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Evaluation of a virtual reality enhanced bullying prevention curriculum pilot trial

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ABSTRACT

Introduction: Bullying is a widely prevalent public health and safety issue that can have serious long-term consequences for youth. Given the limited efficacy of traditional bullying prevention programs, a need exists for novel, theoretically informed, prevention programming. Construal Level Theory provides a useful framework.

Methods: This study evaluated a pseudo-randomized pilot trial of a virtual reality enhanced bullying prevention program among middle school students ($N = 118$) in the Midwest United States. Two models were proposed. The first predicts reductions in bullying behavior (traditional bullying, cyberbullying, relational aggression) at post-test, mediated by changes in empathy in the virtual reality condition compared to the control condition. The second predicts increases in school belonging and willingness to intervene as an active bystander at post-test, mediated by changes in empathy in the virtual reality condition compared to the control condition.

Results: The virtual reality condition yielded increased empathy from pre-to post-intervention compared to the control condition. Through the mediating role of empathy, changes in the desirable directions were also observed for traditional bullying, sense of school belonging, and willingness to intervene as an active bystander, but not for cyberbullying or relational aggression.

Conclusions: The scope and practical limitations of the virtual reality trial prevented a larger scale and more rigorous evaluation; however, results justify an expanded examination of virtual reality as a youth violence prevention tool.

1. Introduction

1.1. Bullying: a consequential health and safety issue

Bullying, defined "as aggressive, goal-directed, behavior that harms another individual within the context of a power imbalance" (Volk, Dane, & Marini, 2014, p. 2) is recognized internationally as a widespread public health and safety concern (Center for Disease Control and Prevention, 2018; World Health Organization, 2010). It takes several forms (traditional, relational, cyberbullying) and is linked to an array of negative acute and lasting health outcomes for victims (Center for Disease Control and Prevention, 2018; World Health Organization, 2010). Traditionally, bullying includes physical and relational aggression perpetrated by one or a group of

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students onto a/some target victim/s (Salmivalli, 2010). Relational aggression is a non-physical form of bullying that refers to directly or indirectly threatening or damaging one's relationships or social standing through means such as rumor spreading or social exclusion (Crick, 1995). Recent data indicate that between 31% and 48% of students ages 12–18 years report being relationally victimized by their peers and about 25% report physical victimization (Zhang, Musu-Gillette, & Oudekerk, 2016). With the rise of technology and internet use, cyberbullying has also emerged as a form of bullying that occurs via text messaging and social media platforms. A review of prevalence studies between 2004 and 2014 indicates that between 5% and 65% of students report being victimized, and rates vary between cultures (Brochado, Soars, & Fraga, 2017; Zhang et al., 2016). A substantial literature has found strong associations between all forms of victimization and academic difficulties, school adjustment, anxiety, depression, suicidal ideations and completion, future perpetration, and other conduct problems (Geel, Vedder, & Tanilon, 2014; Moore et al., 2017).

Unfortunately, many currently implemented interventions have shown little to no efficacy in preventing perpetration behavior, and particularly in the U.S. (Yeager, Fong, Lee, & Espelage, 2015). In a meta-analysis that examined age-related efficacy in 19 evaluations of bullying prevention programs internationally, Yeager and colleagues found modest desirable effects of programming among younger children (grades 1 though 7) but not in older children (grades 8 through 12). Though in their review of 14 randomized trials, Jiménez-Barbero, Ruiz-Hernández, Llor-Zaragoza, Pérez-García, and Llor-Esteban (2016) found that on average, these programs yield reductions in bullying, although the effect size was negligible (Cohen's $d = -0.12$). Taken together, there is insufficient evidence of the efficacy of bullying prevention programs among youth and early adolescents, which may be further exacerbated by evaluations that obtain null results and are thus less likely to be published (Easterbrook, Gopalan, Berlin, & Matthews, 1991). As such, there is a great need for novel and theoretically informed approaches to prevention, especially among older adolescents.

To this end, researchers have examined risk and protective factors associated with various forms of perpetration and victimization experiences. Literature on characteristics common to perpetrators have consistently identified low levels of empathy as a strong predictor of aggression perpetration and lack of willingness to intervene in conflict (e.g., bullying, relational aggression, cyberaggression; Jolliffe & Farrington, 2011; Mitsopoulou & Giovazolias, 2015). For purposes of the current study, empathy is defined as taking the perspective of another person and understanding what that situation might feel like for that person (Eisenberg & Fabes, 1990). A study of almost 1000 adolescents in Spain also supported this assertion, as empathy levels were inversely related to aggression perpetration generally as well as bullying and cyberbullying specifically (Casas, Del Rey, & Ortega-Ruiz, 2013). Conversely, high scores on measures of empathy are associated with positive outcomes such as school connectedness (Ahmed, 2008) and willingness to intervene when witnessing a bullying instance (Espelage, Polanin, & Low, 2014; Gini, Albiero, Benelli, & Altoè, 2007). Interestingly, Gini and colleagues found that low-level empathetic responses were strongly predictive of bullying behavior and high-level empathetic responses were predictive of intervening to help victimized others, among adolescent boys only (not girls). However, girls more often engage in relational aggression than traditional bullying (Paquette & Underwood, 1999), so perhaps this was not captured. Several studies also support inverse associations between empathy and relational aggression (Batanova & Loukas, 2014; Ettekal, Kochenderfer-Ladd, & Ladd, 2015).

