BUTTERFLY LOVERS

Design Rationale of a Cooperative Virtual Reality Game for Promoting Compassion in Multigenerational Families

JESSICA CHENG, SYDNEY RUBIN, CHRISTINA LELON, XIAN LU, JEFFREY DOAN, PATRICK BENDER, ASHLEY YU-CHIH, BRENDA CHEN, NATHAN LIM, GABRIELLE KANELLOS, KELSEY RICE, MARYALICE JORDAN-MARSH, & MARIENTINA GOTSIS

> 'We don't stop playing because we grow old; we grow old because we stop playing' – George Bernard Shaw, 1856-1950

PROSOCIAL PLAY AND EMOTIONAL SKILL DEVELOPMENT

Starting in early childhood and continuing through adolescence, play is an important tool for young people to develop interpersonal skills and to self-manage emotions. Recently, investigators found that dramatic pretend play uniquely helped preschoolers with emotional control, the foundation of other interpersonal and emotional skills (Goldstein & Lerner, 2017). Other investigators have found correlations between moderate video game play and better mental health, including lower prevalence of depression and higher self-esteem, compared to those who have never played games or who played excessively (Johnson, Jones, Scholes, & Carras, 2013). "Moderate" video gameplay is associated with higher levels of adolescent social well-being in middle school compared to adolescents who did not play games (Allahverdipour, Bazargan, Farhadinasab, &

Moeini, 2010). Many young people use video games for relaxation and stress relief, or to forget problems and manage their mood (Granic, Lobel, & Engels, 2014; Lobel, 2016). Therefore, video game play may positively affect psychological resilience (Johnson et al., 2013).

Adults can also experience the emotion-management benefit of playing games. Although the research is limited, an emerging consensus is that "playfulness in later life improves cognitive, emotional, social, and psychological functioning and healthy aging overall" (Chesam, Wyss, Müri, Mosimann, Nef, 2017; Yarnal & Qian, 2011, p. 53). In one survey of participants aged 63 to 92, 60% reported playing video games either regularly (at least once a week) or occasionally (at least once a month); this group presented with slightly better emotional well-being, including lower negative affect and depression, compared to non-gamers (Allaire et al., 2013). In moderation, playing video games can be an important contributor to emotional skill development in early life and help stabilize emotional well-being in adulthood.

The emergence of Virtual Reality (VR) technologies has provided a new way for people to experience games. VR can evoke an incredibly strong sense of *presence* through perceptual immersion and other kinds of engagement. There are different types of presence, including both physical presence and self-presence. Physical presence is the sensation of having your own body literally inside a virtual world, but there is also *self-presence* where you feel that you are "inhabiting" a virtual character (Lee, 2004). VR designers can capitalize on *self-presence* to construct experiences that accurately represent diverse perspectives. Feeling closer to or more identified with certain groups after understanding another's perspective can inspire compassion towards individuals in that group and motivate prosocial behavior. For instance, in one study, participants experienced color-blindness in a virtual environment; after the experience, they were more willing to help color-blind people in the real

world compared to participants who only imagined what it would be like to be color-blind (Ahn, Le, & Bailenson, 2013). VR can also encourage prosocial behavior through the embodiment of prosocial characters. For example, in one VR experience, players occupied superhero avatars and helped others in a virtual environment. Over the following three to four months, experimenters found that players were more likely to exercise prosocial behavior in the real world after having embodied a helpful virtual character (Rosenberg, Baughman, & Bailenson, 2013). Such perspective-taking experiences can lay the foundation for empathy, compassion, and prosocial behaviors towards other persons or groups.

Prosocial play can also encourage healthy intergenerational relationships with family members. Video gaming is equally accessible to people of all ages, and children are often welcoming of older family members in their games; in one questionnaire, 42% percent of youth participants reported that they played with mature adults including those in their grandparents' generation. 69% of participants played with generations that were different from their own (Voida & Greenberg, 2012). Intergenerational console gaming has been a method for generations to gather and play while learning from each other's experiences. By building mutually respectful relationships across generations, gaming experiences are an opportunity to generate familiarity and help build codependent family networks.

The Impact Potential of Prosocial Intervention: Preventing Elder Abuse As an Example

Failure to build codependent networks creates potential intergenerational stress and frustration. The Family Caregiver Alliance (2016) reported 42% of caregivers are taking care of at least one parent, 14% care for a child, and 7% for a grandparent. Elder abuse or neglect, which comes in many forms, is often associated with non-malicious behavior (World Health

Organization, 2017). Yet, there are few interventions that are focused on improving the relationship between the caregiver and the older adult. One such intervention, The Eliciting Changes in At-Risk Elders (ECARE) program, focused on a "community-based" approach that involves "building alliances with the elders and the family members" (Mariam, McClure, Robinson, & Yang, 2015, p. 19). ECARE emphasized developing older adults' sense of autonomy and giving them a voice so that they could raise any concerns to prevent future elder abuse. This intervention did show decreased risk factors in Economic and Housing, and Social and Community functions and there was less dependency and isolation detected in these older adults. When older adults feel a sense of dependency and isolation, they may be at risk for elder abuse because they feel like they have no voice or means to prevent it (Pillemer, Burnes, Riffin, & Lachs., 2016). Thus, it is important to empower the older adult, because the older adult's attitude towards the caregiver can impact the relationship and the perceived caregiving burden (on both sides). When the older adult feels independent, they also perceive less of a burden placed on his or her caregiver. For the caregiver, when an older adult is willing to voice his or her concern there is an open communication system which helps to lessen the perception of the caregiving burden. By promoting prosocial play, issues of isolation may be combated to build a positive mindset in older adults to foster their confidence and autonomy.

