Student Preferences for Safe and Psychologically Comfortable School Facilities

STUDENT PREFERENCES FOR SAFE AND PSYCHOLOGICALLY COMFORTABLE SCHOOL FACILITIES

by

Daniel Lamoreaux

A Dissertation Submitted to the Faculty of the

DEPARTMENT OF DISABILITY AND PSYCHOEDUCATIONAL STUDIES

In Partial Fulfillment of the Requirements

For the Degree of

DOCTOR OF PHILOSOPHY

WITH A MAJOR IN SCHOOL PSYCHOLOGY

In the Graduate College

THE UNIVERSITY OF ARIZONA

2017

THE UNIVERSITY OF ARIZONA
GRADUATE COLLEGE

As members of the Dissertation Committee, we certify that we have read the dissertation prepared by *Daniel Lamoreaux*, titled *Student Preferences for Safe and Psychologically Comfortable School Facilities* and recommend that it be accepted as fulfilling the dissertation requirement for the Degree of Doctor of Philosophy.

Michael Sulkowski Date: 11/17/2017

Sheri Bauman Date: 11/17/2017

Jina Yoon Date: 11/17/2017

Final approval and acceptance of this dissertation is contingent upon the candidate's submission of the final copies of the dissertation to the Graduate College.

I hereby certify that I have read this dissertation prepared under my direction and recommend that it be accepted as fulfilling the dissertation requirement.

Dissertation Director: *Michael Sulkowski* Date: 11/17/2017

STATEMENT BY AUTHOR

This dissertation has been submitted in partial fulfillment of the requirements for an advanced degree at the University of Arizona and is deposited in the University Library to be made available to borrowers under rules of the Library.

Brief quotations from this dissertation are allowable without special permission, provided that an accurate acknowledgement of the source is made. Requests for permission for extended quotation from or reproduction of this manuscript in whole or in part may be granted by the head of the major department or the Dean of the Graduate College when in his or her judgment the proposed use of the material is in the interests of scholarship. In all other instances, however, permission must be obtained from the author.

SIGNED: Daniel Lamoreaux

ACKNOWLEDGEMENTS

I wish to express a stupendous and grand thank you to all the vital people that carried me to this glorious milestone. Without the unwavering support of my Creator, my fabulous wife, my children, and my parents (my faculty advisor helped a bit too…) this quest would have been an insurmountable obstacle of Tolkien proportions. Indeed, I cannot help feeling that this experience has given me a glimpse of the burden, pain, and subsequent relief that Frodo Baggins experienced on the craggy slopes of Orodruin as he rid himself of the One Ring and completed his equally taxing and epic quest! As my journey finally winds down I am grateful to have been part of the fantastic institutions that are the University of Arizona and its College of Education. I would recognize the immense contributions and time devoted by my stalwart advisor and committee chair Mike Sulkowski, as well as the unique skills and knowledge that each of my other faculty and instructors have imparted to me. Thank you all!

TABLE OF CONTENTS

LIST OF TABLES

Abstract

In the current atmosphere of intense concern over school violence, steps are often hastily taken to "fortify" schools without forethought for how such actions may adversely impact the school environment and students' psychological wellbeing. Given the paucity of evidence that unequivocally demonstrates the effectiveness of metal detectors, security cameras, and other security features (NASP, 2013; Addington, 2009), this study investigates a potentially more sound approach toward enhancing school safety initiatives. Crime Prevention through Environmental Design (CPTED) is one philosophy that is commonly used in the design of safe schools, and—consistent with this philosophy—the present study investigates whether schools designed around CPTED principles are perceived as being safer and/or more psychologically comfortable when they are compared to schools that do not adhere to CPTED design elements.