1.2. Theoretical framework: Construal Level Theory

Given the strong correlation between risk perception and behavior modification (i.e., when a risk is perceived to be imminent, behavior changes; Brewer et al., 2007), many have found it helpful to examine and manipulate how individuals mentally represent risk associated with problem behaviors (Ahn, 2015; Chandran & Menon, 2004; Park & Morton, 2015; Weber, 2006). Construal Level Theory (Liberman & Trope, 1998) asserts that individuals' mental representations of events are a function of psychological distance.

Broadly, Construal Level Theory posits that individuals create mental representations of objects or events based on perceived psychological distance (Liberman & Trope, 1998). Psychological distance is comprised of four dimensions (Trope, Liberman, & Wakslak, 2007) that includes temporal distance (present versus future), social distance (me or close/similar others versus distant/different others), spatial distance (here versus far away) and uncertainty (is going to happen versus may happen). The theory posits that events that are perceived to be psychologically closer are likely to be associated with concrete, detailed, contextualized, mental representations while psychologically distal events are associated with more abstract, stable representations (Liberman & Trope, 1998). This phenomenon can be conceptualized as shifting between the “how” and “why” of an object or an event. Individuals are likely to think more about the details regarding a psychologically close event (e.g., thinking about going to a doctor appointment later today in terms of drive time, wait time, etc.). Conversely, distal events are associated with more abstract, stable, holistic representations having to do with the higher-level reasons of the importance of the event (e.g., thinking about going to a doctor appointment next year in terms of why an annual appointment is important for maintaining good health).

Behaviors are highly influenced by perceived psychological distance (see Trope et al., 2007 for review). These principles have been used to inform messaging that manipulates psychological distance, and thus intentions and behaviors. For example, Chandran and Menon (2004) found that framing the risk of heart attack using one day versus one year changed participants' intention to engage in preventative behaviors. Loewenstein (1996) proposed the mechanism of “hot and cold” systems, which asserts that salience, vividness, and emotional impact decrease with psychological distance. Said differently, operating with low psychological distance allows for more fluid and malleable thought processes. In support of this theory, some research has found that decreased psychological distance allows for the manipulation of empathy, which has been found to shift behavior toward more generous or others-focused decisions, both hypothetical and real (Loewenstein, 1996; Pronin, Olivola, & Kennedy, 2008).

1.3. Virtual reality and empathy

Virtual reality offers a highly immersive experience that allows for simulating decreased psychological distance on all four dimensions. Given that perspective-taking is a core component of empathy, using virtual reality to simulate assuming role of another person in an environment that feels realistic, it is not surprising that this experience has been shown to build or activate empathy in users: For example, one study (Kalyanaraman, Penn, Ivory, & Judge, 2010) found that when mentally healthy individuals engaged in a virtual reality experience meant to provide a psychosis simulation, they reported higher levels of empathy for individuals diagnosed with schizophrenia, compared to reading a similar experientially-descriptive narrative and completing a written reflection. Several researchers have conducted experiments to this end, though with mixed evidence regarding behavior modification (Ahn, Bailenson, & Park, 2014; Morina, Ijntema, Meyerbröker, & Emmelkamp, 2015; Schwebel, McClure, & Porter, 2017; Theng, Lee, Patinadan, & Foo, 2015; van Loon, Bailenson, Zaki, Bostick, & Willer, 2018.). However, the evidence is clear that virtual reality experiences can evoke empathy in viewers (Garner, 2018; Janda et al., 2004; Tettegah, Taylor, Whang, Meistninkas, & Chamot, 2006) which can lead to prosocial behavior in certain contexts (van Loon et al., 2018). Data on the relevant neurological processes offer some support for this phenomenon (Gu & Han, 2007).

1.4. The current study

However, to our knowledge, Construal Level Theory and virtual reality have not been used to guide bullying prevention research despite ostensible relevance. Several critical components of bullying (see above definition) make it a behavior theoretically susceptible to modification by altering psychological distance.

First, goal-directedness is a critical component of bullying behavior as discussed above. This aspect highlights that bullying is decidedly not accidental, but rather motivated by an attractive end. These perceived rewards often include gaining relative social status (compared to victim) or perceived dating opportunities (Volk, Camilleri, Dane, & Marini, 2012). There appears to be a trade-off (consciously or unconsciously) between perceived social status gain and harm to others. This trade-off choice represents a possible point of intervention, where framing could alter the decision-making processes that leads to the ultimate choice to engage in bullying behaviors.

Additionally, bullying is psychologically distant on all four dimensions. Foremost, bullying by definition occurs across a power dynamic, be it a relative social power dynamic or one that embodies systemic power imbalance such as racism or homophobia. Students consistently report that they believe victims are bullied because they are different from the bully or from the norm in some way (Swearer & Cary, 2007). This alludes to perceived social distance between the bully and victim as playing a determinant role in the bully-victim relationship. Several interventions have included role play and perspective-taking components specifically to address this aspect, which have yielded some efficacious signals among late middle school and early high school students (Espelage, Low, Polanin, & Brown, 2015; Ttofi & Farrington, 2011).

Regarding the other three facets of psychological distance, for most students engagement in bullying as a perpetrator, victim, or witness is not occurring right now (temporal distance) or here in the room (spatial distance). For many it may never occur, or unattractive consequences of engaging are improbable (probability; see rates of occurrence above). Also, examples of incidents discussed in programming lessons are hypothetical and occurrence is not impending or guaranteed. If bullying is perceived abstractly in a number of ways that existing interventions are not sufficiently addressing, students are provided with no motivations or conditions to change attitudes or behaviors.