INTERACTIVE ENTERTAINMENT AND RESILIENCE-BUILDING

It has been proposed that technology designed to target affiliative physiological systems and emotions, including compassion, can help users cultivate resilience and well-being (Calvo & Peters, 2014). We are more likely to respond with compassion when we feel a personal connection to a subject. This connection can facilitate empathizing with that person as well as gaining a better understanding of their thoughts and

feelings. That understanding can strengthen social support systems, which are crucial for resilience and well-being. Through building a supportive network, reciprocal communication can be built. Technology can be used as a tool for users to build awareness as well as know how to effectively express their emotions and needs.

Virtual Reality, Empathy, and Compassion

VR is a potential tool for practicing compassionate communication while problem-solving across generations or other differences. VR interactions can tune us into the personal experiences of others through compelling narratives. Strong feelings of presence in a virtual environment can lead to feeling highly similar or "at one" with the embodied group member or character. In some situations, this can indeed result in positive affiliative feelings, development in understanding, "empathy," and even prosocial behavior (Ahn, Le, & Bailenson, 2013). However, the construction of VR as an "empathy machine" or cure all is a mechanistic model that misses the potential to develop compassionate behavior based on meaningful connections (Bloom, 2017, para. 2). There are numerous reasons to reconsider the idea that VR is a silver-bullet solution for empathy, which can also help reframe how we can use the medium most effectively.

Virtual environments that are intended to promote empathy are not always effective. Poor design in simulation-based training for nursing was shown to risk developing "pity" and aversion to those who need help, rather than developing a drive to help (Kenny, 2016, p. 161). Furthermore, attempts to recreate real-world social experiments in VR have shown that people sometimes react differently to virtual avatars than to actual people given the same type of task (Bohil, Alicea, & Biocca, 2011). If the virtual world created does not offer a high enough "tracking level" or high-fidelity enough embodied interaction,

then overall feelings of presence may be compromised (Cummings & Bailenson, 2016, p. 7). The VR experience is skewed and can dangerously alter the users' sense of reality. Additionally, some experiences designed to inspire empathy through VR are unsuccessful or even backfire by *increasing* biases against an outgroup (Bloom, 2017; Groom, Bailenson, & Nass, 2009).

Finally, it is important to recognize that empathy is not inherently good, positive, or moral. Singer and Klimecki (2014) define empathy as "the capacity to share the feelings of others" (p. 875), regardless of whether those emotions are positive or negative. We can imagine an "empathy machine" that captures and replicates perfect distillations of negative experiences, which would be undesirable and harmful (Robertson, 2017, para. 2). Even a goal of increasing empathic skill is ambiguous because not all empathic responses to people who are suffering are constructive.

There are two kinds of responses in that situation: compassion and empathic distress. Each has distinct neural correlations and different effects on well-being. Compassion is "characterized by feelings of warmth, concern and care for the other" (Singer & Klimecki, 2014, p. 875), whereas empathic distress occurs if you share in the sufferer's negative affect. If we experience empathic distress, our motivations can transform from other-focused to self-focused, and we may withdraw from the situation to manage our own stress instead of helping someone else. When repeated over time, empathic distress can lead to burnout (Singer & Klimecki, 2014). Therefore, when we empathize with others, it is not desirable to try to "step out" of ourselves and "become" the other person, or "step into their shoes," as is sometimes promised in VR experiences.

Retaining self-other distinction is crucial for the accuracy of both cognitive and emotional empathy, and over-identifying

with a subject's negative emotions puts people at risk for empathic distress (Singer & Klimecki, 2014). On the other hand, when we respond to someone's suffering with compassion, we are more likely to experience positive emotions and be motivated to help that person. Therefore, a compassionate response leads to better outcomes for both the sufferer and the observer/helper (Singer & Klimecki, 2014). Importantly, the way we respond to someone in need of help is not fixed. It is possible to "train" our compassionate response, and even one day of compassion training has been shown to increase prosocial behavior (Leiberg, Klimecki, & Singer, 2011). Compassion trainings are one potential source of inspiration for VR designers interested in these constructs.

VR does not promote compassion, enhance perspective, or foster prosocial behavior by virtue of its format alone, but properly designed VR experiences can make these outcomes possible. Unique qualities of VR—the ease with which VR creates strong feelings of perceptual and self-presence (Lee, 2004)—can be harnessed by designers towards empathic, compassionate, and prosocial ends if designed with informed sensitivity to the complexity of these systems.

Development of Butterfly Lovers VR

Our exploratory research informs the design brief rationale for a cooperative VR game prototype titled "Butterfly Lovers VR" (BLVR) using a museum as the game setting. We hypothesized that a VR game with interchangeable roles that required accomplishing a shared task could be leveraged as a prevention tool to promote compassionate behavior in potentially stressful relationships. In BLVR, we have designed a shared experience tackling a particular task to generate a new appreciation for the perspective of the other person. We were intent on creating an experience that can help build communication between a dyad and highlight possible related difficulties in motor control that

may be experienced with aging. In our focus group work, older adults reported exasperation with their motor difficulties often leading to frustration and impatience from caregivers. We were careful to avoid triggering any traumatizing experience of elder abuse in an overt manner when developing an embodiment of a limited motor capacity. We anticipate that this experience will trigger the development of compassionate action, which can reduce the risks of abuse and neglect. Such experiences could help preserve and increase the resilience of multigenerational families that are currently affected by age-related impairments, or that may be affected in the future. Although issues of elder abuse were the catalyst for the creation of BLVR, much of its core design could be applied to a variety of other problems that could be alleviated through improved empathic skill, perspective taking, and compassionate communication and actions.

