Outside Museum Walls: The Impact of Community Facilitators in an Outdoor Social Science Exhibition

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Abstract

The museum field has begun exploring the effects of facilitation on visitors' learning, focusing on facilitation by museum staff inside museum buildings. However, some museum professionals contend that museums have a responsibility to serve their communities in the spaces where community members spend time, rather than expecting the public to come to them. Less is known about the effects of facilitation on visitors in urban outdoor spaces where interactions with facilitators are unexpected. The present study contributes to this line of literature by describing a quasi-experimental study that assessed the effects of exhibition facilitation led by community stewards using a trauma-informed approach in an outdoor, freely accessible civic plaza. Video observation and visitor interview data were collected. The present study found that facilitation increased visitors' exhibit usage, overall satisfaction, and some but not all assessed areas of affective and metacognitive learning. The study highlights the value of research conducted in partnership and the power of content-humanizing facilitation.

Introduction

Facilitation is an important component of informal educational settings. Many science museums employ facilitators (also called educators, explainers or docents) to deepen visitors' engagement and understanding of exhibit content and to help visitors practice skills of science, such as making observations and sharing evidence-based conclusions. A relatively small but growing number of researchers have studied exhibit facilitation in museums, zoos, and aquaria (hereafter, "museums") (e.g., Gutwill & Allen, 2010; Kisiel, 2006; 2021; Lindemann-Matthies & Kamer, 2006; Lussenhop & Auster, 2015; Machado Corral et al., 2021; Mony on & Heimlich 2008; Pattison et al., 2018). We hope to add to this expanding body of knowledge by offering results of an investigation of facilitation in an unusual informal setting. Drawing on practices of community-based research (CBR), we formed a hybrid research team with community researchers and conducted a quasi-experimental study to assess the effects of facilitation on science learning in an outdoor, freely accessible urban plaza where passersby had no expectation of encountering science museum exhibits.

In the present study, we focused on what Pattison and colleagues (2018) refer to as "unstructured" facilitation, "unscripted conversations between educators and visitors" as opposed to structured facilitation, which are "preplanned experiences that museum educators might lead, such as a school group program or stage demonstration" (p. 5). During unstructured encounters, museum facilitators tend to help visitors use, understand, and see the relevance of exhibits (Machado Corral et al., 2021).

The power of unstructured facilitation in museums

Prior research has shown that unstructured facilitation can have a significant, positive impact on museum visitors' learning experiences. In a rigorous, quasi-experimental study of unstructured facilitation at three math exhibits in a science museum, Pattison and colleagues (2018) found that facilitation increased dwell time, satisfaction and mathematical reasoning, but negatively affected intergenerational communication. Facilitators in that study had been trained in "responsive facilitation," where the facilitator observes families to assess their needs, then offers appropriate support such as orientation, posing new challenges, and offering just-in-time explanations (Pattison et al., 2017; 2018). Another science museum study of a simpler form of facilitation at an engineering design challenge exhibit focusing on families with children ages 7-14 found that families who had at least one "encouraging check-in" with a facilitator spent more time in the exhibit, tested their designs more, and ended up having more interactions with the facilitator than families without a check-in (Lussenhop et al., 2015). In addition, that study also found that children's science self-efficacy after the experience correlated with the number of interactions between families and facilitators. In yet another study of the power of facilitation, Machado Corral and colleagues (2021) employed the Visitor Engagement Framework to analyze 25 hours of

video that captured about 15,000 visitors interacting with 137 science museum exhibits (Barriault & Pearson, 2010). They found that visitors who were facilitated were significantly more likely to experience "breakthrough" behaviors (e.g., testing variables, making comparisons) than visitors who used exhibits without interacting with a facilitator. The researchers also categorized the facilitation behaviors they observed on video into four categories: Comfort (providing welcome and positive affect), Exhibit Use (offering instructions and usage tips), Information (providing explanations, facts, context or stories), and Reflection (making connections, asking trigger questions, soliciting predictions, or posing challenges). The most frequent facilitation behavior found was Comfort, followed by Exhibit Use and then Information. Reflection was relatively rare, with only about half as many occurrences as Comfort. This finding suggests that while museum facilitators may support psychological safety and help visitors get started at exhibits, they may not focus as much on encouraging visitors to deepen their conceptual understanding.

In fact, research on the effect of facilitation on content learning has produced mixed results. A comparative study of learning at a zoo found that visitors who were facilitated while interacting with a touch table developed a greater understanding of the concepts than visitors who only read labels and did not access a touch table (Lindemann-Matthies & Kamer, 2006). Although the result was positive, facilitation was confounded in that study with experiencing a touch table, making it difficult to ascertain the true impact of facilitation. Mony and Heimlich (2008) investigated the effectiveness of zoo docents' communication on visitors' understanding of the zoo's five key conservation messages. They found that signage was actually the communication channel visitors mentioned most when reporting back messages they had received from the zoo. When visitors mentioned interacting with docents, they reported that the docents answered questions and provided facts about the animals, rather than take-away messages about conservation.

While the studies reviewed so far have taken place inside institutional spaces (museums or zoos), one research project has explored the interactions of facilitators and learners in public settings such as national parks. Verbeke et al. (2018) set out to understand unstructured facilitation during "roves," spontaneous information sessions that park interpreters provide as they encounter visitors on trails. They observed two different conversation styles, Linear and Fluid, each of which had benefits and drawbacks. During linear conversations, interpreters initiate conversation, disseminate information and invite questions. While such conversations may be more comfortable for some visitors and allow for greater dissemination of scientific content, they also constrain opportunities for interpreters to better understand and respond to visitors' interests. Fluid conversations, on the other hand, constitute a back-and-forth interaction initiated by either party. These conversations may be more effective at reinforcing visitors' interests, but are shorter and less focused on science content. Although the study sheds light on different types of facilitation, it did not assess the impact of facilitation on learning outcomes.

In summary, prior research has discovered different types of interactions between facilitators and learners and has investigated the impact of facilitation on learning in different informal learning institutions and across different scientific content domains. The studies have consistently found that facilitators typically help museum visitors use exhibits and engage in scientific or mathematical thinking. Research is less conclusive about the impact of facilitation on content learning.

Facilitation in a new context

To our knowledge, prior informal science facilitation research has focused only on contexts in which people have knowingly entered a learning space focusing on science and nature. The research described in this paper focuses on unstructured science facilitation in an entirely new environment: outdoor, urban public spaces. In 2019, the Exploratorium installed a social science exhibition called *Middle Ground: Considering Ourselves and Others,* situated two miles away from the museum, in the culturally and economically diverse Civic Center of San Francisco. For more details about the exhibition, see Gutwill et al. (2022).

The Civic Center houses the city's key government and cultural institutions, including the San Francisco City Hall, Civic Center Plaza, the San Francisco Main Public Library, and The Asian Art Museum of San Francisco. The Civic Center also houses key community based organizations that serve the community, such as GLIDE memorial church and the Tenderloin Museum. Alongside these landmarks are commercial office buildings and family-owned eateries representing cultures and foods from around the world. Additionally, the Civic Center is also a site for community and cultural events, making the area a focal point for residents, government employees, professionals, Bay Area visitors, and global tourists. Despite its prominence, the Civic Center and its adjacent neighborhoods are plagued by inequality and many other social challenges, such as people experiencing homelessness, mental health struggles, drug addiction, and poverty. According to the San Francisco Planning Department's (2017) neighborhood profiles from that time, the residents in the Tenderloin and Civic Center areas experienced lower socio-economic status than those in museums or even than those in the rest of San Francisco, with 29% having attained a college degree as compared to 53% of the overall city's adults (SF Planning Department, 2017) and 73% of the adults who visit science museums (COVES, 2019). The median household income in that neighborhood was $20,700, less than one-third of the median income for San Francisco ($78,710) or museum-goers in 2019 (about $100,000). The long-standing ravages of inequity, substance abuse and violence create a great deal of trauma within the Civic Center area. Recognizing these challenges, city officials have announced a long-term aim of "changing how people engage with the place and with each other so that everyone could feel welcome and experience the best of San Francisco every day" (SF City Planning, 2017).

The Middle Ground exhibition responded to the city's call to connect people to their social environment and to other people from different backgrounds. The exhibition focused on three broad areas of social science: Social cognition, social influence and social connection. The learning goals were to (a) inspire metacognitive reflection about how cognitive shortcuts influence one's social beliefs and actions, (b) encourage visitors to engage with people perceived to be fundamentally different from themselves, and (c) foster prosocial emotions, such as compassion, connection, and mutual respect (for the effect of intergroup contact on emotions, see Chien & Atwell Seate, 2017; Brown & Hewstone, 2005; Harwood & Joyce, 2011; Pettigrew & Tropp, 2008). Given that Middle Ground was placed in a high-traffic, outdoor public space, passersby were typically not in the area to use the exhibition or learn science.

Previous research on *unfacilitated* exhibits in outdoor urban areas discovered that context has a profound impact on science learning at those exhibits. Cardiel and colleagues (2016) undertook a design-based research project to install two STEM exhibits outside various bus stations around Portland, Oregon. Their most important challenge was capturing travelers' attention, because people had no expectation of encountering a science learning experience. Although the study did not involve facilitation, it provides helpful lessons for designing learning experiences and thinking about the need for facilitation in an outdoor urban context. The research explored designs that would stimulate situational interest—the focused attention and positive feeling states that may be triggered by something in the environment (Hidi & Renninger, 2006). Situational interest is a "fundamental motivator" driving people to spend time and exert effort to find out more about a particular stimulus (Cardiel et al., 2016, p. 41). Cardiel and colleagues found that the precursors to people becoming fully engaged in learning were "(a) the presence of other individuals already engaged with the prototype, (b) the surprise and novelty offered by the experience, and (c) a generally welcoming and inviting atmosphere that does not discourage attention" (Cardiel et al., 2016, p. 50). All these precursors may be enhanced by facilitation. Facilitators can model engagement by playing with exhibits in the absence of other users, actively welcome and invite passersby into the exhibition, and highlight unexpected and surprising content. Cardiel and colleagues also found that outdoor urban contexts may undermine science learning for the people who did attend to the exhibits. Only about one-third of visitors to the unfacilitated exhibits at transit stations actually connected their experiences to the underlying STEM concepts. The researchers conjectured that people actually thought differently at the bus station than in the museum: "It seemed that visitors in public spaces are operating using mental schemas that differ from those brought to bear on experiences within museums and science centers." (p. 53). This shift in mental schemas may necessitate facilitation to activate a mindset for learning.

Given the location of Middle Ground, with its diverse potential audience and unexpected encounters with a science learning experience in an outdoor public space, we believed that facilitation may enhance initial engagement, psychological safety and prosocial feelings, science relevance, as well as conceptual learning and metacognitive self-reflection, meaning that visitors

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at Middle Ground would be more likely to think about the exhibited social science concepts and how their own minds engage in cognitive biases (aka metacognition) than unfacilitated visitors.

The present study of exhibit facilitation had two other unusual features beyond its location: (1) The facilitators were not museum staff; they hailed from Urban Alchemy (UA), a non-profit, community-based organization that employs previously incarcerated people to provide safety and service in struggling public spaces through a combination of compassion, respect and de-escalation. (2) The study was conducted by a collaborative research team of staff from the Exploratorium and Urban Alchemy, drawing on practices of community-based research (CBR). In the following two sections, we describe Urban Alchemy's facilitation approach and our partnership in forming a collaborative research team. For details on the interplay of the Middle Ground exhibition, Urban Alchemy, and the Civic Center, please see Gutwill et al. (2022).

