



Developing Cross-Cultural Data Infrastructures (CCDIs) for Research in Cognitive and Behavioral Sciences

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Abstract

Cross-cultural research provides invaluable information about the origins of and explanations for cognitive and behavioral diversity. Interest in cross-cultural research is growing, but the field continues to be dominated by WEIRD (Western, Educated, Industrialized, Rich, and Democratic) researchers conducting WEIRD science with WEIRD participants, using WEIRD protocols. To make progress toward improving cognitive and behavioral science, we argue that the field needs (1) data workflows and infrastructures to support long-term high-quality research that is compliant with open-science frameworks; (2) process and participation standards to ensure research is valid, equitable, participatory, and inclusive; (3) training opportunities and resources to ensure the highest standards of proficiency, ethics, and transparency in data collection and processing. Here we discuss infrastructures for cross-cultural research in cognitive and behavioral sciences which we call **Cross-Cultural Data Infrastructures (CCDIs)**. We recommend building global networks of psychologists, anthropologists, demographers, experimental philosophers, educators, and cognitive, learning, and data scientists to distill their procedural and methodological knowledge into a set of community standards. We identify key challenges including protocol validity, researcher diversity, community inclusion, and lack of detail in reporting quality assurance and quality control (QAQC) workflows. Our objective is to help promote dialogue and efforts towards consolidating robust solutions by working with a broad research community to improve the efficiency and quality of cross-cultural research.

A powerful critique of cognitive and behavioral research is that the majority of results, including those about human universals, are based on populations from Western, Educated, Industrialized, Rich, and Democratic (WEIRD) societies that do not represent much of humanity alive today or in the past (Henrich et al. 2010;

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Muthukrishna et al. 2021). The WEIRD bias in psychological research is well-documented and accepted by the research community as a fundamental issue to the field (Arnett 2008; Nielsen et al. 2017; Gurven 2018; Hruschka et al. 2018b; Kline et al. 2018; Rad et al. 2018; Barrett 2020a). As time has passed since the coining of the term WEIRD (Henrich et al. 2010), researchers have realized that the bias has cascading effects that permeate many aspects of scientific practice, including the diversity of institutions and researchers, the design of research studies, and the validity of protocols (Kline et al. 2018; Broesch et al. 2020; Forscher et al. 2021; IJzerman et al. 2021; Silan et al. 2021).

The WEIRD bias occurs in part because much of the research in cognitive and behavioral science is done by English-speaking and Western-based academics who collect data from participants who are either part of the undergraduate body where they work or are based in nearby neighborhoods (Kline et al. 2018). Such studies are often skewed toward highly educated, high-income, and ethnically homogenous groups that fail to represent diversity within and across cultures and societies (Kline et al. 2018; Barrett 2020a, b). The dearth of empirical studies with diverse populations has significant implications for the scientific accuracy and generalizability of social scientific research (Rowley and Camacho 2015; Apicella and Barrett 2016; Nielsen et al. 2017; Kline et al. 2018; Broesch et al. 2020). This bias has led to an under-estimation and misinterpretation of behavioral and cognitive variation as well as a propensity to misconstrue outliers as the central tendency (Henrich et al. 2010), both of which limit the ability of social scientists to characterize universal human qualities or to develop theory that explains variation (Gurven 2018).

Cross-cultural research can provide unique insights into the processes by which cultural diversity in cognition and behavior emerges and changes within and between populations (Barrett 2015, 2020a), however, much of the currently reported cultural variation in human cognition and behavior cannot yet be explained. Meanwhile, the pace at which this cultural variation is documented is growing. Due to widespread acknowledgment of the importance of this critique, there is increasing demand for research to be conducted cross-culturally. There is also increasing awareness of the related problems that go beyond the issue of sample diversity (Kline et al. 2018; Forscher et al. 2021; IJzerman et al. 2021; Silan et al. 2021) as well as for the problematic dichotomization that comes with viewing the world in WEIRD vs non-WEIRD terms (Ghai 2021). Broesch et al. (2020) recently addressed the growing tension between the increase in support for cross-cultural research and the lack of sufficient interdisciplinary conversation around cross-cultural research practices, such as methodology and research design, as well as community involvement. Similarly, Urassa et al. (2021) stressed the critical need for more equitable collaboration with partners in low- and middle-income countries, which will take time and investment, but will ultimately lead to more inclusive global research. We aim to contribute to this conversation by suggesting specific areas of need for standards and best practices along with respective paths forward.

Interest in cross-cultural research is growing, but the field continues to require improvement regarding (1) data workflows and infrastructures to support long-term high-quality research that is compliant with open-science frameworks; (2) process and participation standards to ensure research is valid, participatory, and inclusive;

and (3) training opportunities and resources to ensure the highest level of proficiency, ethics, and transparency in data collection and processing (Gurven 2018; Kline et al. 2018; Broesch et al. 2020; Hruschka 2020).

The aim of this paper is to promote dialogue and interest from the research community in mobilizing to develop infrastructures for cross-cultural research in cognitive and behavioral sciences. We suggest that designing *Cross-Cultural Data Infrastructures (CCDIs)* will improve the efficiency and quality of cross-cultural research and that the infrastructure we advocate for will elevate the state-of-the-art in research practices in the fields of cognitive and behavioral sciences. To accomplish this, we recommend constructing global networks of psychologists, anthropologists, demographers, experimental philosophers, educators, and data scientists to distill their procedural and methodological knowledge into a set of research community standards and open-science materials available for the training of new and diverse teams of researchers.