A 2015 meta-analysis on the use of information and communication technologies (ICTs) in bullying prevention programs (Nocentini, Zambuto, & Menesini, 2015) identified only one that utilizes virtual reality, the Mii Program. However, Mii is a tool designed to assess for problem behaviors such as bullying by using virtual reality environments and has not been evaluated empirically (Carmona, Espinola, Diaz, & Iribarne, 2010). Though not as immersive, similar virtual environments such as videogames have demonstrated some positive signals in bully prevention among older adolescents, seemingly due to their use of positive affective states, engagement and self-actualizing experience, and social connectedness in their interventions (Nocentini et al., 2015). Virtual reality also has these properties but offers an even more realistic and immersive experience. However, Nocentini et al. (2015) call for an increased focus on the efficacy of ICT-focused prevention programs.

To explore virtual reality as a violence prevention tool, we used a pseudo-randomized controlled design to pilot test the effects of a virtual reality enhanced bullying prevention program compared to the business as usual in bully prevention in two Midwestern United States middle schools. The enhanced program includes professionally-designed virtual reality scenarios which place students into the situations as if they were witnessing them in real life (e.g., at the party or in the hallway watching an altercation). This in-vivo experience decreases all four dimensions of psychological distance (spatial, social, temporal, hypothetical) that the traditional curriculums do not. The enhanced curriculum also included related activities that have shown associations with increasing empathy. These activities included reflecting on character identification, perspective-taking discussion questions, and creating short films aimed to evoke empathy (Bearman, Palermo, Allen, & Williams, 2015; Staub, 1971). We hypothesized that the classroom randomly selected to receive the virtual reality enhanced intervention would demonstrate decreases in bullying behaviors (traditional, relational, and cyberbullying), increases in willingness to intervene to help others who are being bullied, and increases in school sense of belonging compared to the control condition. Further, we hypothesized that empathy would mediate the associations between the virtual reality treatment and our outcomes (bullying behaviors, willingness to intervene, and school belonging).

2. Method

2.1. Participants

One-hundred eighteen 7th and 8th grade students from two Midwest United States middle schools participated in this study (72 in the control condition school, 46 in the experimental condition school) and completed assessments at two time points (pre, post). Convenience sampling was used to recruit both schools: schools were selected based on support from the school district, principal, and staff willingness to accommodate scheduling. School principals confirmed that no other bullying prevention programming had been implemented at either school since the current students have been enrolled. 55% of participants identified as girls, 43% as boys, and 2% as non-binary or another gender. Participant ages ranged from 11 to 14 years ($\bar{x}$ = 12.50, *SD* = 0.61) and the racial composition is as follows: 25% African-American/Black, 3% Asian or Pacific Islander, 9% Hispanic/Latinx, 24% mixed race, 37% white, and 2% other. Ninety-nine percent of students at one school and 70% of students at the other school received free or reduced lunch (FRL). The schools were demographically similar (Intervention School: 785 students, 34% African/American/Black, 20% White, 54% female; Control School: 680 students, 33% African/American/Black, 29% White, 54% female).

2.2. Measures and materials

2.2.1. Measures

Each participant completed demographic information that included questions about sex, age, grade, and race/ethnicity. Then, students completed questions assessing empathy, school sense of belonging, willingness to intervene in bullying episodes, traditional bullying perpetration, relational aggression perpetration, and cyberbullying perpetration.

2.2.2. Empathy

The 5-item Empathy subscale of the Teen Conflict Scale (Bosworth & Espelage, 1995) measures adolescents' ability to listen to, care for, and trust others. Students were asked to indicate how often they would use items in the scale to describe themselves (e.g., “I can listen to others; ” “I get upset when my friends are sad”). Response options are on a 5-point Likert scale ranging from *Never* (0) through *Always* (4). High values indicate more frequent empathic behaviors. In the current study, Cronbach's alpha coefficients were 0.60 for both pre and post time points.

2.2.3. School belonging scale

Perceived belonging at school was assessed with 4 of the 20 items from the Psychological Sense of School Members Scale (Goodenow, 1993). Students were asked how much they agree with statements such as “I feel proud of belonging to this school.” Response options ranged from *“Strongly Disagree,”* (0) *through “Strongly Agree”* (4). In the current sample, Cronbach alpha coefficients were 0.60 for both pre and post time points.

2.2.4. Willingness to intervene in bullying episodes

The University of Illinois Willingness to Intervene in Bullying Episodes was used to assess student's willingness to intervene when others are being bullied. The 5-item scale was developed from a series of interviews and surveys of students in grades 3rd through 8th (Espelage, Green, & Polanin, 2012). The researchers asked students the extent that they agree with statements about intervening directly or indirectly when they encounter bullying (e.g., “If a kid is being teased, I will stick up for him/her.”, “I will tell an adult if a kid is being teased a lot.”). Response options ranged from “*Strongly Disagree*” (0) through “*Strongly Agree”* (4). Cronbach's alpha coefficients were 0.84 and 0.86 for pre and post time points respectively.

2.2.5. Bullying perpetration

The nine-item Illinois Bully Scale (Espelage & Holt, 2001) was used to assess the frequency of traditional bullying perpetration in middle school. For example, students were asked how often in the past 30 days they engaged in each behavior (e.g., teased other students, excluded others from their group of friends, threatened to hit or hurt another student). Response options ranged from “*Never*” (0) through “*7 or more times*” (4). The construct validity of this scale has been supported via exploratory and confirmatory factor analysis (Espelage & Holt, 2001). Higher scores indicated more self-reported bullying behaviors. Cronbach's alpha coefficients were: 0.71 for pre and .81 for post time points.