Urban Alchemy's trauma-informed facilitation

Urban Alchemy's mission involves making public spaces safer by offering respectful, friendly interactions with all members of the public, regardless of race or class. They employ a trauma-informed, empathy-based approach. According to Carello and Butler (2015), "to be trauma-informed, in any context, is to understand the ways in which violence, victimization, and other traumatic experiences may have impacted the lives of the individuals involved and to apply that understanding to the design of systems and provision of services so they accommodate trauma survivors' needs and are consonant with healing and recovery" (p. 264). For Urban Alchemy, a trauma-informed lens refers to seeing and engaging the whole person, and taking into account a person's past traumas and resulting coping mechanisms when attempting to understand their behaviors. UA staff, called Practitioners, are expected to lead with empathy and kindness. In practice, this can mean performing wellness checks with people sleeping on the sidewalk, using narcan to reverse a drug overdose, directing tourists stepping off a tour bus, and greeting a person heading to work, all in the course of a few hours. Compassion lies at the center of their approach, as described by the three UA Practitioners who facilitated Middle Ground during the present study:

> It took me a long time to love and have compassion for myself. And in finding that, I'm able to use it with others, you know, find the goodness in people and love them for it and have compassion to their situation. [UA Facilitator 1]

> Just me being able to be open about my past, about my struggles, to let them know that I'm nothing better than anyone else. I'm right there with you. [UA Facilitator 2]

> I listen to what people have to say. And I care enough to give them advice or care enough to just help out if I can...like, I had extra socks and some shirts and stuff, so I will give them to people that don't have it. [UA Facilitator 3]

In addition to creating a welcoming community space by greeting passersby and offering assistance, Urban Alchemy Practitioners de-escalate potentially aggressive or harmful behaviors, such as raised voices, fast motions or frustrations (Hammonds, Clark-Johnson, and Dickey, 2022). To de-escalate, they employ kindness and empathy; try to understand as opposed to being understood; and endeavor to heal the other person in the process. Urban Alchemy leaders have a saying that underscores their view of folks who are agitated: Hurt people hurt people. Their trainings teach UA Practitioners to actively make several assumptions whenever de-escalating a challenging situation: The person is (1) suffering from long-term trauma or distress, (2) potentially dealing with intersecting issues of mental health, homelessness and addiction, (3) seeking help and community while trying to navigate through their trauma, and (4) carrying any weapons to protect themselves rather than harm others. As Urban Alchemy's website states, Practitioners "share a special bond with society's most vulnerable, because we see ourselves in their struggle. We know what it means to be dismissed and disrespected" (Urban Alchemy, n.d.). Several of the Practitioners live in neighborhoods where they have witnessed some traumatic events, such as murders, sexual assaults and other violent crimes, and also behaviors such as explosive yelling, public defecation and urination, nudity and other boundary-crossings. Moreover, they all have long-lasting relationships with many people who live and work in San Francisco's Civic Center, where the Middle Ground exhibition was installed.

In 2017, Urban Alchemy began offering trauma-informed services in Civic Center. Through daily interactions, UA Practitioners built relationships with community members, including those experiencing homelessness, those on their way to work, those visiting the cultural institutions in the area, and established their status as a *community-based* organization committed to providing care and service to the neighborhood. As it happens, the Exploratorium had installed an exhibition called Sound Commons in the area the prior year to engage the public in active sonic experiences (the Exploratoirum, 2022). The Practitioners posted near Sound Commons quickly began using the exhibits as props for initiating conversations with passersby, and then developed their own methods for facilitating deeper conversations at the exhibits, without explicit support from Urban Alchemy or the Exploratorium. As Middle Ground was being created, the Exploratorium staff noticed that UA Practitioners were facilitating learning at the Sound Commons exhibits, apparently enhancing the experience for exhibition users. The Exploratorium staff then connected with UA leadership to explore ways to continue and support this emergent facilitation. Together, they developed a partnership where the Middle Ground project would financially support UA facilitation at the exhibition, and the research focus would shift to understanding the impact of UA's facilitation on visitor learning and experience. This shift is described in the CBR section below, along with details regarding the collaboration in designing research methods, collecting data, and disseminating the results.

After the partnership was formalized, three Urban Alchemy Practitioners began working as facilitators at the newly installed Middle Ground exhibition. They did not have any formal training in

inquiry-based facilitation techniques, but had gained experience, either in prison or at Urban Alchemy, in trauma-informed care, effective communication, de-escalation and/or cognitive-behavioral therapy. When they first assumed the role of facilitator at Middle Ground, they were given a tour by the Exploratorium staff of the exhibits and underlying scientific content.

Interviews with facilitators from Sound Commons and Middle Ground revealed facilitation strategies used at both exhibitions, such as: Smiling and greeting people, maintaining eye contact, inviting passersby to try exhibits, demonstrating exhibit use, encouraging users with praise and support, promoting laughter with good humor, employing open and honest communication, and engaging users in conversations about deeper meaning to the experiences. The facilitation strategies employed by UA practitioners shared some similarities with those used by museum educators in facilitating visitors' experiences within museums (e.g., Machado Corral et al., 2021; Pattison et al., 2017; 2018). However, a distinctive feature of the UA approach was the voluntary self-disclosure of personal traumatic experiences, vulnerabilities, and biases by the UA facilitators. This practice, undertaken without any specific requirements or expectations, could lead learners to open up about their lives and engage in metacognitive self-reflection, a key goal of the Middle Ground project. Indeed, the intergroup communication literature has identified self-disclosure to be an important predictor in reducing biases (Tam et al., 2006; Turner et al., 2007). In aligning research plans with the UA community partners, UA facilitation became the independent variable in the present study.

Community-Based Research in practice

The study's methodology was informed by a community-based research (CBR) approach. Rather than a method per se, CBR is an *orientation* to undertaking collaborative research between academic researchers and community members. It involves doing research *with* rather than on communities (Hall, Tandon, & Trembley, 2015). It emphasizes equitable partnership between researchers and those directly affected by and knowledgeable of the local circumstances of the issue being studied (Horowitz et al., 2009; Macaulay et al., 2013; Minkler, 2005). In CBR, research questions focus on an issue or need identified by community partners. While quantitative and qualitative methods can be employed, study design choices and data collection methods ought to be determined based on their ability to address the research problem and their usefulness to community partners (Leavy, 2017; Strand et al., 2003). In this section, we describe our attempt to apply CBR values in practice.

Community-based research is often messy; we include this paragraph to stress the importance of transparency around that untidiness. While the majority of this paper was written by the first two authors, the remaining authors participated at different phases of the project and all contributed to revisions of this paper to represent a shift toward a more community based-approach. The Exploratorium original research proposal, written by Josh Gutwill and Toni Dancstep without

inclusion of Urban Alchemy, focused the research on exhibit design. Josh Gutwill was PI for the research project, overseeing all of its aspects. Hsin-Yi Chien joined the project after the partnership with Urban Alchemy and the planning of the research study had already begun, and her key role involved managing the data collection, analysis and interpretation. Toni Dancstep, as part of the initial Exploratorium research team, worked to progress the research toward a more community-focused approach. After spending significant time watching public engagement at Sound Commons, and talking to UA Practitioners about their facilitation practices, she encouraged the Middle Ground team to consider UA facilitation as a focus for the research. After several conversations between Middle Ground staff and UA staff, it became clear that such research would be useful to the UA team by developing an understanding of the impact of their facilitation work in the community, and in communicating the importance of that work. The team ultimately changed the research focus from exhibit design to investigating the impact of UA facilitation. This was one way to ensure the project was benefiting the community *and* the Exploratorium. Robert Dixon was the primary facilitator in the Middle Ground exhibition. Louie Hammonds, oversaw all Urban Alchemy activity in the area, including facilitation and research, and acted as a general advisor to the research project and the shift in focus. Robert Dixon's and Louie Hammonds's authorship is present in the previous section on UA facilitation and throughout the interpretation of the findings. Toni Dancstep also encouraged the Exploratorium team to reconsider methodology that was more aligned with equitable, community-focused approaches. Cecilia Garibay, the project's external evaluation partner, who has expertise in culturally responsive equitable research and evaluation approaches, was asked to provide ongoing advising and reflection as we worked to make our research practices and partnership more equitable and responsive. Part of that shift included the expansion of the research team to incorporate three Urban Alchemy Practitioners, including Kevin Lee, as researchers. (The UA researchers were different individuals from the UA staff who facilitated the Middle Ground exhibition.) As the team worked to truly integrate UA and the Exploratorium researchers, Shannon McManimon was brought in to share concrete examples of research partnerships between community members and educational institutions, and to shape the approach and conversations related to this work. Kevin, Cecilia, Toni, and Shannon contributed to the development, reflection, and writing about the community-based approach here and in the discussion.

Despite the variety found in different instantiations of CBR, Community-Based Research typically includes two important characteristics throughout the process: Involvement of community members and shared decision-making in various phases of research, including the development of study questions and instruments as well as the process of data collection (Garibay & Teasdale, 2019; Horowitz et al., 2009; McManimon et al., 2020; Viswanathan et al., 2004). These commitments necessitate reflective practice and willingness to change based on the needs, knowledge, and perspectives of different participants. For example, the three UA researchers brought invaluable insider knowledge regarding the context of the research site and the lived

reality of the various communities utilizing the space. For their part, the Practitioners felt a strong connection to the community, as one of them lived in the Civic Center neighborhood and the others had experienced similar traumas to people in the surrounding community. However, we recognize that Urban Alchemy Practitioners did not represent prototypical community members but rather community-based organization workers.

Embedded in CBR is a commitment to power sharing and respecting multiple forms of knowledge and expertise (Leavy, 2017). Yet, a fundamental power imbalance existed in the relationship between team members, as the grant funds for the project came to the Exploratorium which then flowed to Urban Alchemy. Urban Alchemy staff members often deferred to Exploratorium staff, viewing them as team leaders. Still, the Exploratorium researchers endeavored to move toward an equitable relationship with the Urban Alchemy researchers during a three-week training period that preceded data collection. First, the research team got to know one another through multiple conversations and team building exercises. For example, team members discussed positionality and power, explicitly noting that the Exploratorium research assistants and the Urban Alchemy researchers earned the same salary. The team worked through Ryoo and Shae's (2015) value mapping activities and also discussed each member's goals while working on the project, which ranged from advancing the informal STEM field to meeting personal and financial needs. Perhaps equally important was the time spent together. As Keven Lee, the fifth author, put it, we came in together, we left together, we ate together, which brought on camaraderie and togetherness. Conversations also included the power and authority of the research team's leader. This topic was particularly interesting, as the meaning of "collaborative decision-making" had to be negotiated: The Exploratorium staff were comfortable with a leader who explored different ideas and fostered consensus, while the Urban Alchemy researchers initially wanted the leader to make all the decisions. In the end, we compromised with a collaborative process that the leader "finalized" by voicing the (joint) decision.

The team also engaged in multiple training and mutual skills sharing and development sessions. The Exploratorium researchers led sessions on the protection of human subjects (including an interactive CITI certification that was translated from academese for all researchers), recruitment methods, and interviewing techniques; Urban Alchemy researchers provided training sessions on de-escalation and trauma-informed care for the research team. Given that the Civic Center included vulnerable communities that experienced trauma and marginalization, the UA researchers' lived experiences in prison and in the community, along with their trauma-informed lens, helped ensure that the language used in the study instruments and the way all the researchers communicated felt authentic, accessible, and respectful. For example, the Urban Alchemy researchers helped adapt a version of the MacArthur Scale of Subjective Social Status (Adler and Stewart, 2007), altering the language so as to minimize psychological distress in historically marginalized participants. Additionally, the UA researchers urged the Exploratorium researchers to approach our Emotions toward Different Others measure (detailed in the Method

section) with greater sensitivity. They advised the team on the potential triggering effects of certain emotion words, like "anger", within the study's context. This guidance led to the omission of certain sensitive terms from the research instrument.

One of the most important negotiations about our research methods arose when the Exploratorium researchers were describing how to adopt a neutral tone and body stance when recruiting and interviewing participants, so as to reduce participants' pleasing and social-desirability biases. The Urban Alchemy researchers resisted this approach, questioning whether we would "just be vultures" ready to swoop down on unsuspecting exhibition visitors. They felt strongly that in the Civic Center environment, it would be critically important to smile, make light small talk, use open body language, and give enthusiastic responses. They said that looking neutral would be interpreted as unfriendly, and that recruitment would feel like an invasion of personal space. Two UA researchers also pointed out that as Black men, they must adopt a positive demeanor to overcome people's prejudicial reactions. For some Exploratorium researchers, who were trained in traditional Western post-positivist research methods, moving away from neutrality was concerning and uncomfortable. The full team explored this discomfort together. In the end, the team settled on a mixed approach: Researchers would be highly positive during recruitment, take a neutral tone and refrain from answering questions during the interview, and then enthusiastically engage participants after the conclusion of the interview. After reaching agreement about the research methods, UA and Exploratorium researchers paired up to conduct data collection and engage in debriefing sessions.

After data collection was completed, the Exploratorium researchers transitioned away from Community-Based Research (CBR) approaches. They undertook the coding, analysis, and interpretation of the data in-house, rather than collaborating with community partners in these stages. This decision was based on the Exploratorium researchers' view that statistical data analysis requires extensive professional training, an expertise they could bring to the partnership. However, this approach introduced a limitation: the analysis and interpretation of the results were predominantly shaped by the perspective of the Exploratorium researchers. In retrospect, we realize that this represented a missed opportunity to invite UA partners to learn statistical data analysis and participate more integrally in the data analysis and interpretation process. To more faithfully follow the CBR principles, the Exploratorium researchers could have had conversations with UA partners to determine whether equal participation in the data analysis and interpretation process fit with their goals, or whether they preferred to defer these tasks to the Exploratorium researchers. This conversation would require careful communication and deep understanding between parties to ensure that Exploratorium researchers were not putting undue pressure on UA to participate *equally* rather than our goal of *equitable* participation, in which each participant contributes in ways that match their personal goals and desires, even if it results in different contributions from different stakeholders (Nee, 2021). This realization underscores the need to ensure that each partner's preferred modes of contributions are explicitly discussed and

respected both at the onset and throughout the project. We'd also encourage future CBR projects to intentionally allocate more budget and time towards collaborative analysis and sense-making.