We propose that designing and implementing CCDIs can have at least three primary areas of impact. First, achieving broad interdisciplinary and international consensus on standards of practice for cross-cultural projects will improve the transparency of the decision-making processes in research and create better standards for involvement with communities where fieldwork occurs. Second, the infrastructural tools developed by, and made available to, a more diverse field of researchers supports a wider spectrum of researchers conducting cross-cultural research and evaluating the validity of cross-cultural methods, both of which are needed to rectify the biases inherent from historical overreliance on WEIRD populations by WEIRD researchers. Third, including community leaders and stakeholders from the beginning phases of research design will ensure that the appropriate perspectives contribute to the interpretation and modification of study measures while also creating opportunities for more equity and capacity building. We do not intend to suggest that the solutions here are completely sufficient. In some cases, we recognize the solution and in others we see the challenge and only know that it will take a community-effort to define a solution. In some cases, the solutions would require major shifts in scientific practice that aren't likely to be quickly achieved. That said, we nonetheless hope to promote dialogue and interest from the research community in mobilizing to find solutions for the needs acknowledged here.

1 Goal and Objectives

The goals of CCDIs are to improve data quality, protocol validity, ethical standards, and accuracy of explanations in cross-cultural cognitive and behavioral research. The implementation of CCDIs has a data science objective, an accessibility and inclusivity objective, and a training objective:

Data science objective: There is a need to elevate the state-of-the-art in cross-cultural research by improving standards for data quality and protocol validity. For CCDIs, *workflows* should be systematically organized sequences of tasks that handle and manipulate data and/or the procedural rules needed to produce certain

outputs in a standardized and replicable fashion. Cross-cultural research presents unique workflow challenges due to the complexity associated with many types of transformations and processing required for data and protocols, including translations and back-translations, protocol calibration and validation, video coding, synthesizing different types of data, and the need to track statuses at all steps of the process. Researchers may need an approach that is versatile and flexible, such that adjustments can be made for changing circumstances. Factors like these require designing workflows that are transparent, reproducible, and lead to the collection of valid and high-quality data. This in turn provides a firmer foundation for identifying and avoiding unintended sources of bias and supports tighter linkages among the construct of interest, observed variation, and explanation. Likewise, data quality requires processes for adopting and validating protocols for cross-cultural research. These protocols should also ensure that the process of evaluating and modifying methods is documented, which, along with the collection of qualitative data and input from community members (see below), provides essential insight into why variation was observed across sites for a given task. The challenges of ensuring protocol validity, though universal, are of increased importance and difficulty in cross-cultural research, due to the potential for problematic Western bias in design and interpretation (Kline et al. 2018; Ijzerman et al. 2021).

Accessibility and inclusivity objective: The diversity crisis in cross-cultural research is not limited to participant recruitment but extends to the researchers conducting studies and the institutions that support them (Arnett 2008; Nielsen et al. 2017; Urassa et al. 2021). CCDIs should be constructed to ensure perspectives are included across a globally and locally representative range of researchers and institutions and to create outputs that improve the accessibility of cross-cultural data and protocols for the research community at large. This objective can also be supported by sharing the systems used by researchers in the design, collection, and management of these studies, and ensuring that the research process itself is informed by a wide diversity of research perspectives. Several critiques of psychological research have identified a bias toward studying participants that are drawn from WEIRD populations (Henrich et al. 2010; Nielsen et al. 2017; Barrett 2020b). More needs to be done to ensure that addressing this critique includes not just participant recruitment, but that it also includes the process by which hypotheses are formulated and tested as well as how the construct validity of protocols is evaluated and documented (Meadon and Spurrett 2010). Expanding researcher and institutional access is key to developing improved protocols, research questions, and procedures for checking and validating methods.

Training objective: The training of research assistants and those collecting data at sites in a cross-cultural project is another often overlooked challenge especially compounded by research that expands geographic, linguistic, and cultural diversity. In order for young and early career researchers to obtain the best training on cross-cultural research practices, these infrastructures should be made publicly available and include materials necessary to ensure transparent, reproducible, and process-oriented procedures covering all aspects of protocol design, data handling and cleaning, and translation. We suggest that having these tools made pub-

lic and easily accessible creates an important training opportunity for researchers seeking to do cross-cultural work by making explicit the processes and considerations crucial to conducting research held to the highest scientific standards.

2 CCDI Challenges and Solutions

In a recent review, Kline et al. (2018, p. 1) present a well-constructed and actionable critique of cross-cultural research in developmental psychology. They note four key *problematic assumptions* that are common across psychology but play a particular role in limiting the effectiveness of cross-cultural research aims: “(i) the universality assumption, that empirical uniformity is evidence for universality, while any variation is evidence for culturally-derived variation; (ii) the Western centrality assumption, that Western populations represent a normal and/or healthy standard against which development in all societies can be compared; (iii) the deficit assumption, that population-level differences in developmental timing or outcomes are necessarily due to something lacking among non-Western populations; and (iv) the equivalency assumption, that using identical research methods will necessarily produce equivalent and externally valid data, across disparate cultural contexts.”