Overview of Game Concept – Story

Butterfly Lovers is the legend of Liang Shanbo and Zhu Yingtai, with its origins at least as early as the Song Dynasty (960-1278 AD). It is arguably the most popular and widespread story of tragic romance in traditional China (Idema, 2010) and is also found in other traditions—see Romeo and Juliet. The narrative is a classic tragic folk or fairy tale where social circumstances force the parent to reject the unsuitable partner. Our adaptation of *Butterfly Lovers* offers players an opportunity to rescue the couple from the tragic fate of the original Chinese story by providing a possible alternative ending. In this alternate, lover empowered version, the parent and daughter [or son] cooperate to solve a puzzle involving an ancient artifact that will establish an acceptable lineage that gives the daughter wealth and freedom to marry as she chooses.

In the current concept, the game takes place in a museum. Players are thrown back across time into ancient China. They must cooperatively solve puzzles to find proof of lineage that will

permit uniting the two lovers. The player in VR would roleplay as one of the lovers' elderly parents, closely assisted by a player outside of the VR in augmented reality (AR). The AR player will role play as the daughter [or son] and help direct the parent towards task completion. The team conceptualized the challenges of the person playing as the elderly parent in VR across a spectrum of "disability" that can impair vision, hearing, mobility, or other senses that are critical to problem-solving in the game challenge. These roles model an intergenerational caretaking relationship and its related challenges in perspective taking and communication.

An earlier proof-of-concept (*BabyView*) developed for Children's Hospital Los Angeles explored asymmetrical play between two different VR experiences in a child safety education game, which was found to be promising in internal playtesting. The underlying game mechanics of having two different VR experiences from *BabyView* were adapted for Butterfly Lovers VR. With each player being presented with different information from the two different modes, players are required improve their communication skills and work patiently together to solve the game puzzle. The intent is that players would select a role (older adult or "caregiver") independent of their real-life circumstances. They would be encouraged to play again in the alternate role.

Gameplay and Prototype Description

The game mechanics would utilize HTC Vive for a virtual environment and a tablet for augmented reality. The VR person role playing the elderly parent wears an HTC Vive headset and the AR person role playing the daughter [or son] is given a tablet and sensors (augmented reality; AR). Within their two respective environments, players will need to interact to accomplish a series of staged tasks throughout the narrative game. The stages in the game are displayed in Figure 1.

In our current prototype, the player in the VR environment suffers from an intermittent hand tremor, which results in some difficulty with grabbing items. This may cause the player to drop things, making it challenging to complete the task of holding a set of nesting bowls that must be found and arranged properly. With this obstacle, the AR player is forced to be patient and accommodate speed and method of navigation for the VR player.

The VR environment is hazy, and the VR player needs to look around the environment in order to find clues. The augmented reality (AR) player can help to "clear away" the haze, making the VR player's memories clearer through exploring the environment set up in the museum. Then, the AR player has to find the bowls for the VR player, but the VR player being immersed in the virtual environment cannot see the bowls in the museum that the AR player can. When the AR player finds the bowls, they are required to place them in a particular spot so that they appear in the virtual environment for the VR player. The VR player is tasked to stack the bowls. With the completion of that task, a clue will appear about the path to their final destination. The VR player then must bring the (virtually) stacked bowls to their final location without dropping them. The final location displays the item that they're looking for, both in AR and VR.