During the pandemic shutdown of 2020, the first four authors gave presentations at a variety of virtual national and local meetings (Gutwill et al, 2020a; 2020b; 2020c). During these presentations, we were able to return to CBR approaches with the multi-organizational team discussing and disseminating results together.

In summary, the two organizations joined forces to create and implement a research study that was led by the Exploratorium staff, but collaboratively adapted research questions, revised methods, collected data, and disseminated results. Nonetheless, it is important to note that for the Hsin-Yi Chien, Josh Gutwill, and Toni Dancstep, who were in charge of writing the original research proposal and/or overseeing the study, this was their first experience conducting research with a CBR orientation. Consequently, some of our practices might not have fully aligned with established CBR best practices.

Research Questions

The present study asked the overarching question: How does trauma-informed facilitation impact public engagement and learning at interactive social science exhibits in an urban environment? This inquiry emerged from a collaboration between the Exploratorium staff and the leadership of Urban Alchemy. The Exploratorium was keen to investigate effective approaches to bring informal science learning to community spaces. Urban Alchemy, whose contract work primarily focused on providing street cleanup and safety at the time of the formulation of our partnership, was interested in a study that would explore their role as public facilitators to demonstrate their expertise and values beyond providing safety and service.

This overarching question led to the following research questions:

1. How does Urban Alchemy facilitation affect usage of the Middle Ground exhibition as measured by dwell time and number of exhibits used?
2. How does UA facilitation impact emotional and cognitive learning, as assessed in visitor interviews?

Methods

Overview

To explore the effects of Urban Alchemy facilitation on visitors' engagement and learning, the Exploratorium research staff decided to employ a quasi-experimental design and perform quantitative analyses. The methodological choices were driven by two factors. First, an

experimental design provides the most powerful means by which to investigate causal effects (Campbell & Stanley, 2015), which is the objective of this study. Second, although the Exploratorium researchers acknowledge that the use of quantitative methods and a post-positivist paradigm might reinforce the dominance of experts and create a power imbalance between academic researchers and community partners (Cancian, 1992), the Exploratorium and UA leadership agreed that quantitative methods were most likely to help the community partners achieve their goals of demonstrating their value. Scholars and practitioners of CBR have emphasized that the chosen methodology should be determined in part by its utility to community partners (Leavy, 2017; Strand et al., 2003). According to the CEO of Urban Alchemy, one of her goals of our partnership was to present scientific evidence regarding the effectiveness of Urban Alchemy's trauma-informed model to funders (L. Miller, personal communication, April 19, 2019). Indeed, quantitative results have often been effective at influencing government agencies, policy-makers, and funders due to the authoritative standing conventionally accorded to post-positivism among intellectual elites (Strand et al., 2003). In light of this, the collaborative research team determined that a quantitative approach would be appropriate.

We assessed the impact of facilitation on learning in the exhibition with a between-subjects design, in which visitors experienced the exhibition in one of two conditions: Control and Facilitated.[1] When in the Facilitated condition, Urban Alchemy facilitators greeted visitors and passersby, and facilitated their experience in the Middle Ground exhibition. Facilitators were not given rigid prescriptions regarding how they ought to engage the visitors. Instead, they utilized their trauma-informed training and the social skills acquired through their life experiences to tailor their facilitation strategies to the unique dynamics of each visitor interaction and the prevailing contextual factors. Common strategies employed by facilitators included welcoming passersby and encouraging them to interact with exhibits, demonstrating how to use the exhibits, inviting visitors to further explore the exhibition, supporting learning experiences with positive affirmation and humor, and engaging visitors in discussions about the deeper meanings and implications of their experiences.When in the Control condition, facilitators remained just outside the exhibition area and did not interact with visitors. Their presence in the Control condition was intended to communicate safety to users of the exhibition.

The study employed a multi-method approach and collected two sets of data: (1) video observations and (2) interviews of visitors to the exhibition. In the following, we describe the procedures, participants, and measures of the video observation sub-study and the interview sub-study, respectively.

Video Observation

To answer RQ1, we conducted a video observation study to examine how facilitation influenced visitors' stopping behaviors in the exhibition (Serrell, 1998; 2010). Specifically, the video

observation study was concerned with two dependent variables: (1) the number of exhibit(s) each sampled visitor used and (2) the total amount of time they spent at the exhibits.

Procedure

Middle Ground was installed in the front plaza of the San Francisco Main Library. We recorded visitors' movements with a camera mounted on the fifth floor of the Library, aimed down at the exhibition for six days. Two hours of video were recorded each day, from 12:30 p.m. - 2:30 p.m. No audio was recorded, and people's individual identities could not be ascertained from the video. (All procedures were approved by Ethical and Independent Review Consulting, an external Institutional Review Board, protocol #06815.) The total data set included 12 one-hour-long videos (Control: 6 hours; Facilitated: 6 hours).

Participants and Measures

A trained Exploratorium research assistant watched the video recordings and tracked every visitor who (1) appeared during the first ten minutes of each video and (2) used at least one exhibit for 17 consecutive seconds or more.[2] The research assistant tracked which exhibit(s) each sampled visitor used, as well as the time they spent at each of the exhibits.[3] Based on Serrell's (1998) suggestion, a return to a previously utilized exhibit did not increase the total number of exhibits used, but it was included in the total time.

In total, we collected and entered timing and tracking data for 90 visitors (Control: $n = 54$; Facilitated: $n = 36$). The 90 visitors observed through the video recordings do not include any participants in the visitor interview study. Due to the distance from which the video camera was placed, the individual characteristics of visitors such as their estimated gender, age, and ethnicity were not discernable; therefore, we do not report the demographics of the video observation participants.

To assess intercoder reliability, a second Exploratorium research assistant coded half of the video dataset. Intercoder reliability was calculated with Krippendorff's α in SPSS using Hayes and Krippendorff's KALPHA macro (Hayes & Krippendorff, 2007). Krippendorff's α is considered the standard reliability measure of coding and can account for chance agreement (Hayes & Krippendorff, 2007; Lombard et al., 2002). The results of the co-coded data showed acceptable intercoder reliability (Krippendorff's $\alpha = .78$).

Visitor Interviews

Procedure

To shed more light on RQ1 and to answer RQ2, the Exploratorium-Urban Alchemy joint research team conducted a visitor interview study. Data collection occurred weekly on two weekdays and two weekend days over the course of six weeks from August to October, 2019. During the

interview data collection phase, the two study conditions (i.e., Facilitated vs. Control) were switched out every half-day, and a coin-flip in the morning determined the sequence of the conditions for that day.

To randomly sample visitors, interviewers observed every second visitor who used[3] at least two exhibits and approached them when they exited the exhibition area. To avoid confounding factors, interviewers screened prospective participants and excluded them if they (a) had any affiliation with the Exploratorium or Urban Alchemy, (b) had prior experience with the Middle Ground exhibition, or (c) had failed to interact with an Urban Alchemy facilitator in the Facilitated condition. Participants who met the inclusion criteria were invited to participate in the interview study and were asked for their verbal consent to be audio-recorded. Of the 169 participants interviewed, 160 agreed to be audio-recorded.

During the interview process, interviewers used a tablet to record participants' responses to closed-ended questions with a questionnaire created in Qualtrics. Participants' responses to open-ended questions were audio recorded and later transcribed and coded. Below, we describe participant characteristics and the study variables.

Participants

A total of 169 visitors participated in the interview study (Control: $n = 88$; Facilitated: $n = 81$). At the end of each interview, participants were given the tablet to fill out their demographic information privately. For gender identification, the options provided were "female", "male", "prefer to self-describe" with an accompanying open text box for participants to share their gender identity in their own words, and "prefer not to say." These options were selected to align with the gender question used in the exit survey of the Exploratorium at the time. However, we acknowledge that these terms may not be the most appropriate measures for gender, as they could be conflated to reflect biological sex rather than gender identity, and are not inclusive of the whole gender identification spectrum. Regarding racial and ethnic identity, participants were given multiple ethnic/racial categories, along with options for self-description and opting not to disclose, and were instructed to select one or more categories with which they identified. Due to the limited representation of ethnic minority groups in our sample, we consolidated the ethnic and racial categories into "White" and "Non-White" for reporting in the following and in our inferential analysis. For gender, we excluded participants who did not identify as male or female from the inferential analysis due to their small sample size. For a complete breakdown of participant demographics by condition, please see Table 1.

Among participants in the Control condition ($n = 88$), 53% ($n = 38$) of those who shared their gender identification ($n = 77$) identified as females, 37% ($n = 28$) of those who provided their racial identification ($n = 75$) identified as Whites, and the mean age of the Control sample was 38.0 years ($SD = 16.0$). As for participants in the Facilitated condition ($n = 81$), among those who

disclosed their gender identification ($n = 69$), approximately 65% ($n = 45$) identified as females, and among those who shared their racial identification ($n = 72$), 38% ($n = 27$) described themselves as Whites. The mean age of the Facilitation sample was 39.5 years ($SD = 17.1$).

Prior research suggests that perceptions of power and social class could also influence individuals' social viewpoints, such as perspective-taking and empathic accuracy (Blader et al., 2016; Galinsky et al., 2006), as well as their attitudes toward others and toward social justice (Duckitt, 2006; Pratto et al., 1994). In this regard, participants' subjective evaluation of their own social status might influence their openness to the exhibition content and, hence, their learning experience. Therefore, we decided to measure participants' subjective evaluation of their social status, using an adapted version of the MacArthur Scale of Subjective Social Status on a ladder of rungs ranging from 1 to 10 (Adler et al., 2000).[4] For each condition, subjective social status ratings were not normally distributed and were negatively skewed. The median subjective social status scores for participants in the Control and the Facilitated condition were 6 ($min = 1, max = 10$) and 6 ($min = 2, max = 10$), respectively.

To assess the equivalence of the participants in the two conditions, Chi-Square tests were performed to examine the gender and ethnic distributions by condition, and Mann-Whitney U tests explored if the two conditions differed in terms of participants' ages and their subjective social status ratings. No significant differences by condition were found: gender (participants who chose to self-describe were excluded from the analysis due to the small sample size): χ^2 (1, $N = 142$) = 3.2, $p = .07$; race: χ^2 (1, $N = 147$) = 0, $p = .98$; age: $U(N_{Facilitated} = 69, N_{Control} = 74) = 2490$, $Z = -0.26, p = .80$; subjective social status: $U(N_{Facilitated} = 74, N_{Control} = 77) = 2613, Z = -0.89, p = .37$).

In addition to demographic factors, we checked whether the participant visited the Middle Ground exhibition alone or in a group, as group size might affect participants' experience in the exhibition. In the interview study, the research team recorded observational notes after each interview, including group size of the interviewed participant. During analysis, group size was categorized as either a singleton or a group. To assess potential differences in group size between the Facilitated and Control conditions, a Chi-square test was performed. The results indicated no significant difference in visitor group size between the conditions, χ^2 (1, $N = 168$) = 0.03, $p = 0.87$. Specifically, in the Facilitated condition (n = 81), there were 23 singletons (28.4%) and 58 group visitors (71.6%). The Control condition (n = 88) comprised 26 singletons (29.5%) and 62 group visitors (70.5%).

Measures

As our dependent variables, we assessed participants' overall experience, motivation for visiting and for continued engagement, affective responses, and metacognitive learning experiences in the exhibition.

Overall Experience. An adapted version of the science museum field's Overall Experience Rating (OER) was used to measure how participants assessed the quality of their experience in the exhibition. Participants were asked "Overall, how good or bad was your experience for this visit?" on a 5-point scale: *Very Bad* (1)*, Bad, Good and Bad, Good,* and *Very Good* (5).

After giving their overall experience ratings, participants were asked to explain the reasons for their ratings. Participants' responses were deductively coded using a coding scheme informed by Raymore's leisure facilitator framework (Raymore, 2002). Raymore defined facilitators as (sometimes non-human) factors that enable, encourage, and *enhance* leisure experience. Given that reasoning for one's overall experience rating is mainly concerned with identifying elements that contribute to (a lack of) satisfaction with the leisure experience, Raymore's leisure facilitator framework provided a useful analytical frame of reference.

Raymore's leisure facilitator framework identifies three factors that work in tandem to facilitate people's participation (Kim et al., 2011; Raymore, 2002):

- Intrapersonal: individual characteristics, traits, and beliefs, such as personal interest and curiosity. For example: "I like science, or anything that makes you think."
- Interpersonal: individuals or groups, including family members, peers, and strangers. For example: "Not only as soon as I got there to each area was I greeted, but she [UA facilitator] ran through everything with me to make sure that the experience was fulfilled."
- Structural: external features or factors in the physical or social environment, such as attractions presented in the environment and the atmosphere of the area. For example: "Well, first of all, the yellow was really eye-catching . . . I really liked it. "

Based on this framework, participants' reasoning for their overall experience rating was coded for the presence or absence of intrapersonal, interpersonal, and structural factors.