Kline et al. (2018) suggest remedies for these problematic assumptions, all anchored in cultural evolutionary theory. Thus, part of the solution to improving Western bias is possible by recognizing the dual nature of contribution to observed variation, as genes and culture interact, and also by recognizing the importance of qualitative data on the cultural context of traditions and learning as part of the process of human development. Accomplishing this recognition requires more systematic documentation of the local social and ecological environment that surrounds a population being studied as well as more site-specific documentation of cultural practices and norms – which requires community involvement and participation, as well as the understanding of the researcher’s positionality. Kline et al. (2018) note that this kind of documentation and evaluation of context presents major challenges for experimental control and evaluating methodological validity (Heine and Norenzayan 2006).

CCDIs require the development of tools that will help researchers meet these critical challenges and address these problematic assumptions. Next, we identify specific CCDI challenges and then propose solutions.

CCDI Challenge 1. Protocol Validity As it stands, the lack of procedural and practical infrastructure for conducting research across cultures, especially with the added difficulties of working with children in developmental research, has posed a major impediment to understanding learning across cultures. To address this, the community needs ways to adapt research to understudied populations (Nielsen et al. 2017). The use of protocols that are not adopted for cross-cultural work or that fail to include community feedback creates failures of interpretation and missed opportunities for new insights. To meet such challenges, CCDIs call attention to

often-overlooked details, such as: how research assistants are trained, how protocols are developed with construct validity (and other types of validity), or the amount and types of qualitative information that accompany experimental studies.

At the level of study design and interpretation, the *equivalence assumption* (Kline et al. 2018), is the belief that the same protocol will capture the same intended construct validly and consistently across a range of cultural contexts. That is, the protocol measures what it is intended to measure and measures it in a comparable way in many different contexts. This is a profound and common problem that rarely goes evaluated (Zuilkowski et al. 2016; Chester and Lasko 2021), even though most protocols are developed by WEIRD researchers based at WEIRD institutions. For example, Zuilkowski et al. (2016) tested a two-dimensional Western-developed pattern reasoning assessment, concluding that the results were highly skewed, and a two-dimensional version was not appropriate for young Zambian children, who had less exposure to two-dimensional objects like books. A subsequent, locally-adapted three-dimensional version was used for comparison, further supporting that the two-dimensional version was biased towards those with formal schooling.

Increasing sample diversity alone does not solve the problems of replicability and bias that come with an over-reliance on WEIRD populations. Because of the equivalence assumption, which overlaps with concerns over a lack of construct validity (Clark and Watson 2019), most studies cannot be certain that the differences they document are “genuine” rather than due instead to “methodological inconsistencies” or differences in how the protocol is received (Rossier et al. 2013; Gurven 2018; Amir and McAuliffe 2020). As such, in making assumptions of protocol equivalency, researchers magnify the additional risk of misattributing variation in task performance to the cognitive construct the task is intended to capture (construct validity), when in fact the variation is due to some form of unidentified error (Zuilkowski et al. 2016; Amir and McAuliffe 2020; Chester and Lasko 2021). Candidates for such sources of this error might still be cross-cultural in nature but could stem from variation in how the task is perceived, variation in the relationship between participant and experimenter (e.g., gender, age, teacher-student), variation in translation or translatability of task protocols, variation in the perception of a measurement scale (Lee et al. 2002), variation in participant response and non-response due to cultural norms, or variation in task implementation deriving from either training or recruitment of research assistants.

Researchers should avoid assuming, implicitly or explicitly, that the protocols for the tasks and resulting behavioral data are immune from variation due to norms or culturally-specific perceptions (Amir and McAuliffe 2020). At a minimum, a cross-cultural data workflow should include validity checks and pilot stages allowing researchers to assess variation in perception and comprehension of the protocol instructions, study materials, or testing environment. These assessments will likely require iterative adjustments and inputs from local researchers. In a review of experiments in social psychology, Chester and Lasko (2021) found that most studies, not just cross-cultural studies specifically, did not present any evidence of construct validity; 42% of the manipulations they reviewed lacked any sort of pilot validity testing or manipulation check, which they argue is likely a contributor to reliability issues. In cross-cultural research, such checks may be even more critical.

Cross-cultural researchers often emphasize external validity, but explicit attention to internal validity or construct validity is rare. In an appraisal of cognitive assessments in a cross-cultural context, Zuilkowski et al. (2016, p. 341) concluded that “many studies have used Western-developed measures without proper consideration of contextual validity. Across domains—from language to cognition to non-cognitive skills—this results in varying degrees of bias that call into question the findings of these studies.” Hruschka et al. (2018b) demonstrate that documenting the process for how protocols are iteratively adapted for cross-cultural research can itself become a source of insight into cross-cultural cognitive variation.

Protocol validity has already been shown to affect results in cross-cultural studies and to directly influence documented variability in a task’s intended construct. For instance, in evaluating the Mirror Self-Recognition (MSR) test, whereby children were marked on the forehead and placed in front of a mirror to test the development of self-concept, Broesch et al. (2011) found that children from non-Western populations (e.g., Kenya, Grenada, Fiji, Peru, and Saint Lucia), did not orient toward the mark on their forehead at 72 months, far beyond the index of 24 months previously established by research with children from the US and Canada. These findings suggest that the MSR test may not be a universal measure of the development of self-concept, as is commonly assumed, due to the significant cross-cultural differences that suggest a difference in the test’s meaning. In a comparative study of an innovation task that involves child participants fashioning a hook to retrieve an item from a narrow tube, Lew-Levy et al. (2021) found that children innovated with the pipe cleaner outside of the experimental setting much more readily than from within it. This suggested the possibility of an issue with internal validity related to the protocol or experiment, and one that could have led to inaccurate interpretations if not for the use of observational data to supplement the experimental tasks.

