults experiencing posttraumatic distress after sustaining a serious injury (including PTSD, a major depressive episode, or an anxiety disorder) indicated positive benefits and effects of the UP over usual care (O'Donnell et al., 2021). Upon completion of treatment with the UP, participants demonstrated significantly larger decreases in PTSD and co-occurring emotional disorder symptoms compared with participants in the treatment as usual condition with improvements lasting through six-month follow-

up (O'Donnell et al., 2021). While much of the research has been limited by small sample sizes and focused on adults, such findings suggest that targeting emotion avoidance and promoting emotion regulation through a transdiagnostic approach like the UP can help alleviate trauma-related symptoms. However, further work is required to assess whether the UP offers equivalent benefit in treating PTSD compared to current first-line, disorder-specific treatments for PTSD (O'Donnell et al., 2021). Therefore, we aimed to assess whether the UP-C and UP-A could be beneficial in treating the needs of youth exposed to trauma or maltreatment and which adaptations may be needed to make the treatment most appropriate for this population.

5 Study on the Adaptation of the UP-C for Youth who had Experienced Maltreatment

5.1 Setting

To study adaptations of the UP-C to treat the mental health issues of youth impacted by severe child maltreatment, our team worked with Hull Services, a non-profit agency in Calgary, Canada that provides behavioral and mental health supports for youth and their families.

5.2 Design

The UP-C was implemented in two different group homes operated by Hull Services. Each home worked with youth up to age 13 and operated with a ratio of 2-3 youth per staff member. Youth typically stayed in these group homes for 12-18 months. The goal was to stabilize the children's mental health to facilitate a transition to living in the community. Three cohorts of youth and caregivers were run between January 2020 and February 2022, with cohorts consisting of a mix of youth from both

group homes. New adaptations to the UP-C were introduced or discarded after each cohort.

The therapy consisted of 15 weekly sessions lasting 60-75 minutes each (except as noted under *Unsuccessful Adaptations*, where longer, less frequent caregiver sessions were attempted for the first cohort). Youth and caregiver groups were run at separate times for the first 10 sessions and then brought together for the final five sessions so that youth and caregivers could work together on emotion exposures.

5.3 Training in the UP-C

A two-day training was provided by the lead developer of the UP-C (author JEM) for Hull Services clinicians to allow them to facilitate the UP-C. Training began with an explanation of the rationale for using transdiagnostic CBT programs, such as the UP-C and UP-A, and the empirical evidence to support the UP-C and UP-A's efficacy. Next, each session of UP-C was covered in order with training on the theoretical and practical components of facilitating youth and caregiver sessions. Training was a mixture of didactic instruction, group discussion, and role playing. The training also incorporated elements of the UP-C adaptation for pediatric irritability (Hawks et al., 2020) because facility staff indicated irritability is a common symptom of youth in group homes. Weekly clinical supervision sessions were conducted by the study team to ensure treatment fidelity.

To account for clinician turnover, comprehensive training was provided (by authors DL and GD) for new UP-C facilitators before the second and third cohorts. Additionally, a simplified one-day training for junior staff (non-clinicians) was used as part of an unsuccessful attempt to incorporate the UP-C into the therapeutic milieu (see section on *Incorporating UP-C into therapeutic milieu*).

5.4 Participants

This study enrolled 19 children from the group home. Children's ages ranged from 9-13 with a mean age of 11. Eleven youth (58%) identified as male, seven (37%) identified as female and one (5%) did not specify a gender. The most common ethnicities were European (42%) and Indigenous (37%). Fifteen children (79%) lived in the group home at the start of treatment, while the remainder were living in the community with caregivers as part of their transition plan. Three youth (16%) had no caregiver involvement in their life. Fourteen youth (74%) were in the legal custody of the provincial child welfare authority. Child maltreatment scores were examined via chart review with the Maltreatment Classification System (Barnett et al., 1993), which showed high rates of exposure to maltreatment: 84% Physical Neglect (Failure to Provide), 74% Physical Neglect (Lack of Supervision), 74% Emotional Abuse, 58% Physical Abuse, 42% Moral/Legal/Educational Maltreatment, and 32% Sexual Abuse.

The study also enrolled 18 caregivers who were 32-60 years old with a mean age of 45. Thirteen caregivers (72%) identified as female while five (28%) identified as male. In noticeable contrast to the youth, 15 (83%) of caregivers self-identified with European ethnicity and only one (6%) self-identified as Indigenous ethnicity. Caregivers included a mix of biological parents (17%), adoptive parents (28%), foster parents (28%) and extended family (28%). Over half of the caregivers reported economic stability with 60% saying they "never" run out of money at the end of the month.

5.5 Data Collection and Analysis

5.5.1 Quantitative Data on UP-C Fidelity and Effectiveness

After each therapy session, fidelity to the core aspects of the intervention was rated by at least one clinician and at least one researcher. The fidelity forms identified 2-7 core components per session that clinicians were expected to cover. Youth, caregivers, and staff completed psychometric surveys designed to assess the severity of common psychiatric issues (e.g., anxiety, depression) at baseline, mid-treatment (2 months) and end-of-treatment (4 months). We estimated the percentage of clients showing a treatment response with the Reliable Change Index (RCI; Ferguson et al., 2002).

5.5.2 Qualitative Data on UP-C Implementation and Adaptation

A focus group was conducted with 16 clinicians after the initial training to understand how the needs of clients could be addressed by the UP-C, and how the UP-C may need to be adapted to fit with agency philosophy and workflow. After conducting three cohorts of UP-C in the group homes, an additional round of qualitative interviews was conducted with seven clinicians who facilitated UP-C in the group homes. Focus groups and interviews were audio recorded and transcribed verbatim. The text was analyzed using the Consolidated Framework for Implementation Research (Damschroder & Lowery, 2013) to identify key barriers and facilitators towards implementation of the UP-C.

5.6 UP-C Fidelity and Effectiveness

Fidelity data showed that the UP-C could be administered in a way that was faithful to the core components of the manual while also being adapted to the needs of the group home. Averaging across all raters (clinicians and researchers), the percent of concepts covered was 88% for the youth sessions and 89% for caregiver sessions. Item-level agreement between researchers and clinicians was 89%

indicating that the fidelity ratings had strong inter-rater reliability.

All youth and caregivers completed UP-C therapy, suggesting the program was highly acceptable to participants. Youth showed improvements over time in key psychiatric domains, providing preliminary evidence for effectiveness of the UP-C in group homes. Severity of the youth's Top Problems showed steady reductions over each week of treatment. Comparing the surveys at post-treatment to pre-treatment, youth showed reduced depression, reduced anxiety, reduced neurosis, reduced life difficulties, reduced disruptive behavior, reduced sleep impairment, and improved emotion regulation (see Table 2). Caregivers also experienced changes in themselves over the course of treatment, reporting reduced emotional dysregulation and increased emotional self-efficacy (see Table 3).

Instrument / Respondent	% Responding (Responders / Total)
Child Depression Inventory 2 Short Form	
Youth	37% (7/19)
Caregiver	21% (3/14)
Staff	60% (6/10)
Screen for Child Anxiety Related Disorders (41 item)	
Youth	42% (8/19)
Caregiver	21% (3/14)
Staff	70% (7/10)
Children's Automatic Thoughts [measures neuroticism]	
Youth	47% (9/19)
Strength and Difficulties Questionnaire – Total Difficulties	
Caregiver	29% (4/14)
Staff	40% (4/10)
Disruptive Behavior Rating Scale	
Caregiver	14% (2/14)
Staff	30% (3/10)
PROMIS Sleep Related Impairment (4 item)	
Youth	31% (4/13)
Emotion Regulation Checklist – Emotion Regulation	
Caregiver	14% (2/14)
Staff	30% (3/10)

Note. Percent responding was calculated using the Reliable Change Index.

Table 2. Change in Cognition and Behavior Among Youth

Instrument / Respondent	% Responding (Responders / Total)
Difficulties in Emotion Regulation Scale	
Caregiver	70% (7/10)
Emotional Self-Efficacy Scale	
Caregiver	50% (5/10)

Note. Percent responding was calculated using the Reliable Change Index.

Table 3. Change in Cognition and Behavior Among Caregivers

5.7 Successful Adaptations

See Table 4 for descriptions of the successful adaptations.

5.7.1 Inclusive Language: “Caregiver” Instead of “Parent”

The term “parent” may not be fitting for many of the youth in group homes, as many children in these settings have limited or no contact with a biological parent. In the three cohorts run as part of our feasibility study, only three of 19 youth had a biological parent participating in UP-C with their child. Instead of using the term “parent,” staff substituted the term “caregiver” as an inclusive way to describe all the adults in the child’s life who provide care for them, including facility staff.

Description	Rationale	Usage by Cohort (of 3)
Inclusive language: “caregiver” instead of “parent”	Increase tolerability for youth	All
Modified examples of difficult emotions	Increase relevance for youth	All
Incorporating elements of the UP-C irritability module	Increase relevance for youth	All
Additional staff support for clinicians during UP-C sessions with youth	Increase tolerability and effectiveness for youth	All

Additional staff support for youth and caregivers to practice UP-C content outside of sessions	Increase effectiveness for youth and caregivers	All
Conducting caregiver sessions online	Increase attendance for caregivers	All (started halfway through cohort 1)

Table 4. Successful Adaptations made to UP-C for Group Home Environment

5.7.2 Modified Examples of Difficult Emotions

Clinicians delivering the UP-C noted that they needed to modify many of the examples used in the manual to fit with the lived realities of youth in the group home environment. One clinician noted: the “UP as it was presented was talking about phobias or being afraid of spiders, and that’s not really something that’s a concern...our kids are dealing with some pretty intense trauma, some pretty intense emotions. So, we were successful and able to shift it to be specific to our clientele and our kids and what they needed it for.” For instance, the UP-C manual discusses prospective anxiety with an example of a youth who is nervous about playing in an upcoming sports game because they are worried that they will play poorly. However, group sports participation is uncommon among youth in group homes. Instead, clinicians used an example of a youth seeking a permanent home who would soon move in with a caregiver and was nervous that the placement would fail if they could not find a way to successfully live with their caregiver.

5.7.3 Incorporating Elements of UP-C Irritability Module

Clinicians utilized certain strategies that are part of a UP-C adaptation focusing on pediatric irritability (Hawks et al., 2020). Staff noted that hostile attribution bias was common among youth and caregivers. Specifically, both youth and caregivers often assumed that their counterpart was engaging in inappropriate

behavior in a deliberate attempt to be annoying. The strategies from the UP-C irritability module were used to counter hostile attribution bias. For youth, clinicians used a cartoon character called “Out to get me Owen” as the personification of a child who thinks people do mean things to him just to bother him. Youth were encouraged to identify the “thinking traps” that Owen falls into and then consider whether they might be doing something similar in their own lives. For caregivers, staff emphasized mindfulness and empathy to help the caregiver with self-regulation when their child was misbehaving. Clinicians also taught caregivers how to use praise and rewards strategically to shape their child’s behavior.

5.7.4 Additional Staff Support for Clinicians during UP-C Sessions with Youth

The UP-C manual recommends two clinicians co-facilitate group sessions. For the group sessions with youth, junior staff (or practicum students) provided additional behavioral supports for clinicians. Junior staff would sit with the youth and keep them focused on the lesson and discussion. When a youth became overwhelmed or dysregulated, the junior staff would remove the youth from the room and work with them one-on-one to help them calm down so that they could re-enter the session without disrupting the other participants. Including junior staff in UP-C sessions also had the added benefit of teaching junior staff some of the UP-C content so that they could continue to promote UP-C skill use with the youth outside of the session.

5.7.5 Additional Staff Support for Youth and Caregivers to Practice UP-C

Content Outside of Sessions

By design, floor staff at the group home were supposed to help youth with their UP-C homework and to work on UP-C skills with the youth outside of the

session. Likewise, family support workers were asked to help caregivers practice and utilize UP-C skills outside of the session. Interviews and focus groups with staff indicated that this work did occur and that it was perceived as a beneficial way to reinforce content, especially because the youth and caregivers often had limited interactions and therefore would not have been able to practice UP-C content with each other consistently.

5.7.6 Conducting Caregiver Sessions Online

When the study began, caregiver sessions were conducted in-person once per month on Saturday mornings and multiple sessions of content were covered in the same day. This modification was done to increase the feasibility of caregivers to attend UP-C sessions. However, the COVID-19 pandemic arrived during the first cohort and temporarily moved all sessions online. Even when physical distancing rules were relaxed, weekly group sessions via videoconference remained the standard means for conducting caregiver sessions. Most caregivers in this study had jobs and multiple children in the home, so caregivers noted it was easier for them to attend sessions if they did not have to commute to the group home. However, staff at the facility continued to believe in the power of in-person sessions to build connections with other caregivers and to facilitate collaboration between youth and caregivers. While online caregiver sessions were viewed favorably, staff were unanimous in their opinion that conducting youth sessions online (which had been required at some points during the COVID-19 pandemic) was a bad idea because the youth were more distracted and more difficult to engage over videoconference.

5.8 Unsuccessful Adaptations

See Table 5 for descriptions of unsuccessful adaptations.

Description	Rationale	Usage by Cohort (of 3)	Reason Adaptation not Successful
Reframing UP-C “Top Problems” as “Top Priorities”	Increase tolerability for youth	1	Difficult to interpret scores when using Top Priorities
Having family support workers facilitate one-on-one UP-C sessions with caregivers in-home	Increase attendance for caregivers	1	Hard for staff to find time to work on UP-C in home. Adaptation no longer needed once caregiver sessions moved online.
Incorporating UP-C into therapeutic milieu	Increase effectiveness for youth	3	Different milieu model already in place. High turnover rate for floor staff implementing milieu.

Table 5. Unsuccessful Adaptations made to UP-C for Group Home Environment

5.8.1 Reframing UP-C “Top Problems” as “Top Priorities”

Prior to implementation, some staff expressed concerns that the use of Top Problems for weekly improvement tracking (as a standard part of the UP-C) would pathologize the children and reinforce the notion that there is something wrong with them. Since the therapeutic milieu is designed to be strengths-based and goal-directed, staff initially wanted to use a Top Priorities system rather than a Top Problems system. The Top Priorities system proved to be unfeasible for several reasons: sometimes the goals were outside of the scope of UP-C (e.g., “to live at my grandparent’s house”) and sometimes the goals were so vague that it would be hard to quantify progress (e.g., “learn to deal with grumpiness”). The rating scale for Top Priorities (0-8 Likert scale) was uninterpretable because it was unclear how to rate the strength of a priority and whether an increase or a decrease was considered progress or regression. Once the team reverted to the manualized suggestion of using Top Problems (e.g., “I get really mad and say things I don’t mean and throw things at my caregiver”), it became easier to rate these constructs and to track

progress. In post-implementation interviews, staff said that they found that their original concerns about using Top Problems were unfounded and that youth did not seem bothered by generating and rating these constructs.

5.8.2 Having Family Support Workers Facilitate One-on-One UP-C Sessions with Caregivers In-Home

Since the initial plan was to have only one caregiver session per month, family support workers were going to teach caregivers UP-C content during in-home visits. However, no dedicated and protected time was provided to family support workers to teach UP-C content, and it proved difficult for staff to add this additional content onto their already full agendas of tasks to do with caregivers. The eventual change to utilizing weekly, online caregiver sessions, meant that in-home sessions were no longer necessary to ensure that caregivers learned all the content.

5.8.3 Incorporating UP-C into the Therapeutic Milieu

After the success of the first and second cohorts of UP-C, staff and researchers attempted to incorporate the UP-C into the therapeutic milieu for the third cohort. A member of the research team (author DL) conducted a full-day training for each of the two main shifts at the group home so that they would understand all the core concepts and how to work with youth on the content. The training was more practical than theoretical because the goal was to have staff help the youth practice skills they had already learned. Fully incorporating the UP-C into the milieu proved unfeasible because of the high turnover rate for junior staff, competing demands on staff time as well as role confusion about who was responsible for utilizing the UP-C. The difficulty of getting junior staff to utilize the UP-C was summarized by one manager as, “New frontline child and youth care

counselors, they almost get this tunnel vision: it's the shift in front of them, it's the core counselling skills they're learning, it's managing and supporting the kids in the moment. Things like a CBT type of curriculum is a bit higher-level for some people, and so it's not even on their radar."

5.9 Barriers to Implementing UP-C in Group Home

5.9.1 Capacity of Youth: Trauma Exposure and Cognitive Abilities

Years of exposure to abuse and neglect mean that many youths in group homes often are delayed in their psychosocial development. Their logical reasoning may be impaired, which can make it difficult to use certain UP-C skills like problem-solving and cognitive flexibility. Youth often had difficulty with reading and writing, making completing UP-C homework difficult. Many of the youth also displayed particularly high anxiety combined with low distress tolerance, making it difficult for them to participate in groups due to escalating rapidly and becoming disruptive. When a youth first arrived in the group home, one clinician summarized their concerns regarding the youth's readiness for the UP-C: "They're needing to integrate their sensory and regulatory components first, before they can even get to more traditional talk-based type therapies." At this early stage in treatment, a different clinician noted, "They would be much more suitable to equine or play therapy. That would be the beginning place for them."

5.9.2 Capacity of Caregivers: Burnout and Complex Relationship with Youth

Caregivers of children in group homes are often suffering from significant burnout, may be struggling with their own mental health issues and may not have a strong bond with the youth, all of which make it difficult to support a youth participating in the UP-C. If the caregivers are adoptive parents, foster parents, or

extended family, they may not yet know the child very well and it may take time to build a trusting relationship. Even if the biological parent is a caregiver, the child-caregiver relationship is likely strained. Caregivers are often dealing with their own mental health issues or socio-economic challenges, making it difficult to provide support for a child with high needs. One family worker described the necessity of repairing the youth-caregiver relationship to lay the groundwork for starting UP-C: “typically when kids first come into the program there’s a high degree of burnout from our families. So, we have some healing time for stabilization that we typically do. Stabilizing behaviorally for the child and also just giving caregivers time because there’s a high degree of burnout. And then we work on relationship pieces. So, we slowly work on healing that relationship and [once] they’re feeling like they can work together, now [we] move forward. So, they have to get to a place where they both feel safe, and they both feel like they can move forward. So, the child feels like they’re more in control, the caregivers feel like they’re more in control.” A trusting relationship may be critical to the success of UP-C because the treatment utilizes (among other techniques) behavioral exposures, which deliberately encourage youth to approach uncomfortable situations to build their distress tolerance.