2.2.6. Relational aggression perpetration

The Relational Aggression Perpetration Scale (Crick, 1996) was used to measure exclusion, rumor spreading, and other activities meant to damage another child's reputation or social relationships across five items. Response options range from “*Never*” (0) to “*All the time*” (3). A confirmatory factor analysis supported the scales' construct validity (Crick, 1996), and the scale's Cronbach alpha coefficients were 0.88 and 0.85 at pre and post time points.

2.2.7. Cyberbullying perpetration

Cyberbullying perpetration was assessed with a four-item scale based on (Ybarra, Espelage, & Mitchell, 2007). Students were asked how often they did these things in this school year: made rude or mean comments to anyone online; spread rumors about someone online, whether they were true or not; made aggressive or threatening comments to anyone online; and sent a text message

that said rude or mean things. Response options included "*Never*" (0) through "*Often*" (3). The Cronbach's alpha coefficients were 0.90 and 0.86 at pre and post time points.

2.3. Intervention

2.3.1. Virtual reality enhanced bullying prevention curriculum

Entitled *Stand Up*: *Virtual Reality to Activate Bystanders Against Bullying*, this curriculum was designed to integrate the virtual reality experience into standard practice of short-term bullying prevention. A study staff member delivered the entire curriculum (including discussion components etc., such that teachers had no involvement). This staff member is highly credentialed (holds a doctorate degree in education) and trained (over 20 years working as a teacher and administrator in K through 12 settings, worked with the production team to ensure proper delivery of this curriculum). This process occurred during an hour once a week (during homeroom time) over a six-week period.

The curriculum consisted of six lessons. The first lesson introduced and taught participants how to use the technology. The following three lessons each began with a discussion (led by the interventionist), then utilized the virtual reality equipment to experience three original bullying-relevant scenarios. Students were directed to adopt the perspectives of various characters (see descriptions below) in activities. Afterward, students individually responded in writing to several discussion questions and participated in a brief interventionist-led discussion on perspective taking. During the last two sessions, students were grouped into small teams to create short videos aimed to spread an anti-bullying message. This project involved developing scripts, recording a 30–60 s video, and presenting the video to the entire group.

The virtual reality scenarios (approximately 5 minutes each) guided participants through scripted adaptations of realistic bully-relevant scenarios using Daydream goggles ("Daydream," n.d.), a commercially available virtual reality delivery system that has been used in previous virtual reality research (Dascalu, Bagis, Nitu, Ferche, & Moldoveanu, 2017; "Daydream Impact - Eastern Congo Initiative," 2018; "Daydream Impact - Rising Seas," 2018; Immersive virtual reality Education, 2018). Each focused on one of the following topics (consecutively): being an active bystander and standing up for victims, the consequences of common ineffective responses to bullying, and how to make a difference with small and realistic actions.

The first depicted a scenario where a student was bullied (traditional bullying, relational aggression) and became an outcast at school. Then, when his only friend was the victim of bullying and relational aggression (in person and online), he participated to gain social standing with the popular students. In the end, the victim sought help from a teacher and the friend stood up for her amongst his new popular friends. Students were asked to take the perspective of the victims in the scenario and reflect on how they felt. They were then asked to take the perspectives of the bystanders and reflect on what they could have done to intervene and what might have stopped them from doing so.

The second portrayed three short scenes that showed adults (presumably teachers) delivering different ineffective responses to bullying: "everything's fine" (there is no bullying), "it's not a big deal" (bullying is real but not a problem) and "it's hopeless" (bullying is an insolvable problem). Students were asked to adopt the perspectives of these adults. The reflection activities asked students to focus on the messaging they have received from educational systems about bullying, the role these systems have in allowing bullying to continue, and how to realistically create change.

In the third, participants time-travel to a future where bullying no longer exists. Peers from the future explain how bullying became extinct and teach the time-travelers how to be change agents and use small actions to intervene. The time-travelers are then inspired to return to their reality and implement these strategies.

Scenario content was informed by empirical literature on bystander intervention (Polanin, Espelage, & Pigott, 2012), an advisory board consisting of two prominent bully researchers, and were professionally scripted during a retreat by three screenwriters who specialize in creating virtual reality experiences, and experiences were then created by virtual reality production experts (employed by GoogleVR).

2.4. Procedure

Institutional review board approval was secured at the University of Florida and active parental consent was obtained for all participants. One hundred and seventy-three students were enrolled in the study and 118 completed surveys at both time points (pre, post), yielding an 86% completion rate. A class at one middle school was randomly selected to receive the virtual reality enhanced bullying prevention program (hereafter referred to as the virtual reality condition) during the measurement period. A class at a different middle school in the same county served as a "business-*as*-usual" control comparison group, which included only enforcement of existing anti-bullying policies during the measurement period (no curriculum).

All participants were assessed on all measures at two time points: one week pre-intervention (T1) and one week post-intervention (T2). Measures were collected via paper and pencil.

2.5. Data analytic plan

To test the effects of a virtual reality enhanced intervention on traditional, relational, and cyber bullying perpetration behaviors, students' willingness to intervene in bullying, and perceptions of school belonging we fit two path models to the data using Mplus 7.4. The first model examined the direct effect of the treatment (versus control) on traditional, relational, and cyber bullying perpetration at time 2, controlling for time 1. This model also examined the mediating effect of empathy on traditional, relational, and cyber

Table 1
Means (or n) and Standard Deviations (or %) of all Variables.