As these examples illustrate, protocol validity is related to both the *Western centrality assumption* (that Western populations represent a normal and/or healthy standard against which development in all societies can be compared) and the *deficit assumption* (that population-level differences in developmental timing or outcomes are necessarily due to something lacking among non-Western populations). Protocol validity is also related to the *universality assumption* (Kline et al. 2018), which occurs when any observed cross-cultural differences are assumed to be due to ‘culture’ (Apicella and Barrett 2016; Kline et al. 2018). Cultural differences should not be readily inferred based on a single statistical difference in a measured outcome between sites (which is common in cross-cultural research). The measurement of the complexity of culture is often inadvertently reduced to representation as a categorical variable for study location in a regression model. All of these assumptions are problematic and will require considerable effort to overcome, but improving and ensuring the validity of protocols in cross-cultural research is one of the most salient needs in the field. This problem is already recognized for experiments in single-population WEIRD samples and, as such, is an important source of error contributing to documented variation in multi-site studies. The failure to systematically evaluate protocols is a barrier to high-quality replicable and valid research on par with the lack of population diversity.

CCDI Solution to Challenge 1. Protocol Development Workflow We suggest that developing a cross-cultural study should include a clear process of protocol development, one that allows for multiple rounds of adaptation and refinement. This *protocol development workflow* can be based on the collective expertise from published studies that include explicit information on the protocol development process. There have been several recent influential studies outlining the implementation of multi-stage processes for cross-cultural protocol development that provide excellent examples to build upon (Holding et al. 2018; Hruschka et al. 2018b).

Hruschka et al. (2018a, b) is based on a social discounting task used as part of long-term fieldwork in rural Bangladesh. They demonstrated several ways that assumptions about participant perception of, and interaction with, the task could contribute to the task's ability to measure its target cognitive construct: how the weighting of social ties affects a willingness to share a financial resource. Parts of the protocol, such as measuring social closeness by depicting the participant as an abstract circle in proximity to other abstract circles, were not understood the same way in the various locations initially included in their study and became sources of participant confusion. However, a viable and successful revision process was applied and accomplished via a collaborative process with the community that included frequent and iterative checks of validity and understanding, as well as back-checks to ensure alterations to the protocol preserved validity across sites.

Holding et al. (2018) employ a multi-stage within- and-between site validation process for a comparative study that involved several tasks. The validation process had been developed over years of previous work on the topic

(Holding and Kitsao-Wekulo 2009; Holding et al. 2010). In brief, this consisted of i) “clearly define the concepts and constructs to be measured”; ii) “to identify a potential pool of measures of the concepts and constructs, and to review their content for potential challenges to engagement”; iii) maintain test equivalence across items in the battery; iv) consolidate “culturally appropriate conceptual vocabularies” with input from a panel of experts that included personnel from each location in the study; v) produce instructions for the tests in each local language using a multi-step process of translation and back-translation; vi) evaluate visual material for cultural relevance. Most importantly, from the perspective of a general recommendation that could be widely adopted across cognitive and behavioral research, they report the results of this process in a table that lists each construct of the study, how it will be measured (which tasks/methods), the nature of the stimuli, and a summary of any revisions that were made (separated by visual stimuli, verbal stimuli, and protocol) to adopt the measures for their cross-cultural project.

Currently, little formal instruction exists on how to adapt protocols to maintain validity across populations. We recommend that CCDIs combine the steps of the Hruschka et al. (2018b) protocol development process with those of Flake et al. (2017) and Holding et al. (2018). Such a process should include opportunity for input from experts within the team, but especially from experts in the any relevant local cultural contexts. For protocol development in new contexts, conducting literature searches, including qualitative and observational data, and anticipating modifications that will need to be made in advance is important, but it will not always be possible to predict all protocol issues a priori (Hruschka et al. 2018b). Thus, it

is also crucial to allow time and space for substantial protocol piloting and subsequent revisions in the field, informed by pilot responses, community and local collaborator's feedback. Additionally, we suggest that CCDIs should include tracking how protocols are perceived and modified for each population in a study (Flake et al. 2017; Holding et al. 2018; Hruschka et al. 2018b). This allows researchers to document variation in the validity of protocols in each step of the process as they are developed and modified using a combination of qualitative and quantitative methods. The importance of the qualitative data goes beyond the calibration of methods, extending its benefits to a discovery process that moves the excessive focus from the WEIRD context when it comes to the process of discovery. Qualitative methods, like participant observation, can inform designs and heuristics from unexpected angles. For instance, Danziger (2010) designed vignettes to study the concept of lying in Mopan Maya communities after she realized that members of the community were using the concept in a way that resembles mental opacity - as an equivalent of the concept of "falsehood". After this ethnographic hunch, she was able to validate this intuition with experimental methods, which in turn led to the finding that the concept of lying in Mopan Maya societies was different than the concept used in the US in significant ways. Further, these CCDIs should include documenting the process of research design, the context around the study environment, and a process for obtaining feedback from those who take and/or administer each task. We look to methods of longer-term studies that use ethnography and other forms of qualitative documentation (Kline et al. 2018), echoing the calls for more contextual information in cross-cultural research and the inclusion of researchers with long-term relationships with field sites (Rai and Fiske 2010).