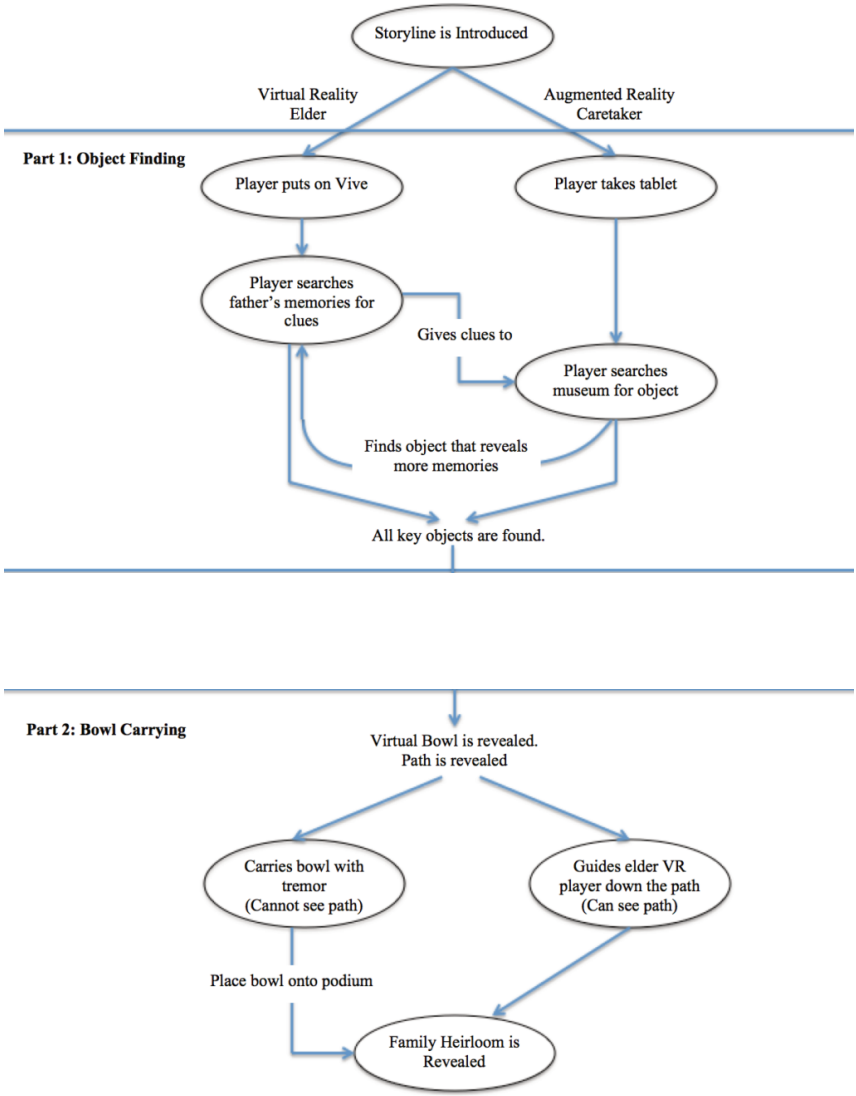

Figure 1. Current Gameplay Flowchart.

Virtual Environment for Butterfly Lovers. We developed a paper prototype of the gameplay experience and a virtual environment that includes a color-blocked sketch of an interior

space with museum-style podiums on which objects can be placed and moved around. Technical infrastructure is being developed for the communication between the VR and AR players before interaction design can take place. The first task to be tackled is the appropriate modeling of hand tremors, anticipating any compensatory behaviors of dropping objects and how one may use one's own body to prevent drops. In modeling hand tremors, we hope to accomplish user embodiment of a common affliction among the elderly. Being set in a museum of ancient China, we are careful to have the VR environment designed so that it is true to the historical time period. In addition to the technical challenges and cultural sensitivity concerns associated with this goal, embodiment in a virtual environment is not guaranteed:

> Seeing one's own body has been reported to have analgesic properties (modulating pain). Analgesia has also been described when seeing an embodied virtual body co-located with the real one. However, there is controversy regarding whether this effect holds true when seeing an illusory-owned body part (Nierula, Martini, Matamala-Gomez, Slater, & Sanchez-Vives, 2017, p. 645).

For the purposes of BLVR, it is important to see how hand ownership will be taken and whether the person will experience analgesia as they take on an embodied virtual body—yet within the person's own body. Achieving virtual body ownership of an accurately depicted hand tremor will continue to be an obstacle in building the virtual experience and must be prototyped further prior to complex game design and virtual environment modeling. The design focus is to develop a functional platform for two-player interaction that can foster the basic desired behaviors even without much structured gameplay. If this can be mastered, we will proceed with proposed game development.

ETHICAL DESIGN CHALLENGES OF VR GAMES AS PROSOCIAL INTERVENTION

VR is a powerful technological medium that is still quite new

experientially to most consumers. It is therefore worth exploring some of the ethical and practical challenges of developing experiences with the medium. Firstly, VR comes in many flavors and the technology through which it is delivered dictates safety regarding ergonomics and repetitive or prolonged use (Gent, 2016). At the time this paper is being written, most VR technology companies and digital interaction experts (Gotsis, cited in Gent, 2016; Gotsis, 2016) do not recommend that their devices be used by children under 12 because little research has been done on the effects of prolonged VR use with children.

At a practical level, many higher-end VR devices have poor ergonomic fit for smaller heads and developing eyes. Dilemmas of aging vision have not been explored. The specific platform and technology chosen can limit or promote prosocial behavior, but some creative design of the content and interaction can circumvent this phenomenon. Projection-based VR is inherently more social because the head is not enclosed. If using a head-mounted display instead, people of any age should not be left alone because they are blind to their environment and therefore at risk for injury.

The necessity of a "bystander" who is not in VR themselves is underutilized in interaction design and can be leveraged to promote social play. For example, in the game *Black Hat Cooperative* (Team Future LLC, 2016), one player is in VR trying to collect treasure. The other player is on the computer with full access to the map of the virtual environment. In such case, the bystander is not only looking over the VR player, but is also able to contribute to the goal of the game. This is a cooperative game in which both players have a role, so that the "bystander" can contribute to the game play and have equal role importance between the two players. BLVR is being designed with this perspective.

Technology issues aside, the strongly embodied nature of VR

necessitates caution when designed for users with limited or less developed cognitive or motor capacities, such as children with developmental delays or adults with degenerative disorders, or for any individual with emotion dysregulation problems (Madary & Metzinger, 2016). Certain experiences could negatively impact people with untreated severe trauma in unexpected ways (Madary & Metzinger, 2016). Obtaining consent for exposure to certain thematically challenging experiences as a prelude to interactive entertainment can itself model acts of compassion. This team advocates an intentional prosocial approach to the design of experiences, including careful consideration of context, audience, and what happens before and after the experience. We are careful to ensure that while the intermittent hand tremor is realistic to the experience that many older adults face, the disability is not designed to be a "trigger alert" reminding of past trauma. Lastly, since prolonged exposure to VR can manipulate the self-model and our perceptions of others and the world, it is imperative that the design of "empathic" and "compassionate" experiences are considered through the lens of ethical research and participant beneficence (Madary & Metzinger, 2016).