	Mean (or n)	Standard Deviation (or %)
Sex		
Female	65	55%
Male	51	43%
Non-Binary	2	2%
Conditions		
Treatment	46	39%
Control	72	61%
Age	12.50	0.61
Physical Bullying Perpetration T1	0.30	0.33
Physical Bullying Perpetration T2	0.37	0.44
Cyber Bullying Perpetration T1	1.07	0.65
Cyber Bullying Perpetration T2	1.13	0.56
Relational Aggression Perpetration T1	0.26	0.44
Relational Aggression Perpetration T2	0.28	0.45
Empathy T1	2.28	0.70
Empathy T2	2.18	0.67
Willingness to Intervene T1	2.16	0.62
Willingness to Intervene T2	2.07	0.68
School Belonging T1	1.98	0.47
School Belonging T2	1.91	0.56

bullying perpetration at time 2. Similarly, the second model examined the direct effect of the treatment group on students' willingness to intervene and perceptions of school belonging. The model also examined the mediating effect of empathy on students' willingness to intervene and levels of school belonging. All effects are standardized. Full Information Maximum Likelihood (FIML) was used to address missing data and a robust maximum likelihood estimator was used to address any non-normality in the data by estimating robust standard errors.

3. Results

3.1. Descriptive statistics

Descriptive statistics for the sample are shown in Table 1. There were slightly more females (55%) than males in the current sample. The treatment group made up 39% of the sample (n = 46). The average age was 12.5 years old. Table 2 shows correlations between all the variables across both time points.

3.2. Path model

To examine our hypotheses, we fit two path models, the first examined risk factors (traditional, relational, and cyber bullying perpetration; see Tables 3 and 4) and the second examined protective factors (students' willingness to intervene in bullying and school belonging; see Tables 3 and 5). Both the risk (CFI = 0.935, TLI = 0.893, RMSEA = 0.049, SRMR = 0.082) and protective

Table 2
Bivariate correlations between all variables.

	BP1	BP2	CP1	CP2	RA1	RA2	EM1	EM2	WI1	WI2	SB1	SB2
BP1	1	–	–	–	–	–	–	–	–	–	–	–
BP2	.71**	1	–	–	–	–	–	–	–	–	–	–
CP1	.20†	.06	1	–	–	–	–	–	–	–	–	–
CP2	.37**	.45**	.45**	1	–	–	–	–	–	–	–	–
RA1	.36**	.27**	-.01	.22†	1	–	–	–	–	–	–	–
RA2	.28*	.43**	.12	.31**	.22*	1	–	–	–	–	–	–
EM1	-.17†	-.30**	-.12	-.23*	.02	-.33**	1	–	–	–	–	–
EM2	-.28*	-.40**	-.10	-.19†	-.08	-.22*	.52**	1	–	–	–	–
WI1	-.08	-.21†	-.07	-.17	.00	-.31**	.33**	.12	1	–	–	–
WI2	-.06	-.31**	-.27*	-.16†	-.05	-.18†	.30**	.44**	.58**	1	–	–
SB1	-.13	-.21†	-.20†	-.18	.02	-.21†	.28**	.26*	.26**	.33**	1	–
SB2	-.23*	-.15	-.26*	-.11	-.10	.05	.07	.30**	.03	.24*	.51**	1

Note. BP1 = Physical Bullying Perpetration T1; BP2 = Physical Bullying Perpetration T2; CP1 = Cyber Bullying Perpetration T1; CP2 = Cyber Bullying Perpetration T2; RA1 = Relational Aggression Perpetration T1; RA2 = Relational Aggression Perpetration T2; EM1 = Empathy T1; EM2 = Empathy T2; WI1 = Willingness to Intervene T1; WI2 = Willingness to Intervene T2; SB1 = School Belonging T1; SB2 = School Belong T2.
$^{\dagger}p < .10$; $*p < .05$; $**p < .0$.

Table 3
Standardized effects of sex and age controls predicting all variables.

	β	*SE*
Risk Factor Model		
Physical Bullying Perpetration T1 ← Sex	−0.26**	0.09
Physical Bullying Perpetration T2 ← Sex	−0.20**	0.07
Cyber Bullying Perpetration T1 ← Sex	−0.22**	0.09
Cyber Bullying Perpetration T2 ← Sex	−0.08	0.09
Relational Aggression Perpetration T1 ← Sex	−0.17	0.10
Relational Aggression Perpetration T2 ← Sex	−0.18	0.11
Empathy T1 ← Sex	0.17	0.10
Empathy T2 ← Sex	0.23**	0.09
Physical Bullying Perpetration T1 ← Age	−0.22	0.19
Physical Bullying Perpetration T2 ← Age	−0.02	0.18
Cyber Bullying Perpetration T1 ← Age	0.41	0.22
Cyber Bullying Perpetration T2 ← Age	−0.26	0.24
Relational Aggression Perpetration T1 ← Age	−0.33	0.22
Relational Aggression Perpetration T2 ← Age	−0.10	0.19
Empathy T1 ← Age	0.10	0.19
Empathy T2 ← Age	0.11	0.16
Protective Factor Model		
Willingness to Intervene T1 ← Sex	0.16	0.10
Willingness to Intervene T2 ← Sex	0.13	0.07
School Belonging T1 ← Sex	0.25**	0.10
School Belonging T2 ← Sex	0.10	0.09
Empathy T1 ← Sex	0.17	0.10
Empathy T2 ← Sex	0.23**	0.09
Willingness to Intervene T1 ← Age	−0.12	0.18
Willingness to Intervene T2 ← Age	−0.12	0.18
School Belonging T1 ← Age	−0.14	0.10
School Belonging T2 ← Age	0.04	0.20
Empathy T1 ← Age	0.09	0.19
Empathy T2 ← Age	0.11	0.16

Note. *$p < .05$; **$p < .01$; ***$p < .001$.