Modifying protocols to have verifiable validity (internal, external, and construct) in cross-cultural research will not generally be an easy or fast process. It will require validating aspects of the protocol before the study begins, piloting each iteration of the protocol as it is developed, and conducting back-verifications across all recruitment sites in the study. Importantly, as a first step, we strongly recommend that researchers document the process of protocol development, in whatever form it takes, and include discussion of this information in published articles, supplementary materials, or documented with open access. As reporting protocol development becomes more common and the number of test cases from published studies increases, we suggest that the protocol development workflow will naturally become more standardized, allowing researchers to adopt the process across a wide range of task types and settings. The formats of pre-registrations for cross-cultural studies could include plans for establishing validity and the steps intended for protocol adaptation.

CCDI Solution to Challenge 1. Procedures for Increasing the Use of Contextual Information In addition to a formal process of validity checks, improving cross-cultural research requires increased use of contextual information (Heine and Norenzayan 2006; Ceci et al. 2010; Rai and Fiske 2010; Flake et al. 2017; Kline et al. 2018). Such information can be acquired through survey of existing indices (e.g., the Human Area Relations Files) coupled with qualitative data (e.g., focus group discussions, interviews, participant observation), increased community participation, and

collection of community surveys and data on participant characteristics, including demographics but also attitudes and norms gained via interview (e.g., cross-cultural research needs more cultural anthropology). This solution promotes the importance of qualitative information on community context and perception of study tasks while also developing standardized procedures for collecting and tracking such information. We recommend that qualitative information and community characteristics be collected or accounted for before or alongside study protocol design. Collecting contextual information with communities as well as discussing study goals and design with local collaborators can yield valuable feedback on likely sources of variation for how tests will be received and what factors may affect their ecological validity (Flake et al. 2017).

CCDI Solution to Challenge 1. Process for Researcher Training Because variation in protocol implementation can also contribute to unintended sources of variation, it is crucial to have standardized processes for training researchers and research assistants. For this reason, CCDIs should include best-practice guidelines for researcher training on data collection and the implementation of protocols. This solution is required to support those for workflow and protocol development. We recommend a training process that will include a multi-step instruction and evaluation procedure with multiple rounds of videotaped (where appropriate) practice runs of a task and feedback from more experienced personnel who have already completed the training. Though information about these processes is not often formally published in social sciences, health-related fields suggest that these training processes for research assistants work better if they are proactive and preventative in nature, having been established prior to the start of a project, avoiding the need for reactive changes mid-study once issues have already arisen and data may be compromised (Nelson and Morrison-Beedy 2008). Most projects will have some form of such procedures, but the specifics of which are rarely reported. We encourage more transparency and open-access publication of the training procedures used in cross-cultural studies. Standardizing the reporting of these procedures and aggregating such approaches to training across multiple projects will help identify the most efficient processes for ensuring high-quality data and improve replicability as well as allow opportunities for external researchers to provide feedback. While the focus of this solution is on training data collectors and managers, Principle Investigators, particularly in psychology, may lack training in qualitative methods. Given the recurring value of qualitative methods throughout this discussion, part of this solution is to increase the training of the experimental psychologists who may wish to engage in cross-cultural research with methods like participant observation, focus group discussions, and standard interview techniques that will be essential for improving the quality of cross-cultural research.

CCDI Challenge 2. Lack of Explicit and Efficient Data Quality Assurance and Quality Check (QAQC) Workflows Successful progress in the field is reliant on the ability to verify and replicate every step of a given project. Key to replicability is a robust and appropriate data Quality Assurance and Quality Check (QAQC) system, which

checks data and videos for protocol deviations and violations, as well as inspects the quality and consistency of all data types. An additional challenge of cross-cultural research is therefore the critical need to implement QAQC processes on complex datasets that may require many stages of translation or coding and recoding. Multi-site multi-task data sets in particular require careful, often centralized, QAQC workflow handling to ensure maximal data quality. This process includes tracking progress through stages of data collection, entry, initial checks, corrections, translation checks, a process for data re-coding, and additional checks based on reviewing videos of the tasks (if applicable). Our own system involves data entry by research assistants in Excel (if possible, tablet-based data collection can save a tremendous amount of time), custom software for checking of basic data entry and formatting errors in R, translations, video coding, and a project management software for tracking the status of each dataset as it moves through the workflow and finally becomes part of a 'masterfile'. This system has evolved over time to solve each successive challenge as they emerged across a series of projects. Many researchers have systems that solve similar problems and we are confident that working collaboratively across teams to develop data processing infrastructures would produce better results than individual efforts.

Each of these stages requires significant infrastructure, specialized skill sets, and rigorous training. A great deal of efficiency and quality, and ultimately, study replicability, can be lost and gained based on the functionality of a workflow tackling these challenges. Such systems are labor-intensive to develop and minor missteps can result in undetected sources of variation in data quality. Cross-cultural research would strongly benefit from researchers publishing documentation of their QAQC systems, which can be reviewed, refined, and ultimately, used as a platform for other researchers in the field. In turn, such an approach would help avoid concerns stemming from research groups using their individual QAQC process, which despite attempts otherwise may be influenced by their own research culture and methods (Leonelli 2017).