Youth with no caregiver involvement in their life faced an additional barrier to participating in the UP-C because the UP-C involves the caregiver as much as the child. To rectify this, a staff member at the facility would take on the role of the caregiver in helping the youth complete their therapy homework and practice skills and exposures throughout the week. Staff had mixed opinions about whether the effectiveness of the UP-C was diminished for children without a caregiver. One staff member noted that she felt a particular youth was less engaged in the UP-C program because her biological mother chose not to participate. Another clinician was unsure

about enrolling youth without a caregiver, asking “Does this inadvertently or indirectly reinforce that loneliness, isolation, lack of family connection?” This staff member felt that they should have a serious discussion with the youth before enrolling them without a caregiver, suggesting, “I would for sure want to sit down with whoever that person is and go, ‘So, we really think this group could go well. However, one of the things I’m worried about is that it’s gonna be your keyworker [a staff member] and lots of the other kids are going to have parents.’ Like, to at least give them an opportunity to discuss that and then maybe check-ins throughout the group.”

5.9.3 High Turnover Rate for Junior Staff

Considering that most youth lived in the group home during treatment, it was critical for staff to be involved in helping youth practice UP-C skills and work on emotion exposures outside of treatment. In the manualized treatment, this role would be filled by parents who were also UP-C participants. In addition to training clinicians (senior staff) to facilitate UP-C sessions, the study team also provided a shorter training for floor workers (junior staff). While the senior staff were long-term employees with significant clinical training and experience, the junior staff (which comprise the bulk of the workforce in group homes) had less clinical training and often did not stay in the role for very long, as it was an entry-level position serving as a steppingstone into the field of child and youth care. This meant that it was hard to maintain a critical mass of knowledge about the UP-C that would allow the floor workers to consistently and effectively work on UP-C skills with youth throughout the day. One manager noted the difficulty of equipping floor staff with the skills to use the UP-C: “we have a lot of young staff that it’s their first role out of school, and they’re already pretty anxious and overwhelmed...I do think UP requires a level of specificity and clinical skills and knowledge that we shouldn’t try to underestimate. Maybe

preserve it a little bit for a couple of key roles.” Overall, management felt that they needed to prioritize training the junior staff on utilizing the therapeutic milieu, since this was considered fundamental to the treatment plan whereas the UP-C was considered an ancillary aspect of treatment.

5.10 Facilitators to Implementing the UP-C in the Group Home

5.10.1 Detailed Knowledge of Youth’s Background, Strengths, and Weaknesses

One advantage of implementing the UP-C in a group home (relative to community practice) is that clinicians administering the UP-C are likely to have a relationship with the youth and an in-depth knowledge of the skills they need to build. In fact, staff felt that their knowledge and understanding of the children was sufficient such that they did not get much value from the creation and monitoring of Top Problems (see Weisz et al., 2011) which is a core element of goal setting and progress monitoring in the UP-C. One clinician noted: “Because it’s a treatment program, they’re living there, we’re talking about their goals, they’re focused on these goal areas. They know what their goals are and how to achieve them.”

5.10.2 Strong Clinical Need for Family Supports during Transition into the Community

A major reason that group home staff were open to implementing the UP-C was because the most difficult phase of treatment is the transition out of the group home and into the community. As one staff member noted: “I think that’s often where the rubber hits the road, where most our crisis calls come in... we see that being the time where things break apart - foster homes or kinship homes - where the behaviors come back and it’s really intense and they get very overwhelmed.” The UP-C was

primarily used as a support for youth and families during the transition process. Because the UP-C is highly collaborative between youth and caregivers, staff believed it was beneficial to have families work on UP-C skills together to resolve problematic behaviors as youth were moving home. One family support worker summarized the optimal timing as, “I think the best time [to use UP-C] would be just before kids are thinking of transitioning [into the community] and then we can continue to incorporate the learnings of the UP-C as we transition.”

5.10.3 Philosophical Compatibility between UP-C and Therapeutic Milieu

Staff noted a high degree of philosophical compatibility between the standard therapeutic milieu and the UP-C, which encouraged uptake of the UP-C (the therapeutic milieu at Hull Services is based on the *Neurosequential Model of Therapeutics*; Hambrick et al., 2019; Perry, 2019). For example, one staff member drew a parallel between the types of emotion exposures utilized by the UP-C and the behavioral strategies used by the milieu: “When you were talking about the exposures, that’s really small amounts that they can slowly get used to over time which kind of makes sense, because to me that’s the same thing. We do the same thing with emotional regulation. It’s intense emotion but how can we, in small amounts, start to get used to dealing with these difficult emotions? Because that’s exactly what we do: practice, practice, practice, practice. So, exposures are similar to that.” When asked if they felt the UP-C was a trauma-informed approach, staff consistently said that a trauma-informed lens is less about the therapy content and more about the delivery: “our trauma-informed approach is often more about the body language, facial expression, tone of voice and quality components that the adults need to be mindful of.” Overall, the elements of philosophical compatibility between the UP-C and the milieu made it much easier to establish staff’s buy-in of

the benefit of the UP-C and willingness to incorporate the UP-C into existing workflows.

5.10.4 Staff and Client Satisfaction with Initial Cohorts

Based on the qualitative data, staff and clients agreed that the perceptions that the program was successful had a major impact on the decision to continue with offering and evaluating the UP-C in the program. Staff felt that youth rapidly began using core UP-C skills: “I found an increased use of certain coping tools...but also a bit of that confidence piece. I think that comes from doing the ladders, being able to accomplish a particular goal or on their way to accomplishing a particular goal.”

Staff felt that caregivers also benefited from gaining a new repertoire of language to understand what their child is going through and to learn new skills to use to help their child. Caregivers also appeared to benefit from meeting other caregivers who were going through similar struggles. However, staff reported consistent challenges with implementing exposures at the end of the program, which involve deliberately exposing children to stressful situations to work on emotion regulation. One facilitator summed up the experience of caregivers as: “I’ve had a lot of positive feedback from parents that they feel like they learned a lot, even though the exposures were the biggest challenge for all the parents. They found that very difficult. They loved all the learning and the things that they learned leading up to the exposures and then somehow, we get to the exposures and that they found very challenging. That’s pretty much consistently what I saw. But did benefit. And would practice.”

5.11 Key Findings

After three rounds of implementing, modifying, and evaluating the UP-C in the group home, staff and researchers felt that they had arrived at a final version that achieved implementation goals because it had high fidelity to the manualized treatment, was feasible for staff to implement, and was acceptable to families to participate. The additional resources afforded by the group home environment were leveraged to offset the additional challenges of working with a complex population. Youth and caregivers were dealing with significant trauma, mental illness, and attachment issues, all of which made it more difficult to administer a CBT approach that requires extensive collaboration between youth and caregivers. However, staff were able to partially mitigate these issues through their pre-existing knowledge of, and relationship with, the families and by the fact that group homes have many staff available to provide one-on-one support. If a youth had no caregiver available, a staff member helped reinforce and practice UP-C content.

The optimal timing for beginning the UP-C was identified, which was supporting youth who were transitioning from living in the group home to a placement in the community with caregivers. When youth first arrived at the facility, the staff expressed that youth were not yet suitable for the UP-C because of the extent of their behavior dysregulation and their relationship with caregivers (if existing at all) was highly strained. Once the group home staff had time to stabilize the youth and begin to (re)establish the youth-caregiver relationship, staff would talk to the family about taking part in UP-C. Staff considered the ideal time to start UP-C as being just prior to starting the community transition. However, it was not practical to optimize the timing of UP-C for every family since the UP-C is a group therapy and each family was on a different treatment timeline.

Meta-analyses comparing outcomes for children placed in family foster care versus residential care indicate that overall, youth in family foster care experienced fewer internalizing and externalizing problems as well as better perceptions of care (Li et al., 2019). However, family foster home placement may not be appropriate for youth in acute distress and successful placement requires (among other factors) that the youth is able to integrate safely into the home (Li et al., 2019). Research suggests that youth with mental and behavioral health difficulties experience higher likelihood of placement instability and are less likely to display improved psychological adjustment in their foster home, compared with youth without mental and behavioral health difficulties (Barber et al., 2001; Newton et al., 2000). Furthermore, foster home placement instability can negatively impact children's development of emotion-regulation and contribute to social-emotional and mental health difficulties (Fisher et al., 2006; Lewis et al., 2007; Newton et al., 2000). These patterns highlight the importance of providing youth with additional mental and behavioral health supports, such as the UP-C, to promote smooth transitions and sustainable placements.

6 Implications for Implementing Cognitive Behavioral Therapies in Group Homes

Research on mental health care in group homes finds low rates of milieu-based program models, which were developed for group homes and are considered best practice; instead, programs often implement stand-alone interventions that were delivered for other settings and may be difficult to implement in group homes while maintaining fidelity to the original treatment model (James et al., 2015; James et al., 2017). Research on such practices is highly limited and adaptations are often made to preexisting treatments without empirical study, contributing to limited

understanding of the factors that promote successful implementation and which adaptations, if any, may be warranted to promote effectiveness of evidence-based practices within the group home setting (James et al., 2015; James et al., 2017).

Successful implementation of an evidence-based program into an existing therapeutic program requires extensive planning and monitoring. As a starting point, we recommend engaging in interviews and offering training widely within an agency so that diverse staff have the opportunity to learn about the program and consider whether it will be helpful for their clients and fit within their existing workflow. This aligns with Mendel and colleagues' (2008) Framework for Dissemination which highlights that successful implementation of evidence-based treatments begins with an adoption phase in which key stakeholders collaborate to identify the needs and preferences of the organization, a treatment is selected, and buy-in to adopt this practice is established. Regular consultations with staff before, during, and after implementation is critical to understanding possible needs for adaptation and to evaluate which adaptations were successful. Utilizing an existing framework to structure implementation, such as the Consolidated Framework for Implementation Research (Damschroder & Lowery, 2013), can help to understand the factors that are facilitating or blocking utilization of the innovation. As the UP-C is a transdiagnostic approach to CBT, the findings from the present study may be of broad utility for clinicians and researchers attempting to implement CBT in group homes.

Many aspects of adapting the UP-C to make it trauma-informed may not be about adapting any specific content or lesson; rather, it is about being aware of - and compassionate towards - the unique life circumstances of participants. Because group homes have a major influence over the lives of youth in their care, it is critical

that these facilities accurately identify which youth are good fits for the UP-C or other evidence-based programs.

Clinicians should carefully consider the caregiver situation of potential youth participants. The fact that some youth have strained relationships with parents, some are developing new relationships with new caregivers, and some have no caregivers at all, is a sensitive topic for these youth. To get the most benefit from the UP-C, effort should be made to enable youth to have a strong relationship with a caregiver who can help the youth learn and practice the content. A staff member can be utilized as this caregiver, but staff need to be mindful of making the youth feel included and supported in the program.

Leveraging the additional staffing resources of a group home is critical to implementing the UP-C, but this is challenging given the high turnover rate at group homes. Indeed, a survey of 75 American group homes found that the top two barriers to implementing evidence-based care were adequately training staff on an intervention and managing staff turnover (James et al., 2017). In the present study, after trying a few different options, management settled on the decision that senior staff would be trained to facilitate and utilize the UP-C because this group has a relatively low turnover, but it was not feasible to train junior staff in the UP-C given their higher turnover. While efforts should be made to maintain staff, sustainable implementation efforts must consider the likelihood of turnover, and programs can benefit from emphasizing the training of long-term employees to be future trainers of new staff within their organization.

Milieu-based treatment, where every aspect of a child's life is designed to build skills and be therapeutic in some way, is considered the best practice for children's group homes (AACRC, 2014; Houston et al., 2010; Huefner & Ainsworth,

2021; James et al., 2017; Whittaker et al., 2016). Incorporating the UP-C into the therapeutic milieu was challenging in the present study, in part because the group homes already had a milieu-based treatment that staff were satisfied with (the *Neurosequential Model*) but also because UP-C was utilized at the end of treatment, meaning that, at any given time, most youth in the group home had not been exposed to the UP-C. However, other teams have adapted the UP-C for the therapeutic milieu when working with youth with significant behavioral and mental health issues (e.g., in a partial hospitalization program; Kennedy et al., 2022). Given the flexibility of a transdiagnostic intervention like the UP-C, it can be deployed in dynamic ways within group homes so that it complements the needs of clients, staff, and organizations.

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**HEAL PA: The Movement to Make Pennsylvania a Trauma-Informed and
Healing-Centered State**

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Abstract

In 2019, Pennsylvania Governor Tom Wolf signed an executive order to create the Office of Advocacy and Reform and empowered that office to make Pennsylvania a Trauma-Informed State. Using the core principles of community organizing, that new office brought together experts, stakeholders, and community leaders to create both a plan and a movement. The results have been a nationally recognized plan, a large and growing coalition, and an impressive list of early wins and progress with more to come. The creation of the Trauma-Informed PA Think Tank, the Trauma-Informed PA Plan, HEAL PA, and the Resilient PA website have been a testament to the power of collective impact and community action.

Keywords: Trauma-Informed Care; Healing-Centered; Trauma-Aware; Trauma-Sensitive; Trauma-Informed PA; HEAL PA; Resilient PA; Trauma-Informed State; Trauma; Resilience; Adverse Childhood Experience (ACEs); Philadelphia ACEs Study; Governor Wolf; Office of Advocacy and Reform (OAR)

1 The Beginning

On July 31st, 2019, Governor Tom Wolf signed the “Protection of Vulnerable Populations” executive order (“Executive Order - 2019-05- Protections of Vulnerable Populations,” 2019), thus creating the Office of Advocacy and Reform (OAR), an Executive Director and a Child Advocate to staff the office, and the mandate that Pennsylvania become a trauma-informed state. The order also created a Council on Reform to create initial recommendations for this new office. That council came up with 121 recommendations covering issues for children, adults with disabilities, seniors, and the LGBTQ+ community just to name a few. I'm a firm believer that if you have 121 priorities, you probably won't get very much done.

I didn't join the OAR as its first Executive Director until December of 2019. What drew me to the office was really one line within the executive order. That was the line about this office working to make Pennsylvania a trauma-informed state. That struck me as the true soul of the office, because if you could get that done, if Pennsylvania was truly healing-centered, then those 121 recommendations would just be the natural course of action for a commonwealth with a changed perspective on trauma and human service.

At that point, I had been doing anti-poverty work for the bulk of my career and had worked with vulnerable populations since I was a teenager. Over and over again the role that chronic and toxic stress and trauma were playing in the lives and outcomes of people I served in three very different states was just too much to deny. So, the opportunity to get the state focused on trauma and healing, even knowing the Governor only had three years left before he was term-limited at that point, felt like too good an opportunity to miss. I felt certain it was possible to get a statewide trauma-informed movement launched to set the Commonwealth on that path, and to

make enough progress that it could be sustainable regardless of who the next governor might be.

The main reason I thought all of this was possible was because I see that these issues around trauma as intertwined with so many of the negative outcomes and community ills that have been with us since time immemorial: poverty, crime, substance use, mental illness, suicide, gun violence, domestic violence, child abuse, and on and on. In a career of doing anti-poverty work, working at two different federally qualified health centers, and even early in my career working with children and adults with intellectual and physical disabilities, I would see trauma over and over again feeding into this cycle of hurt people hurting people. Another way to think about this is through the public health construct of a syndemic, where you have a set of linked health problems involving two or more afflictions, but they're interacting with each other. There's this overlap that creates a sort of feedback loop from one trauma or stressor into another. So, we created this monster of a Venn diagram (see Figure 1 below) to show this intersection of how all of these different issues that we tend to work on in silos. Our funders, especially government agencies, certainly have tended to see these issues as unrelated, and have contributed to the silos by separating the funding for each issue and preventing the “comingling of funds.”

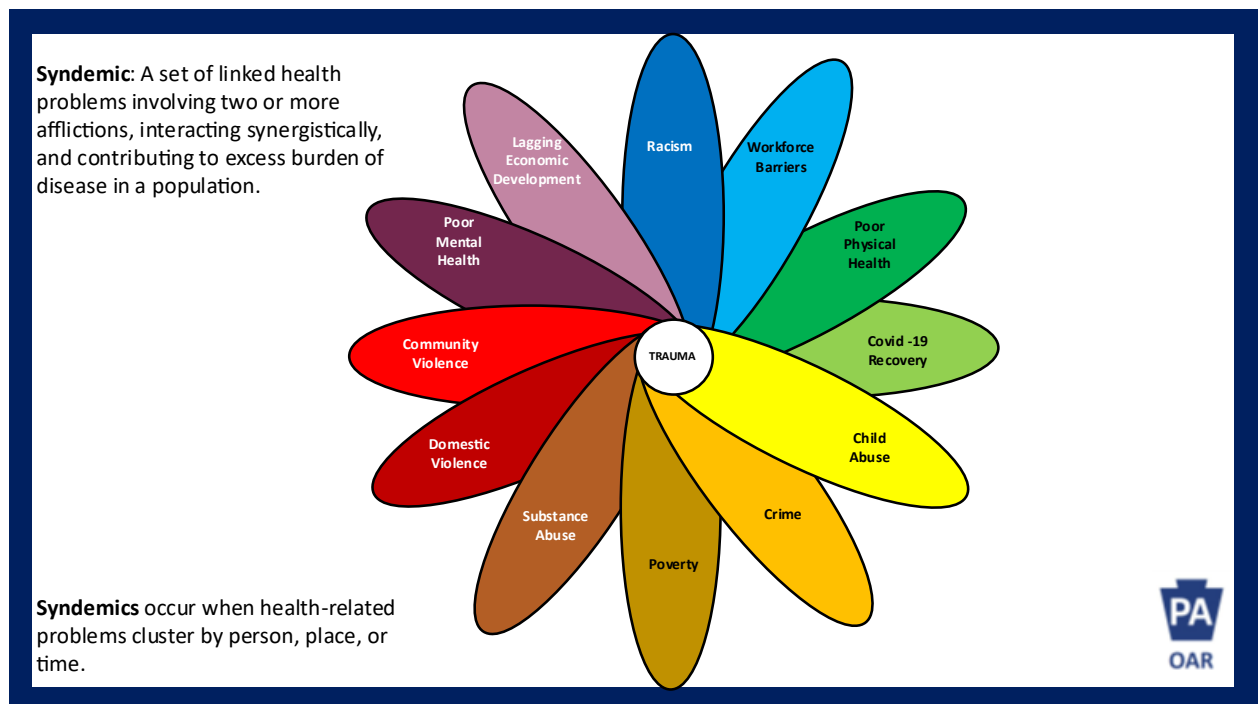


Figure 1: Venn Diagram Showing the Trauma Syndemic

In doing the work more globally and having lived through trauma and poverty as a child, I had always seen how all these events and experiences were connected. These historically siloed approaches have failed to move the needle for decades. While the movement to be trauma-informed and healing-centered may not be a silver bullet, I believe it's the closest thing we're ever going to have in terms of trying to reduce these negative outcomes in our communities.