A final consideration for the design of role-playing interventions is the concept of empathy as a "risky strength" that one has to learn to regulate (Tone & Tully, 2014, p. 1547). Tone and Tully (2014) explain that "patterns of empathic responding" (empathy and emotion regulation that are context-sensitive) developed in childhood remain stable in later periods. Although perspective-taking may increase in adolescence, findings in adulthood are mixed.

Adolescence is known to be a sensitive period for strengthening skills acquired in previous years because the brain undergoes a process known as "synaptic pruning" (Huttenlocher & Dabholkar, 1997, p. 26). Adolescents who have rich and meaningful social experiences during that period are likely to

increase their resilience. This perspective comes from a more constructivist developmental framework that unifies both typical and atypical development into a continuum of theories for all children and adolescents on their path to adulthood (Arsalidou & Pascual-Leone, 2016). The up swell of interest in engaging older adults in digital interactions has not been matched by exploration of any developmental considerations. Under this framework, we advocate for thoughtful design of experiences that leverage such game play and VR to promote prosocial behavior and, emotional skill development, which in turn can increase individuals' and families' resilience.

MEASUREMENT CHALLENGES FOR INTERVENTION IMPACT

Experiences such as BLVR may be short, but could be powerful in sparking and sustaining conversations in public and private settings. Measuring the impact of these experiences, both positive and negative, presents a challenging evaluation task for efficacy, safety, and effectiveness. Our research lab has some experience with measuring short-term and long-term impact of interventions for behavior change. Most of the research literature combines measures of impact for usability, feasibility, knowledge, attitudes, and behavior. Usability is often measured through the Intrinsic Motivation Inventory (IMI) Likert scale (Ryan & Deci, 2000). At minimum, we prefer to use the interest/enjoyment, value/usefulness, and perceived competence subscales, which we have found to have excellent internal consistency and reliability across heterogeneous populations, settings, and interventions. An overall score can be calculated for comparisons between interventions, but in this prototype evaluation, we set a goal of expecting at least 70% of participants to score the experience above the scale's average in order to gauge entertainment efficacy.

From the standpoint of ethical, practical, and pleasurable design,

leveraging the strengths of interactive entertainment means aiming for better than average overall experience than other interventions (e.g., slide presentations, online education, brochures). For immersive experiences, we have experience using the ITC-SOPI, which measures presence across multiple psychophysiological constructs, including side effects, and is widely used in VR research (Lessiter, Freeman, Keogh, & Davidoff, 2001). In our most recent studies, we found great value in using the IMI and ITC-SOPI together, as they reveal a much more nuanced understanding of overall player experience than a standardized and more generic usability rating, such as the SUS (Brooke, 1996).

Our recent study of a mixed-reality shoulder exercise game (in review) also showed great interactions between IMI and ITC-SOPI and psychosocial measures. Thus, even for public-facing interventions, we recommend brief non-clinically-oriented instruments for measuring quality of life, depression-happiness, and anxiety in order to gain a better understanding of participant impact (Joseph, Linley, Harwood, Lewis, & McCollam, 2004; World Health Organiztion, 2004). For BLVR, it is likely that a scale related to caregiving experience and attitudes should be used to establish a baseline understanding of participants, and could be re-administered after play or at a future follow-up to see whether any attitudes have shifted.

For this type of intervention, one may focus on measuring magnitude of changes across scale items, for example, items related to helplessness or frailty. A mix of desirable and undesirable attitudes must be included in order to properly evaluate impact. Lastly, one could also administer a (desirable and undesirable) behavior inventory pre-intervention, and then conduct a later follow-up to gain a better understanding of the impact of such experiences (Jordan-Marsh et al., 2013). This can include specific acts of compassion, conversations about

compassionate action, and expressions of desire to change things in a positive direction.

Measuring empathy proves to be a difficult task. We use the definition of empathy that conceives it as a capacity to share another's emotions, be they pleasant or unpleasant. Empathy is a cognitive skill that may not necessarily lead to an observable action. Compassion is a type of empathic response towards someone who is suffering which often motivates us to help. Feeling compassion for another person is not equivalent to experiencing their emotions directly, but compassion can still inspire care and prosocial behavior. Compassionate behavior can be actively observed as it is performed as a reaction of prosocial skills. Empathy and compassion are separable on the psychological and neurological level, but they often work together in social situations (Preckel, Kanske, & Singer, 2018).

Empathy is difficult to measure biometrically because it is a cognitive skill that can be difficult to observe. To start, we can try to measure how players feel about each other during a play experience. One can arguably observe and measure a series of prosocial behaviors based on a scale, which may determine the range of empathy based on compassionate actions. However, there is a clear distinction between empathy as a personality trait and compassion as observable actions performed to help others. One could tape the interaction between participants and analyze helpful behavior both qualitatively and quantitatively. This is expensive and time-consuming research that nonetheless should be undertaken by experiments that aim to influence such behaviors.

Empathy is difficult to measure because of its many components and the standard of instruments are often based on a series of questionnaires subject to one's biased self-assessment. To detect if there are any improvements of empathy based on an intervention, it is imperative to take the questionnaire pre- and

post- intervention. Yet, instruments and surveys are not effective for measuring empathy change, but they are used to compare baseline empathy levels in populations. The Empathy Quotient (EQ) is a Likert-style questionnaire used to compare empathy levels across populations on the autistic spectrum (Allison, Baron-Cohen, Wheelwright, Stone, & Muncer, 2011). This instrument is one dimensional, trying to measure empathy as a whole. Alternatively, the Empathetic Assessment Index (EAI) analyzes components that were thought to be pertinent to empathy development: affective response (AR), perspective taking (PT), self-awareness (SA), emotion regulation (ER), and empathic attitudes (EA) (Gerdes, Lietz, & Segal, 2011). The test was repeated a week after to see if there were any changes. This scale addressed both the internal mindset as well as the outward expression. Another scale also utilized different prosocial skills to measure empathy development. The Balanced Emotional Empathy Scale (BEES) was a 30-item instrument for measuring the extent to which participants identify with another's emotions (Mehrabian, 1996). Such instruments that can measure possible changes in empathy scores after an intervention are most relevant for this and similar projects.