In the current study, the researcher visited three middle schools and four high schools across southern Arizona where students used their school laptops or computer labs to complete an online survey via Qualtrics survey software. Nine hundred students in grades 7 through 12 completed the survey, which included preexisting measures of risk behavior, previous exposure to violence, and school climate, as well as a novel instrument entitled the Preferable School Design Measure (PSDM). The PSDM presented pairs of photographs featuring a CPTED school design and a non-CPTED school design, then asked respondents in which school they would feel safer and more psychologically comfortable, respectively. Results indicate that students had a significantly greater preference for CPTED versus non-CPTED school designs ($p < .001$), both in terms of perceived psychological comfort ($d = .70$) and physical safety ($d = .84$). No significant differences were found in preferences for CPTED schools based on age, race/ethnicity, self-reported academic achievement, levels of previous exposure to violence, or socio-economic

status, which suggests that identified preferences are generally robust to many common between-group demographic differences. Overall, study results suggest that implementing CPTED designs may be an effective approach to engender feelings of both safety *and* comfort among students. Moreover, it is conceivable that by changing the current landscape of mediocre school facilities, the academic and psychosocial outcomes of students inhabiting these facilities might be greatly enhanced.

Chapter 1: Introduction

Rates of School Violence and Crime

Although their tragic nature of violent school attacks garners extensive media attention, school shootings actually are quite rare. The National Center for Education Statistics report on *Indicators of School Crime and Safety* found that of the total number of youth homicides in the United States, an average of less than 2% occur on school grounds. Moreover, this estimate has remained relatively stable from 1992 to 2012 (Robers, Zhang, Morgan, & Musu-Gillette, 2015), suggesting that school violence is not increasing as the media often portrays. The most recent annual data, from the period of July 2011 to June 2012, indicates there were 15 homicides of students aged 5 to 18 in schools around the US. In comparison, during that same school year, there were 1,184 children and youth homicides that occurred *outside* of school grounds (Robers et al., 2015). These statistics indicate that school shootings are exceedingly rare and that the tendency to overlook the improbability of attacks fuels inaccurate perceptions. As a result, the widespread fear of school shootings and the often draconian efforts to tighten school security following tragic events may be unwarranted.

In light of the data on stable rates of school violence, schools are arguably safer than they were a decade ago (NASP, 2013). Nevertheless, concern from the public and from educators continues to reveal a fear of school shootings (see Ewton [2014] for review), which perpetuates the call for increased school security measures. Phaneuf (2009) elucidates one source of these concerns, indicating that excessive attention to rising youth violence rates in the 1980's and school shootings in the 1990's gave rise to "moral panic" and the conceptualization of school violence as an "epidemic." As a result, media coverage of school violence often describes exaggerated incidence rates, overgeneralized profiles of potential shooters, and inaccurate

presumed risk factors that misinform and scare the public (Phaneuf, 2009). Fortunately, however, research has sought to dispel these alarmist messages through revealing better strategies associated with reducing school violence in its myriad forms.

School Crisis Prevention and Safety

The U.S. Secret Service and the U.S. Department of Education conducted a major study titled the *Safe School Initiative* to discover potential patterns among school shooter profiles and thus produce better information for preventive strategies (Vossekuil, Fein, Reddy, Borum, & Modzeleski, 2002). This study involved analyzing data from 37 incidents occurring between 1974 and 2000. The report revealed that 95% of the attackers were students of the school involved in the incident, all were male, nearly three fourths reported feeling bullied or harmed in some way, and three fourths also had a history of attempting suicide (Vossekuil et al., 2002). The importance of these findings cannot be overstated. Based on the common threads stated above, attempts to reduce bullying, create positive school environments, and provide school-based student support services (i.e. counseling, mental health/suicide prevention) could potentially have as dramatic an effect on school violence as physical safeguards.

Current practices in procedural safeguards also have an important role in school safety. Guidelines from the U.S. Department of Education outline four phases of school emergency management including prevention/mitigation, preparedness, response, and recovery, of which prevention is most salient to the present discussion (U.S. DOE, 2003). Violence prevention often includes use of policies such as requiring visitor sign-in, visitor name badge use, bullying prevention programs, zero tolerance discipline policies, classroom intercom systems, and school resource officers (Phaneuf, 2009; Ewton, 2014). In addition to these policies and strategies,

placing deterrents in the school's physical environment is also a common prevention practice and these physical barriers to crime can take many forms.