Table 4
Standardized effects and standard errors of risk factor path model.

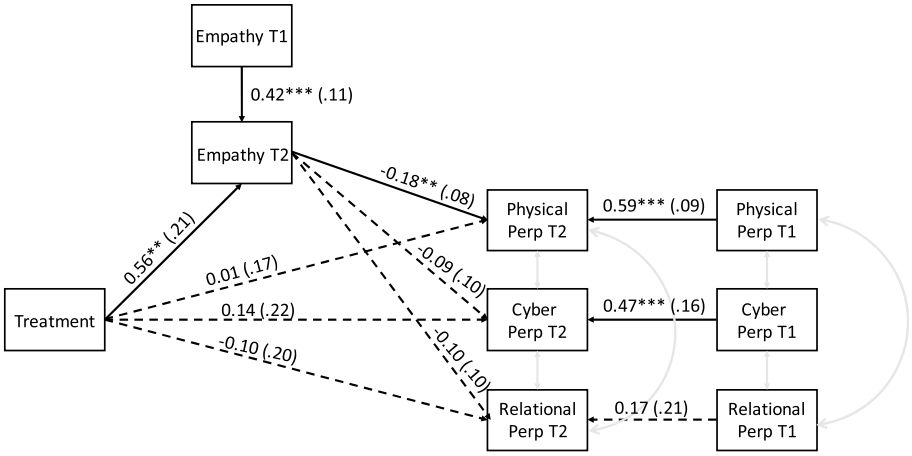
	β	*SE*
Physical Bullying Perpetration T2 ← Treatment	0.01	0.17
Physical Bullying Perpetration T2 ← Physical Bullying Perpetration T1	0.59***	0.09
Physical Bullying Perpetration T2 ← Empathy T2	−0.18**	0.08
Cyber Bullying Perpetration T2 ← Treatment	0.14	0.22
Cyber Bullying Perpetration T2 ← Cyber Bullying Perpetration T1	0.47**	0.16
Cyber Bullying Perpetration T2 ← Empathy T2	−0.09	0.10
Relational Aggression Perpetration T2 ← Treatment	−0.10	0.20
Relational Aggression Perpetration T2 ← Relational Aggression Perpetration T1	0.17	0.21
Relational Aggression Perpetration T2 ← Empathy T2	−0.10	0.10
Empathy T2 ← Treatment	0.56**	0.21
Empathy T2 ← Empathy T1	0.42***	0.11
Physical Bullying Perpetration T1 with Cyber Bullying Perpetration T1	.19*	0.09
Physical Bullying Perpetration T1 with Relational Aggression Perpetration T1	.34**	0.11
Cyber Bullying Perpetration T1 with Relational Aggression Perpetration T1	-.01	0.12
Physical Bullying Perpetration T2 with Cyber Bullying Perpetration T2	.38**	0.13
Physical Bullying Perpetration T2 with Relational Aggression Perpetration T2	.31*	0.14
Cyber Bullying Perpetration T2 with Relational Aggression Perpetration T2	.28*	0.14

(CFI = 0.909, TLI = 0.878, RMSEA = 0.052, SRMR = 0.083) factor models had acceptable model fit. Fig. 1 shows the path model for the risk factors that examined the direct effect of the virtual reality treatment on traditional, relational, and cyber bullying perpetration at T2 and the indirect effect through empathy at T2. This model controlled for age and sex which indicated that females reported lower rates of traditional, relational and cyber bullying perpetration and higher rates of empathy compared to males (see Table 3). Traditional, relational, and cyber bullying perpetration are significantly positively correlated at both T1 and T2 (see Table 4). Contrary to our first hypothesis, we did not find evidence of any direct effects of the virtual reality treatment on reductions in various forms of bullying behaviors; however, we found one significant indirect effect through empathy. More specifically, individuals in the treatment group reported significantly higher rates of empathy at T2 ($\beta = 0.58$, SE = 0.21, $p < .01$) compared to the control group, while controlling for T1 levels of empathy ($\beta = 0.43$, SE = 0.08, $p < .001$); in turn, empathy was associated with

Table 5
Standardized effects and standard errors of protective factor path model.

	β	*SE*
Willingness to Intervene T2 ← Treatment	−0.10	0.19
Willingness to Intervene T2 ← Willingness to Intervene T1	0.58***	0.09
Willingness to Intervene T2 ← Empathy T2	0.35***	0.08
School Belonging T2 ←Treatment	−0.02	0.20
School Belonging T2 ←School Belonging T1	0.47***	0.10
School Belonging T2 ←Empathy T2	0.24**	0.10
Empathy T2 ← Treatment	0.56**	0.21
Empathy T2 ←Empathy T1	0.42***	0.11
School Belonging T1 with Willingness to Intervene T1	.19	0.11
School Belonging T2 with Willingness to Intervene T2	0.16	0.12

Note. $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$.