CCDI Solution to Challenge 2. QAQC Workflow Similar to solutions for the previous challenges, we encourage the publication and open sharing of these QAQC processes across projects, which currently is not common practice. This can be used to facilitate the development of software or data management tools or simply an informed procedural basis that can help researchers solve these challenges more readily and transparently. Progress along these lines has been made in other fields, particularly biology and healthcare, where step-by-step descriptions of data collection, quality assurance, and screening protocols are well documented (Welch et al. 2017; Yenni et al. 2019; Venkatachalam et al. 2020). These include detailed descriptions of how data is entered and organized and how data errors and missing data are diagnosed and treated (Welch et al. 2017; Venkatachalam et al. 2020). Issues of this variety may be extensions of those typical of any experimental work with human subjects, but some are especially common in mixed-method comparative projects because they often include multiple languages and multiple kinds of data. CCDI QAQC workflows can enhance the transparency of data processing and handling, the efficiency of tracking the status of a given data set, the status and progress of

associated procedures like research assistant training or translation, and bring the ideals of contemporary Data Science (sensu Wickham and Grolemund 2017) while ensuring accessibility to a broad audience.

CCDI Challenge 3. Researcher Diversity Part of the WEIRD bias stems from the fact that the majority of cognitive and behavioral research that is funded and published is conducted primarily by WEIRD researchers located in WEIRD institutions (Arnett 2008; Meadon and Spurrett 2010; IJzerman et al. 2021). In the field of psychology specifically, this contributes to the *Western centrality assumption* and limits appreciation for the value of wide comparative contexts (Kline et al. 2018). Arnett (2008) showed that most researchers, institutions, and subjects published in APA (American Psychological Association) journals were American (from the U.S.), emphasizing how non-representative Americans are in terms of the total global population (fewer than 5% of the world can be considered American) and suggesting that this presents a real problem for psychological research in general. Cultural attitudes about individualism, prominent in the United States, can infiltrate study designs and interpretations in cross-cultural research IJzerman et al. 2021. The majority of funding opportunities and awards go to researchers based at institutions in North America (IJzerman et al. 2021). The underlying issue with a lack of researcher diversity is not only that researchers are not reflective of the communities being studied, but that there is a range of perspective and research interests not being represented within the field of developmental psychology (Meadon and Spurrett 2010; Broesch et al. 2020). Increased diversity in perspectives and research interests is likely one of the most efficient ways to remedy the WEIRD sampling problem (Hruschka et al. 2018a; IJzerman et al. 2021; Urassa et al. 2021).

CCDI Solution to Challenge 3. Global Networks, Local Partnerships Because a lack of researcher diversity leads to missed opportunities for additional perspectives or areas of interest, where possible, cross-cultural research teams should come from a wide range of institutions and include evaluations and perspectives from students and early career faculty from a range of backgrounds (IJzerman et al. 2021). We suggest that cross-cultural projects involve diverse international and interdisciplinary teams, ensuring that researchers from non-WEIRD communities are driving the conversation around improving the state of cross-cultural research. Researchers from local institutions have extensive experience working with local communities and topics, but their work may be less accessible or not available in journals that WEIRD researchers primarily consult. We recommend researchers studying populations that they are not a part of being intentional about including researchers more local to the community. Depending on context, these may be members of the community and/or affiliates of relevant institutions in the region. Furthermore, local partnerships with institutions in low- or middle-income countries require opportunities for equitable collaboration and leadership on projects as well as authorship, financial investment, and recognition of local institutional authority, with the ultimate goal of cultivating independent research infrastructure (Savage et al. 2021; Urassa et al. 2021). Conversations with local partners should be initiated by researchers seeking to work in

these field sites and should focus on how non-local researchers can support growth opportunities for local researchers and how they can support research infrastructure. Savage et al. (2021) suggest that research teams should recruit from diverse communities “at all levels of organization and all stages of a project” and that contributions can be acknowledged through intellectual means, like co-authorship, or with financial compensation. They also suggest that the values of diverse stakeholders are included and synthesized directly in the project’s design and implementation.

One approach to encouraging more researcher diversity across levels is to organize projects such that researchers (e.g., postdocs) are on site for the majority of the period funded by a particular grant. One project implemented this strategy by hiring local postdoctoral fellows that worked with local universities under the supervision of local researchers at each fieldsite. The advantages of this structure include that researchers are in near continuous contact with the studied populations, which also provides the opportunity for multiple visits to the field. It also increases the opportunity for the postdoc to build networks across institutions. The postdoc and any additional researchers can be hired locally, thus increasing the opportunity to increase project diversity and build capacity. The increased field time (and likely decreased travel costs) can help avoid collecting data under rushed conditions, leading to better quality data.

As we have outlined, we believe building a diverse global network of multi-disciplinary researchers will help to improve the ethics and scientific quality of cross-cultural research. However, we also recognize that generating such a network may be (at least initially) difficult for some scientists (for example, early career researchers). At the minimum, researchers should seek collaborations and consult experts from different disciplines and diverse institutions and extract feedback before a project launch. Early career researchers (ECR’s) in particular can seek collaborations with other ECRs as well as with more senior and experienced scientists to lay the foundations for creating these networks. Indeed, for ECRs to be able to make this progress, it will also require buy-in from the funders who provide infrastructure and opportunities.