Advantage of Real World Setting in VR: Museum As an Example

The origin of this project can be traced to the culmination of work by members of the USC Suzanne Dworak-Peck School of Social Work Arts Incubator, convened after a 2-day workshop hosted by the University of Michigan in July 2014. The committee included members from the USC Pacific Asia Museum and USC School of Cinematic Arts as well as Social Work faculty. One of the challenges that emerged from this committee was concern for elder abuse and neglect and what could be done to prevent it. A transdisciplinary team at the USC Creative Media & Behavioral Health Center led by Jordan-Marsh and Gotsis decided to investigate the possibility of producing a

public art exhibit for the USC Pacific Asia Museum that used virtual reality to explore this topic. A large team of student and faculty scholars, artists, and researchers was convened and met weekly over the course of two years to conduct formative research in the field, prototype ideas, organize field trips, and evaluate technologies.

The USC Pacific Asia Museum has a concentration in Asian art, so this *Butterfly Lovers* narrative is suitable for the audience and expertise of the museum. Museums and public exhibits have a long tradition of uniting families toward pleasurable learning opportunities, with and without technology, and across many subjects and themes (Borun, Cleghom, & Garfield, 1995). Play, engagement and learning have been studied extensively in these settings, with researchers investigating both the relationship of individuals and technology (or object), and the interactions between people as they engage with museum experiences and objects (De Kort & Ijsselsteijn, 2008; Pavik & Bridges, 2013). Museum visitors engage in experiences through their interests in a specific subject, theme, object, or technology, but are also led by natural curiosity through curated spaces and stories. The museum setting predisposes visitors to a mindset of openness and can introduce new and unknown topics or reframe old ones through a new lens.

De Kort and Ijsselsteijn (2008) note that with "the introduction of embodied interaction devices in games, suddenly in-game actions become directly visible and transparent to the public" (p. 18:8). The authors hypothesize that positive effects of embodied play occur because humans naturally experience their environments in a social and kinesthetic manner. The authors take a position that digital gaming is an "activity that is embedded within a socially meaningful context of co-players and spectators, embodied through increasingly natural gaming interfaces," (p. 8). Therefore, the combination of a museum setting and technological gaming provides an engaging

combination that can foster open learning. The evolution of low-cost walking VR and augmented reality will contribute to the proliferation of these technologies in public settings, especially museums. We hypothesize that this platform is a natural expansion for museums to cultivate positive conversations and intergenerational experiences.

Limitations and Prospects

BLVR is a very brief experience and is not focused on significantly developing empathy. Empathy is a complex skill that cannot simply be gained through one intervention, but there can be positive changes in prosocial behavior to help foster compassionate actions. The proposed BLVR museum-based intervention offers a five-minute virtual reality experience which can allow for the development of perspective-taking as a building block toward empathetic communication.

Looking forward, biometrics can also be an instrument to measure levels of stress. High levels of stress are strongly correlated with an increased sense of caregiving burden, thus leading to an increased risk for elder abuse. If stress indicators such as the galvanic skin response were used to measure stress levels, then we would be able to detect the stress threshold and see if this is related to challenges in players' communication. We would also be able to more accurately measure when there is a possible risk for a trigger alert to ensure a safe experience. The ability to monitor the stress threshold will allow us to identify aspects that exacerbate the caregiver burden and challenge communication. This may lend itself to a post-play debrief that can provide closure and learning through the experience.

CONCLUSION

The formative research stage of the project has fostered the exploration of research and preliminary VR applications. This includes how play can be used to promote prosocial behavior and

emotional skill development in children and adolescents, and how interactive entertainment can be used as an intervention to increase resilience in intergenerational families. A powerful application of this research can be an intervention aimed at changing the conversation about elder abuse and neglect through a public exhibit in a museum setting. This speculative design in-progress is an example of how one can bridge multiple disciplines to develop a covert intervention that serves multiple stakeholders. The team is continuing research, design, and proof of concept development through small grants until we feel confident we are ready to pursue production funding.

ACKNOWLEDGMENTS

We would like to thank the USC Pacific Asia Museum and the USC Suzanne Dworak-Peck School of Social Work Arts Incubator participants, specifically Christine YuYu and Susana Bautista. In addition, we would like to acknowledge Jessica Cheng for her leadership in bringing this paper to publication status as part of her Provost Undergraduate Research fellowship. We also thank Eileen Hsu, Alyssa Matlosz, Allison Comrie, Hallie Pewthers, Griffin Shue, and Neil Banerjee. Funding for this project has been provided by the USC Suzanne Dworak-Peck School of Social Work, and the following USC intramural funds: Provost Undergraduate Research Fund, Summer Undergraduate Research Fund, and the Undergraduate Research Associates Program.