Note: All effects are standardized. Sex and Age are regressed on all variables but are not shown for ease of reading. $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$.

Fig. 1. Path Model of Risk Factors. Note: All effects are standardized. Sex and Age are regressed on all variables but are not shown for ease of reading. $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$.

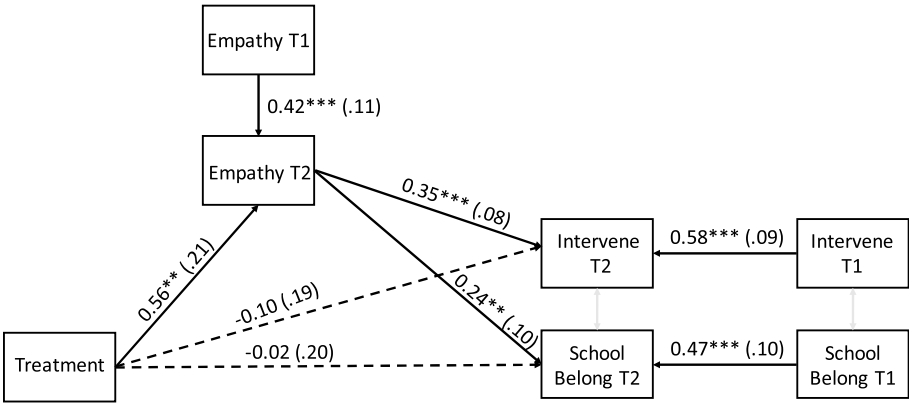
significant decreases in traditional bullying perpetration at T2 ($\beta = -0.19$, SE = 0.21, $p < .01$) while controlling for T1 levels ($\beta = 0.59$, SE = 0.09, $p < .001$). That is, being in the virtual reality treatment group predicted increases in empathy larger than one half a standard deviation (0.58), and in turn, a one standard deviation increase in empathy was associated with a 0.19 standard deviation decrease in traditional bullying perpetration. The mediation effect of the virtual reality treatment on reductions in traditional bullying perpetration behaviors via empathy was also significant ($\beta = -0.53$, SE = 0.03, $p = .04$; see Table 6), and provided further evidence which suggested that the virtual reality treatment lead to increases in empathy at the following time point (T2) which in turn was associated with reductions in traditional bullying perpetration.

Fig. 2 shows the path model for the protective factors that examined the direct effect of the virtual reality treatment on individuals' willingness to intervene in bullying and perceptions of school belonging at T2 and the indirect effect through empathy. This model controlled for age and sex which indicated that females reported higher rates of empathy and school belonging compared to males (see Table 3). Willingness to intervene and school belonging are significantly positively correlated at T1 but not T2 (see Table 5). While we did not find evidence of any direct effects of the virtual reality treatment on increases in willingness to intervene or school belonging, we found two significant indirect effects through empathy. More specifically, individuals in the treatment group reported significant increases in empathy ($\beta = 0.59$, SE = 0.21, $p < .01$) at T2 compared to the control group, while controlling for

Table 6
Standardized mediation effects and standard errors.

	Estimate	SE
Treatment → Empathy T2 → Physical Bullying Perpetration T2	−0.49†	0.03
Treatment → Empathy T2 → Willingness to Intervene T2	0.10**	0.04
Treatment → Empathy T2 → School Belonging T2	.07	0.04

Note. $^{\dagger}p < .10$; $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$.



Note: All effects are standardized. Sex and Age are regressed on all variables but are not shown for ease of reading. *$p < .05$; **$p < .01$; ***$p < .001$.

Fig. 2. Path Model of Protective Factors. Note: All effects are standardized. Sex and Age are regressed on all variables but are not shown for ease of reading. *$p < .05$; **$p < .01$; ***$p < .001$.

T1 levels of empathy ($\beta = 0.43$, SE = 0.11, $p < .001$); in turn, empathy was associated with significant increases in willingness to intervene ($\beta = 0.37$, SE = 0.08, $p < .001$) and school belonging at T2 ($\beta = 0.24$, SE = 0.10, $p < .01$) while controlling for T1 levels. That is, being a member of the treatment group predicted increases in empathy by more than one half a standard deviation (0.59), and in turn, a one standard deviation increase in empathy was associated with a 0.37 standard deviation increase in willingness to intervene and a 0.24 standard deviation increase in school belonging. The mediation effect of the treatment on individual willingness to intervene via empathy was significant ($\beta = 0.11$, SE = 0.04, $p = .01$; see Table 6) and provided further evidence which suggested that the treatment lead to increases in empathy which in turn was associated with increases in students' willingness to intervene in bullying.

4. Discussion

The current research evaluated a pilot trial of a virtual reality enhanced bullying prevention program compared to a business-*as*-usual control group. We proposed two models by which the intervention would evidence success. In the first, students in the virtual reality condition would demonstrate decreases in perpetration of bullying behaviors (traditional bullying, relational aggression, and cyberbullying) through a mediating pathway of empathy in comparison to the business-*as*-usual control condition. In the second, we expected that students in the virtual reality condition would report increases in willingness to intervene as an active bystander as well as school connectedness, also through a mediating pathway of empathy, in comparison to students in the control condition.