2 The Trauma-Informed PA Think Tank

Recognizing that starting the work of becoming a trauma-informed state was probably the most impactful thing we could do as an office within state government in the time we had, we got to work right away. In January of 2020, at the very end of the month, I put out a call for a think tank. The very first thing I wanted to do was surround myself with people who knew more about trauma than I did. My perspective was very much focused on how trauma was interacting with people living below the

poverty line, but I knew that it's much broader than that. So, we put out a call for people to join a volunteer think tank, but we wanted it to be clear that this was serious business and not just a vanity posting for the usual suspects. Applicants had to send in their resume and go through an interview process. My immediate thought was that I'd be lucky if ten people signed up to go through all that just to volunteer for four months to do this work with me.

To my surprise, we got 68 applicants. Out of those 68, after doing the interviews and looking at and scoring resumes, I came to the conclusion that every single one of the applicants could have served on a think tank about trauma or adverse childhood experiences. It was an amazing group of people. I immediately had to change my expectations on the structure of the think tank.

Again, I originally thought I'd be lucky if the group was made up of ten people. Because of the quality and number of applicants, I immediately had to expand the group to 25 people. I knew that change was necessary by the time I had started the interviews.

If you've been paying attention to the timing of all of this, you can probably guess the next unexpected factor that occurred. I was in the middle of conducting the interviews when the COVID-19 pandemic sent us all home in March of 2020. Thankfully, I had always intended to form a think tank that was geographically diverse in addition to being ethnically diverse and from diverse fields and backgrounds. I didn't want to just have a group that was made up of people from Philadelphia, Pittsburgh, and Harrisburg. I wanted suburban and rural populations represented in this group in addition to people from all the big universities and urban centers. As a result, the think tank was always going to be virtual. All of the interviews were scheduled as phone interviews from the start, and our eventual

meetings had already been set as Zoom meetings. So, when the pandemic hit its first wave, we were still able to stick to our timeline.

I actually spent the process more worried about the work / life balance and the behavioral health of all the members with everything that was happening all around us. That includes my own mental health. Some of our members were on the front lines of responding to COVID-19. I see it as a testament to the quality of these incredible human beings that we were able to start our work on time and, maybe more importantly, finish on time in June of 2020. For me at least, working on the plan gave me something on which to focus that I could control in a world that had been turned upside down and had left me, for one, feeling helpless and afraid. It was cathartic work. No matter what kept us on course, that timeline was crucial in my eyes due to the very short timeframe within which we knew we had the support of the Governor's Office.

The group spent its time focused on six priorities (see Figure 2 below). The first was level-setting and defining terms on how we talk about trauma. We found that the definitions and language were all over the place. Some people were going to one workshop for an hour and calling themselves trauma-informed, while other organizations had turned their entire set of policies and their corporate cultures upside down to become what they saw as trauma-informed. Everyone was using the language differently. We wanted to make sure that we had common language.

Second was setting mission, vision, and values for the effort. If people were going to join this movement, we thought it was important that they know what they were signing up for. We had to answer the key questions. Why is this work important? What is our vision for the future for Pennsylvania? What are our expectations of those who join us?

Third was building a network to connect community-based, grassroots movements across the Commonwealth. We certainly recognized that we were late comers to the game as a state government entity. We knew that communities have been doing this work before the Governor's executive order, in some cases for decades, and we wanted to value that work. I especially didn't want it to feel like we were trying to come in and tell people what to do or to take that work over because we were from the Governor's Office. Rather, we wanted to support the work that had already been done and connect its champions to each other. It was also important to make sure that folks that were just starting out and wondering, "How do I become trauma-informed in my community?" or, "How do I get my community, my county, or my municipality to become trauma-informed?" would have others that they can connect with who are further along than they were.

Fourth was prioritizing changes at the state level to affect culture, policy, and practice. That culture one is a big deal. I'm a believer in the statement that culture eats strategy for breakfast. If you don't embed these practices in the culture of an organization, including state government, then it'll just be another training; another fad that will fade away to make room for whatever the next thing is that people are making noise about. To be clear, culture is what everyone on a team does when the boss isn't looking. That can either be positive or negative. For it to be positive, that takes all of us working intentionally toward that end. If we work together to build a trauma-informed, healing-centered culture, then our teams are going to be healing-centered not because they're told they have to be, but because we as a team have decided that's just who we are.

Fifth was our focus on healing from the trauma of a major disaster like COVID-19. We weren't thinking in that direction in the very beginning of planning for

the think tank, but certainly by the time we got the group together in April of 2020 we were in the throes of the pandemic and seeing the stresses and traumas that it was creating for everyone. That context turned our focus from survivors of specific traumas to everyone.

Finally, we focused our time together on healing the damage of racism and historical trauma. That actually was part of our initial planning from the beginning, but the murder of George Floyd happened while we were meeting as a think tank and added an urgency to that work. The intersectional nature of the pandemic trauma with long-standing racial and historical traumas was clear to us as we did our work. Each seemed to be feeding into the other, making the reaction to each new stressor or tragedy exponentially harder to process in a healthy way.

The Six Priorities of The Trauma-Informed PA Think Tank

Virtual meetings from March through June 2020 focused on:

- 1. Defining the terms we would be using as a commonwealth to ensure we were all speaking the same language.**
- 2. Setting mission, vision, and values for the effort.**
- 3. Building a network to connect and support community-based, grassroots movements across the commonwealth.**
- 4. Prioritizing changes at the state level to affect culture, policy, and practice.**
- 5. Healing from the trauma of a major disaster like the Covid19 pandemic.**
- 6. Healing the damage of racism, communal, and historical trauma.**



Figure 2: The Six Priorities of the Trauma-Informed PA Think Tank

From April into June the think tank met and worked through these six focus areas. I facilitated virtual brainstorming sessions, small “table” discussions in Zoom breakout rooms, big group meetings, and reviews of our summarized notes. Armed with these notes in mid-June, I sat down to write what would become the Trauma-Informed PA Plan in mid-June with a self-imposed deadline of finishing a draft that could go to the Governor in July and have a final, public plan released by the time we reached the one-year anniversary of the Governor’s executive order.

We wanted a plan that was both aspirational and actionable. To get there, part of the editing process involved putting the draft plan in front of experts within multiple state agencies so they could examine our initial goals. We wanted to know if we had gone far enough. In some cases, we actually made our recommendations even bolder as a result of this review because we found that the state had already started some related strategy. Some things were further along than we thought while we were brainstorming.

By mid-July 2020 we put the plan in front of the Governor. He read through the plan, had us present it to the cabinet, and approved it without a single suggested edit. I think that fact speaks both to all of the hard work of the think tank and agency experts as well as to his commitment to doing this work even when it pushed for the government to do more and live up to its best ideals. The result was a plan that was hailed as a national “exemplar” by both PACES Connection and the Campaign for Trauma-Informed Policy and Practice.

3 The Trauma-Informed PA Plan

The plan itself is focused on three key pillars that mirrored our focus areas during the think tank’s work. Pillar one is the improvement of policy and practice within state government. What are we doing to change the culture of state

government? What can we change within existing policies across multiple agencies? Within our licensing power of service providers, how do we make sure that our licensing is requiring those providers who are receiving state dollars and who are under state oversight to become trauma-informed and healing-centered over time?

The second pillar is the community-based, grassroots movement piece. How do we connect all those different and disparate local movements to each other? How do we encourage more local communities to become trauma-informed? How do we provide as much free support, training and organizational technical support especially, to organizations and communities that want to do that work? If any state is going to become a trauma-informed state, then I don't believe they can get there solely with the organizations that have budgets for training and consultants and the like. We felt it was crucial to make sure there's at least a baseline of available knowledge and support that evens the playing field for organizations that don't have a lot of resources: small nonprofits, human service agencies, and even faith-based organizations in rural parts of the commonwealth that have no government funding at all. If we're going to get there, we have to all get there together.

The final pillar of the plan is under the umbrella of communal trauma, which encompasses both that racial trauma and historical trauma piece as well as the communal traumas surrounding natural disasters and other community-wide crises. How do we look at those issues through a trauma-informed and healing-centered lens? How do we prevent things like racial discrimination, radicalized violent extremism, disproportionate minority contact with our government programs and law enforcement? When it comes to natural disasters, how do we recover the flooding and environmental disasters that are escalating in Pennsylvanians and all across the country: the world? How do we help communities not just recover physically, but

recover emotionally from the traumas that they experience together after a mass shooting?

Taken another way, the plan has three strata of healing. How do we heal our damaging policies and practices and fix broken systems that hurt people? How do we heal communities from the pain of shared tragedies? How do we bring communities of practice together to heal individuals who are struggling with trauma and its symptoms? We have there the macro, mezzo, and micro strategies woven together with the same kind of synergy and intersectionality that we see working toward harm when these systems and traumas are left to take their course.

3.1 Recommendations

The plan has a total of 48 recommendations in all. I'm just going to go over some highlights of those here. I would recommend that anyone who wants to dig into the details of the plan more fully read through it at www.healpa.org (Jurman, 2020). Some things that we recommended in the plan were already underway, but we thought they needed greater support and emphasis from the movement. They were things like insurance parity; making sure that behavioral health is covered at the same rate and in the same ways that physical health is covered by insurance companies in the Commonwealth. We have a long way to go to get there.

Telehealth coverage was another. Throughout the pandemic, the ability to connect virtually to healthcare providers of all sorts was a matter of necessity. Transportation barriers and lack of providers physically present in all communities has been a huge barrier to mental health care. We want to see telehealth coverage continue as a permanent regulatory change and not just as part of a disaster declaration.

Another key policy stance that fit into our plan was advocacy for a living minimum wage. From my experience in years of anti-poverty work, and from living in poverty myself as a child, I know that people with low incomes live with chronic and toxic stress every day. They also encounter higher numbers of Adverse Childhood Experiences (*Adverse Childhood Experiences (ACEs)*, 2020) and traumas as a result of that context of being under-resourced. Those were stressors they were living with long before the COVID-19 pandemic. My hope was the pandemic would create a moment of empathy from people who have never experienced chronic stresses; that they would understand how damaging poverty can be for the first time. That might have been naïve given our politics, but politics are beside the point when it comes to how trauma and chronic stress affect our brains.

The truth is when you're living in constant fear at the bottom of Maslow's Hierarchy of Needs it doesn't matter what's causing the fear or the lack of safety. It doesn't matter whether you're feeling those stresses because you feel the pandemic is very real and very scary, or you feel it's all a hoax and someone is trying to take away your freedom. It doesn't matter if your political commercials highlight police violence against black and brown people or if your commercials show black and brown people rioting in the streets like they're coming for you next. It doesn't matter which side of these argument you're on. You're feeling unsafe and are immersed in unyielding, chronic stress.

So, we end up in this place where all Pennsylvanians, if not all Americans, are feeling some level of chronic stress, if not full-blown trauma. I think there's a moment of empathy for people who were feeling those kinds of stresses from poverty and racism and other forces long before we ever heard of COVID-19 that we

should be leaning into as a society. Whether we have the will or the energy to do so within our polarized cultural narratives is another matter.

We also wanted to add our voices to the calls for universal broadband access across the state. Telehealth coverage is only as useful as the infrastructure at our disposal to receive it.

Continuing the Governor's pre-pandemic anti-stigma campaign for mental health, Reach Out PA ("Pennsylvania Launches 'Reach Out PA,'" 2020), is also a priority. We need to work to help people recognize that this is all of us. It's also important to point out that in many cases, things that we might have thought of as illnesses are actually the way a normal, healthy brain responds to trauma and to unhealthy levels of unrelenting stress. These aren't disorders. They are coping mechanisms pushed to their breaking point.

In terms of initiatives that weren't already underway in state government, a key recommendation of the plan is conducting and facilitating a large amount of training to level-set as a commonwealth and begin the work of changing our culture through shared knowledge. Everyone needs to have a basic and shared understanding of what trauma-informed care is, what trauma is, what chronic stress is, and what adverse childhood experiences are just as a start. We would like to see that kind of training for every single state employee, no matter what their function is in the Commonwealth of Pennsylvania. We also want to see training for all our police officers and our judges, our parole officers, social workers, teachers, pediatricians, you name it. We want training for anyone who takes care of or interfaces with human beings.

One important point is that these training resources need to be free whenever possible. The movement will need to create some resources that are

readily available to everyone to be able to level-set the community about trauma-informed care regardless of the size of their budget.

We want state licensure to be based on people. The way we license facilities should be about more than whether or not fire extinguishers are charged in the hallways or that those hallways are the appropriate width. It should also ensure the people there are being well taken care of. Are the people that are there being cared for in a trauma-informed and healing-centered way? Are they happy? Those things are very important and we want them included in licensure requirements.

Our plan includes the expanding of our ACEs definition in Pennsylvania. We looked at the Philadelphia ACEs study (Cronholm et al., 2015) and agreed with it on the five additional ACEs it added to the list of original Centers for Disease Control and Prevention and Kaiser Permanente ACEs study from the late '90s. Those include witnessed violence, felt discrimination, unsafe neighborhood, experienced bullying, and lived in foster care. We also added experiencing poverty for an extended period of time. That one's been a little controversial. I've gotten into some debates with some representatives from other states that are doing this work but we included some supporting research on this point (Hughes & Tucker, 2018). In addition, my experience doing anti-poverty work supports that when we're talking about deep poverty for an extended period of time, the constant, toxic stresses and the traumas that creates while exacerbating other ACEs is in and of itself an Adverse Childhood Experience.

We feel it's important for the Commonwealth to declare child abuse a public health crisis. We recognize that our numbers were far too high prior to the COVID-19 pandemic and all the additional stressors that were put on parents and caregivers as a result. We were at 38% of all Pennsylvanians having experienced either physical

or emotional child abuse, according to the Department of Health in a study that was released right before the pandemic started. Recognizing that we expect child abuse, domestic violence, and other factors to get even worse throughout the pandemic. We also expect reporting to go down even as cases go up because children aren't in front of mandated reporters as often as they were prior to the pandemic. It's critical that we treat this prevalent ACE as the public health crisis it is.

The plan requires the evolution of organizations that are funded by the state to move from trauma-aware, to trauma-sensitive, to trauma-informed, and ultimately to healing-centered (see Figures 3-6 below; Jurman, 2020). We created a continuum to help guide organizations and agencies on how to do that. In many cases I think people have expected that this takes a lot of money to make those changes. We're of the mindset that it really doesn't have to take a lot of money to make these changes. What it does take is intention, and it takes time. There are resources involved, but not necessarily spending a lot of money on trainers or consultants, and certifications, and those sorts of things. Those are great if you can afford them. However, we feel like every organization can become trauma-informed just by being intentional and spending the time on things like their human resources policies, the way they engage with their customers, their physical space and how their physical space feels to someone who might be experiencing the effects of trauma.

Definition	Processes	Indicators
Level 1 Trauma-Aware Key Task: Awareness and attitudes The entity becomes aware of trauma, the prevalence of trauma and considers the potential impact on customers and staff.	Leadership understands that knowledge about trauma may enhance the organization's ability to fulfill its mission and seeks additional information on the prevalence of trauma for the population served. The entity conducts a self-assessment to identify existing strengths, resources, and barriers to change, as well as practice that is consistent or inconsistent with trauma informed care. Awareness training (including definitions, causes, prevalence, impact, values and terminology of trauma-informed care, etc.) is required for employees, subcontractors, and volunteers or offered to participants in other types of groups. People are informed about additional trauma resources and encouraged to continue their professional development or other learning. Opportunities are created within the organization to explore trauma and, if pursued, contemplate what this means for the agency, staff, customers, and community.	Most Staff: 1. Learn the definition of trauma and its impact on people; 2. Begin the internal process of becoming aware of their own adversity and trauma; 3. Begin to recognize their own attitudes and perceptions that may be influenced by trauma; 4. Become aware that knowledge about the impact of trauma can change the way they see and interact with others.

Figure 3: Trauma-Aware Definition, Processes, and Indicators

Definition	Processes	Indicators
Level 2 Trauma-Sensitive Key Task: Knowledge, application, and skill development The entity begins to: 1. Explore the principles of trauma-informed care (safety, choice, collaboration, trustworthiness, and empowerment) within their environment and daily work; 2. Build consensus around the principles; 3. Consider the implications of adopting or not adopting the principles; and 4. Prepare for change.	Values of a trauma-informed approach are processed with all levels of internal and contracted staff. Leadership prepares the entity for change and assures there is a process for reflection to determine readiness for change. The entity examines its commitment to customer involvement and identifies next steps. The entity begins to review tools and processes for universal screening of trauma appropriate to the population and setting. The entity begins to identify potential resources for trauma specific treatment.	The entity values and prioritizes the trauma lens and begins to apply it. Trauma training for all staff, including new staff orientation, is institutionalized. Basic information on trauma is available and visible to both customers and staff, through posters, flyers, handouts, web sites, etc. Direct care workers begin to seek out opportunities to learn new trauma-related skills appropriate to the setting and population served. Management recognizes and responds to compassion fatigue and vicarious trauma in staff.