Physical school security measures. Physical school security measures are often among the first solutions proposed after tragic school incidences and they include metal detectors, surveillance cameras, security guards, and perimeter fencing. These measures have been more widely adopted in recent years. For instance, only 19% of U.S. public schools used surveillance cameras in 1999 (Ewton, 2014), whereas in the 2011-2012 school year, the NCES reported that 64.3% of schools utilized cameras (Robers et al., 2015). Other examples of security measures include use of controlled building access during school hours, which increased from 81.5% of schools in 2003 to 88.2% of schools in 2011, and controlled grounds access during school hours, which increased from 39.4% of schools in 2003 to 44.1% in 2011 (Robers et al., 2015). In addition, in the 2011-2012 school year, 24% of public schools conducted random dog sniffs for drugs, 12.1% did random sweeps for contraband, 7.4% of public schools required the wearing of student ID badges, 5% conducted random metal detector checks on students, and 2.7% required daily metal detector clearance from students (Robers et al., 2015). Although these security measures are intended to prevent and reduce school crime and violence, evidence regarding their effectiveness is still under debate, leaving room for alternative approaches (NASP, 2013; Phaneuf, 2009).

An Expanded Definition of Safety

Reeves, Kanan, and Plog (2010) explain that a "safe school" does more than simply establish measures to prevent crises or create emergency response protocols. Rather, a safe school is one that focuses on creating a positive climate with effective prevention and intervention programs. Various studies have sought to reveal and summarize the specific

attributes of effective safe schools—and interestingly—physical security measures rarely appear in the lists of top traits. Instead, key findings often highlight traits related to school climate, a broad term that describes the quality of socio-emotional health at the school-wide level and that now includes safety and the physical environment (Bosworth, Ford, & Hernandaz, 2011; Bradshaw, Waasdorp, Debnam, & Johnson, 2014).

Common school climate factors that promote sense of safety include the following: high academic expectations; meaningful parent and community involvement; promotion of good citizenship and character; provision of outlets for children to express concerns and feelings; and clearly defined goals, rules, and policies (Reeves et al., 2010). Further evidence for the favoring of climate-based solutions comes from a study by Johnson (2009), which involved reviewing 25 studies about safe school environments. This study concluded that students in schools with less violence had a sense of ownership over their school, perceived that their school environment was positive and learning-focused, and thought that their school was orderly. Johnson (2009) indicates that a preference for policy and climate-based solutions over school security strategies has been observed across several studies, indicating that perhaps physical security measures are not as crucial to school safety as current beliefs suggest. In light of these findings, Reeves et al. (2010) call for "a balance between physical and psychological safety to create and maintain a safe and positive environment" (p. 6).

Physical safety and psychological safety. Definitions of physical safety often emphasize the physical vulnerabilities of school buildings and the steps taken by adults to protect students from bodily harm and violence (Reeves et al., 2010). Conceptions of school violence often include rape, sexual battery, attacks or fights with or without a weapon, and robbery (DeAngelis,

Brent, & Ianni, 2011). However, school violence has also been more broadly categorized as actions that disrupt, cause harm, or damage school property (DeAngelis et al., 2011).

On the other hand, psychological safety encompasses school climate and emotional health. It involves a need for students to feel safe and comfortable at school as well as free from fear and psychological harm (Reeves et al., 2010). Research indicates that psychological safety is a key factor in creating a supportive environment that, in turn, impacts learning in the entire school community (Higgins, Ishimaru, Holcombe, & Fowler, 2012). Reeves et al. (2010) assert that psychologically safe schools promote emotional and social wellbeing, cultivate a positive environment, and increase the likelihood that students are mentally "available" to learn. Consequently, schools that prioritize psychological safety possess characteristics such as positive behavior support systems, effective early intervention programs, educational and therapeutic interventions, high parental involvement, school-based mental health services, and teacher support (Reeves et al., 2010).

While acknowledging the importance of both physical safety and psychological wellbeing in school contexts, one challenge concerns preventing these priorities from impinging on one another. A solution that may serve this need for balance but has yet received little research attention is the use of architectural design to support physical safety and psychological wellbeing in schools.