Interview transcripts were divided and distributed to two trained Exploratorium coders, with 20% of the data being co-coded. During this process, the two research assistants met twice to check agreement and discuss edge cases. These discussions kept the two assistants aligned with the coding scheme and with one another. The results of the co-coded data showed acceptable intercoder reliability, with Krippendorff's αs ranging from 0.72 to 0.85.

Motivation. Participants' motivation for visiting and their continued engagement was assessed by two open-ended questions:[5] "Who or what motivated you to first stop and use the exhibition?" and "Who or what motivated you to use multiple exhibits?" Given that the motivation questions asked participants to describe factors that encourage their (continued) visitation, Raymore's leisure facilitator framework again offered a useful analytical frame for the analysis. Responses to the two motivation questions were coded by the same pair of research assistants using the same coding scheme and the same training and coding procedures as those for the OER question.

Examples of the scheme applied to the question of motivation to use the exhibition include:

- Intrapersonal: "I care about these social issues."
- Interpersonal: "I saw some people holding hands and dancing to the music, and it looked fun!"
- Structural: "Just really curious about the bright yellow color of the project."

Krippendorff's αs ranged from .74 to .92, showing acceptable intercoder reliability.

Emotions toward Different Others. One objective of the Middle Ground exhibition was to foster prosocial feelings among visitors toward different "others" (i.e., individuals that one deems to be different from oneself). To assess participants' emotions toward different others after their experience in the Middle Ground exhibition, participants were asked to indicate whether their experience in the exhibition brought about feelings of discomfort, respect, connection, and compassion for those who were different from them, on a 4-point likert scale from *Strongly Disagree* (-2) to *Strongly Agree* (2).

The four emotions—discomfort, respect, connection, and compassion—were chosen for their important motivational and behavioral consequences for intergroup relationships and prejudice reduction. For example, discomfort or anxiety toward others have been found to have negative effects on intergroup relations, because they lead to avoidance and a greater reliance on cognitive biases and stereotypes (Stephan & Stephan, 1985). In contrast, emotions such as compassion and connection increase the likelihood of seeing similarities between self and others and, hence, could promote positive attitudinal or behavioral orientations toward others (Aron et al., 1991; Stephan & Finlay, 1999). Additionally, recent research indicates that the feeling of respect has the potential to promote acceptance for outgroups and serves as an important antecedent to societal pluralism (Eschert & Simon, 2019; Simon et al., 2019).

We decided to measure each of these emotions as a discrete emotion, instead of combining them into a composite scale, because the appraisal theory of emotion (Lazarus, 1991) and intergroup emotion theory (Mackie et al., 2008) both suggest that these emotions could have distinct behavioral implications.

Metacognition about Bias and Social Interaction. Adapted from Meluch (2015), two yes-no questions measured participants' engagement in metacognition about bias and social interaction: "Do you feel like you learned anything about yourself or others during your experience in the exhibition?" and "Did your experience in the exhibition make you think about how you act with other people?" For each of the two metacognition questions, participants who answered "yes" were followed up with a prompt asking them to tell us more about what they learned. Additionally, given that the goal of the present study was to explore the effect of facilitation on visitors' experience and learning, we were most interested in metacognition that took place *during* visitors' experience in the exhibition. However, the interviews themselves may have encouraged interviewees to engage in self-reflexivity and metacognition. To account for this potential confounding effect, participants were asked to specify at what point they noticed their learning with three alternatives: during their experience in the exhibition; during the interview; or both (for a similar procedure, see Meluch, 2015).

The Middle Ground exhibition was designed to encourage visitors to reflect on the various types of biases in social interaction with others. We expected two types of metacognition to occur in the Middle Ground exhibition: metacognitive knowledge (i.e., awareness or reflection of ideas, beliefs, or theories about self or others) and metacognitive feeling (i.e., online monitoring of the feelings and affective experiences during a cognitive experience; see Efklides, 2001, 2006, 2008; Flavell, 1979). Thus, we coded participants' open-ended responses about what they learned about themselves and others and/or how they acted with others for the presence or absence of metacognitive knowledge and metacognitive feeling. Examples of these two types of metacognition during the Middle Ground experience include:

- Metacognitive knowledge (reflection on biases or engaging in perspective-taking): "This exhibition makes you realize that you're still a little judgmental and that you should still keep improving on that."
- Metacognitive feeling (reflection on or monitoring of one's affective responses to the exhibition's content): "Hearing his story made me feel so much compassion for him."

Two Exploratorium research assistants used the above-described coding scheme to code the presence or absence of metacognitive knowledge and metacognitive feeling. Participants' responses were distributed to the two coders, with 20% of the data being co-coded. The results of the co-coded data showed acceptable intercoder reliability for the two metacognition questions, with Krippendorff's αs ranging from 0.77 to 1.

Results

Video Observation

The video observation study examined whether participants in the two conditions differed in terms of two stopping behaviors: the number of exhibits used and the total time spent on Middle Ground exhibits. The two variables were not normally distributed; hence, Mann-Whitney U tests were performed.

Results showed that visitors in the Facilitated condition ($Mdn = 2$, $min = 1$, $max = 8$) used significantly more exhibits than visitors in the Controlled condition ($Mdn = 1$, $min = 1$, $max = 6$), $U(N_{Facilitated} = 52, N_{Control} = 35) = 1156$, $Z = 2.27$, $p = .02$, and the effect size was small ($r = .24$).[6] As for the exhibit engagement dwell time, we recorded the amount of time, in seconds, each sampled visitor spent at each Middle Ground exhibit, and the data entries were then added up to represent the total amount of time per sampled visitor spent using Middle Ground exhibits. Visitors in the Facilitated condition spent between 18 to 1471 seconds interacting with Middle Ground exhibits ($Mdn = 180$), while the total exhibit engagement dwell time by visitors in the control condition ranged from 18 to 1951 seconds ($Mdn = 81$). However, the difference did not reach statistical significance, $U(N_{Facilitated} = 52, N_{Control} = 35) = 1067$, $Z = 1.36$, $p = .17$. Moreover, the average time spent with each exhibit did not differ significantly between the two study conditions, $U(N_{Facilitated} = 102, N_{Control} = 96) = 4710$, $Z = 0.46$, $p = .67$.

Visitor Interviews

Overall Experience

An exploration of the descriptive statistics revealed that, although overall experience rating was measured with a 5-point scale—*Very Bad, Bad, Good and Bad, Good,* and *Very Good*—participants only rated their experience either as *Good* or *Very Good*. Descriptive data revealed that 80% ($n = 64$) of the participants in the Facilitated condition rated their experience as *Very Good*, compared to 61% ($n = 52$) who gave a *Very Good* rating in the Control condition. A Chi-Square test of independence was conducted to examine the effect of facilitation on overall experience rating. Participants in the Facilitated condition were significantly more likely to describe their overall experience in the exhibition as *Very Good* than participants in the Control condition, $\chi^2 (1, N = 166) = 7.51$, $p = .006$. The effect size, $\varphi = .21$, represented a small to medium effect.

Participants' open-ended responses about the reasons for their overall experience rating were coded for three non-mutually-exclusive factors: intrapersonal, interpersonal, and/or structural. As shown in Figure 1, participants in the Control condition were more likely to mention structural reasons for their overall experience rating than participants in the Facilitated condition, $\chi^2 (1, N = 160) = 10.08$, $p = .001$. The effect size, $\varphi = .25$, represents a small to medium effect. About 90%

($n = 74$) of participants in the Control condition, as compared to 68% ($n = 42$) in the Facilitated condition, talked about structural factors when asked to explain their overall experience rating. Participants in the Control condition often commented on the design features and/or the content of exhibits (e.g., "I liked how it was interactive and I think it had a good message behind each of the different setups over there."). Another significant finding was that participants in the Facilitated condition were more likely to include interpersonal components in their responses about their overall experience than their counterparts in the Control condition, χ^2 (1, $N = 160$) = 21.5, p < .001. The effect size, $\varphi = .37$, suggested a medium effect. More than half of participants (55%, $n = 42$) in the Facilitated condition discussed the influence of interpersonal factors on their overall experience rating, and some of them directly attributed their positive experience in the exhibition to facilitation, as manifested in the following quotes: "I think the exhibit itself is pretty good, it's just that adding the people and having people facilitated made it over the good mark." and "The person that introduced me to it, he's very open about his life, and that opened me up and that allowed me to be very open as well. So I enjoyed it." On the other hand, people in the Control condition mentioned interpersonal factors least often (19%, $n = 16$). Some participants in that condition even described a lack of interpersonal interaction as one reason why they rated their experience less favorably, as shown in the following response: "I thought it was interactive. The only thing that I would say is, because I don't have anyone else, I'm not paired with someone to do some of the activities. So I might need to bring someone back." Regarding intrapersonal factors, 26% ($n = 20$) of participants in the Facilitated condition and 20% ($n = 18$) of participants in the Control condition referenced intrapersonal factors when describing their overall experience ratings. The likelihood of mentioning intrapersonal factors in the open-ended responses for overall experience rating was not significantly different between the two conditions, χ^2 (1, $N = 160$) = 0.41, $p = .52$, suggesting that self-driven elements like curiosity and personal interest held a comparable level of relevance to participants' overall experience in both conditions.

Insert Figure 1 about here

Motivation

To explore the ways in which facilitation might help encourage participation and continued engagement, we asked participants to describe what motivated them to (a) use the Middle Ground exhibition in the first place and (b) continue past their first exhibit. Participants' responses were coded for the presence or absence of intrapersonal, interpersonal, and/or structural factors based on the leisure facilitator framework (Raymore, 2002).

We examined participants' reasoning regarding what motivated them to first visit the exhibition. As shown in Figure 2, structural reasons, such as the look and feel of the exhibition (e.g., "I think at

first it was just kind of colorful and eye-catching") and the design of specific exhibits (e.g., "The hands stopped us. The music one."), were given most often by participants in both conditions. Indeed, 61% of participants in the Control condition ($n = 51$) and 47% of participants in the Facilitated condition ($n = 36$) identified at least one structural factor in describing why they initially stopped by the Middle Ground exhibition. This difference was non-significant: χ^2 (1, $N = 160$) = 3.48, $p = .06$. On the other hand, participants differed in their likelihood to include interpersonal reasons in their responses. Participants in the Facilitated condition were significantly more likely to discuss interpersonal factors when explaining their motivation for visiting than those in the Control condition, χ^2 (1, $N = 160$) = 17.97, $p < .001$, $\varphi = .34$, with 42% of participants in the Facilitated condition ($n = 32$) naming at least one interpersonal factor in their response, as compared to 12% of participants in the Control condition ($n = 10$). The effect size represented a medium effect.

Insert Figure 2 about here

We then examined the effect of facilitation on motivating visitors to continue using exhibits beyond their first use. More than half of the participants in the Facilitated condition ($n = 44$) gave interpersonal reasons for continuing to explore the exhibition after their first exhibit, but less than 10% of visitors in the Control condition ($n = 7$) included any interpersonal factors in their responses (see Figure 3). The difference was found to be significant, χ^2 (1, $N = 160$) = 43.64, $p < .001$, and the effect size, $\varphi = .52$, indicated a large effect. Interview responses showed that facilitators encouraged visitors to continue using more exhibits by serving as playmates and/or explainers for visitors. For instance, one participant shared that they wouldn't have been able to experience an exhibit in full without facilitators: "I had tried the holding-hand music one by myself first but realized I needed someone else, and he offered, and then he showed me two or three of the others." Others commented that facilitators provided more context or content about the exhibit(ion), which helped spark curiosity. In comparison, participants in the Control condition were significantly more likely than those in the Facilitated condition to mention intrapersonal factors (e.g., personal interest, values) in explaining what kept them in the exhibition, χ^2 (1, $N = 160$) = 5.9, $p = .015$, $\varphi = .19$. We found that 46% ($n = 38$) of participants in the Control condition, as opposed to 26% ($n = 20$) in the Facilitated condition, mentioned some intrapersonal factors. This finding suggests that intrinsic motivation was an important prerequisite for visitors to have prolonged engagement in the absence of facilitation. In terms of visitors' likelihood to include a structural factor in their response regarding why they continued to use more exhibits, no significant difference between conditions was found, χ^2 (1, $N = 160$) = 1.72, $p = .19$.

Insert Figure 3 about here

Taken together, the present study found that facilitation (a) increased visitors' initial motivation to use the exhibition and (b) helped motivate visitors, even those who may have been less intrinsically interested, to continue their engagement in the exhibition.