Figure 4: Trauma-Sensitive Definition, Processes, and Indicators

Definition	Processes	Indicators
Level 3 Trauma-Informed Key Task: Change and Integration The entity starts to highlight the role of trauma. Staff begins re-thinking the routines and infrastructure at all levels of the entity.	Continued planning and action. Integration of trauma principles throughout the entity continues, including: • Staff behaviors and practices • All job descriptions • Staff supports • Addressing staff trauma • Self-care • Models for supportive supervision • Staff development • Staff performance evaluation Within the organizational structure: • Assess the environment • Assess record-keeping systems • Examine operational policies and procedures • Examine personnel policies • Incorporate self-help and peer advocacy into the workplace	Staff applies new trauma knowledge to their specific work and an observable shift in perspective occurs. Language is introduced throughout the entity that supports safety, choice, collaboration, trustworthiness and empowerment. Policy review finds Identification of needed changes to mitigate negative language and include trauma sensitive approaches in written documents. The organization's personnel policies recognize and support staff by addressing initial and secondary trauma. The organization presumes that all have experienced trauma and services include a trauma screening (i.e., universal precautions approach.). Agency policies and position descriptions allow people (employees, board members, volunteers, etc.) with lived experience to serve in meaningful roles throughout the agency. Changes are made to ensure the physical environment is welcoming, accommodating, and safe. Trauma assessment and treatment models are available for those who need them (either directly or through a referral process). The entity has a ready response for crisis management that reflects trauma informed values. Staff at all levels accept the new direction of the entity and actively participate in implementing trauma informed care.

Figure 5: Trauma-Informed Definition, Processes, and Indicators

Definition	Process	Indicators
Level 4 Healing-Centered Trauma-responsive and healing-centered practices are the norm at all levels of the entity. The trauma model is accepted and so thoroughly embedded in culture and practice that it no longer depends upon a few leaders. The entity works with other partners to strengthen collaboration around trauma informed care.	The entire entity has been reviewed and revised to reflect a healing approach. Systems are created and implemented to measure program progress and outcomes': • Impact on customers and customer satisfaction • Fidelity to a trauma-informed and healing-centered model • Corrective action plans • Staff retention Policies and procedures are revised to contain trauma-informed language, values and processes. Personnel policies are revised to address the potential impact of secondary trauma and recommend interventions that support staff. Stigma related to the effects of trauma and accepting help is reduced. Human resources adapt processes that support hiring staff with knowledge of and expertise or lived experience with trauma. The organization and staff become advocates and champions of trauma-informed decision-making at all levels. The organization publicly advocates for recognition of trauma informed care as an evidence-based approach that is required by policy and eligible for financial support or reimbursement for trauma informed services.	The entity's mission statement, goals or objectives include a commitment to a trauma-informed and healing-centered culture and environment. The entire entity demonstrates a sustainable commitment to trauma informed values (safety, choice, collaboration, trustworthiness, and empowerment) through adherence to trauma and healing principles, advocacy, training, hiring practices and recruitment of volunteers, including the Board of Directors, committees, subcontractors, etc. All employees and volunteers demonstrate skill and effective use of trauma-informed practice with clients, visitors, and other staff, regardless of their assigned job duties, and A process is in place to address unprofessional or insensitive words or actions by employees and volunteers. People from other agencies and the community routinely turn to the entity for expertise and leadership in trauma-informed care. The entity uses data to inform decision-making at all levels. The entity uses feedback from recipients of services to assess program effectiveness and incorporate changes where needed. All levels of management model trauma informed approaches and self-care, a trauma-informed supervision model has been implemented that includes ongoing coaching and consultation, and supervisory support is accessible and readily available to staff onsite. The business model including fiscal structures works to meet the need to address trauma.

Figure 6: Healing-Centered Definition, Processes, and Indicators

Our plan includes getting to the trauma at the heart of racism and discrimination. We have looked at the issues of racism and radicalized violent extremism through this trauma-informed lens and recognizing that trauma is at the heart of these issues as well. Research has shown that adverse childhood experiences are incredibly prevalent among people who are members of white supremacist and violent extremist groups (Windisch et al., 2022). How do we approach this fact without taking accountability away from people who are doing some horrific things? How do we employ public health strategy to prevent radicalization from happening in the first place? If we can recognize the core sources for the fear and anger that lead to hatred and ultimately violence, then we believe we can be successful.

Finally, the plan calls for us to marshal our resources to help connect people to each other and to healers during times of crisis. When people experience the behavioral health impacts of public health crises and natural disasters it is crucial that they know they're not alone, and that they have healthy ways to process what they're going through. We need to create resources like toolkits and structures like healing circles and communal therapy models to help people recover so a traumatic event doesn't become embodied trauma.

4 Implementation: Healing – Empowerment – Advocacy – Learning – Prevention – Action (HEAL PA)

With the Trauma-Informed PA Plan in place, the next step for us was making sure we could implement as many of the recommendations as possible before the end of the Wolf Administration along with building sustainability for the years beyond. We did not want our work and the movement to be at the mercy of political sea changes. To that end, we created a public / private coalition we called HEAL PA. HEAL PA is made up of nearly 150 people from various professional backgrounds. The vast majority of the members are private volunteers with a handful of state agency staff from varying agencies serving alongside them. Like the original think tank members, HEAL PA members are ethnically, geographically, and professionally diverse.

Another thing HEAL PA has in common with the makeup of the think tank is that several of its members are themselves survivors of various types of trauma. It was an incredible experience just to know these people, let alone to see them volunteering their time and talents to make sure that we're implementing the Trauma-Informed PA Plan and its 48 recommendations. They're also using their

professional and lived experience to come up with new recommendations and new goals along the way.

One of the other amazing things that happened is the United Way of Greater Philadelphia and New Jersey gave a trauma-informed grant to the United Way of Pennsylvania, the statewide United Way. They created something called “Resilient PA.” The OAR had a great relationship with the United Way of Pennsylvania from the time our office was formed. As such, we were able to not duplicate each other's work, but figured out how we can be strategically aligned instead. We coordinated what we were doing so we could help each other meet our goals and get further faster.

As we talked it through, we realized HEAL PA had gathered this group of trauma and ACEs and chronic stress experts from varying backgrounds and fields. Meanwhile they had United Ways across Pennsylvania that have over 100 years of experience in messaging, connecting to people, strengthening nonprofits, and informing business and donors of what the needs of our communities are. We each had what the other was missing to succeed.

So, we decided to play to each of our strengths and bring our expertise within HEAL PA together with their infrastructure and expertise at Resilient PA to get those free trainings and resources we wanted to create out to communities all across the Commonwealth. Now we're in the process of launching a Resilient PA website together, which will also serve as HEAL PA's web headquarters. In terms of sustainability, if we had only created our own webpage with the Commonwealth, a future Governor would have the ability to take it down and eradicate our work.

Within HEAL PA we've been building one pagers and toolkits and different materials spelled out in the plan so over the course of this next year you'll see a

growing amount of content on the Resilient PA page for all different types of organizations to make use of (<https://www.resilientpa.org/heal-pa/>). We have a small group working on a guidance for clinical providers for how to connect with patients who are survivors of sexual assault and child sexual abuse. We're getting specific about how we help people recognize some of the ways we might re-traumatize people who've had certain traumatic experiences.

4.1 HEAL PA Action Teams

HEAL PA is made up of 13 action teams with different focus areas and a leadership team composed primarily of action team co-chairs and some invited leaders of other organizations and coalitions. The leadership team is meeting every other month and the action teams meet monthly. There are a handful of action teams that we consider universal, meaning their work impacts all the other action teams. The rest of the teams cover specific impact areas connected to the plan.

Within the universal teams, there's:

- The Community Outreach and Communication action team that works very closely with the United Way of Pennsylvania and Resilient PA on outreach.
- The Policy and Legislation action team has been putting together our slate of policy and legislative priorities.
- The Development action team is focused on looking at any big grants or fundraising that we can do to support the plan.
- The Data and Evaluation action team is focused on making sure that any initiatives we launch can be evaluated to show whether they're succeeding.

Within the specific impact area teams, we have:

- The Training action team looking at how to make free training resources of consistent quality available to people and organizations in the Commonwealth so they're not just wandering looking for resources without knowing what's going to be worth their time and energy.
- The Education action team is focused on improving our education systems' connections with healing-centered approaches.
- The Racial and Communal Trauma Prevention action team is focused on recognizing, healing, and preventing the damage of those traumas.
- The Criminal Justice action team is by far our largest team and is focused on reforms throughout the system.
- The Poverty Reduction action team has started its work focused on bringing plain-language knowledge of trauma, toxic stress, and ACEs directly to people living in poverty.
- The Physical and Behavioral Health action team is working to help healthcare systems recognize the importance of parity and the interrelated nature of the two.
- The Child Abuse Prevention action team has been focused on a public health style campaign.
- The Organizational Support action team is focused on helping organizations move through the continuum we created within the plan.
- The Business Involvement action team is focused on making the business community one of our allies in this work. We didn't realize in 2020 just how prescient the creation of this team would be.

Given the pandemic, private, for-profit business was one of the largest and most eager audiences I had for workshops and speaking engagements about trauma and chronic stress. I've been able to speak to places like the Philadelphia Chamber of Commerce and business leaders who are really concerned that their entire workforce is overstressed, and in some cases traumatized, by things that have happened to them, or their children, or their parents during the pandemic. Those businesses have seen how trauma is affecting things like retention, productivity, and healthcare costs. Focus on mental health has gone from being a stigma to being a crucial part of business success.

5 Early Wins in Year One

We launched the Trauma-Informed PA Plan in July 2020 and HEAL PA in October 2020, so it has not quite been a year since we really dug into implementation. Still, we are extremely pleased with what has gotten done to date.

One, the Office of Mental Health and Substance Abuse Services (OMHSAS) and the Office of Children, Youth, and Families (OCYF) have been working together on trauma-informed care licensing requirements starting with residential mental health providers for youth. They have created surveys and assessments so that we can determine where within our continuum any given licensed provider is as a baseline. We have already distributed the initial surveys. We are expecting, by the end of the 2022 calendar year, to have all our residential behavioral health facilities under OMHSAS at least trauma-aware. That's a huge first step. OCYF will be following right behind with their licensed residential providers.

Two, the Office of Advocacy and Reform recorded our first, free training. We did it for the Department of Human Services (DHS) Office of Income Maintenance. The training has been completed by thousands of employees across the

Commonwealth in multiple county offices. We are working to make it available to public through Resilient PA. It's a training on the intersection of trauma and poverty.

Three, the Pennsylvania Insurance Department and OMHSAS are working on insurance parity and extending telehealth to make that a permanent change in regulation.

Four, Governor Wolf has secured \$368.7 million for broadband access. This was prior to any infrastructure bills that are in-progress in the Biden administration. So, over the next 10 years we're going to be investing at least \$36 million a year to increase broadband access in rural populations.

Five, the Department of Education has added ACEs-related questions to the Youth Risk Behavior Surveillance System (YRBSS) survey and also is working to make the Pennsylvania Youth Survey (PAYS) data available to HEAL PA so we can look at resilience indicators and risk indicators around ACEs for kids across the Commonwealth. They've also created new trauma-informed training modules that are available for free to all PA schools. A few years ago, it became the law that all school districts in Pennsylvania had to receive trauma-informed training every year, but there was no funding that went along with that mandate and little guidance on what trainings would be worthwhile.

Six, the OAR, Department of Health (DOH), OMHSAS, and OCYF worked with the National Governors Association ACEs Learning Collaborative to create a strategy around looking at Universal Healing from ACEs. It's been our stance that regardless of what the official Adverse Childhood Experiences are, after the last two years we should assume that every child in Pennsylvania has an ACE score of at least one. So, while the surveys and the data are going to be important for us to look at areas that are hotspots, and that are disproportionately affected, we also feel that

we should assume every child needs healing now. That means we need to put tools in the hands of caregivers like pediatricians, teachers, and parents so they can address the behavioral health needs of children in real time.

Seven, the OAR has been highlighting the intersectionality between chronic stress and trauma from 2020 and 2021 with all the different, escalating public health emergencies that we've seen in that timeframe. Whether it's the record number of overdoses that we saw last year, the increases in murder rates and gun violence that we're seeing, or the increased pressure on behavioral health services, we want to make sure people recognize that this all relates back to chronic stress and trauma. We can't just put band aids on these issues and act like they're separate problems. We've got to really look at how we address the core causes of those stresses and traumas, and that appropriate treatment that's evidence-based or evidence-informed is put in place.

Eight, the Attorney General's Office and the OAR worked together to create the Pennsylvania Trauma-Informed Network page on the national PACEs connection website (<https://www.pacesconnection.com/g/pennsylvania-trauma-informed-network>). Through the Attorney General's Office, we've been able to connect with 18 different communities, whether it's counties or regions, within Pennsylvania to start or to enhance their grassroots ACEs or trauma coalitions within those communities, and to connect them to each other through the PACEs page.

Nine, within the Legislature, there were two big wins from this past summer. Trauma-informed training is now required for all law enforcement officers throughout the Commonwealth. This was another unfunded mandate with no specific trainings highlighted, but the Attorney General's Office is working on a training curriculum for all police departments. We want to make sure that there's some free training that we

know meets the standards we've set. The Legislature also required enhanced de-escalation training for all police officers.

Ten, we're working with some Community Action Agencies to schedule community conversations with people living below the poverty line as soon as it's safe to gather people indoors again.

Eleven, we're working with Mediators Beyond Borders and other peace-focused groups and individuals on preventing violent extremism connected with white supremacist groups across Pennsylvania. Town hall meetings in rural and urban communities with high levels of white supremacist activity are being planned.

Twelve, the OAR has conducted 77 speaking engagement on trauma as well as its intersectionality with other issues like poverty, juvenile justice, congregate care, intellectual disabilities, and racism to name a few. This new virtual world that we've created out of the pandemic has made that possible. We never could have completed that many engagements if we were still doing things in-person. Our goal has been to take the framework of the plan out to people in different disciplines and challenge them to innovate and determine how to apply that framework to what they do and the people they serve.

Thirteen, we've been actively advocating for funding. We have a request in for American Rescue Plan dollars that would fund several plan initiatives and we're anxiously awaiting to see what happens with the Budget Reconciliation Bill that's focused on nontraditional infrastructure. There's a lot in there that we think would reduce chronic and toxic stresses in lower income families if the Federal Government was to pass things like universal pre-K and childcare support.

This phase of planning and implementation has just been the beginning of a statewide effort to tie together what some communities have been doing for years. The next phase, the hard slog of keeping people together and fighting for systemic change in the midst of a worldwide pandemic, racial and political unrest, and what will likely be an ugly gubernatorial election year, will be crucial. Can the volunteers of HEAL PA and the members of Resilient PA keep this movement focused and thriving in a time when burnout and trauma is affecting them as much as it is those they seek to serve? Time will tell.

What is certain, however, is that the unprecedented traumas and stressors of these times will continue to take a toll on our communities and drive darker and darker outcomes unless and until we get our hands around the core problem we face. We must come out of these times with systems that look at every human challenge through a trauma-informed and healing-centered lens or risk the acceleration of the downward spiral we've been on for decades. We can do this. People like us designed these systems. People like us can fix them.

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**Northampton County: Pursuing Better Child Welfare Outcomes with a
Decision Aid Tool to Support Caseworkers**

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Abstract

One in three children in the United States are investigated for abuse and neglect by the time they are 18 years old. This figure is one in two for children of color.

Resourcing and time constraints are two central challenges being grappled with in the child welfare and wider human services sector. Predictive risk models have been identified as a way to help caseworkers assess additional data and information, within short timeframes, and support their decision-making process about whether or not a referral alleging abuse or neglect is screened in for investigation. Northampton County, PA is in the process of implementing a decision aid tool. Predictive risk models provide additional evaluative support, drawing on a range of data sources that could not typically be accessed or reviewed within the short timeframes available to the caseworkers who make decisions about whether a report is screened in or out. The use and application of these tools is supported by agreed protocols specific to the Department of Human Services team implementing the decision aid tool, and ultimately decisions are made by individual caseworkers, not the algorithm. Independent evaluations of existing decision aid tools including the Allegheny Family Screening Tool and the Douglas County Decision Aid have detected a positive impact on call screening quality.

Keywords: Predictive risk modelling; Child welfare; Decision aid tool, Decision support tool; Call screening.

1 Background

Child welfare statistics in the United States evidence a difficult dilemma: a system that is simultaneously overprotective and interventionist but that struggles to identify and protect some of the most vulnerable, at-risk children in society. In the United States, one in three children are investigated for abuse and neglect by the time they are 18 years old - for children of color, this figure is one in two (Kim et al., 2017). Arguably, this rate of intervention is too high and not reflective of real protection needs in the community. But despite the high level of intervention, each year some of the highest risk children are not protected. In 2020, 1750 children died from abuse and neglect (Administration for Children and Families, 2022) - almost five child deaths for every day of the year. The devastating consequences of “missing the signs” and the fear of overlooking a child who needs protection are an obvious factor in the high number of investigations but people working in the sector also understand that unjustified and unnecessary intervention does real harm to children and families. Which is why a growing number of child welfare agencies are looking for ways to give their workers tools that can help them assess additional data and information - in a timely way - to support their decision-making process about whether a family requires services.

Predictive risk modelling (PRM; Table 1), or predictive analytics tools, is being used by some child welfare agencies to help determine children’s levels of risk. These tools may draw on multiple historical data sources around the individual and their family or may use only the child welfare history. The calculated risk score stratifies the population of referrals and offers workers an additional reference point in their decision-making to, for example, support screening decisions. Adoption of these tools is accompanied by implementation processes and training. The Centre

for Social Data Analytics (CSDA) - a research center at the Auckland University of Technology, New Zealand - has developed several of these predictive analytics tools to support decision-making in child welfare, including the [Allegheny Family Screening Tool \(AFST\)](#). The AFST call screening decision support tool was implemented by Allegheny County, PA, in 2016, and the CSDA has since gone on to develop a range of decision aid tools for child welfare and other human services domains.