CCDI Challenge 4. Community Inclusion in Small-Scale and Under-Explored Populations As much a scientific challenge as an issue of ethics, cross-cultural research commonly includes WEIRD researchers studying non-WEIRD populations. Community connections based on trust and respect are critical, particularly if working with children. The need for careful observation and long-term conversation with communities is essential for modeling protocol adaptation correctly (Holding et al. 2018; Hruschka et al. 2018a). We contend that more cohesion between study development and community input can lead to better protocols, better within-population sampling, validity evaluation, or better-formulated hypotheses about the role of norms and local perceptions in affecting variation study outcomes. In this section, we discuss some examples of current challenges related to community inclusion in the context of methodological and theoretical considerations of cross-cultural research.

A common practice among cross-cultural researchers, particularly when working in small-scale populations, is to employ local research assistants (Barrett 2022).

Local research assistants are used to help with study translation, interpretation, coordination of participation, and data collection. In such cases, local research assistants are typically trained about the study's protocols before testing. However, thorough training includes having a deeper and broader understanding of common 'scientific practices' and relevant considerations, tailored to the complexity and interactivity of the experimental task at hand. Even with a detailed protocol, experimenters often need to make spontaneous adjustments in correspondence to individual testing situations. Without background knowledge of general scientific motivation and considerations, instead of focusing on capturing responses that help to answer the research questions of interest, local research assistants may inadvertently prompt participants to respond in favor of what is conventional based on local standards and expectations. Such research assistants should be provided with support and training in to build capacity and, where possible, provided with further growth opportunities. Other than employing research assistants, members of the communities in which cross-cultural research takes place are often not included as consultants for study design or implementation and are rarely included as co-investigators (Broesch et al. 2020). Deeper community involvement is essential for better protocol development and can improve project planning and the interpretation of results (Meadon and Spurrett 2010; Hruschka et al. 2018b).

CCDI Solution to Challenge 4. Promoting Community Inclusion in Small-Scale and Under-Explored Populations Despite the increasing number of publications about methodological or general issues of cross-cultural research, there is not yet systematic documentation of concrete recommendations for protocol and procedure. To promote community involvement, researchers should create explicit guidelines built on experience from successful long-term field site researchers (Marlowe 2010; Hill and Hurtado 2017; Gurven et al. 2019). We recommend consulting international and interdisciplinary networks on best practices for building trust and for appropriately consenting and compensating communities prior to data collection, particularly those with an ethnographic or anthropological focus, and subsequently including community considerations in published works, with the goal of sparking continued conversation on these topics. Beyond the scientific merit, efforts to properly credit local community members for their contributions to research are essential for the efforts to decolonize the social sciences (Urassa et al. 2021). The involvement of the community in the research design process will also help to ensure studies are set up in a way that better resembles the social dynamics seen in daily interactions within the population being worked with, as anthropological and ethnographic-based work often does. Cross-cultural studies should strive to include designs or setups that resemble naturalistic learning and socializing environments, or employ observation that is generally applicable in any context (Wen et al. 2020; Lew-Levy et al. 2021).

3 Summary of Recommendations

In summary, making progress in achieving a more scientifically robust and inclusive behavioral science will require improvements in the collection and handling of data, in how protocols are developed, and how collaborative partnerships are arranged and managed. An underlying aspect of this is the data infrastructures that facilitate cross-cultural research. With more robust CCDIs, we can make improvements to data quality, protocol validity, ethical standards, and accuracy of explanations in cross-cultural cognitive and behavioral research.

In outlining challenges related to protocol development, researcher diversity, community involvement, and processes for data QAQC, one could easily add related challenges and/or divide these up into component challenges that each require attention. That is, the issues that we focus on here is by no means exhaustive. For some of these challenges, we have suggestions for how to meet them, but in other cases we suspect that finding solutions could be more readily met by compiling the expertise that is distributed across research teams in the cognitive and behavioral sciences (anthropology in particular), and by ensuring input from a wider range of voices that are currently underrepresented when deciding best practices, funding priorities, and the like. In that sense, we are hoping to promote dialogue that will address these challenges, with a recognition that the suggested solutions are not necessarily sufficient, and these issues will take time and community effort to resolve.

That said, there are a few cases where we can suggest solutions or what the ingredients for a solution might look like, which are summarized in Box 1. Protocol development workflows need iterative rounds of piloting, adaptation, and validity checks (see Hruschka et al. 2018b for examples of iterative protocol development). Protocol development should also involve inputs of contextual information from local experts where the protocols will be used. Post-data collection, the process of this development should be well-documented and transparent, especially when noting issues or roadblocks encountered during the process. For many researchers, this will require a marked increase in the amount of qualitative data they collect, which in turn requires appropriate training and tools. As researchers, we should work strategically to find outlets for publishing descriptions of this development process. Certainly, these materials could be in supplementary materials for papers, but they can also be added to project-level open science webpages (like Github or OSF). Pre-registrations could be modified to include processes of validity checks.

All projects that collect cross-cultural data probably have a data workflow (at least implicitly). We suspect that major improvements in efficiency could be made if these workflows were compared and contrasted across projects and the most effective tools and solutions more widely shared. A good data workflow has clear steps, defining the state of the data and the nature of any transformations or coding that occurs at each stage. The workflow should be reproducible over the long term, such that many years after a project is completed a researcher unfamiliar with the project could reproduce the steps from the raw data to the final output. The more that workflow procedures and decisions are published and shared, the more readily we can converge upon community-level optimal practices.