REFERENCES

Ahn, S. J. [Grace] Le, A. M. T., & Bailenson, J. N. (2013). The effect of embodied experiences on self-other merging, attitude, and helping behavior. *Media Psychology, 16*(1), 7–38. https://doi.org/10.1080/15213269.2012.755877

Allahverdipour, H., Bazargan, M., Farhadinasab, A., & Moeini, B. (2010). Correlates of video games playing among adolescents

in an Islamic country. *BMC Public Health, 10*(1), 286. https://doi.org/10.1186/1471-2458-10-286

Allaire, J. C., McLaughlin, A. C., Trujillo, A., Whitlock, L. A., LaPorte, L., & Gandy, M. (2013). Successful aging through digital games: Socioemotional differences between older adult gamers and non-gamers. *Computers in Human Behavior, 29*(4), 1302–1306. https://doi.org/10.1016/j.chb.2013.01.014

Allison, C., Baron-Cohen, S., Wheelwright, S. J., Stone, M. H., & Muncer, S. J. (2011). Psychometric analysis of the Empathy Quotient (EQ). *Personality and Individual Differences, 51*(7), 829–835. http://dx.doi.org/10.1016/j.paid.2011.07.005

Arsalidou, M., & Pascual-Leone, J. (2016). Constructivist developmental theory is needed in developmental neuroscience. *NPJ Science of Learning, 1,* 16016.

Bloom, P. (2017, February 3). It's ridiculous to use virtual reality to empathize with refugees. *The Atlantic*. Retrieved from https://www.theatlantic.com/technology/archive/2017/02/virtual-reality-wont-make-you-more-empathetic/515511/

Bohil, C. J., Alicea, B., & Biocca, F. A. (2011). Virtual reality in neuroscience research and therapy. *Nature Reviews Neuroscience, 12*(12), 752-762. https://doi.org/10.1038/nrn3122

Borun, M., Cleghom, A., & Garfield, C. (1995). Family learning in museums: A bibliographic review. *Curator: The Museum Journal, 38*(4), 262–270. http://doi.org/10.1111/j.2151-6952.1995.tb01064.x

Brooke J. (1996). SUS: A quick and dirty usability scale. In P.W. Jordan, B. Thomas, B. A. Weerdmeester, & A.L. McClelland (Eds.), *Usability Evaluation in Industry* (pp. 189-194). London, England: Taylor and Francis.

Calvo, R. A., & Peters, D. (2014). *Positive computing: Technology for wellbeing and human potential*. Cambridge, MA: MIT Press.

Chesham, A., Wyss, P., Müri, R. M., Mosimann, U. P., & Nef, T. (2017). What older people like to play: Genre preferences and acceptance of casual games. *JMIR Serious Games, 5*(2), e8. http://doi.org/10.2196/games.7025

Cummings, J. J., & Bailenson, J. N. (2016). How immersive is enough? A meta-analysis of the effect of immersive technology on user presence. *Media Psychology, 19*(2), 272–309. https://doi.org/10.1080/15213269.2015.1015740

De Kort, Y. A., & Ijsselsteijn, W. A. (2008). People, places, and play: Player experience in a socio-spatial context. *Computers in Entertainment, 6*(2). https://doi.org/10.1145/1371216.1371221

Family Caregiver Alliance. (2016). *Caregiver statistics: Demographics*. Retrieved from https://www.caregiver.org/pilotIntegration/indexPersistent.html?uri=%2Fcaregiver-statistics-demographics

Gent, E. (2016). Are virtual reality headsets safe for children? *Scientific American*. Retrieved from https://www.scientificamerican.com/article/are-virtual-reality-headsets-safe-for-children/

Gerdes, K. E., Lietz, C. A, & Segal, E. A. (2011). Measuring empathy in the 21st century: Development of an empathy index rooted in social cognitive neuroscience and social justice. *Social Work Research, 35*(2), 83–94. https://doi.org/10.1093/swr/35.2.83

Goldstein, T. R., & Lerner, M. D. (2017). Dramatic pretend play games uniquely improve emotional control in young children. *Developmental Science*. e12601.https://doi.org/10.1111/desc.12603

Gotsis, M. (2016). *Collection of safety and ethics evidence and recommendations for virtual reality (VR) (No. 1.5)*. Los Angeles, CA. http://doi.org/10.13140/RG.2.2.21060.01925/2

Granic, I., Lobel, A., & Engels, R. C. M. E. (2014). The benefits of playing video games. *The American Psychologist, 69*(1), 66–78. https://doi.org/10.1037/a0034857

Groom, V., Bailenson, J. N., & Nass, C. (2009). The influence of racial embodiment on racial bias in immersive virtual environments. *Social Influence, 4*(3), 231–248. https://doi.org/10.1080/15534510802643750

Huttenlocher, P. R., & Dabholkar, A. S. (1997). Regional differences in synaptogenesis in human cerebral cortex. *The Journal of Comparative Neurology, 387*(2), 167–178. Retrieved from http://onlinelibrary.wiley.com.libproxy.uoregon.edu/doi/10.1002/(SICI)1096-9861(19971020)387:2<167::AID-CNE1>3.0.CO;2-Z/pdf

Idema, W. L. (Ed., Trans.) (2010). *The butterfly lovers: The legend of Liang Shanbo and Zhu Yingtai: Four versions, with related texts*. Indianapolis/Cambridge: Hackett Publishing.

Johnson, D., Jones, C., Scholes, L., & Carras, M. (2013). *Videogames and wellbeing: A comprehensive review*. Melbourne, Australia: Young and Well Cooperative Research Centre.