CSDA	Centre for Social Data Analytics
PRM	Predictive risk modelling
AFST	Allegheny Family Screening Tool
DCDA	Douglas County Decision Aid
DAT	Decision Aid Tool
DHS	Department of Human Services
CYF	Children, Youth and Families
CPS	Child Protective Services
GPS	General Protective Services
CAPS	Child Accounting and Profile System

Table 1. Abbreviations for Terms Used in this Chapter

Independent evaluations of such decision aid tools have detected a positive impact on call screening quality. An independent evaluation of the AFST by Stanford University (Goldhaber-Fiebert & Prince, 2019) found that the tool improved the accurate identification of children in need of services and was associated with a

modest reduction in racial disparities in case openings. A second tool, The Douglas County Decision Aid (DCDA), also developed by the CSDA, was introduced by Douglas County, CO, in 2019. [Independent evaluators from Cornell University](#) and Duke University (Fitzpatrick & Wildeman, 2021) found that use of the tool decreases the likelihood of screen-in for referrals with low-risk scores and increases the likelihood of screen-in for referrals with higher risk scores. Evaluation of the impact on longer term outcomes is ongoing. The CSDA team is led by [Professor Rhema Vaithianathan](#), in collaboration with [Professor Emily Putnam-Hornstein](#), John A. Tate Distinguished Professor for Children in Need, University of North Carolina and Co-Director of Children's Data Network, University of Southern California.

2 Origin of the Northampton County Decision Aid Tool

Northampton County's Department of Human Services is one of the agencies implementing a similar tool: the Northampton County "Decision Aid Tool" (DAT). A [New York Times article "Can an algorithm tell when kids are in danger?"](#) about AFST and the work of researchers at the New Zealand-based CSDA research center initially drew the attention of Northampton County's County Executive Lamont McClure and his then newly appointed Director of the Department of Human Services (DHS), Susan Wandalowski. Conversations with Jon Rubin, now Secretary of the Office of Children, Youth and Families (CYF) in PA, followed. Both Wandalowski and McClure also sought out available research on the use of PRM in child welfare. For example, Cuccaro-Alamin and colleagues (2017) reviewed the literature and provided a context for PRM in the current risk assessment paradigm in child protective services (CPS). The authors describe how predictive analytics or PRM using linked administrative data can provide a useful complement to existing approaches. The argument put forward by the authors was that leveraging

technology and using existing data to improve initial triage and assessment decisions would enable caseworkers to focus on what they do best: engaging families and providing needed services.

Driven by the statistics around the high rates of intervention by child welfare agencies - and the acknowledgement of harm caused by unnecessary intervention - the aim of Northampton County's Human Services leadership was to work with the CSDA to develop and implement a tool that would help the County's caseworkers in their decision-making around a child's level of risk for abuse and neglect and the need for investigation. When the tool was [announced publicly](#) in March 2021, DHS described the drivers for the development and use of the DAT (CSDA, 2021):

“By utilizing the Decision Aid Tool, we are looking to more accurately identify the folks who need our assistance and reduce the trauma for families who don't require CYF (Children, Youth, and Families) services. We believe a data driven approach which assists to reduce bias, will help us better utilize our resources.”

“As always, our primary goal is to ensure child safety. CYF handles an average of 8,000 calls on its child abuse hotline every year. We anticipate the Decision Aid Tool will help us direct our resources to where they are needed most.”

To date, Northampton County has carried out consultation with its staff, key stakeholders and community members including families with children who have

been referred for alleged abuse and neglect and who have worked with County caseworkers and experienced assessments and intervention

3 Time Pressures and Information Overload Faced by Child Welfare Caseworkers

To fully understand the drivers behind the development and adoption of the DAT for Northampton County, it is necessary to understand the critical challenges in child welfare and how these contribute to higher levels of intervention.

Resourcing and time constraints are two central challenges being grappled with in the child welfare and wider social welfare sector. While this reality is widely acknowledged, it is largely abstract unless you are working in the sector and confronting it every day. Looking at the numbers being served by the DHS in Northampton County - while noting it has more resources than many other child welfare agencies in the U.S. - helps to illustrate what this means in practice. Northampton County has a population of approximately 300,000 and around 61,000 of these residents are under 18 years old. Each year the County receives thousands of referrals about children and these are categorized either as a CPS report or a General Protective Services (GPS) report. CPS referrals allege a child might have been a victim of abuse and every report must be investigated. GPS referrals do not allege child abuse but may require intervention to prevent serious harm to children. For every GPS report, a caseworker must decide whether it needs to be assessed or if it can be “screened out”. In 2019, Northampton County received around 1000 CPS reports and around 4400 GPS reports. Current numbers are 8000+ calls of which 1200 are CPS and all require assessment. The remaining 6800+ are GPS reports and each of these require a determination as to whether or not they require an assessment.

It is at this point where the DAT will be deployed, to give the Northampton caseworkers and their supervisor access to information that can support their decision about whether or not to screen-in the GPS referrals for assessment. The intake and referral unit is staffed by four caseworkers and one supervisor who are charged with making the determinations about the GPS reports. Prior to 2020 the Northampton County screening unit consisted of just one caseworker and one supervisor but recognition of the demand on this small team saw the unit expanded in mid-2020 and it is now a team of four caseworkers with one supervisor. The small number of staff handling the large number of reports and referrals - and the decisions around further investigations - is just one part of the resourcing and time pressures. Processes around decisions and investigations all have fixed timelines that need to be met to ensure vulnerable children are not left unprotected. These timelines are necessarily tight but this creates additional pressure, especially in complex cases. Additionally, referrals received for an open case, whether this is GPS - Primary or Secondary, CPS Secondary, Law Enforcement Officer, or Information & Referral Unit, are automatically sent on for assessment/review by the caseworker actively assigned to the case.

The table below shows the different timelines caseworkers need to meet for a range of CPS and GPS report actions. It is important to note that the Northampton DAT is only used to support the decision-making that occurs around the call screening action (indicated in blue in Table 2) but the actions and timelines outlined below illustrate the pressures on workers and their supervisory teams. The actions and timelines also show the level of intervention - and, arguably, intrusion - for families once a GPS referral is screened in. It is therefore critical to limit any unjustified and unnecessary interventions.

Report type	Action	Timeline
CPS report	Report assigned to worker and CYF begins investigation	Within 24 hours - often immediate
CPS report	CYF to determine whether report is substantiated	Within 30 days, or maximum of 60 days if circumstances permit
GPS report	Call screener collects information that can be used to make decision about whether to investigate or "screen out"	Immediate via phone call with referral source. Can include gathering additional information from other systems, calling the referral source again for more detail, reaching out to family.
GPS report	Visit child if emergency protective custody has been issued or is needed - or if it cannot be determined from the report if emergency protective custody is needed.	Immediate.
GPS report	Report screened in for assessment and transferred by the screening supervisor to a GPS intake caseworker and supervisor - high risk.	"High risk rating" time period - family must be seen immediately or within 24 hours.
GPS report	Report screened in for assessment and transferred by the screening supervisor to a GPS intake caseworker and supervisor - moderate risk.	"Moderate risk rating" time period - family must be seen within the range of 24 hours to five (5) days. Dependent on age of child/children and functioning of adults.
GPS report	Report screened in for assessment and transferred by the screening supervisor to a GPS intake caseworker and supervisor - low risk.	"Low risk rating" time period - family must be seen within seven (7) days.
GPS report	Visit all other children in the family of the child identified in the GS report.	Within three (3) business days of the first face-to-face contact.

GPS report	Determine whether the GPS report is 'valid' or 'invalid'.	Must be completed within 60 days of the referral. Upon completion of the assessment, CYF must immediately notify the state-wide ChildLine.

Table 2: Child Protective Services and General Protective Services Timelines for
Key Reporting and Assessment Actions

Source: Pennsylvania Department of Human Services, Child Protective Services
2019 Annual Report

Within these timelines, caseworkers are evaluating a massive amount of information about the child or children in the report, their families, and any available historic data or reports. The timeframes allowed in the decision-making process are necessarily short but the breadth of information that a caseworker is expected to assess in a *matter of hours* before making a determination about whether to screen-in a call, paired with the potential harm if the assessment does not correctly ascertain the child's level or risk/the need for intervention, creates an environment where decisions are biased towards assessment and intervention.

To understand the complexity and volume of information that caseworkers are assessing, it is useful to look at the different risk factors and threats they need to evaluate. One, the core domains used to assess safety of the child or children in a referral are the type of maltreatment, nature of maltreatment, child functioning, adult functioning, general parenting, and parenting discipline. Two, evaluation of immediate, present dangers includes establishing whether the maltreatment is current/happening now, whether it involves the face or head, the level of seriousness of any physical injuries, whether it is premeditated, whether there is sexual abuse,

life threatening living arrangements, unexplained injuries, bizarre cruelty, and the scale and nature of abuse. Three, in evaluating the children and caregivers, caseworkers try to establish if the child is fearful or needs medical attention, if the caregiver's view of the child is bizarre/disturbed, if the vulnerable child is unsupervised or alone for extended periods, if caregivers are unable to perform parent responsibilities, dangerous, out of control or intoxicated, if there is spousal/partner abuse occurring, and if there is a risk the family will flee. Four, safety threats that caseworkers are evaluating - and which would support a GPS report ultimately being identified as 'valid' - include that a caregiver or caregivers:

- intended to cause serious physical harm to the child
- is threatening to severely harm a child or are fearful that they will maltreat the child
- is violent and/or acting dangerously
- will not or cannot control their behavior
- cannot or will not explain the injuries to a child
- reacts dangerously to child's serious emotional symptoms, lack of behavioral control, and/or self-destructive behavior
- cannot or will not meet the child's special, physical, emotional, medical, and/or behavioral needs
- is not performing duties and responsibilities in the home that assure child safety
- lacks parenting knowledge, skills, and/or motivation or presents an immediate threat of serious harm to a child

- does not have or does not use resources necessary to meet the child's immediate basic needs which presents an immediate threat of serious harm to a child
- perceives child in extremely negative terms
- overtly rejects county agency intervention, refuses access to a child, and/or there is some indication that the caregiver(s) will flee
- or the child is fearful of the home situation, including people living in or having access to the home
- or child sexual abuse is suspected, has occurred, and/or circumstances suggest abuse is likely to occur

Caseworkers also take into account a series of risk factors in the child and family environment, and in terms of the caregiver, household members and/or perpetrator of the alleged abuse. In the child and family environment, caseworkers assess risk factors including vulnerability of the child, severity/frequency and/or recentness of abuse or neglect, whether there is prior abuse or neglect, extent of emotional harm, family violence, condition of the home, family supports, and the stressors. In assessing the caregivers and/or perpetrators of the alleged abuse, caseworkers consider their age, physical, intellectual, and emotional status, the level of cooperation with the process, parenting skill and/or knowledge, whether there is alcohol or substance abuse, access to children, whether there have been prior incidents of abuse and/or neglect, and the parental relationship with the child.

Additional factors that caseworkers use in evaluating risk and making a determination about the validity of the report include whether the referral source was named or anonymous, past interactions with child welfare to determine if a pattern

exists, the County's prior experience with similar referrals/cases, prior similar referrals for the same family or by the same referral source, and the caseworker's own experience, knowledge and intuition.

Northampton County's processes related to determining whether a GPS referral can be screened-out, include a review of all captured information obtained from incident reporting sources, collateral contacts, interviews with children and families (from calls and face-to-face contact), and state databases. From these sources, the caseworkers look to identify the following factors:

1. Child's age and ages of any siblings, as identified by the reporting source, case history, or other information obtained from Department of Public Welfare databases
2. Prior referrals or existing history with family - if case was assessed or opened previously, services provided, if children were placed, parents' cooperation, and review case notes and other completed forms in the Child Accounting and Profile System (CAPS)
3. Who the "Identified Adult" is and their relationship to the child(ren)
4. If the child only lives with one parent, if they visit with the other parent
5. If there are other adult household members or relatives and if they are positive supports for the child
6. If the child reports any pain, injury, or impairment in the referral
7. Who the referral source is - a named source versus an anonymous source
8. What the allegations are and the veracity of the allegations. There are many times an anonymous referral source will say the child was at a doctor's office

or that the police were involved - these individuals are all mandated reporters and they would have called in a report if they had any concerns

9. If the child says they feel safe or not safe in the home
10. If there are current community services working with the family - such as diversionary services, outpatient mental health, etc.
11. The child's functioning - if they are delayed, have mental health issues, have history of drug/alcohol usage
12. The adult's functioning - if they have mental health issues (in treatment or not treated), history of drug/alcohol usage, history of domestic violence

Prior to making screen out determinations, screening unit staff make collateral contacts and conduct initial face to face contacts to follow up on referrals. This leads to further clarification and discovery, allowing the screener to better assess if there is anything substantial in the allegations that would require further involvement from CYF and further assessment by a GPS intake worker.

Looking at the volume of information, range of sources, and the timelines outlined in the list above it becomes clear that it is a significant challenge for caseworkers to canvas all of the data available for each referral and to make decisions that adequately weigh all the different factors. It is also important to note that the DAT tool is only used to support decision-making around whether a GPS report is determined to need an assessment or whether it is "screened-out" and does not require assessment. The decision about whether or not a GPS report requires an assessment is critical and ultimately determines whether or not further intervention takes place.

4 Data-Supported Decisions: What a Decision Aid Tool Looks Like in Practice

In the context of child welfare, decision aid tools are as described: an aid for decision-making. These tools use predictive analytics to turn significant quantities of data into a useful, accessible source of information that intake workers and caseworkers can use to support their decision-making. The CSDA and the Northampton County DHS team are very clear about the support role of the tool. DHS has described the role of DAT:

“This tool is simply one part of the decision-making process; human caseworkers and supervisors will always make the final determination on when to investigate or screen out a referral (Wandalowski, 2021).”

The Northampton County DAT is being built specifically for Northampton County using the County’s own data and capturing data points that reflect previous child welfare involvement for the household (see Table 3). The Northampton DAT PRM is trained on Northampton County data which comprises the County’s child welfare data (historical data about past allegations, findings etc.) as well as information about the current referral (e.g. the allegation).

Data domain	Data points <i>(these are example data points, not a complete list)</i>
Demographics	Age group, gender, age of mother. <i>Note: race is not included as a predictor.</i>

History of each person on the referral in the Child Welfare system	Count of referrals for child within the last 90 days Mother was ever placed as a child (Yes/No) Count of founded investigations for the alleged perpetrator.

Table 3: Example Data Used in Northampton County Decision Aid Tool Predictive Risk Model

Source: Centre for Social Data Analytics

There is the potential that the scope and access Northampton County has to its child welfare data will change in coming years and this would then be factored into the tool. Northampton is one of 50+ counties that currently use CAPS which is managed by the private company Avanco International. Through CAPS, counties have limited access to their own data. Some of the early conversations between Northampton County and CSDA researchers centered on whether the County's data would be sufficient and what the needs would be in terms of information technology infrastructure to support the DAT and sourcing of data. CSDA evaluations have shown the data to be sufficient, despite drawing from far less data than tools developed for other agencies and counties.

The AFST developed for Allegheny County, PA, uses rich administrative data to generate a screening score for incoming calls alleging child maltreatment and neglect. As with the intended application of the Northampton DAT, the AFST score is an additional piece of information that helps call screeners as they decide whether to open an investigation - the call screener and not the tool makes the decision. Allegheny County introduced this decision support tool with the aim of improving

accuracy and consistency of call screening decisions. Allegheny County has updated the AFST multiple times after its launch. While all versions use existing child welfare data concerning children and adults named, the types of additional integrated data have changed with subsequent updates. For example, a recent AFST update has used *inter alia* jail records, juvenile probation records, as well as history in the homelessness system.

The data sources used by the Northampton DAT are likely to evolve over time as CSDA in partnership with Northampton County carries out ongoing evaluation and refines the tool. As evidenced in previous projects with Allegheny County and Douglas County, the County teams will play an essential role in shaping and refining the tool to ensure it is effective for their own teams and communities.

The development of the Northampton DAT and its implementation is a multi-year process and validation of the prototype is a critical step along with training intake workers and supervisors. CSDA and Northampton County have completed a round of community and stakeholder consultation and are now working to deploy an initial tool. Researchers are comfortable that they have a high-performing model and in the first instance will apply this to review referrals where there has been an initial screen-out.

Another significant step in building a decision aid tool is the set of protocols that are developed around the tool. These protocols are unique to each County and their teams but include how and when the score is used; recommendations for oversight from additional team members, such as managers or supervisors; under certain circumstances, such as when a high scored call is to be screened out or when a low scoring call is being screened-in, especially where the allegation might be associated with poverty or where it is a family of color.

In evaluating the DAT prototype, the CSDA research team typically generate screening scores for historic referrals that have already been triaged providing an opportunity to assess the accuracy of the DAT in identifying risk scores. For Northampton County, three years of data spanning 2016 to 2020 has been sourced from CAPS. During a feasibility study as part of the development of the Douglas County Decision Aid (DCDA), when the CSDA generated screening scores for historic referrals that had already been triaged by the County, they found a large proportion of children with the highest risk scores were being screened-out and a large proportion of those with the lowest risk scores were being screened-in. The CSDA team proceeded to develop and implement the DCDA, a tool which produces a risk score from 1 to 20, indicating the likelihood that a child involved in a referral will be subject to a removal within two years of the referral. Like the DAT, the DCDA is a decision support tool designed to help triage incoming calls alleging child maltreatment and neglect. The tool uses data from the child welfare system. This tool is embedded in the existing team process used by caseworkers and supervisors at Douglas County. The timeline for the DCDA was similar to the Northampton DAT, which is expected to be implemented by Fall 2022. For the DCDA, in early 2017 CSDA researchers developed a prototype child welfare (maltreatment) PRM for Douglas County, Colorado. The DCDA was implemented by Douglas County leadership as a year-long randomized controlled trial in February 2019.

For the Northampton County and the DHS team, when the DAT tool is in use the caseworkers will still enter the referral information into the computer system as they have always done but the PRM algorithm will then generate a risk score indicating the likelihood of the child's risk of removal from their home within a one-year period (see Figure 1). This risk score draws on all the County's available data

for that child and family - far more than an individual could readily access or assess - to provide additional information on the child or children's levels of risk for maltreatment. If there are multiple children involved in a referral that is being screened, each child will have a score generated and the highest score, indicating the greatest level of risk of removal, is what will be considered in determining whether the referral is screened-in or out.