Emotions toward Different Others

Normality test results indicated that the four affective variables (discomfort, respect, compassion, and connection) were not normally distributed; therefore, Mann-Whitney U tests were conducted to examine if facilitation had an impact on visitors' affective responses towards people different from themselves. Participants in the Facilitated condition reported a significantly higher level of connectedness (Mdn = 1, M = 1.07, min = -2, max = 2) with different others than participants in the Control condition (Mdn = 1, M = 0.79, min = -2, max = 2), $U(N_{Facilitated}$ = 74, $N_{Control}$ = 78) = 2320.5, Z = -2.30, p = .02. The mean rank for the Facilitated condition was 84.14 and the mean rank for the Control condition was 69.25. The effect size associated with facilitation on connectedness, r = .18, represented a small to medium effect. However, the differences in the other three affective variables did not reach the level of statistical significance (discomfort: $U(N_{Facilitated}$ = 71, $N_{Control}$ = 80) = 2733, Z = -0.44, p = .66; respect: $U(N_{Facilitated}$ = 75, $N_{Control}$ = 72) = 2478.5, Z = -0.95, p = .34; compassion: $U(N_{Facilitated}$ = 72, $N_{Control}$ = 75) = 2373, Z = -1.39, p = .16; for descriptives, see Figure 4).

Insert Figure 4 about here

Metacognition During the Experience in the Exhibition

We were interested in the effect of facilitation on visitors' metacognitive learning in the exhibition. Specifically, we analyzed participants' awareness of their learning relating to (a) something about themselves or others (hereafter referred to as "metacognition about self or others") and (b) how they acted with others during their experience in the exhibition (hereafter called "metacognition about social interaction"). As described in the Methods section, we considered any participants as not engaging in metacognition if they said they experienced metacognition only during the interview. Consequently, responses from these participants were recoded into negative responses to the yes-no questions regarding metacognition.

Metacognition about Self or Others. We found that 68% of participants in the Facilitated condition (n = 48) and 56% of the participants in the Control condition (n = 45) stated that they had learned something about themselves or others during their experience in the exhibition (i.e., engaged in metacognition about self or others). Chi-Square test results revealed no significant difference between conditions, χ^2 (1, N = 151) = 2.05, p = .15.

Participants who did experience metacognitive learning were asked to describe what they learned about themselves or others. Their open-ended responses were coded to identify which aspect(s) of metacognition participants experienced (for descriptive results, see Figure 5). No significant difference was found between participants in the two conditions regarding their likelihood to mention either metacognitive knowledge, χ^2 (1, $N = 87$) = 0.47, $p = .49$, or metacognitive feeling, χ^2 (1, $N = 87$) = 0.01, $p = .91$.

Insert Figure 5 about here

Metacognition about Social Interaction. Chi-Square test results suggested that significantly more participants in the Facilitated condition (66%, $n = 49$) than the Control condition (48%, $n = 37$) stated that they had learned something about how they acted with others during their experience in the exhibition, χ^2 (1, $N = 151$) = 5.08, $p = .02$. The effect size, $\varphi = .18$, indicated a small to medium effect.

We then turned to participants' qualitative responses regarding what they thought they had learned about social interaction. Again, we found no significant differences between participants in the two conditions regarding their likelihood to mention either metacognitive knowledge, χ^2 (1, $N = 80$) = 2, $p = .16$, or metacognitive feeling, χ^2 (1, $N = 80$) = 0.06, $p = .80$. Descriptive results of the coding analysis for metacognition about social interaction are presented in Figure 6.

Insert Figure 6 about here

Discussion

Prior studies have provided some empirical evidence regarding the positive effects of museum staff facilitation on visitor satisfaction, exhibit usage, and scientific sense-making in an indoor museum setting (e.g., Pattison et al., 2018). However, less is known about the effects of facilitation on visitors in public outdoor spaces, where both engagement in scientific inquiry and interaction with facilitators are not expected. Indeed, some studies indicate that the mental schemas of people in public places differ from those employed during their experiences in museums and science centers (Cardiel et al., 2016). The present article seeks to fill this gap by describing a quasi-experimental study that assessed the effects of facilitation led by Urban Alchemy Practitioners in an outdoor social science exhibition. We collected two sets of data—video

recordings and interview data—to examine the pattern regarding the effects of Urban Alchemy facilitation.

Urban Alchemy facilitation at Middle Ground

Our video observation data showed that visitors to the exhibition used significantly more exhibits when Urban Alchemy facilitators were present, and interview data revealed that participants in the Facilitated condition were significantly more likely to mention interpersonal factors, such as the Urban Alchemy facilitators, when explaining why they stopped at the exhibition and why they continued to visit more than one exhibit. These results, taken together, indicate that Urban Alchemy facilitators were effective in not only inviting people into the exhibition but also encouraging them to engage with a variety of exhibits. Our field notes support this, showing that facilitators frequently greeted passersby, inviting them to interact with the Middle Ground exhibition and to continue exploring after engaging with an exhibit oftentimes by using humor and offering validation. Despite this seemingly positive effect of facilitation on increasing visitors' exhibit usage, our reviewers raised the questions as to whether facilitators might have inadvertently exerted social pressure on visitors. This pressure may arise from societal norms that encourage adherence to requests or instructions to demonstrate sociability, especially when interacting with perceived authority figures. The authoritative presence of Urban Alchemy facilitators, signified by their badges and uniforms, could intensify this perceived obligation to comply. Given that one of the key attributes of informal learning environments is their free-choice nature, finding a balance between respecting visitor autonomy and leveraging the benefits of social interaction with facilitators remains a challenging yet essential task for professionals in the field of informal learning.

Contrasting with our earlier finding about increased exhibit usage under facilitation, our video observation data revealed that despite a higher median dwell time in the Facilitated condition, as indicated by descriptive statistics, Urban Alchemy facilitation did not significantly increase the amount of time visitors spent at exhibits. This finding stands in contrast to the result in Pattison et al.'s (2018) research that indoor museum facilitation prolonged exhibit engagement. Two potential explanations might address this discrepancy. First, our small sample size and the large variance found in both conditions may adversely affect our analytical power. Second, an outdoor urban space may differ from a traditional museum setting in terms of the time people have to spend at exhibits. Museum visitors often intentionally plan and pay for their trip to the museum; hence, taking the time to enjoy the experience and engage in learning is likely to be the primary goal during their visit (COVES, 2019; Falk and Dierking, 1992; 2000). In contrast, outdoor urban public spaces are generally used by the public as transition zones to get from one place to another (Cardiel et al., 2016). People entering an outdoor urban space often have existing or alternative plans and might be limited with regard to the time they could spare. Our Urban Alchemy facilitators might consciously or unconsciously take this factor into consideration when interacting

with visitors. While they frequently encouraged visitors to further explore the exhibition, they might also simultaneously be cognizant of the visitors' time constraints, careful not to unduly extend their engagement with visitors. Indeed, given that "respect", "empowerment", and "empathy" are fundamental to Urban Alchemy's ethos, UA facilitates might thrive to implement these trauma-informed values by empowering visitors with the freedom to choose when to end their visit as one way to demonstrate both respect and care. Future research exploring the role of facilitation in outdoor exhibitions is recommended to enlist a larger sample size and to further investigate whether dwell time is a meaningful indicator of engagement in public urban spaces.

The interview study investigated the impact of Urban Alchemy facilitation on visitors' satisfaction and their affective and metacognitive learning experiences in the exhibition. Prior studies examining the effects of staff facilitation within museums have generally indicated that facilitation could help increase visitor satisfaction. In agreement with this line of research, our interview data showed that, while interview participants in both conditions had a positive experience in the exhibition, those who were facilitated reported a significantly more favorable experience than participants in the Control condition. However, findings regarding the influence of Urban Alchemy facilitation on visitors' affective and metacognitive learning experiences were somewhat weaker. The Middle Ground exhibition was designed to encourage visitors to engage in various forms of direct or indirect contact with people they perceived to be different from themselves or with whom they had little meaningful interaction. It was hoped that, through these interactions, Middle Ground visitors would experience more prosocial feelings toward others and would engage in metacognitive reflection about their bias and social interaction experiences during their time in the exhibition. In addition, we were curious if Urban Alchemy facilitators, with their expertise in trauma-informed care, could further enhance visitors' affective and metacognitive learning. We measured four discrete emotions participants felt about "different others" after their experience in the exhibition—discomfort, respect, compassion, and connection—and found that only the reported feeling of connection was felt by significantly more participants in the Facilitated condition. While speculative, the reason we observed a significant difference only in the reported feeling of connection may be explained by the line of scholarship that theorizes the feeling of interpersonal connection as an *antecedent* for the emergence of positive intergroup emotions (e.g., Pettigrew, 1998). In this sense, feelings of connection might represent the initial stage for other prosocial emotions to develop. Interview quotes from participants in the Facilitated condition showed that Urban Alchemy facilitators often shared personal stories of being stigmatized. Research shows that meaningful disclosure can foster a sense of connection (e.g., Tam et al., 2006), and Urban Alchemy facilitators revealing their own vulnerability through their self-disclosure likely contributed to facilitated participants' greater feelings of connection. As for metacognitive learning, this study only found partial support that facilitation increased visitors' likelihood of engaging in metacognitive learning. In particular, our findings indicated that participants in the Facilitated condition were significantly more likely to be aware of learning something regarding

how they acted with others than participants in the Control condition; however, this pattern was not observed when it came to metacognitive learning about oneself and others. Moreover, facilitation had no effect on the two facets of metacognition we examined, namely, metacognitive knowledge and metacognitive feeling. Taken together, these results suggest that, while facilitation was found to have some positive impact on visitors' metacognitive learning, our analyses did not paint a clear picture regarding how facilitation fosters metacognitive learning. Future research is needed to unpack the mechanisms through which facilitation influences metacognition.

Why did Urban Alchemy facilitation have some impact on visitors' experience and learning? We posit the answer broadly lies in the alignment between the content and the type of facilitation performed. The UA facilitators brought trauma-informed perspectives and skills borne of life experience and training well suited to social science content about stereotypes, fast-and-slow thinking and altruism. As formerly incarcerated individuals, the UA facilitators had lived through challenging experiences, worked hard to understand their own motivations and those of the people around them, and committed to work that serves their community. In the exhibition, they acted as a learning partner to visitors, but more importantly, they humanized the content, infusing it with deeper meaning. Indeed, many visitors to the exhibition who met an Urban Alchemy facilitator explicitly mentioned how the facilitator's life story, and the visitor's own first and second impressions, exemplified much of the content. Here are several examples:

> I was kind of looking at everything more universally but he made it a little more personal.

> He was easy to talk to and engaged me in telling my own story as well as his own story.

> She was that stranger that we're encouraged to talk to in this exhibit. You know I mean like that's part of the point, right?

> The one that I was really moved on and what was sitting with me when he approached us was this one over here [Referring to a flip-up label that reads, "That person's strange—why would I talk to them?" and then under the flap, "That person's really different—I could learn something from them."] Just that little tiny piece of like, oh, you could be judging someone … And then you flip it up and then it has this, like, hey you could turn that around and think really different about this….I was relating to how much we need that. And then somebody [UA facilitator] who I could say is quote unquote different, approached us.

UA facilitators brought experience and skills that included deep respect, compassion, and welcome for all persons, regardless of station, as well as contagious curiosity toward the science in

the exhibits. We believe that this deep alignment between their background and the content of the exhibition created greater meaning for visitors to the exhibition.

Although we did not find significant effects across all measures, the present study found empirical support that Urban Alchemy facilitation had positive impacts on public visitors' experience and learning at the Middle Ground exhibition. The significant effects were generally small to medium in size, which might in part be related to the setting of the Middle Ground exhibition. As people mainly do not expect to interact with strangers in public urban spaces, Urban Alchemy facilitation might violate people's beliefs about proper social distance in such a setting, which could compromise its impacts. According to the Expectancy Violation Theory (Burgoon, 2015), unanticipated violations of social norms could cause arousal for people who have a lower threat threshold, and such an arousal might reduce people's cognitive ability to process the message coming from the expectancy violator (i.e., Urban Alchemy facilitators). Future studies could examine whether strategies that help orient or normalize facilitator-visitor interactions in outdoor exhibitions may improve the effectiveness of facilitation. Another possible explanation for the small effects noticed in the present study might relate to the fact that Urban Alchemy facilitators, though possessing high emotional intelligence and great empathy, were not trained beforehand to facilitate inquiry-based learning. The Exploratorium and Urban Alchemy are currently working together to infuse inquiry-based techniques into their facilitation.

One of Urban Alchemy's primary objectives in participating in this partnership was to gather empirical evidence supporting the efficacy of their trauma-informed approaches as a solid starting point to demonstrate their role in fostering positive community changes to various city officials and funding agencies, thereby expanding their reputation beyond their conventional focus on street safety. To this end, the Exploratorium and Urban Alchemy have employed the findings of this study as concrete proof of the effectiveness of community facilitators in promoting public informal learning. This evidence has been instrumental in obtaining additional funding from sources like the National Science Foundation, the San Francisco Recreation and Park Department, and the Simons Foundation to help expand the outreach of Urban Alchemy and the Exploratorium, enabling both to bring community engagement and informal science learning to a wider range of sites, and further strengthening this invaluable partnership.