The first model yielded an association between receiving the virtual reality intervention and increased empathy between T1 and T2, compared to the control group. Additionally, receiving the virtual reality intervention was associated with decreased traditional bullying perpetration, mediated by empathy (no direct effects were observed). However, the same was not true for cyberbullying nor relational aggression as outcomes; no direct nor indirect effects were found. Regarding the second model, receiving the virtual reality intervention was associated with increased school connectedness and willingness to intervene as an active bystander compared to the control group, through empathy as a mediating pathway. These results suggest that manipulating empathy using a virtual reality-enhanced intervention can positively influence constructs that often protect against a culture of aggression in schools (Espelage et al., 2012; Gini et al., 2007; Nickerson, Singleton, Schnurr, & Collen, 2014). Though only partial support was found for these hypotheses and no conclusions can be drawn regarding the potent component of this intervention, these results are somewhat consistent with previous work that has tested virtual reality as a tool to evoke empathy (Janda et al., 2004; Tettegah et al., 2006) and work that has proposed manipulating empathy as a mechanism of aggression reduction and prosocial promotion (Gini et al., 2007; Ttofi & Farrington, 2011).

While we did not assess the contribution of each component, extant research supports several aspects of the current intervention as conducive to its goals. First, virtual reality provides a solitary learning experience while engaging. These individualized experiences may allow for students to absorb the material without distraction from social dynamics or disruptive behavior that occur in a group setting (Jonkmann, Trautwein, & Lüdtke, 2009). Additionally, this intervention also included lesson plans and activities that provided opportunities to process the virtual reality content. This aspect was meant to connect the virtual reality experiences to the intended messaging as to amplify it. Additionally, this practice likely prevented priming effects (i.e. watching a bullying scenario and then feeling primed to bully; Buckley & Anderson, 2006).

However, inconsistency in effects across forms of aggression is atypical considering some previous literature that has found cyberbullying to correlate with relational aggression and traditional bullying (Calvete, Orue, Estévez, Villardón, & Padilla, 2010; Modecki, Minchin, Harbaugh, Guerra, & Runions, 2014 for review). Several possible explanations arise. Though extant literature has identified commonalities among perpetrators of these three types of aggression, they are distinct in nature and do not always

demonstrate identical properties (Casas et al., 2013). Also, compared to other forms of youth aggression, perpetration of cyberbullying is associated with notably low levels of empathy and perspective taking among adolescents (Brewer & Kerslake, 2015; Pettalia, Levin, & Dickinson, 2013; Steffgen, König, Pfetsch, & Melzer, 2009). Therefore, conjuring empathy may be more challenging regarding online aggression. Additionally, key features of the encounter differ between in-person and online behavior, that intervention design should consider (e.g., perpetrators may feel a sense of anonymity and lack of consequence; Barlińska, Szuster, & Winiewski, 2012; Pettalia et al., 2013). Similarly, relational aggression is conceptualized as indirect aggression (e.g., spreading rumors, social exclusion; Crick, 1995). In these scenarios, the victim is not always aware of the social damage or exclusion. There may be more psychological distance between the perpetration behavior and the consequence, which may deter creating sufficient empathy to change behavior (Loewenstein, 1996; Pronin et al., 2008).

Further, these findings should be interpreted cautiously given several limitations. First, the sample size was small, which may have limited our ability to detect effects and generalizability of findings. Additionally, practical and ethical constraints did not allow for a highly rigorous design (e.g., a business as usual vs. curriculum without virtual reality vs. curriculum with virtual reality). Thus, the present results do not allow for inferences regarding comparative effectiveness of virtual reality-integrated programs with other non-virtual reality programs. Replication in larger samples and comparison to existing programming is necessary, especially given cost considerations attached to virtual reality. Additionally, we can draw no conclusions regarding sustained effects. Finally, we relied solely on student self-reported data for all measurements, which presents a number of limitations including social desirability bias and memory inaccuracies. Also, the alpha coefficients of 0.60 for the empathy and school belonging scales represent threats to internal validity. This study also did not formally examine the liking or excitement born of introducing a novel technological instrument. It is possible that this contributed to adherence. Future research should more closely examine the unique contribution of the virtual reality component specifically, role of psychological distance in bullying, and utilize other or additional forms of measurement such as behavioral tasks (live or in virtual reality), observations, or multiple informant strategies (e.g., teacher reports, parent reports).

Regarding feasibility, using virtual reality is inherently inequitable given school budget determinants. The Google Daydream used in this study can be purchased from electronic retailers for about $30, though options that range in price and quality are also commercially available. It is not clear from this study how much this intervention would cost if scaled up to more than one classroom or school. Economic cost analyses should be conducted in future studies. Further, there are practical challenges (charging, portability) that need to be considered.

Students were asked to provide feedback on acceptability via open-ended questions. When prompted to describe what they liked, several common threads emerged. Many students (25) indicated they liked the realistic aspect. Fifteen found the content meaningful in some way. Three students appreciated the solitary experience. Regarding what they disliked, 4 students reported not liking the content of the program. Seven students noted practical issues (e.g., becoming nauseous). Six students felt like they did not have enough time to engage with the virtual reality experiences. These reports confirm that liking the program may contribute to adherence and thus effects.

Despite limitations, these findings signal the potential usefulness of virtual reality in this area, and justify further exploration of this desperately needed novel approach to intervention design. Future directions in this area should address the shortcomings described above and continue to explore virtual reality as a potentially useful tool for enhancing school-based aggression interventions. Ways to strengthen the virtual reality experience to be more “potent” are (1) to include an interactivity component that involves decision-making and (2) to create characters that the user is likely to stronger identify with based on identity components (Kalyanaraman & Sundar, 2006).

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