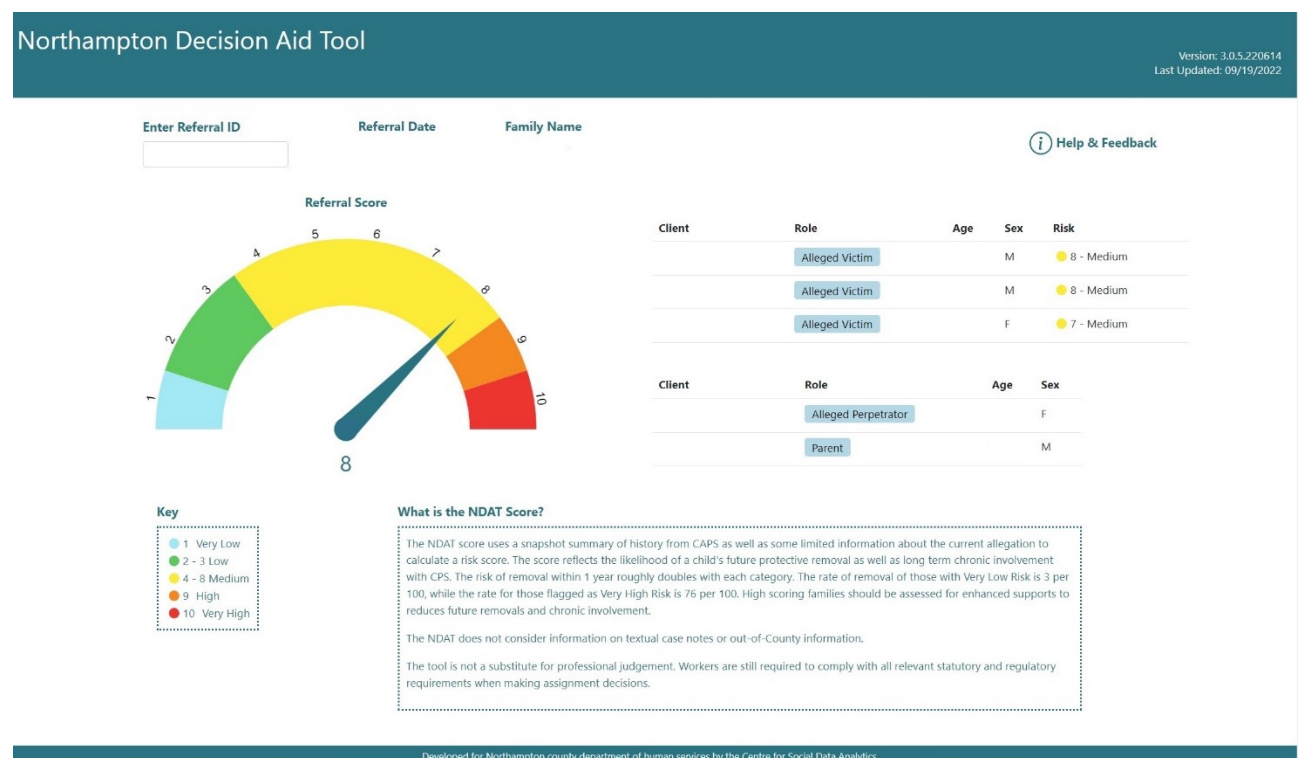


Figure 1. The Northampton County Decision Aid Tool (DAT)

5 Conclusion

The risk score that is generated through the use of the Northampton County's DAT will be one of the many pieces of information the caseworkers use to support their screening decisions. It will also allow intake managers to prioritize those screening decisions that they may want to review. It will be an additional evaluative support, one that draws on a range of sources that could not typically be accessed or

reviewed within the small window of time available to the caseworkers who must make decisions about whether a GPS report is screened-in or out. As stated by Northampton County's Director of Human Services, Sue Wandalowski, during her presentation on the Northampton County DAT at the 2021 Annual Conference on Child Maltreatment at Penn State:

"Ultimately, the caseworker is going to do what they always do and consult with the supervisor. They're going to review, not only the score from the model, but all of the information that they've collected [over the phone]."

Director Wandalowski went on to state in this same presentation that the DAT, applied within the County's agreed protocols, will provide an additional piece of information - underpinned by rich data - for caseworkers to consider as part of their wider assessment:

"It will strengthen the already robust decision-making around a child's level of risk for abuse and neglect and the need for investigation. These are such critical decisions and everyone working in child welfare must be driven by a desire to get these right."

The DAT will put vital, accessible information into the hands of Northampton County caseworkers but whether or not a referral is screened-in or screened-out will continue to be a decision that is made by the individual, not the algorithm.

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**The Child Maltreatment T32 Training Program at Penn State: Innovation for
Creating the Next Generation of Scholars in Child Maltreatment Science**

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Abstract

Creating innovation in child maltreatment research and practice begins with novel and rigorous approaches to training future professionals. This chapter describes a new program for professionals seeking formalized training in child maltreatment. The Child Maltreatment T32 (CMT32) Training Program at Penn State is supported by a Federal grant from the National Institutes of Health and offers dedicated, transdisciplinary training in multiple areas of child maltreatment for both graduate students and postdoctoral fellows. In addition to a core set of general program requirements, CMT32 Fellows specialize their training across four related tracks: Biology and Health, Developmental Processes, Policy and Administrative Data Systems, and Prevention and Treatment. Each track offers access to a wide range of Mentors who further shape the training experience of each Fellow through their own diverse experiences, training, and research methods as applied to the substantive area of child maltreatment. This chapter describes the CMT32 Training Program at Penn State while identifying the innovative ways in which we are preparing the next generation of scholars to address current and future challenges for children and families affected by maltreatment.

Keywords: child maltreatment; training; T32; fellowships; biology and health; developmental processes; policy and administrative data systems; prevention and treatment; policy

1 Background

Child maltreatment (CM) is a significant public health issue. Currently, over 6 million children a year are reported for CM concerns and lifetime estimates indicate 30-40% of US children experience some form of CM by the time they are 18 - rates that have been stable for the past decade (Finkelhor et al., 2015; Hussey et al., 2006; Kim et al., 2017). Not only are millions of youth maltreated each year but this experience is directly related to a myriad of behavioral and physical health problems, most of these lifelong and significant in their impact to well-being (U.S. Department of Health & Human Services et al., 2019). Deleterious outcomes from CM not only affect the direct victim, the victim's family, and the broader community but also accrue significant costs to society - close to \$1 billion each year for social service intervention (Finkelhor et al., 2015) and over \$200 billion in lifetime costs for a single cohort of children reported for CM (Fang et al., 2012). National reports continue to call for increased research to advance prevention and treatment approaches but CM is a complex issue. Not only does CM lead to a myriad of differing outcomes over the lifespan but it is multi-determined and prevention and treatment efforts are often spread across siloed systems. Responses to CM also vary according to state and regional policies and the availability of community-based agencies to meet family needs. As noted in the Institute of Medicine report by the Committee on Child Maltreatment Research, Policy, and Practice for the Next Decade (2014), "Existing research and service system infrastructures are not sufficient for responding to this public health challenge (p. 385)".

Despite the complex nature of CM, there is no systematic training program in the U.S. to develop predoctoral or postdoctoral scholars who are fully endowed with the necessary skills to affect real change in the well-being of youth and families

affected by CM. Part of the reason for this dearth in training is due to the cross-disciplinary nature of the science on CM. Specifically, CM is a subject for research and training in social welfare, psychology, human development, neuroscience, sociology, medicine, and law among other disciplines, making a comprehensive training model impractical to date and leaving each field to address one aspect of CM at a time (e.g., clinical interventions, neurological impact, or policy change). The purpose of the Child Maltreatment T32 (CMT32) Training Program at Penn State is to address this training gap by providing, for the first time, comprehensive and multi-level training using a transdisciplinary approach that includes preparation in the multi-faceted issues in need of research to advance the field of CM. So far, traditional approaches to training in CM have led to narrowly-bound research and training programs oriented to small pieces of the problem with knowledge dissemination similarly limited to discipline-specific outlets. The field of CM then struggles to integrate learning across the academic ecosystem to develop practice and policy approaches that work in real-world settings with sufficient effect sizes to create large scale change. To effectively address CM, the next generation of scholars needs to be capable of embracing this complexity through participation in transdisciplinary training approaches that can overcome the current, siloed nature of research and training. This requires an innovative, state-of-the-art training model to effectively translate what is learned into practice and policy. The [CMT32](#) at Penn State is this very training (see Figure 1).

2 Organizational Structure of the CMT32

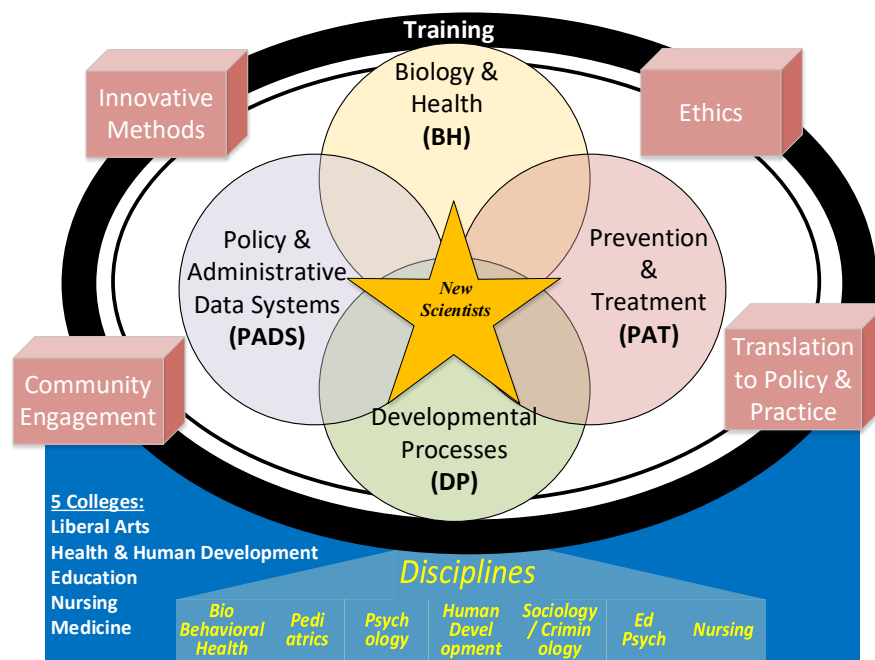


Figure 1. Conceptual Training Model of the CMT32

The organizational structure of the CMT32 (see Figure 2) is supported by an advisory board comprised of Principal Investigators leading independent T32 training awards at Penn State and across the country. Two faculty within the Child Maltreatment Solutions Network ([CMSN](#)) at Penn State serve as Multiple Principal Investigators and joint Program Directors. CMSN faculty serve as Primary Mentors along with an impressive list of Affiliate Faculty, or Secondary Mentors, all of who come from five unique Colleges within Penn State representing diverse training disciplines relevant to CM, including the Colleges of Education, Liberal Arts, Health and Human Development, Medicine, and Nursing. Each of the four training tracks are led by Track Leads (TLs) who are CMSN faculty with a strong history of federal funding and successful mentoring of trainees. TLs have particular expertise in their respective tracks and ensure that trainees and mentor teams within and between

tracks meet regularly and develop projects together. For example, CMT32 trainees work on research projects with their Primary and Secondary Mentors as well as with other trainees leading to a set of research papers and presentations the trainee can co-lead as well as dissertation and postdoctoral fellowship applications for funding. Faculty in each of the training tracks collectively have published over 200 papers on CM or CM-relevant topics making this one of the most productive collection of scholars working together on CM in the field. Moreover, CMSN and Affiliate Faculty have mentored nearly 200 graduate students within the past 10 years and served as advisors to multiple K-award and F-award fellows. In addition to high quality mentoring and institutional supports, trainees benefit from a comprehensive and integrative training plan which includes seminars, Summer Institutes, formal graduate-level coursework, scientific meetings, immersion learning, and other core training activities. Hence, the environment at Penn State could not be stronger or richer as an excellent training arena for new scholars in the CM sciences.

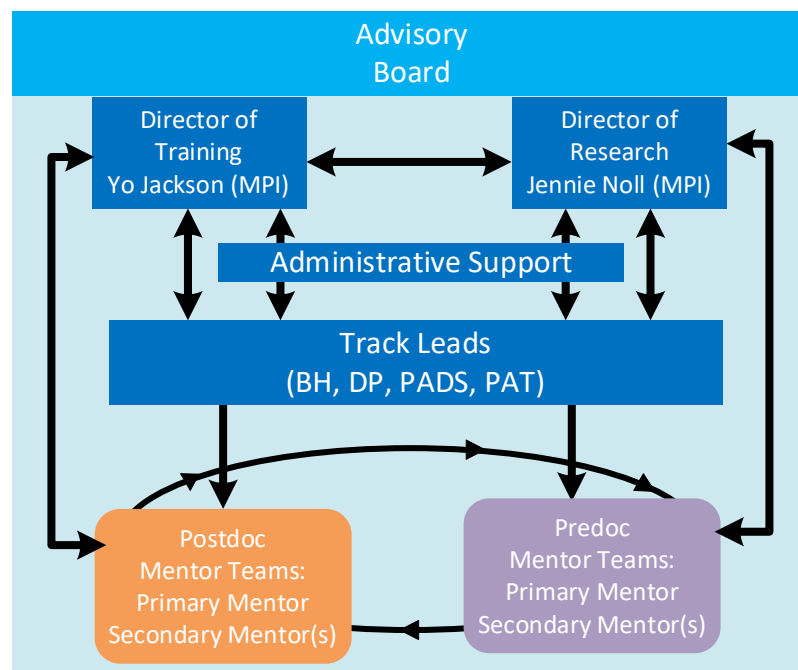


Figure 2. Organizational Structure of the CMT32

3. Program Directors

Dr. Yo Jackson, Program Director of Training (PDT), and Dr. Jennie Noll, Program Director of Research (PDR), collaboratively serve as the Program Directors for the CMT32. Dr. Jackson is Professor of Psychology in the College of Liberal Arts at Penn State and a board-certified clinical child psychologist. Her primary role is to oversee and coordinate all aspects of the training program including providing administrative oversight of recruitment activities, contracts, budgeting, onboarding, evaluations, grievances, and remediation. She oversees the administration of the CMT32 by: (1) coordinating recruitment, admissions and trainee evaluation, (2) leading the Professional Development Seminar and the CM Proseminar, (3) providing oversight and coordination as needed with mentors on training plans and intervene on training issues when needed, (4) reviewing products of the trainees and coordinating evaluation of the training program, (5) coordinating CMT32 meetings to ensure good program training integration and communication, (6) coordinating the teaching of required courses each semester and ensuring trainee participation in CMT32 meetings, (7) coordinating the CMT32 Summer Institute, (8) leading policy activities (e.g., policy workshop), and (9) overseeing community engagement projects.

Dr. Noll is a developmental psychologist and Professor of Human Development and Family Studies (HDFS) in the College of Health and Human Development at Penn State. She currently directs Penn State's CMSN and is Principal Investigator of the P50 Capstone Center, The Translational Center for Child Maltreatment Studies ([TCCMS](#)) at Penn State. Dr. Noll is primarily responsible for coordinating the research efforts of CMT32 trainees, including identifying projects across participating faculty that fit and complement trainee interests, foster cross-

collaborations, and support the realization of research products. In her role, she assists in the overall administration of the CMT32 by: (1) aiding in the selection of trainees and trainee evaluation, (2) ascertaining trainee research interests and pairing trainees with mentoring team and research projects, (3) overseeing research progress and productivity for all trainees (e.g., assure conference presentation, publication, and grant writing milestones are met), (4) coordinating the Ethics Seminar, (5) teaching grant writing seminars and courses, (6) coordinating the submission of grants originated by T32 trainees, (7) coordinating all T32 meetings, and (8) conducting the Summer Institute.

4 Transdisciplinary Training in the Science of Child Maltreatment

The impact of CM is multisystemic, thus the approach to training experts in CM must also develop across systems and specialties. CM impacts the biology and developmental trajectory of its victims and, given its wide-ranging effects, requires unique and effective treatments and policy approaches to improve the lives of survivors. The training model organizes the training experience into four tracks (See Figure 1): Biology and Health (BH); Developmental Processes (DP); Prevention and Treatment (PAT); and Policy and Administrative Data and Systems (PADS). Each CMT32 fellow selects one of these tracks as their primary area of training, acknowledging that the fellow has a core disciplinary focus guiding their fellowship. However, CMT32 fellows also select a secondary training track, and potentially a tertiary track, to learn the value of integration across other disciplines and to be able to implement team science. Through concerted efforts in recruitment of top scientific talent over the past ten years, Penn State now has the necessary faculty experts to provide the mentoring needed to develop trainees who are well-versed in the basic as well as the applied sciences of CM across all four tracks. Working from a

transdisciplinary perspective, trainees are exposed to a wide range of research and applied experiences as well as numerous didactic opportunities that immerse them in an environment perfectly suited to develop scholars who will devote their careers to solving the complex problem of CM. This training allows CMT32 fellows to move beyond the strengths of their disciplinary foundations to develop into scholars with the necessary skills to advance the field of CM science.

In addition to topical expertise in the four training tracks, training and practice in ethics, innovative methods, community engagement, grant writing, and translation to policy and practice is integrated throughout the CMT32 to ensure trainees are facile with methods that are cutting-edge, ethical, fundable, and interpretable across disciplines. This training also emphasizes how the community affected by, or at-risk for, CM can be included in the design and dissemination of research and how results should be meaningful for improving policy and practice. Expanding the science in CM requires scholars who understand the nature of CM and are experienced in the transdisciplinary applications of their work. Integration is not simply a goal; it is meaningfully articulated in and across the training activities. In addition, CMT32 fellows publish research papers and create conference presentations, take courses in grant writing, attend seminars in advanced research methods and CM ethics, produce a community engagement project, and develop policy papers that demonstrate the products of this integrated training model. The CMT32 training plan provides not only the necessary cross-discipline exposure but also specific trainee products that demonstrate knowledge and skill acquisition that allows trainees to use this integrated training throughout their careers in CM science. The CMT32, with its focus on productivity and integration across the four training tracks, is creating new

experts who will move the CM field forward in ways that are tangible, meaningful, sustainable, and long overdue.