School and the Built Environment

Largely unknown to the general population, research has revealed that the built environment influences a diverse array of childhood behaviors and outcomes. For instance, toxins from the built environment are tied to reduced cognitive abilities and impaired socio-emotional functioning (Evans, 2006); environmental noise impacts learning, memory, and

attention (Evans, 2006); and crowded environments are associated with reduced motivation, psychological distress, and higher rates of aggression (Halpern, 1995). In this vein, there likely are numerous other ways that physical environments might impact children's health and behavior, hence the importance of researching and understanding such factors.

Research has begun to reveal characteristics of optimal learning environments. For example, several studies have shown that students attending smaller schools tend to have higher test scores, fewer problematic student behaviors, and stronger feelings of school connectedness (Evans, 2006). Further, higher quality school facilities have been found to be associated with positive perceptions of school climate and higher academic achievement (Uline & Tschannen-Moran, 2008). Others have found that the combined influence of specific indoor environmental qualities such as air quality, temperature, acoustics, lighting, and aesthetics increases students' perceived learning and positively influences student satisfaction with the overall classroom environment (Choi, Guerin, Kim, Brigham, & Bauer, 2014). Kuller and Lindsten (1992) highlight several adverse health and behavioral effects on students in windowless classrooms and suggest that continuous use of windowless classrooms should be avoided. Recent research has also suggested that creative, flexible classrooms with "inspiring aesthetics" increase student engagement, which is associated with positive learning outcomes (Jankowska & Atlay, 2007). Similarly, Scott-Webber, Strickland, and Kapitula (2013) conducted pre/post research and observed an increase in student engagement among higher education classes that moved to classrooms with evidence-based design elements, and ongoing research continues to reveal the impact of the physical environment on student perceptions and performance (Marchand, Nardi, Reynolds, & Pamoukov, 2014). In short, the built environment's influence on human health, school climate, student engagement, and achievement implicate architecture as a significant

factor in creating the psychologically safe school described by Reeves et al. (2010). This implies that schools that are designed to ensure that students feel safe, comfortable, and at ease prepare students to learn and thrive.

Although many findings have yet to be empirically corroborated, current literature on the school's physical environment suggests that the features of built space influence students in important ways. Unfortunately, most stakeholders and administrators involved in school safety planning appear to be uninformed of such environmental influences, as school security measures often clash with school design practices. For instance, although research discourages windowless classrooms (Kuller & Lindsten, 1992), increased fear of school shootings has led to practices such as eliminating, minimizing, or covering classroom windows, ostensibly to reduce the school's vulnerability to intruders. However, research on the impact of the school physical environment suggests that overly prioritizing safety while neglecting comfort and psychological wellbeing is misguided (Evans, 2006; Marchand, Nardi, Reynolds, & Pamoukov, 2014; Maxwell, 2000).

To address school safety without sacrificing best practices in architecture and design, many architects, policy-makers, and state school facilities boards are adopting principles of design called Crime Prevention through Environmental Design (CPTED; Arizona School Facilities Board, 2007; Philpott & Kuenstle, 2007). CPTED emphasizes natural, subtle methods of deterring illegal activity by designing facilities that facilitate (1) *natural surveillance*, (2) *access control,* and (3) *territoriality/maintenance*. CPTED principles have found broad appeal among school planners but current empirical research on the use of CPTED in schools is very limited. Many researchers have investigated CPTED in non-school environments, and preliminary findings suggest that it is effective in reducing crime (Taylor, 2002). In addition to

crime prevention, CPTED in school settings would also support psychological wellbeing by communicating positive messages, fomenting student ownership, and reducing the opportunity for out-of-sight acts (CDC, 2014). What remains to be studied are student perceptions of safety and psychological comfort in CPTED school environments.