Beyond the museum walls

Despite the increasing awareness of museums' duty to dismantle educational and social barriers so that people who have been historically excluded by museum practices would be valued, represented, and included, most science museums today continue to attract a predominantly wealthy, culturally dominant (e.g., non-indigenous, English-speaking), highly-formally educated audience (COVES, 2019). Given these institutions' grounding in dominant cultural values, ways of thinking, and colonizing of artifacts, people from low-income and historically minoritized

backgrounds often perceive such institutions as "not for them" (Dawson, 2014). Access barriers, such as high admission fees or transportation costs, often discourage marginalized groups' participation. Moreover, museum practices, mirroring dominant culture, often fail to include marginalized groups among visitors, staff, and exhibit content, leaving such groups feeling and being excluded inside traditional museum settings.

The overriding goal of museums is to provide public service and accessible education for all (American Association of Museums, 1992). In this sense, our service and engagement should not be confined by museum walls. The Middle Ground project sought to leverage the Exploratorium's resources to increase meaningful access for people who have been historically excluded from museums by installing a social science exhibition in a freely accessible, public, outdoor space, enlisting Practitioners from a community-based organization as facilitators, and seeking to apply CBR principles to inform, modify and conduct the research. Along the way, we developed a new model that encourages museum professionals to bring contextually relevant exhibitions to public spaces and meet people where they are (for more details about our TILL model, see Gutwill et al, 2022, 2023). In addition to installing an outdoor, public exhibition to engage diverse racial, economic, linguistic, and cultural communities, the Middle Ground project also aimed to reduce psychological barriers to participation for people from historically marginalized groups by partnering with Practitioners of Urban Alchemy, who came from and were familiar with the needs and interests of the local communities and were experienced in trauma-informed care, to serve as facilitators at Middle Ground. Our study results showed that visitors to the Middle Ground exhibition, particularly those who were facilitated by Urban Alchemy, had a positive experience. It is our hope that colleagues in the field of museums will join us in collaborating with historically marginalized communities to support informal learning experiences within their own neighborhoods.

CBR reflection

The Middle Ground research represents an initial attempt for several of the authors to incorporate CBR into our work. We would like to acknowledge that, as novices, our practices leave plenty of room for growth and continued understanding. CBR requires that both academic researchers and community stakeholders are actively involved in decision-making during all phases of the research process—from research question(s) identification to dissemination (Leavy, 2017). The Exploratorium staff sought to follow this guideline by: drawing inspiration from the practices of Urban Alchemists to shift the research study's focus from exhibit design to facilitation; changing the research questions based on usefulness to UA leadership; interrogating and adapting study instruments with UA leadership, facilitators, and researchers; co-creating recruitment methods and co-collecting data with UA researchers; and co-authoring and co-presenting study findings with UA leadership and facilitators. Looking back, the museum staff exercised greater power than the Urban Alchemy staff during study development, research training, data analysis, and

interpretation of results. The fact is that this NSF-funded research study was skewed toward serving the needs of the museum field to broaden community participation in informal science learning, rather than meeting the needs of this community-based organization. A research project that was more community-based would have involved community members (i.e., people living and coming to the Civic Center area) in leading, for instance, the formation of research questions, development of methods, and interpretation of results. All of these would involve joint decision-making around priorities and forms of validity, trustworthiness and credibility.

Although the Exploratorium staff did not fully envision an equitable partnership at the outset of the project, both partners gained a deeper understanding of each other's strengths and contributions as the project unfolded. Urban Alchemy Practitioners commented that the Exploratorium exhibits served as effective props that enabled them to have meaningful conversations with community members. In addition, the skillsets they acquired during Middle Ground led many Urban Alchemy facilitators and researchers to advance their careers. The Exploratorium has become increasingly aware of the importance of incorporating a trauma-informed lens in museum work (Price et al., 2022) and is humbled by Urban Alchemy's commitment and skills to bring care to communities experiencing homelessness, mental health struggles, drug addiction, and poverty in an inequitable society. Indeed, the Middle Ground experience has taught the Exploratorium research staff to critically examine their epistemological beliefs and to reflect on how their traditional ways of doing research could disempower and distance groups minoritized (or even caricatured) by Western science and traditional approaches to educational research.

Future Directions

We believe that the success of the Middle Ground project lies in a partnership among multiple community-based organizations. Although present findings from the Middle Ground project should be taken as incipient support for an emerging model, validity requires further investigation. With new funding from the National Science Foundation (NSF 2116110), the Exploratorium has begun a project to scale up Middle Ground to develop, test and refine a facilitation model that focuses on supporting learners' inquiry experience in a trauma-informed manner. The team is attempting to apply what we have learned about equitable research practices in this new study.

We hope to build upon the research reported in this article, which provides evidence for the important impacts of facilitation in outdoor, publicly accessible, science museum exhibitions.

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References

Adler, N. E., Epel, E. S., Castellazzo, G., & Ickovics, J. R. (2000). Relationship of subjective and objective social status with psychological and physiological functioning: Preliminary data in healthy, White women. *Health Psychology, 19*(6), 586–592. doi:10.1037/0278-6133.19.6.586

Adler, N., & Stewart, J. (2007). The MacArthur scale of subjective social status.*MacArthur Research Network on SES & Health.*

American Association of Museums (Ed.). (1992). *Excellence and Equity: Education and the public dimension of museums.* American Association of Museums.

Aron, A., Aron, E. N., Tudor, M., & Nelson, G. (1991). Close relationships as including other in the self. *Journal of Personality and Social Psychology, 60*, 241-253. doi:10.1037/0022-3514.60.2.241

Chien, H.-Y. & Atwell Seate, A. (2017). When talking differences makes us closer: Communicative dynamics of group salience in intergroup contact. *Communication Studies, 68*(4), 455-475. doi:10.1080/10510974.2017.1361458

Gutwill, J. P., Chien, H.-Y., Hammonds, L., & Dixon, R. (2020a, October 21). *Creating Middle Ground: Transforming Urban Outdoor Spaces with Social Science Exhibits and Facilitation about Biases.* [Conference presentation]. Association of Science-Technology Centers. Virtual location.

Gutwill, J. P., Chien, H.-Y., Hammonds, L., & Dixon, R. (2020b, November 12). *Creating Middle Ground: Transforming Urban Outdoor Spaces with Social Science Exhibits and Facilitation about Biases.* Virtual presentation to Urban Alchemy. San Francisco, CA, United States.

Gutwill, J. P., Chien, H.-Y., Hammonds, L., & Dixon, R. (2020c, November 20). *Making Middle Ground: Transforming Urban Outdoor Spaces with Social Science Exhibits and Facilitation.* Virtual presentation to the School of Education at the University of California, Berkeley. Berkeley, CA, United States.

Gutwill, J. P., Chien, H.-Y., Lani, S., Winterheld, H., Miller, L. & Garibay, C. (2022). Creating Middle Ground: Transforming outdoor informal learning landscapes. *Curator, 65*, 869-886. doi:10.1111/cura.12493

Gutwill, J. P., Lani, S., & Chien, H.-Y. (2023). Transforming learning landscapes: A radical model for informal science learning. In J. Diamond & S. Rosenfeld (Eds.), *Amplifying informal science learning* (pp. 3-17). Routledge.

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory.* Prentice Hall.

Barriault, C., & Pearson, D. (2010). Assessing exhibits for learning in science centers: A practical tool. *Visitor Studies*, *13*(1), 90–106. doi:10.1080/10645571003618824

Blader, S. L., Shirako, A., & Chen, Y. R. (2016). Looking out from the top: Differential effects of status and power on perspective taking. *Personality and Social Psychology Bulletin*, *42*(6), 723-737. doi:10.1177/0146167216636628

Brown, R., & Hewstone, M. (2005). An integrative theory of intergroup contact. In M. P. Zanna (Ed.), *Advances in experimental social psychology* (Vol. 37, pp. 255-342). Elsevier.

Burgoon, J. K. (2015). Expectancy violations theory. In Berger, C. R., Roloff, M. E., Wilson, S. R., Dillard, J. P., Caughlin, J., Solomon, D. (Eds.), *The international encyclopedia of interpersonal communication.* John Wiley & Sons. oi:10.1002/9781118540190.wbeic102

Campbell, D. T., & Stanley, J. C. (2015). *Experimental and quasi-experimental designs for research*. Ravenio books.

Cancian, F. M. (1992). Feminist science: Methodologies that challenge inequality. *Gender & Society*, *6*(4), 623–642.

Cardiel, C. L. B., Pattison, S. A., Benne, M., & Johnson, M. (2016). Science on the move: A design-based research study of informal STEM learning in public spaces. *Visitor Studies*, *19*(1), 39–59. doi:10.1080/10645578.2016.1144027

Carello, J., & Butler, L. D. (2015). Practicing what we teach: Trauma-informed educational practice. *Journal of Teaching in Social Work*, *35*(3), 262–278. doi:10.1080/08841233.2015.1030059

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd Ed.). Academic Press.

COVES. (2019). *Understanding our visitors: Multi-institutional museum study (July 2018-June 2019)*. Collaboration for Ongoing Visitor Experience Studies.

Duckitt, J. (2006). Differential effects of right wing authoritarianism and social dominance orientation on outgroup attitudes and their mediation by threat from and competitiveness to outgroups. *Personality and Social Psychology Bulletin*, *32*(5), 684-696.

Efklides, A. (2001). Metacognitive experiences in problem solving: Metacognition, motivation, and self-regulation. In A. Efklides, J. Kuhl, & R. M. Sorrentino (Eds.), *Trends and prospects in motivation research* (pp. 297-323). Kluwer.

Efklides, A. (2006). Metacognition and affect: What can metacognitive experiences tell us about the learning process? *Educational Research Review, 1*(1), 3-14. doi:10.1016/j.edurev.2005.11.001

Efklides, A. (2008). Metacognition: Defining its facets and levels of functioning in relation to self-regulation and co-regulation. *European Psychologist, 13*(4), 277-287. doi:10.1027/1016-9040.13.4.277

Eschert, S., & Simon, B. (2019). Respect and political disagreement: Can intergroup respect reduce the biased evaluation of outgroup arguments? *PLOS ONE, 14*(3), e0211556. doi:10.1371/journal.pone.0211556

Falk, J. H., & Dierking, L. (1992). *The museum experience*. Whalesback Books.

Falk, J. H., & Dierking, L. (2000). *Learning from museums: Visitor experiences and the making of meaning*. AltaMira Press.

Flavell, J. H. (1979). Metacognition and cognitive monitoring: A new area of cognitive-developmental inquiry. *American Psychologist, 34*(10), 906-911. doi:10.1037/0003-066x.34.10.906

Galinsky, A. D., Magee, J. C., Inesi, M. E., & Gruenfeld, D. H. (2006). Power and perspectives not taken. *Psychological science*, *17*(12), 1068-1074. doi:10.1111/j.1467-9280.2006.01824.x

Garibay Group. (2021). *Middle Ground summative evaluation* [Summative Evaluation]. https://www.informalscience.org/street-smarts-experiments-urban-social-science.

Garibay, C., & Teasdale, R. M. (2019). Equity and evaluation in informal STEM education. *New Directions for Evaluation*, *2019*(161), 87–106. doi:10.1002/ev.20352

Gutwill, J. P., & Allen, S. (2010). Facilitating family group inquiry at science museum exhibits. *Science Education*, *94*(4), 710–742.

Gutwill, J. P., Hido, N., & Sindorf, L. (2015). Research to practice: Observing learning in tinkering activities. *Curator*, *58*(2), 151–168.

Hall, B., Tandon, R., & Tremblay, C. (2015). *Strengthening community university research partnerships: Global perspectives*. University of Victoria & PRIA.

Hammonds, L., Clark-Johnson, I., & Dickey, J. (2022). *Urban Alchemy de-escalation training*.

Harwood, J., & Joyce, N. (2012). Intergroup contact and communication. In H. Giles (Ed.), *The handbook of intergroup communication* (pp. 167-180). Routledge.

Hayes, A. F., & Krippendorff, K. (2007). Answering the call for a standard reliability measure for coding data. *Communication Methods and Measures, 1*, 77-89. doi:10.1080/19312450709336664

Hidi, S., & Renninger, K. A. (2006). The Four-phase model of interest development. *Educational Psychologist*, *41*(2), 111–127.

Horowitz, C. R., Robinson, M., & Seifer, S. (2009). Community-based participatory research from the margin to the mainstream: are researchers prepared? *Circulation*, *119*(19), 2633-2642. doi:10.1161/CIRCULATIONAHA.107.729863

Kim, B., Heo, J., Chun, S., & Lee, Y. (2011). Construction and initial validation of the leisure facilitator scale. *Leisure/Loisir, 35*(4), 391-405. doi:10.1080/14927713.2011.648402

Kisiel, J. (2006). An examination of field trip strategies and their implementation within a natural history museum. *Science Education*, 90(3), 434–452.