4.1 The Biology and Health Training Track (BH)

One of the most important challenges for researchers focusing on the biological and health impacts of CM will be to better understand the complex ways in which multiple key physiological systems act *in tandem* to shape the lifelong health trajectories of youth with a history of CM. A substantial literature already links CM to increased risk of cardiovascular disease (Dong et al., 2004), obesity (Noll et al., 2007), diabetes (Thomas et al., 2008), lung cancer (Brown et al., 2010), chronic pain (Irish et al., 2009), headaches (Anda et al., 2010), sexually-transmitted infections (Hillis et al., 2000), autoimmune diseases (Dube et al., 2009), and all-cause mortality (Chen et al., 2016) later in life.

In addition to research on distinct health problems, the field is also beginning to understand the ways in which CM alters some of the physiological mechanisms that, in the long run, may result in these increased morbidity and mortality rates. For example, alterations to immune system functioning following exposure to CM represent one likely mechanism connecting early life adversity to increased morbidity and mortality. CM has been linked to elevated systemic inflammation in adulthood (Baumeister et al., 2016; Danese et al., 2011; Danese et al., 2008; Matthews et al., 2014) and greater stimulated proinflammatory cytokine production and reduced glucocorticoid sensitivity among youth (Marin et al., 2009; Schreier et al., 2014), although the effects of CM on functional immune outcomes among youth remain poorly understood. Research has furthermore examined the role of telomeres, DNA-protein structures at the end of chromosomes (Blackburn, 1991, 2000) that are considered hallmarks of biological aging (López-Otín et al., 2013; Puterman & Epel,

2012; Shalev, 2012). Finally, epigenetic mechanisms likely play a key role as well, with emerging research suggesting that a history of CM is predictive of subsequent DNA methylation of genes responsible for regulating stress response systems (Beach et al., 2011; Mehta et al., 2011; Romens et al., 2015; Roth et al., 2009).

In the context of this information, it is also important to consider the possible impact of gene X environment (GxE) interactions (Cicchetti & Handley, 2017) due to the fact that not all children exposed to CM experience problematic development even if additional stressors occur (De Bellis et al., 2001; Heim et al., 2013; Opel et al., 2014; Pechtel et al., 2014; Teicher et al., 2012; Tomoda et al., 2012; Tottenham et al., 2010). Therefore, it is important to consider whether there might be fixed predispositions, such as genetic factors, that may moderate outcomes by conveying risk or determining resilience. Insight into the impact of GxE interactions on trajectories of biological embedding of maltreatment is a critical next step in the advancement of personalized approaches to identifying pre-disease markers that confer particular vulnerability to the effects of early-life stress (Klengel et al., 2013). To date, investigation of these physiological mechanisms has largely taken place in isolated, parallel tracks without in-depth examination of the interconnected ways in which these physiological systems interact with each other.

The CMT32 is providing trainees with the opportunity to study these very questions through active research within Penn State's TCCMS as well as other federally-funded awards led by CMT32 Program Faculty, including the study of the extent to which stress 'gets under the skin' to impact neuroendocrine dysregulation, inflammatory cytokines, neurotoxic effects on brain structures and function, telomere erosion, polygenic risk, and the interplay of endocrine, immunological, epigenetic

and metabolomic influences on adult morbidity and future models of resilience and reversibility efforts.

4.2 The Developmental Processes Training Track (DP)

CM creates disruptions to the normative life course and contributes to failures in achieving skills or resolving key components of major developmental stages throughout the lifespan (Cicchetti, 2004). Multiple domains of child development can be affected by such disruptions, including biological, social, emotional, cognitive, linguistic, and moral development. These disruptions increase the likelihood that patterns of maladaptation, psychopathology, and other impairments due to CM will develop and persist, creating a cascade of negative sequelae for subsequent developmental stages (National Research Council, 1993). CM tends to recur over time, making a developmental approach to the timing and course of CM essential in understanding its effects (Connell et al., 2007; Cowell et al., 2015; Jaffee & Maikovich-Fong, 2011; Jonson-Reid et al., 2012; Vidal et al., 2017). Understanding the causes and correlates of CM incidence and recurrence can inform etiology, prevention, and treatment of associated impairments.

CM exposure is heterogenous in nature, therefore developmental scientists study dimensions such as CM frequency, timing, severity, perpetrator, and type (e.g., physical abuse, neglect, sexual abuse). Notably, causes of CM differ across individuals and not all maltreated children go on to suffer the negative effects of maltreatment (Cicchetti & Handley, 2019). Accordingly, a major focus for developmental researchers is understanding what contributes to risk and resilience for children exposed to CM (Cicchetti, 2004). The heterogeneity of CM suggests that developmental etiological models are essential to test the complex interplay of individual, familial, and environmental factors that contribute to the occurrence and

recurrence of CM (Belsky, 1993; Coulton et al., 2007; Lynch & Cicchetti, 1998). These complex contributing factors make their impact across multiple time scales, for example, from the effects of second-by-second interpersonal interactions between parent and child (Lunkenheimer et al., 2019) to the influence of foster care involvement over years and across stages (Goemans et al., 2015). Further, prospective longitudinal research is necessary to explicate developmental mechanisms of change related to CM (Cicchetti, 2004).

Accordingly, to improve scientific knowledge on CM, we must train developmental scientists in the study of CM who can model the process, causes, and correlates of CM incidence at varying time scales, the cascading effects of stage-salient disruptions, and the variation in pathways of CM with appropriate developmental theoretical frameworks and sufficient ecological and measurement validity. In the DP track, trainees receive training and opportunities in integrative, emerging research areas provided by CMT32 mentoring faculty and research projects. Some examples include TCCMS projects on the microlevel dynamics of parent-child biobehavioral regulatory processes associated with CM, the longitudinal effects of CM on school engagement and academic achievement, systemic longitudinal effects of CM on caretaker-child relations, the intergenerational transmission of trauma and maltreatment within families, the nature and scope of heterotypic development in youth exposed to CM, and the potential moderating or mediating effects of services and community factors; all of these research foci require a developmental lens to better understand the impact of CM on the developing child and his/her environment. Additionally, the CMT32 exposes emerging scholars to numerous approaches to measurement and methods of CM research including the use of self-report, case file and administrative data records,

longitudinal prospective cohort designs, microanalytic time series approaches, longitudinal trajectory modeling, and the provision of varying treatments and services that may play a role in trajectories across development.

4.3 The Prevention and Treatment Training Track (PAT)

A recent U.S. Preventive Services Task Force report designated the existing science for CM prevention as incomplete (Curry et al., 2018), citing a failure in research methods linking intervention effects to reductions in actual cases of CM. The overall impact of extant prevention on proxies of CM rates (e.g., emergency room visits, parenting stress) have also been small to modest (Casillas et al., 2016) with several implementation factors, including provider training, supervision, and program fidelity having a significant effect on program outcomes (Michalopoulos et al., 2019). Similarly, although each year 1.9 million families identified by the child welfare system to be at-risk receive targeted interventions (U.S. Department of Health & Human Services, 2019), effects sizes of these targeted prevention strategies have also been shown to be small to moderate (Euser et al., 2015) and vary widely (Guastaferro & Lutzker, 2017; Guastaferro et al., 2012). Finally, the majority of programs touted to prevent CM were not actually designed to impact CM directly nor evaluated within the child welfare population. For example, Nurse Family Partnership was developed to target prenatal health, Parents as Teachers was designed to target child development outcomes, and Early Head Start was developed to enhance school-readiness. It should also be noted that the vast majority of prevention programs focus mainly on targeted parenting behaviors linked to physical abuse and neglect and do not target risk factors linked to child sexual abuse such as identifying grooming behaviors, internet behavior, and recognizing the emotional and physical signs of sexual abuse (Black et al., 2001; Noll et al., 2022).

As such, the field of CM prevention is in need of innovative strategies that: (1) are shown to impact rates, as opposed to proxies, of CM, (2) show increased and consistent effect sizes, (3) can be implemented and scaled-up with fidelity, and (4) are specially designed and evaluated to prevent all types of CM. CMT32 trainees are able to work on projects with mentors that target actual CM rates, especially related to sex trafficking and child sexual abuse prevention across several counties in PA and in the development and implementation of CM prevention programs broadly with child welfare community partners.

Regarding treatment, psychiatric disorders are the primary driver of healthcare utilization and costs in the CM population (Yanos et al., 2010) due to the presence of multiple disorders that are highly comorbid and transcend diagnostic domains (Blanco et al., 2014; Merikangas et al., 2010; Molnar et al., 2001; Putnam et al., 2013). Traditional approaches to treatment development have focused on efficacy trials that select samples based on a single disorder, namely posttraumatic stress disorder (PTSD), despite high-rates of comorbidities with other disorders and a general lack of knowledge on treatment efficacy when the presenting complaint is not PTSD. These treatments can also be inefficient and inflexible, proscribing ordered sequences of treatment phases or redundant treatment components that require extended time commitments from children and families in the community. This is critical, as attrition across standard care in the community can range from 39.5%-50.0% (Cohen et al., 2011; de Haan et al., 2013), mandating that treatments achieve benefits across diverse psychiatric disorders prior to drop-out. These limitations have led to a common concern among practitioners that existing treatments may not be equipped to address the full behavioral health needs of the CM

population in community practice settings (Allen & Armstrong, 2014; Lau & Weisz, 2003; Palinkas et al., 2008).

The CMT32 PAT Track provides trainees opportunities to learn about the most effective treatments that exist for children exposed to maltreatment and that can address a wide range of psychiatric conditions and presentations, including Trauma-Focused Cognitive-Behavioral Therapy, Parent-Child Interaction Therapy, and Prolonged Exposure, but also to participate on projects investigating innovative and optimized approaches to treatments on research projects designed to: (1) broaden the focus of treatments beyond PTSD, (2) test and improve the effectiveness of treatments in community settings, and (3) increase efficiency and cost-effectiveness of current programs by identifying active components and examining the mechanisms of actions for these treatments that can both alleviate practitioner concerns and exert the maximum impact on public health.

4.4 The Policy, Administrative Data, and Systems Training Track (PADS)

CM poses a significant public health crisis, and its effects are felt at the individual, family, community, and societal level (Fang et al., 2012; Leeb et al., 2008; U.S. Department of Health & Human Services, 2019). Children impacted by CM and their families are frequently involved in myriad of systems including child welfare, physical and behavioral health care, juvenile and adult corrections, education, and other public systems (Bright & Jonson-Reid, 2015; Colvin, 2017; Jonson-Reid, 2011; Vidal et al., 2019; Vidal et al., 2017). This complexity requires that CM researchers develop expertise in systems-focused research methodologies that leverage complex and integrated administrative data systems to elucidate individual, family, and contextual processes leading to maltreatment exposure and its effects, provide more accurate means of detection and prediction of adverse outcomes, and also

provide a means of empirically testing the efficacy of intervention responses to maltreatment (Petersen et al., 2014; Putnam-Hornstein et al., 2013; Wilson et al., 2015). These advances are critical to developing more effective evidence-based policies and practices to prevent CM or ameliorate its negative effects on children and youth.

In recent years, CM research has begun to capitalize on advances in computational capacity and data infrastructure to make significant progress in this area. Specific advances, such as the creation of community- and state-level integrated data systems (IDSs), which link individuals and families across multiple public and private systems, allow researchers to create population-level cohorts to investigate risks for maltreatment or examine cross-system and downstream effects associated with CM (DeHart & Shapiro, 2017; Putnam-Hornstein et al., 2013). CM researchers also have access to multi-state and multi-year child protection and foster care data (e.g., NCANDS and AFCARS data, NYTD) through the National Data Archive of Child Abuse and Neglect (NDACAN), and may link these data sources to each other or to external data sources including county or state-level census data or to state policy information (e.g., the State Child Abuse and Neglect (SCAN) Policies Database; <https://www.scanpoliciesdatabase.com/>) to assess population- or rigorous policy-level factors contributing to CM response or outcomes.

At the analytic level, machine learning methods (Amrit et al., 2017; Gillingham, 2015) and predictive analytic modeling (Cuccaro-Alamin et al., 2017; Russell, 2015; Wilson et al., 2015) provide the means to leverage computationally intensive data sources (including IDS data, text or narrative data, and other sources) to reveal patterns of past and present behavior and events in order to make inferences about the likelihood of future behavior and events. Other systems science

approaches (e.g., agent-based modeling, microsimulation studies, dynamic and network modeling) allow researchers to model complex associations across multiple systems and ecological levels to better understand the effects of interventions, community structures, and other factors that may impact CM occurrence or moderate its effects (Goldhaber-Fiebert et al., 2012; Hu & Keller, 2015; Hu & Puddy, 2010). IDS-based research can also provide an opportunity to integrate community-level information (including spatial, neighborhood, and place-based events or resources) to conduct research on contextual influences on CM including placed-based risk modeling (Daley et al., 2016; Freisthler et al., 2006; Thurston et al., 2017). Finally, economic methodologies can be leveraged to estimate costs, cost-benefit ratios, or returns on investment (ROI) associated with patterns of risk or service and intervention delivery (Aizer & Doyle, 2014; Goldhaber-Fiebert et al., 2011).

The CMT32 PADS Track provides trainees with a range of opportunities to develop expertise in these methods. Faculty mentors and advisors have extensive experience in the use of administrative and other data sources to conduct rigorous practice- and policy-relevant research across child welfare and other public systems (Berger et al., 2015; Crowley et al., 2021; Font et al., 2018; Maguire-Jack et al., 2020; Prince et al., 2019). Trainees engage in the design and conduct of research using complex integrated and administrative data through active research projects with core faculty via the TCCMS and independent grant projects. Trainees have access to a wide range of local, state, and national administrative data systems maintained in the Penn State Administrative Data Accelerator, including child welfare systems (i.e., CPS and foster care data), health care (e.g., Medicaid and other health care claims data), juvenile justice and corrections, and other child and family serving systems. In addition, trainees will have opportunities to integrate administrative data

sources with research studies implemented in the PAT, DP, and BE tracks, leveraging child welfare, health care, and other data to enhance understanding of intervention effects or the effects of system involvement on developmental and biological processes.

The goal of the CMT32 is to develop scholars who have content expertise within a primary training track but who can simultaneously apply an integrated approach to new science by investigating the complexity of CM from multiple disciplinary perspectives and with diverse colleagues. Thus, the four training tracks offer an organizing framework with the explicit intent to provide scholars with the skills necessary to develop and implement a transdisciplinary agenda while working with scholars from varying disciplines.

5 Track Leads

Each training track has a CMSN faculty member and CMT32 Co-Investigator who serves as a Track Lead (TL) due to their unique expertise in a specific track and their commitment to developing and coordinating training within that track: BH - Hannah Schreier, DP - Erika Lunkenheimer, PAT - Chad Shenk, and PADS - Christian Connell. Having TLs ensures that the training on a given topic will be thorough and complementary across both predoctoral and postdoctoral CMT32 trainees. Specifically, TLs are responsible for: (1) participating in recruitment and selection of trainees, (2) meeting with mentors to review trainee progress, (3) developing and teaching required CMT32 coursework as part of their regular teaching load, (4) participating as guest lecturers in CMT32 seminars (Proseminar, Ethics, Professional Development), (5) communicating with the PDs on the outcomes of the track training, and (6) seeking out new track-specific training opportunities for trainees. TLs also coordinate biannual Track meetings with all track-

specific mentors and trainees to ensure collaboration, progress in training goals, and communication within their track. TLs also provide oversight for the trainees' conference symposium submissions and assist the PDs in collecting evaluative data and in completing evaluative reports. TLs also serve as Primary or Secondary Mentors.

6 Mentoring Teams

Whereas the TLs coordinate overall training opportunities within a given track, the mentoring team coordinates the detailed training for individual trainees. The core of the training program includes a focus on scaffolding - that is, each trainee works with a Mentoring Team that consists of at least two mentors with expertise from two different CMT32 training tracks (and possibly a third Mentor) that range from senior to early career faculty. For example, a trainee might work with a senior-level Primary Mentor whose expertise matches the trainee's goals and whose experience in the field is significant, thus giving the trainee exposure to theoretical and conceptual expertise and large-scale projects. This trainee will learn from this Primary Mentor what the published results of large-scale grant projects look like as well as what the gaps are in the field where additional research is needed. This trainee might also work with an early career faculty member as a Secondary Mentor developing or administering their first large-scale R-level research project, giving the trainee exposure to tasks such as the basics of grant writing and developing research questions. This Secondary Mentor could also give advice about setting up a new lab and work directly with the trainee on new analytic techniques for research. Although trainees will indicate in their application the tracks of interest for their training, the Program Directors work with each trainee to identify a set of mentors for the mentor team that best fits their training goals. The Mentor Teams are composed of mentors

across Penn State who have: (a) substantive expertise in CM, (b) strong history of funding and projects for the trainee, (c) range in experience from early, mid, and senior career levels, and (d) represent more than one training track for transdisciplinary integration from the mentor list below. In this way, CMT32 trainees connect to both the short- and long-term experiences of academics and see the academic trajectory from a range of experts in the field. To this end, we have included Primary and Secondary Mentors with a wide range of experience and expertise both in CM as well as funding history and mentoring experience. Mentor Teams meet as a group with the trainee four times a year to set training goals, discuss specific projects, and review progress. The TLs, PDT, and PDR meet with trainees and their Mentor Team in the biannual Track meetings to offer support in maximizing opportunities for further training.

6.1 Mentors

Each CMT32 trainee has at least one Primary and one Secondary Mentor that together represent two of the four training tracks. Primary Mentors are responsible for overseeing and directing the training plan for a given trainee, including: (1) developing a training plan with the trainee including participation in monthly research team meetings, (2) identifying and supervising projects that engage trainees in the conceptualization, selection, and application of appropriate research design and analyses, including dissemination of research findings, (3) identifying training opportunities including conference presentations and grant writing projects, (4) overseeing and supervising community engagement projects, (5) reviewing training plans with the Mentor Team at the beginning and end of each semester (four meetings a year) to ensure progress and resolve challenges, and (6) communicating with the PDT, PDR, and TLs regarding the progress of the trainee.