While many aspects of workflow and data handling are technical or mechanical, the solutions needed to increase community inclusion may have more to do with adjusting norms among researchers and promoting values of inclusion and ethics. However, the challenge of community inclusion is not a separate prong from trying to improve ‘science’ objectives of replication and data quality, but rather also a vehicle to higher quality research. One key requirement for promoting community inclusion is to avoid ‘helicopter’ or ‘parachute’ research strategies, whereby a cross-cultural researcher focuses almost exclusively on experimental tasks, does a short intensive field season, and does not spend extended periods with study participants or local experts (Silan et al. 2021). To be clear, such research is scientifically flawed as well as unethical. The contextual data that is often needed for cultural context can only be gathered with longer field seasons (longer than the bare minimum to arrive in a location and achieve a target sample size on a given task battery). Likewise, longer field seasons make it possible to establish relationships with local experts and to integrate their perspectives into the research process. For individual researchers, longer field seasons will be more expensive, and thus should be accounted for prior to the funding application process. In turn, funding bodies and reviewers should anticipate these costs and encourage the greater investment in research quality by allowing for field seasons that allocate time for qualitative data collection and stronger ties with local stakeholders.

Box 1: Overview of suggestions.

Protocol Development Workflows

- Plan for protocol piloting and rounds of revision in the field.
- Look for potential variation in perception and comprehension of the protocol instructions, study materials, or testing environment.
- Conduct iterative checks if revisions to protocols are made to ensure validity with the original intent of the study protocol.
- Work with local collaborators to discuss the design and potential issues of the study in the local context.
- Collect contextual/qualitative community information before or during protocol validity checking.
- Document and report the process of protocol development, in whatever form it takes, and include discussion of this information.

Lack of Explicit/Efficient Data (QAQC) workflows

- Create data workflows with clear steps and definitions of the state of the data and nature of any transformations or coding at each stage.
- Ensure sufficient detail so the workflow is reproducible from raw data to final output.
- Publish workflow descriptions so they can be built upon to improve efficiency and effectiveness.
- Work to establish community-level optimal practices.

Researcher Diversity

- Incentivization by funding bodies and reviewers for equitable collaborations with researchers based within the countries where cross-cultural work will occur.
- Consider collaborations with relevant community members, researchers at universities in host countries, as well as experts in NGOs, missionary groups, and other organizations.
- Ensure projects provide equitable authorship opportunities and appropriate compensation.
- Create partnerships with local researchers that support growth.
- For researchers from institutions with highly developed infrastructure, take responsibility for initiating conversations with local researchers about how to best support them and their institutions.

Community Inclusion in Small-scale and Under-explored Populations

- Consult local experts on best practices for building trust and for appropriately consenting and compensating communities.
- Plan for longer field seasons during the funding application process.
- Funding bodies and reviewers can incentivize and promote including community involvement as a necessary part of fieldwork.
- Researchers new to working outside of their own regional experience can seek guidance from long-term researchers.
- Properly credit local community members for their contributions.

Some of these suggested steps may be attainable only to varying degrees to different researchers. For example, funding and project deadlines are typically time-sensitive, and while we encourage researchers to build in time for steps such as

rigorous piloting and extensive QAQC procedures into projects (including funding proposals), we recognize that it may not always be possible. We therefore recommend that in such cases researchers openly document the steps they have taken, to allow better assessment of study generalizability. In general, the first step to addressing most of the challenges discussed is, in fact, the explicit reporting and discussion of procedures used in published studies, or at minimum in some form accessible to the public. As the transparency of important but often overlooked and unreported methods like protocol development, data handling/quality control, training procedures, and community consultation improves, some of these issues will be brought to the forefront of researchers' minds during study origination. Along with creating opportunity for other researchers to learn from previously used infrastructures, this also allows for refining and improving practices through time.

4 Conclusions

Despite the growing recognition that most of what we know about human development is based on a very narrow sample of humans, cross-cultural studies are still rare, often unsystematic, and typically rely on protocols that have not been checked for internal or construct validity. There is a strong need for a new path forward (Heine and Norenzayan 2006; Jensen 2012; Legare and Nielsen 2015), combined with a growing recognition that the WEIRD bias is much more than an issue of participant sampling, as it strongly affects protocols, study design, the membership of the research community, and the interpretation of data in ways that have not yet been fully accounted for. In order to improve the WEIRD bias in psychological research, the field of cross-cultural research has to meet a number of scientific and ethical challenges. With this in mind, we illuminate four major challenges faced in cross-cultural projects and suggest paths forward for building these infrastructures (CCDIs) for the field. These challenges are 1) ensuring protocol validity 2) explicit data quality assurance (QAQC) processes 3) increasing researcher diversity in field, location, and institution, and 4) improving community involvement throughout the research process. Many of the steps we have proposed will be difficult, time-consuming, and costly, while others are as simple as expanding reporting of infrastructure and procedure, but we have come to realize the importance of these steps as we have found shortcomings we have had to address in our own research. Indeed, awareness for many of the areas of need for improvement come from our own experiences and procedures, as the efforts made to improve missteps motivated us to write this paper. We hope that more attention to these challenges can lead to more rapid progress toward efficient solutions.

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