Kisiel, J. (2021). The challenge of identifying impacts of an on-the-floor presenter program. *Visitor Studies Association*, Virtual Conference.

Lazarus, R. S. (1991). *Emotion & adaptation*. Oxford University Press.

Leavy, P. (2017). *Research design: Quantitative, qualitative, and mixed methods, arts-based, and community-based participatory research approaches*. Gilford Press.

Lindemann-Matthies, P., & Kamer, T. (2006). The influence of an interactive educational approach on visitors' learning in a Swiss zoo. *Science Education*, *90*(2), 296–315. doi:10.1002/sce.20127

Lombard, M., Snyder-Duch, J., & Bracken, C. C. (2002). Content analysis in mass communication: Assessment and reporting of intercoder reliability. *Human communication research*, *28*(4), 587-604. doi:10.1111/j.1468-2958.2002.tb00826.x

Lussenhop, A., Auster, R., & Lindgren-Streicher, A. (2015). *Facilitation research for engineering design education (FREDE)*. Museum of Science, Boston.

Macaulay, A. C., Jagosh, J., Pluye, P., Bush, P. L., & Salsberg, J. (2013). Quantitative methods in participatory research. *Nouvelles Pratiques Sociales, 25*(2), 159-172. doi:10.7202/1020827ar

Machado Corral, S., Monteiro, P. H. N., Pisani, K., & Barriault, C. L. (2021). Facilitators improve the learning experience of visitors to a science centre. *Frontiers in Education*, *6*, 516. doi:10.3389/feduc.2021.675124

Mackie, D. M., Smith, E. R., & Ray, D. G. (2008). Intergroup emotions and intergroup relations. *Social and Personality Psychology Compass*, *2*(5), 1866-1880. doi:10.1111/j.1751-9004.2008.00130.x

McManimon, S. K., Causey, L., King, Z., Ronning, E. C., & Bequette, M. B. (2020). On the need for expanded guidance in navigating ethical learning research at science museums. *Journal of Research in Science Teaching*, *57*(5), 651–671. doi:10.1002/tea.21613

Meluch, W. (2015). *Science of sharing experiments & exhibits summative evaluation report*. Retrieved from http://www.informalscience.org/sites/default/files/2015-11-24_SoS_Summative_ Report_Fin_12Nov2015.pdf

Minkler, M. (2005). Community-based research partnerships: challenges and opportunities. *Journal of Urban Health, 82*(2), ii3-ii12. doi:10.1093/jurban/jti034

Mony, P. R. S., & Heimlich, J. E. (2008). Talking to visitors about conservation: Exploring message communication through docent–visitor Interactions at zoos. V*isitor Studies, 11*(2), 151–162. doi:10.1080/10645570802355513

Nee, J. (2021). *Participatory action research in Teotitlán del Valle Zapotec language revitalization* [Doctoral Dissertation, University of California, Berkeley]. https://escholarship.org/uc/item/26v6d2k7

Pattison, S., Randol, S., Benne, M., Rubin, A., Gontan, I., Andanen, E., Bromley, C., Ramos-Montañez, S., & Dierking, L. (2017). A design-based research study of staff-facilitated family learning at interactive math exhibits. *Visitor Studies, 20*(2), 138–164. doi:10.1080/10645578.2017.1404348

Pattison, S. A., Rubin, A., Benne, M., Gontan, I., Andanen, E., Shagott, T., Francisco, M., Ramos-Montañez, S., Bromley, C., & Dierking, L. D. (2018). The Impact of facilitation by museum educators on family learning at interactive math exhibits: A quasi-experimental study. *Visitor Studies*, *21*(1), 4–30. doi:10.1080/10645578.2018.1503879

Pekarik, A. J., Schreiber, J. B., & Visscher, N. (2018). Overall Experience Rating – Measuring visitor response in museums. *Curator: The Museum Journal, 61*(2), 353-365.

Pettigrew, T. F., & Tropp, L. R. (2008). How does intergroup contact reduce prejudice? Meta-analytic tests of three mediators. *European Journal of Social Psychology, 38*, 922-934. doi:10.1002/ejsp.504

Pratto, F., Sidanius, J., Stallworth, L. M., & Malle, B. F. (1994). Social dominance orientation: A personality variable predicting social and political attitudes. *Journal of personality and social psychology*, *67*(4), 741.

Price, C. A., Makdisi, L., Hutchison, G., Lancaster, D., & Keels, M. (2022). Exploring trauma responsive educational practices in a museum. *Journal of Museum Education*, *47*(1), 113–124. doi:10.1080/10598650.2021.1988274

Raymore, L. A. (2002). Facilitators to leisure. *Journal of Leisure Research, 34*(1), 37-51. doi:10.1080/00222216.2002.11949959

Ryoo, J. J., & Shea, M. (2015). Value mapping: An activity for surfacing power dynamics and diverse perspectives in research-practice collaborations. San Francisco, CA: Exploratorium. Retrieved from https://rpp.wtgrantfoundation.org/wp-content/uploads/2019/09/Value-Mapping_Nov2015.pdf

San Francisco Planning Department. (2017). *San Francisco neighborhoods: Socio-economic Profiles. American Community Survey 2010–2014.* San Francisco, CA: Office of the Mayor.

San Francisco Department of Emergency Management. (2021). *Tenderloin emergency initiative: Strategic plan and operations guide.* https://sf.gov/sites/default/files/2022-01/Tenderloin%20Emergency%20Initiative%20Strategic%20Plan%20and%20Operation_12.27.21.pdf

Exploratorium (2022). *Sound Commons: A Living Innovation Zone in UN Plaza.* Retrieved on May 2, 2022 from https://www.exploratorium.edu/publicspaces/projects/un-plaza.

Serrell, B. (1998). *Paying attention: Visitors and museum exhibitions.* American Association of Museums.

Serrell, B. (2010). *Paying more attention to paying attention.* Center for Advancement of Informal Science Education. http://caise.insci.org/news/96/51/Paying-More-Attention-to-Paying-Attention/d,resources-page-item-detail

SF City Planning. (2017). *Civic Center initiative.* SF Civic Center. Retrieved from https://sfciviccenter.org/civic-center-initiative/

Simon, B., Eschert, S., Schaefer, C. D., Reininger, K. M., Zitzmann, S., & Smith, H. J. (2019). Disapproved, but tolerated: The role of respect in outgroup tolerance. *Personality and Social Psychology Bulletin*, *45*(3), 406-415. doi:10.1177/0146167218787810

Stephan, W. G., & Finlay, K. (1999). The role of empathy in improving intergroup relations. *Journal of Social issues*, *55*(4), 729-743. doi:10.1111/0022-4537.00144

Stephan, W. G., & Stephan, C. W. (1985). Intergroup anxiety. *Journal of Social Issue*, 41, 157-175. doi:10.1111/j.1540-4560.1985.tb01134.x

Strand, K., Marullo, S., Cutforth, N., Stoecker, R., & Donohue, P. (2003). *Community-based research and higher education: principles and practices*. Jossey-Bass.

Tam, T., Hewstone, M., Harwood, J., Voci, A., & Kenworthy, J. (2006). Intergroup contact and grandparent-grandchild communication: The effects of self-disclosure on implicit and explicit biases against older people. *Group Processes and Intergroup Relations, 9*, 413–429. doi:10.1177/1368430206064642

Tomczak, M., & Tomczak, E. (2014). The need to report effect size estimates revisited. An overview of some recommended measures of effect size. *Trends in Sport Sciences, 21*, 19-25.

Turner, R. N., Hewstone, M., & Voci, A. (2007). Reducing explicit and implicit prejudice via direct and extended contact: The mediating role of self-disclosure and intergroup anxiety. *Journal of Personality and Social Psychology, 93*, 369–388. doi:10.1037/0022-3514.93.3.369

Urban Alchemy. (n.d.). *Urban Alchemy: Transforming the energy in traumatized urban spaces*. https://urban-alchemy.us/

Verbeke, M., Pattison, S., & Merson, M. (2018). *Visitor interest and the dynamics of interpreter-visitor conversations in national park*. Visitor Studies Association, Chicago, IL. https://www.informalscience.org/sites/default/files/iSWOOP_VSA_2018_Monae%20Verbeke.pdf

Viswanathan, M., Ammerman, A., Eng, E., Garlehner, G., Lohr, K. N., Griffith, D., ... & Webb, L. (2004). Community-based participatory research: Assessing the evidence. In *AHRQ evidence report summaries*. Agency for Healthcare Research and Quality.

Endnotes

[1.] In the methods, results and discussion sections, "we" refers to the Exploratorium research team, led by Hsin-Yi Chien and Josh Gutwill, the first and the second authors.

[2.] When evaluating the video data collected for the summative evaluation, the external Middle Ground summative evaluators used the first ten minutes of each video as their sampling window. Using the same sampling strategy allowed for comparisons and cross-referencing. We defined exhibit use as stopping with feet planted and facing an exhibit for 17 seconds or more (Serrell, 1998). The decision to track visitors who used an exhibit for at least 17 seconds was based on the average sweep rate (SRI) of 435.7 square feet per minute (Serrell, 1998). The Middle Ground exhibition was approximately 1500 square feet and featured 12 unique exhibits (excluding the introduction panel). Following this SRI benchmark, our analysis yielded that an average visitor ought to spend no less than 17 seconds at a single exhibit.

[3.] To calculate dwell time, research assistants were instructed to record two key timestamps for each sampled individual: (1) the onset timestamp, marked by the first moment when the individual either stopped and faced an exhibition cluster/exhibit or initiated physical contact with an exhibit, provided they remained in this engagement for a minimum of 17 seconds; and (2) the offset timestamp, noted at the final moment the individual remained facing the exhibition cluster/exhibit before leaving the entire plaza area. Dwell time was then calculated as the interval between these two timestamps. While we treated the use of tables and chairs provided in the Middle Ground area as a type of exhibit engagement in our analysis of video recording data, visitors who only used tables and chairs during the whole time they were in the Middle Ground exhibition area were excluded from our analysis. In addition, visitors who appeared to have pre-existing relationships with the facilitators (e.g., waving at or hugging the facilitators when they entered the Middle Ground exhibition area) were removed from the analysis.

[4.] The MacArthur Scale of Subjective Social Status is a pictorial representation that uses a 10-step ladder to symbolize social hierarchy, with the top of the ladder representing people who have the most money, education, and respected jobs. Participants were asked to ask to mark where they felt like they stood on this symbolic ladder compared to other people in the United States.

[5.] One reviewer pointed out that the question starter "Who or what motivated you…" might appear leading. Although the internal validity threat associated with this leading bias was controlled for by using a quasi-experimental design, we acknowledge that the wording of this question might introduce bias, and we plan to modify it in future studies.

[6.] Effect size measures *r* (an effect size measure for the Mann-Whitney U test) and phi (φ; an effect size measure for the Chi-Square test of independence) are considered small but notable at .1, medium at .3, and large at .4 or greater (Cohen, 1988).