Secondary Mentors are also responsible for trainee development and provide complementary research training opportunities, such as: (1) including the trainee on research projects, (2) providing unique methodological training, (3) facilitating trainee participation in research papers and conference presentations, and (4) meeting with trainees as a part of regular lab meetings to discuss progress and specific projects. To ensure the transdisciplinary focus of the training plan, and because trainees will identify more than one track of interest, at least one Secondary Mentor is selected from a different training track than the Primary Mentor. Trainees also have the opportunity to identify a Tertiary Mentor, as appropriate, to ensure training goals are met.

The CMT32 includes an impressive team of Primary and Secondary Mentors. The Primary Mentors have extensive CM expertise across the training tracks and most have current NIH funding for their research on CM and a successful history of mentorship (see Figure 3). Together, this group of scientists provides an excellent, transdisciplinary environment for predoctoral and postdoctoral training in the four training tracks. Importantly, the Primary and Secondary Mentors use a wide range of research designs, including prospective, accelerated longitudinal cohort studies, optimization trials, randomized controlled trials, experimental and quasi-experimental studies, intensive longitudinal designs, implementation trials, etc. that facilitate training in, and exposure to, many different approaches. Hence, one goal of the CMT32 is to further develop trainees' critical thinking and expand their skill set so that they may apply multiple methods that cut across domains to address new scientific questions. The selection of Primary and Secondary Mentors was designed to provide both depth and breadth in specific research areas and theoretical orientation. This range exists in the research questions being asked, in the tools

used to answer those questions, and the populations being examined, including comparison samples such as non-maltreated youth and youth at risk for CM given opioid exposure. Also, faculty have experience with a range of NIH funding mechanisms, including program projects (P50), major research awards including R01s, R21s, R03s, and training grants including T, F, and K awards. In addition, grants from other federal sources as well as private industry grants are included in Primary and Secondary Mentor portfolios. Across the entire T32 grant team, there are 14 faculty associated with the BH track, 16 with the DP track, 14 with the PAT track, and 12 with the PADS track - clear evidence of expert coverage across the training plan.

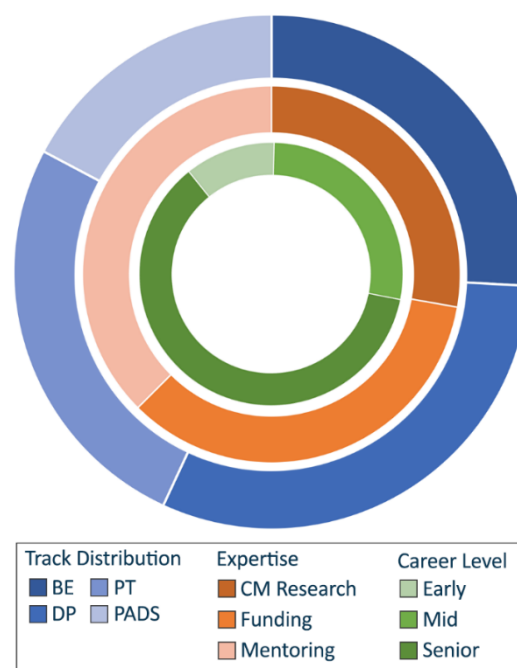


Figure 3. Primary and Secondary Mentor Team Expertise and Experience

As collaboration is essential for addressing the inherently transdisciplinary field of CM, we emphasize that the majority of our faculty collaborate extensively with each other, across departments and across Colleges. Collaboration among the

mentors consists of co-authorship in publications/conference presentations, sharing responsibilities on funded projects (external and internal), co-mentoring students, serving on advisory boards together, etc. As such, it is important to note that many of the faculty collaborate in other important ways that are not necessarily documented in terms of publications. For example, in preparation for PDT Jackson's testimony for the Congressional hearing on the Child Abuse Prevention and Treatment Act (CAPTA), Drs. Noll, Crowley, and Connell worked together to develop the written and oral testimony. Moreover, several of the Secondary Mentors provide consultation on the TCCMS and co-mentor K-awardees. Dr. Miyamoto developed a policy brief on sex trafficking for a Congressional hearing on which Drs. Font, Jackson and Noll provided consultation. Thus, although not all faculty collaborations involve joint publishing of empirical research (though over 100 collaborative empirical papers have been published to date with numerous others in preparation), faculty work together in a variety of important and meaningful ways. As a result, trainees gain the experience of learning within collaborative and transdisciplinary endeavors.

7 CMT32 Training Components

7.1 Overview

Transdisciplinary research does not mean abandoning a core disciplinary focus but rather represents a means of developing a shared understanding of a problem, including a valuing of and grounding in perspectives from other disciplines as well as the complex interplay of factors from a broadly ecological perspective (e.g. "cell to society") to develop innovative programs of research that will advance the field of CM in tangible, impactful, and sustainable ways. The CMT32 was built on common elements, pre- and post-doctoral trainee-specific elements, and within-track

and across-track activities that promote cohesion as well as exposure to the multiple disciplines represented. CMT32 trainees demonstrate a high level of productivity as evaluated by the impact of their research findings on CM science (as indicated by published research and policy papers, conference presentations and grant and fellowship proposals.) Trainees integrate their learning across several training tracks by: (1) developing an understanding of CM science and an ability to frame research questions from a biological, developmental, intervention, and administrative systems perspective, (2) demonstrating an understanding of the range of research methods applicable to research on CM, (3) demonstrating an understanding of the ethical and policy implications of research in CM, (4) developing an independent line of research questions related to the application of CM science in the field, (5) developing skills in building community partnerships, and (6) disseminating and translating science to practice and policy audiences.

The CMT32 at Penn State is designed to provide two years of training at either the predoctoral or postdoctoral training levels. Trainees develop an individualized training plan (ITP) in collaboration with their Mentor Team and in consultation with the PDT & PDR. The plan includes specific research training opportunities, seminars/course work, goals for reproducibility of research, and other experiences appropriate to trainee needs. The ITP has clear short- and long-term benchmarks for progress during the training period and the trainee will regularly review their progress with their Mentor Team and the PDT & PDR. Satisfactory progress on the ITP forms the basis for reappointment to the second year of CMT32 training. Most of the training experiences provided by the CMT32 are shared between the predoctoral and postdoctoral trainees. However, CMT32 postdoctoral trainees are expected to fulfill more leadership roles and to focus on the

development of an independent line of research, whereas the predoctoral training is focused on the development of fundamental knowledge in CM science and learning how to create products from their training experiences.

The CMT32 comprehensive training includes ethics training comprised of the Responsible Conduct of Research and an ethics proseminar led by the PDR. It also includes training in the Research-to-Policy Collaboration (RPC; Crowley et al., 2018) model—a key aspect of the TCCMS—that addresses barriers to the use of empirical evidence by policymakers by identifying policy priorities and facilitating connections between legislative staff and relevant research experts. CMT32 Fellows also participate in TCCMS policy activities including State and Federal briefings and hearings as well as white papers and policy briefs. Fellows also participate in grant-writing and peer-review intensives where F, K, and R-level grant proposals are crafted and submitted and publications are subject to constructive peer-review to support and increase productivity.

7.2 Formal Courses

Predocutorial trainees participate in coursework in the form of two, three-credit cross-listed courses that were developed and are co-taught by the respective TLs. One course, Child Maltreatment: Developmental Processes and Biological Embedding, was developed and is regularly co-taught by Drs. Schreier and Lunkenheimer (BH, DP Tracks) to provide CMT32 trainees depth with respect to training track content but also integration between the two tracks covered in this course. The purpose of this course is to review the breadth of literature on the biological and developmental impact of child maltreatment including sexual abuse, physical abuse, and neglect on youth victims. Students learn how to integrate child maltreatment research into a relevant, cohesive framework for understanding child

maltreatment's wide-reaching effects. The biological focus of the course is on the health consequences of child maltreatment as well as the neurological, neuroendocrine, and stress system-wide embedding of child maltreatment. The course also focuses on the developmental antecedents and sequelae of child maltreatment through childhood, adolescence, and the transition to adulthood, including addressing how intergenerational transmission, parenting, interpersonal relationships, and attachment are associated with exposure to child maltreatment.

The second course, Child Maltreatment: Policy, Administrative Data Systems, Prevention, and Treatment, was similarly developed by Drs. Connell and Shenk to foster predoctoral training within and between the PAT and PADS tracks. The course provides an overview of the major components of the child welfare system (e.g., child protection, family court, foster care, congregate care) involved in the community response to child maltreatment and promotes a critical analysis of key federal policies that guide system activities. CMT32 trainees also become familiar with Federal, state, and community data systems, and with methods to develop integrated data systems and their relevance to evaluating system outcomes and policy effects related to the child welfare system. This course also provides an in-depth examination of the content of major behavioral interventions, both preventive and treatment, applied with the child maltreatment population. Students first receive an overview of the philosophy of science and experimental methods used to develop and evaluate behavioral interventions for child maltreatment. From there, students review emerging paradigms within national funding agencies that focus on identifying and targeting mechanisms to optimize intervention effects. Students, regardless of their prior training, also engage in direct rehearsal of intervention components common across different interventions and programs. While both graduate-level

courses are required as part of the CMT32 predoctoral training, postdoctoral trainees, as well as graduate students from across Penn State, are welcome to attend and complete this coursework.

7.3 Proseminar

While predoctoral fellows participate in the required graduate coursework, postdoctoral fellows participate in a monthly two-hour Proseminar which includes much of the course content included in the predoctoral courses with rotating topic sessions: 8 devoted to the four training tracks (2 each for BH, DP, PAT, and PADS) with specific focus on innovative methodological advances in each field of study; two additional methods sessions devoted to cross-cutting innovations in research design or analysis (e.g., measurement of CM; multilevel modeling; mediation); and two devoted to additional training in the RPC model taught by Taylor Scott, PhD, a policy specialist housed at Penn State who routinely works with congressional staffers and conducts policy workshops and trainings across the U.S. The PDT oversees this seminar and TLs will teach the seminar sessions in their specialization track. The PDT also organizes other experts for guest lectures and the training schedule of the meetings. This serves as an additional opportunity outside the research experiences to expose CMT32 postdoctoral trainees to a wealth of scientific expertise.

7.4 Professional Development Seminar

The PDT leads a monthly, two-hour Professional Development seminar focusing on issues such as, building a successful academic career, improving writing skills, applying for jobs, choosing outlets for scholarly work, writing and responding to reviewer critiques, promoting one's own self and work, setting up a research lab, maintaining writing productivity, and establishing interdisciplinary and inter-

institutional collaborations. During the seminar, trainees discuss their progress in developing a program of research and the training faculty will also participate as guest speakers to describe their research and policy work in CM.

7.5 Track Meetings

Biannual Within-Track and All-Track meetings are scheduled to help monitor and trouble shoot any CMT32 programming difficulties. The PDT and PDR attend each of these meetings to ensure overall program success. Within Track meetings are coordinated by TLs and include all of the Mentors and trainees within a given training track. These meetings are focused specifically on the training in a given track and include opportunities to share research findings, present updates on projects, share funding opportunities, and to provide opportunities for collaboration between trainees and Mentors in a given training track to support the specific academic trajectory of the trainee. All-Track meetings are coordinated by the PDT with the help of the TLs, take place biannually, and include all of the Mentors and trainees across all training tracks. All-Track meetings are devoted to sharing training experiences, ensuring that the planned products are comparable (e.g., peer-reviewed conference presentations), discussing research projects, identifying ongoing or new opportunities for collaboration, and sharing ideas for continued improvements and enhancements of the training experiences across tracks.

7.6 Research Projects

CMT32 trainees are expected to be highly focused and productive with respect to their research training. Mentor Teams work with trainees four times a year to set and evaluate productivity goals. Each trainee, with the aid of their Mentors and other track experts, work on papers and projects within the scope of their training

tracks. However, CMT32 trainees also work on research teams across tracks when appropriate to facilitate a transdisciplinary experience. For example, a trainee in the PAT track can also consider the possible aspects of BH or DP that may play a role in targeting outcomes and should be able to articulate the possible overlap or influence of the other track topics in their work. During All-Track meetings, trainees interact across tracks and gain insight into cross-cutting questions and methods that may enhance their theoretical and methodological perspectives. Given the high level of productivity of the Mentors, it is not unreasonable to expect CMT32 predoctoral trainees to co-author at least two empirical papers and the postdoctoral trainees to publish at least two first-authored empirical papers over the course of each training year. Progress toward research goals is evaluated weekly with meetings involving a Primary or Secondary Mentor and quarterly during Mentor Team meetings.

7.7 Participation in Annual Conferences

As part of the CMSN and TCCMS, Penn State hosts an annual national conference on a pressing topic in CM, inviting the top names in their respective topic areas to give all-plenary addresses. Past conferences have addressed topics including evidence-based prevention and treatment, the biological embedding of stress, trauma-informed schools, integration and use of administrative data for predictive models and analytics, foster care science, and innovative methods to study CM. Each conference culminates with an afternoon session on the second day where all presenters brainstorm about the “next steps” for the field. CMT32 trainees are encouraged to help organize the conference and present either talks or posters, both of which are excellent networking opportunities.

7.8 Summer Institute

The Summer Institute is a day-long immersion experience that is designed to complement the CMT32 training program by leveraging the infrastructures of the 3 Capstone Centers in Child Maltreatment Research that increase trainees' exposure to the larger field of experts in CM, begin cross-Center collaborations, and increase the pipeline of potential applicant pools for predoctoral and postdoctoral training slots. Annually, the TCCMS has an advisory board meeting for 1-2 days each Summer to review emerging data, present various programs of research, identify state-of-the-art methods and emerging innovation, brainstorm solutions to challenges, plan manuscripts and spin-off grants, and spark new collaborations.

7.9 Community Engagement Activities and Projects

Community engagement is a critical part of CMT32 training in dissemination that is sorely needed in the CM sciences. Publications and conference presentations are important but given the direct public health impact of CM on so many youth and families, engaging with the communities affected by the work is critical to training the next generation of scholars. There is little impact on the field if trainees cannot explain and make their work useful to the direct service providers and receivers of services related to CM. Furthermore, prevention of CM is important, and the next generation of scientists have to be able to apply what they know to ensuring that the rates of CM decline in the near and distant future. To this end, the CMT32 includes required training and activities so that the trainees can use their work and its results to inform the public. With the help of their mentors, the nature of this community engagement can take many forms including, but not limited to, doing workshops on the impact of CM on youth physiological well-being for local parent groups, conducting seminars for social welfare caseworkers on assessing and measuring maltreatment, meeting with clinicians who provide behavioral health services to help

them tailor their work to the specific needs of youth exposed to maltreatment, and creating a monthly Facebook live session for parents interested in knowing more about creating safe, stable, nurturing relationships with their children. Trainees from all four training tracks are required to have a community engagement project completed in addition to their other training obligations to ensure that the community engagement training is infused throughout the training experience.

7.10 Development of a Program of Research

Moving from participation in a mentor's program of research to establishing an independent research program can be a difficult transition. Without involvement of additional training activities outside the Primary Mentor's projects and opportunities to develop collaborative research with other established scientists and peers, postdoctoral fellowships can produce well-trained scientists that have no clear plan for developing their own program of research. The CMT32 is designed to ensure that all postdoctoral trainees have the chance to begin the development of their own program of research from the day they begin their training. This process works through the combination of all CMT32 training mechanisms, including the initial self-assessment completed by the trainee, the collaborative development of a track-based training plan designed by each trainee in collaboration with their mentor team, multiple required seminars and optional didactic opportunities, and involvement in ongoing professional development projects outside of the Primary Mentor's projects. The interaction with other trainees and exposure to scientists across the participating faculty will help build a network to support future endeavors.

8 Training Evaluation

Evaluation of the CMT32 program is accomplished in three ways: (1) evaluation of the trainees' progress by the Mentor Team and the PDT & PDR, (2) evaluation of the program by the trainees, and (3) evaluation of the training program by the Advisory Board. In addition to regular review by the trainee's Mentor Team, the PDT & PDR complete semiannual reviews of trainee progress so that any challenges in training can be identified early and remedied in a timely manner. Progress is determined by reviewing the ITP, which is developed by the Primary Mentor, Mentor Team, and trainee and reviewed by the PDT and PDR in the first month of training and updated at the end of every semester. The main metrics of success are timely progress toward Ph.D. completion (predoctoral fellows) and number and quality of CM-related projects (postdoctoral fellows). It is expected that trainees: (1) publish at least 2 CM-focused papers a year (at least two first authored papers for postdoctoral fellows); (2) will have applied for a research award, fellowship or small grant; and (3) will have attended all seminars offered in a given year with satisfactory performance. The PDT also meets with all of the CMT32 trainees to ascertain their satisfaction with the training experience and get feedback on how the training experience could be improved. Trainees and Mentors complete yearly feedback forms to determine their satisfaction with the training, the leadership of the program, and ideas for improvement. As trainees exit the program, exit interviews are completed to gather feedback on ways the training program could be improved.

9 Conclusion

The CMT32 Training Program at Penn State began in 2020 to train the next generation of scientists capable of embracing the complexity of CM through participation in transdisciplinary training that can overcome the current siloed nature

of research and training. Our first training cohort, consisting of four predoctoral and two postdoctoral trainees, is now complete with notable success. Of the four predoctoral trainees who have completed the CMT32, two are now completing postdoctoral fellowships at other Universities to further their training in CM science and two are currently completing their dissertations with CMT32 Mentors as committee chairs or members. Each of the postdoctoral fellows have successfully completed their training and accepted faculty positions at other institutions. As of 2022, there are now four new predoctoral fellows beginning their two-year training with three new postdoctoral fellows. Each of the CMT32 fellows have fully engaged their comprehensive training and have been highly productive in terms of generating publications, conference presentations, and policy briefs during this time. Having made important adjustments based on Fellow and Mentor feedback, the CMT32 at Penn State is fully prepared to meet the task of training the next generation of CM scientists to move the needle on the science, practice, and policy initiatives needed to protect and assist children and families affected by maltreatment.

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