Jordan-Marsh, M., Gotsis, M., Baron, D. A., Kaplan, C., Lee, P.-J., & Hashemian, Y. (2013). *Safety & effectiveness study for helping our heroes (HoH): An educational game developed by SoarTech* (ClinicalTrials.gov identifier: NCT01807806). Los Angeles, CA.

Joseph, S., Linley, P. A., Harwood, J., Lewis, C. A., & McCollam, P. (2004). Rapid assessment of well-being: The Short Depression-Happiness Scale (SDHS). *Psychology and Psychotherapy, 77*(4), 463–478. https://doi.org/10.1348/1476083042555406

Kenny, G. (2016). Compassion for simulation. *Nurse Education in Practice, 16*(1) 160-162. https://doi.org/10.1016/j.nepr.2015.09.004

Lee, K. M. (2004). Presence, explicated. *Communication Theory, 14*(1), 27–50. https://doi.org/10.1111/j.1468-2885.2004.tb00302.x

Leiberg, S., Klimecki, O., & Singer, T. (2011). Short-term compassion training increases prosocial behavior in a newly developed prosocial game. *PLoS ONE, 6*(3), e17798. https://doi.org/10.1371/journal.pone.0017798

Lessiter, J., Freeman, J., Keogh, E., & Davidoff, J. (2001). A cross-media presence questionnaire: The ITC-Sense of Presence Inventory. *Presence: Teleoperators and Virtual Environments, 10*(3), 282–297. https://doi.org/10.1162/105474601300343612

Lobel, A. (2016). *Game on: The relation between gaming and emotional regulation development* (Graduate thesis), Nijmegen, Netherlands: Behavioural Science Institute, Radboud University Nijmegen). Retrieved from http://www.publicatie-online.nl/files/3714/8172/9407/14349_Adam_Lobel_Thesis.pdf

Madary, M., & Metzinger, T. K. (2016). Real virtuality: A code of ethical conduct. Recommendations for good scientific practice and the consumers of VR-technology. *Frontiers in Robotics and AI, 3*(3), 1-23. https://doi.org/10.3389/frobt.2016.00003

Mariam, L. M., McClure, R., Robinson, J. B., & Yang, J. A. (2015). Eliciting change in at-risk elders (ECARE): Evaluation of an elder abuse intervention program. *Journal of Elder Abuse and Neglect, 27*(1), 19–33. https://doi.org/10.1080/08946566.2013.867241

Mehrabian, A. (1996). Manual for the Balanced Emotional

Empathy Scale (BEES). (Available from Albert Mehrabian, 1130 Alta Mesa Road, Monterey, CA 93940, USA).

Nierula, B., Martini, M., Matamala-Gomez, M., Slater, M., Sanchez-Vives, M. (2017). Seeing an embodied virtual hand is analgesic contingent on colocation. *The Journal of Pain: Official Journal of The American Pain Society, 18*(6), 645-655. doi:10.1016/j.jpain.2017.01.003.

Pavlik, J. V., & Bridges, F. (2013). The emergence of augmented reality (AR) as a storytelling medium in journalism. *Journalism & Communication Monographs*, *15*(1), 4-59.

Pillemer, K., Burnes, D., Riffin, C., & Lachs, M. S. (2016). Elder abuse: Global situation, risk factors, and prevention strategies. *The Gerontologist, 56*(Suppl_2) [Supplemental material], S194–S205. https://doi.org/10.1093/geront/gnw004

Preckel, K., Kanske, P., & Singer, T. (2018). On the interaction of social affect and cognition: Empathy, compassion and theory of mind. *Current Opinion in Behavioral Sciences*, *19*, 1-6.

Robertson, A. (2017, May 3). VR was sold as an 'empathy machine' — but some artists are getting sick of it. *The Verge*. Retrieved from https://www.theverge.com/2017/5/3/15524404/tribeca-film-festival-2017-vr-empathy-machine-backlash

Rosenberg, R. S., Baughman, S. L., & Bailenson, J. N. (2013). Virtual superheroes: Using superpowers in virtual reality to encourage prosocial behavior. *PLoS One, 8*(1). http://dx.doi.org/10.1371/journal.pone.0055003

Ryan, R., & Deci, E. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *The American Psychologist, 55*(1), 68–78. https://doi.org/10.1037/0003-066X.55.1.68

Singer, T., & Klimecki, O. M. (2014). Empathy and compassion. *Current Biology, 24*(18), R875–R878. https://doi.org/10.1016/j.cub.2014.06.054

Team Future LLC. (2016). *Black Hat Cooperative* Retrieved from http://store.steampowered.com/app/503100/Black_Hat_Cooperative/: Team Future LLC

Tone, E. B., & Tully, E. C. (2014). Empathy as a "risky strength": A multilevel examination of empathy and risk for internalizing disorders. *Development and Psychopathology, 26*(4pt2), 1547–1565. http://doi.org/10.1017/S0954579414001199

Voida, A., & Greenberg, S. (2012). Console gaming across generations: Exploring intergenerational interactions in collocated console gaming. *Universal Access in the Information Society, 11*(1), 45–56. https://doi.org/10.1007/s10209-011-0232-1

Yarnal, C. & Qian, X. (2011). Older adult playfulness: An innovative construct and measurement for healthy aging research. *American Journal of Play, 4*(1) 52-79.

World Health Organization. (2004). World Health Organization Quality of Life (WHOQOL) BREF. Access at https://www.scribd.com/document/58773058/WHOQOL-BREF

World Health Organization. (2017). *Elder abuse* [Fact sheet]. Retrieved from http://www.who.int/mediacentre/factsheets/fs357/en/