Table 1

Demographics of Interview Study Participants by Condition

Demographic variable	Condition	
	Facilitated (n = 81)	Control (n = 88)
Gender		
Men	23 (28.4%)	36 (40.9%)
Women	45 (55.6%)	38 (43.2%)
Prefer to self describe	1 (1.2%)	3 (3.4%)
Missing or Prefer not to say	12 (14.8%)	11 (12.5%)
Ethnicity		
White or Caucasian	27 (33.3%)	28 (31.8%)
Asian or Asian American	23 (28.4%)	28 (31.8%)
Hispanic or Latinx	10 (12.3%)	4 (4.5%)
Black or African American	5 (6.2%)	2 (2.2%)
Native Hawaiian or Pacific Islander	1 (1.2%)	0 (0%)
Multi-racial	4 (4.9%)	7 (8%)
Prefer to self describe	2 (2.5%)	6 (6.8%)
Missing or Prefer not to say	9 (11.1%)	13 (14.8%)
Group size		
Singleton	23 (28.4%)	26 (29.5%)
Visiting in a group	58 (71.6%)	62 (70.5%)

Figure 1
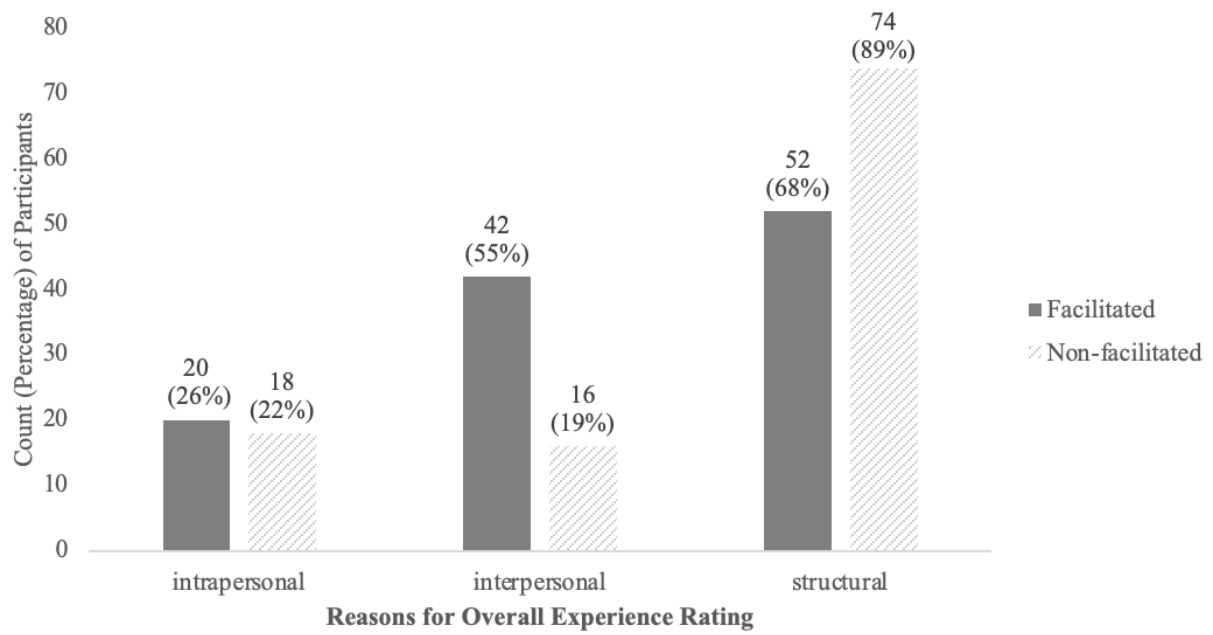
Reasons for Participants' Overall Experience Rating

Figure 2

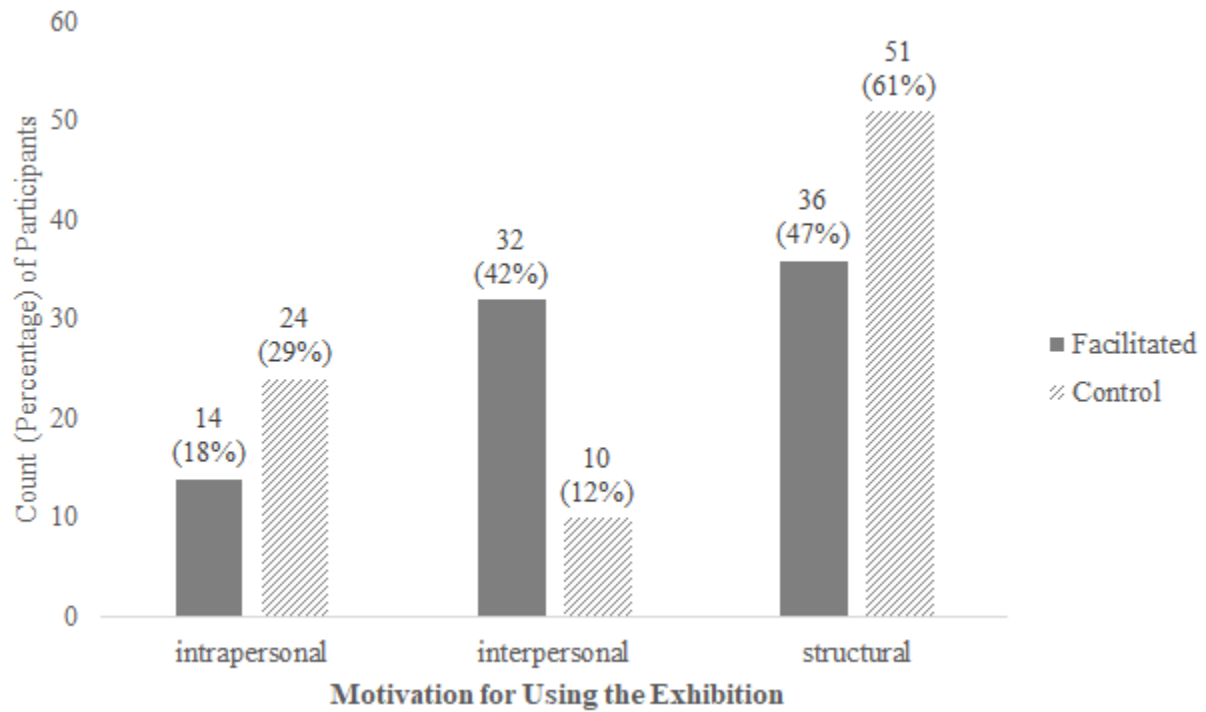*Participants' Motivation for Using the Exhibition*

Figure 3

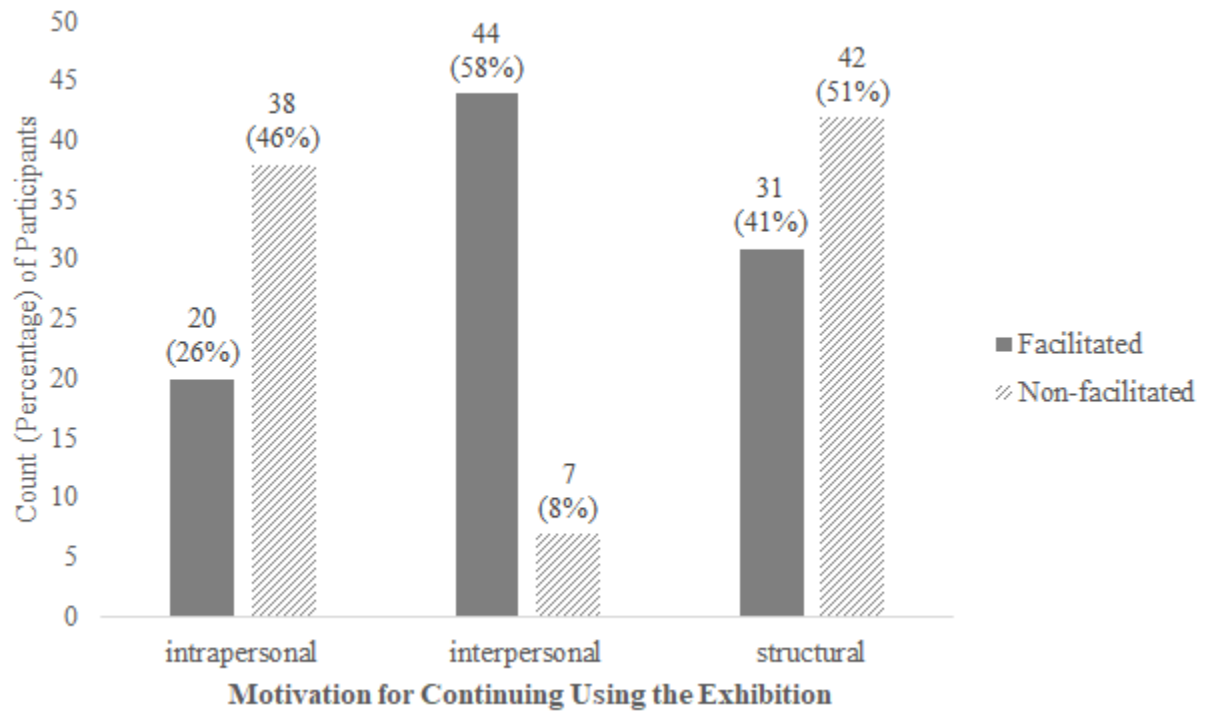*Participants' Motivation for Continuing Using the Exhibition Beyond Their First Exhibit*

Figure 4

Participants' (Mean) Levels of Emotion toward Different Others After Their Experience in the Exhibition
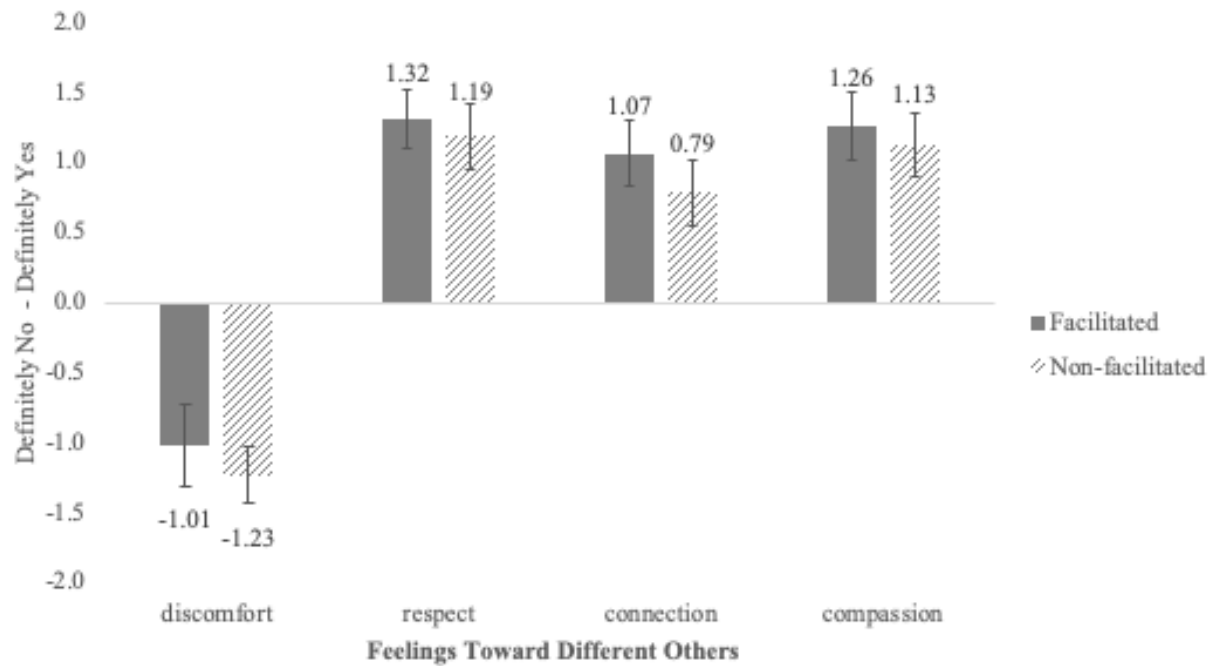
Figure 5

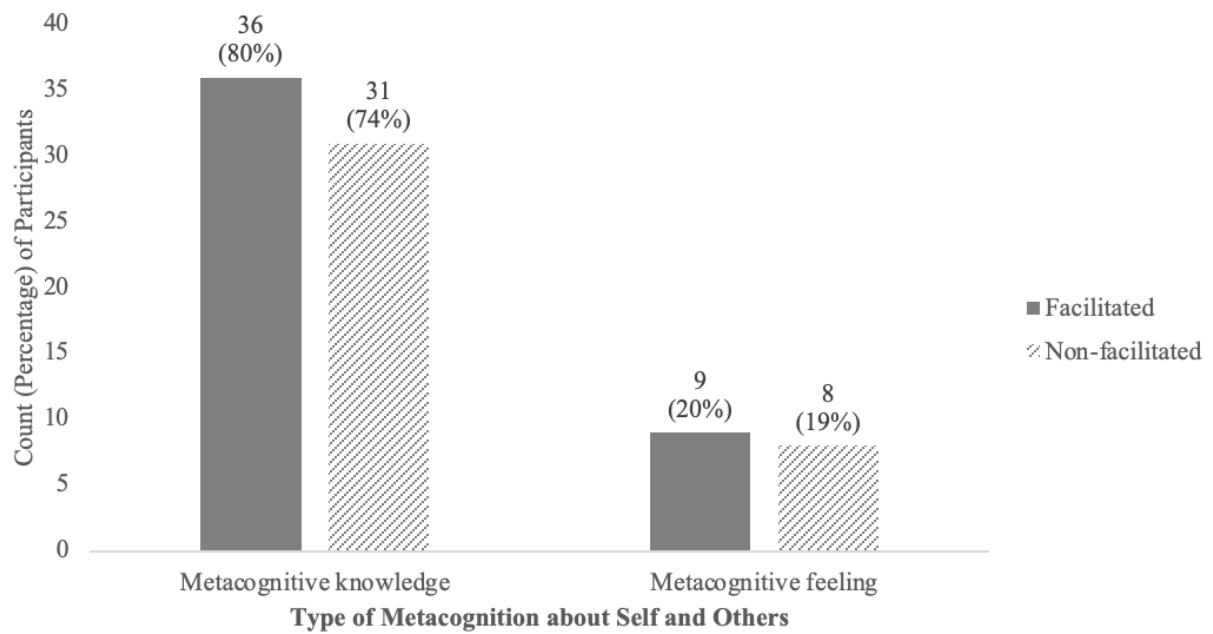*Types of Metacognition About Self and Others*

Figure 6

Types of Metacognition About Social Interaction