Justification of Need for Research

In 2012, the McGraw-Hill Research Foundation produced a white paper calling for research on school design/architecture and the potential impact of school facilities on student outcomes (Baker & Bernstein, 2012). The paper indicates a need for research and calls all stakeholders to participate in efforts to advance research on how school buildings influence student health and functioning. However, despite this request, the issue of safety and security in school design is glaringly absent from the aforementioned white paper; this suggests a need for greater awareness on the use of architecture and design to promote school safety. To address this dearth of information, the present study explores student preferences for two broad types of schools: schools that include CPTED design elements and schools that lack CPTED design elements.

Unique contributions

Architects and designers often emphasize that student input is crucial when designing learning environments (Bickford, 2002; Jerome, 2012). However, few have systematically asked students what aspects of the environment help them feel safe or psychologically comfortable at school. As notable exceptions, two studies that focused on aspects of the environment were conducted by Langhout and Annear (2010) and Maxwell (2000). However, Langhout and Annear utilized K-5 student input, which is unreliable because of young students' low insight and poor metacognitive abilities, while Maxwell's study suffered from methodological flaws and

incorporated very few architectural aspects of the physical environment among the items in its survey. As a result, a more direct, systematic investigation of student preferences is needed.

Preference for safety and psychological comfort in the school's built environment have rarely been investigated together, thus a comparison of student perceptions in these two areas is needed. Maxwell (2000) compared elements of the environment that students and parents felt contributed to a safe and welcoming school, but the study had methodological flaws, including a sample from only one school facility. Further, "welcoming" does not equate with "psychological comfort" as it is defined here. Moreover, because of the Maxwell study's relative age, new research is warranted on this important topic. Additionally, it would be useful to know how student preferences for the aesthetic qualities of safe versus psychologically comfortable schools might converge or diverge. For instance, it is conceivable that students might prefer non-CPTED schools to CPTED schools for safety, but CPTED schools over non-CPTED schools for psychological comfort. Exploring these questions will provide school administrators and architects with direction on how to prioritize physical safety and psychological comfort.

Use of a CPTED-based approach to school design represents an intuitively effective solution to balancing the needs of physical safety and psychological comfort; however, none have compared perceptions of CPTED designed schools and non-CPTED schools. Current research has shown CPTED-based built environments to be generally effective in reducing crime, yet measuring students' sense of safety in such environments has received little research attention. Moreover, many schools are already making use of CPTED concepts (Philpott & Kuenstle, 2007) despite the lack of an empirical basis for doing so. In addition, widespread implementation of CPTED in schools appears to be limited and there is currently no literature that discusses student sense of safety within CPTED school environments. Although researchers

with the Centers for Disease Control have recently explored this topic, results have yet to be published and concurrent research could prove to be a useful comparison. Thus, this study addressed a paucity of research regarding student perceptions of CPTED school environments.

Current Study

Hypotheses and Research Questions

The use of CPTED in school facilities displays promise toward finding a balance between perceptions of safety and comfort. However, little research has investigated either of the former, particularly regarding how findings might inform school-related applications. In this regard, questions that have yet to be addressed include the following: Do students feel safer in schools designed with CPTED compared to non-CPTED schools? Do students prefer CPTED schools over others for psychological comfort? Are student preferences for safety and comfort similar in terms of the type of school preferred for each? The present research fills a discernible gap in the literature by elucidating whether students prefer CPTED-based schools or non-CPTED schools for safety and psychological comfort, and whether those preferences converge or diverge when comparing the perceived psychological comfort and physical safety afforded by each type of school. Consistent with these research questions, the following hypotheses were tested:

1. Students will prefer CPTED-based school designs over non-CPTED schools for the perceived psychological comfort they provide.

    Due to the "progressive" philosophies of CPTED, its implementation often coincides with forward-thinking school design focused on comfort, functionality, and wellbeing. For instance, more and more contemporary architects are designing schools with elements such as large window views, green spaces, gardens,

collaborative group spaces, and comfortable workspaces outside the classroom. Thus, it was believed that students would perceive CPTED school environments as more pleasant and would prefer them over non-CPTED schools for psychological comfort.

2. Students will prefer CPTED designs over non-CPTED school designs for the perceived physical safety they afford.

   CPTED design principles emphasize subtle and mostly covert methods of crime deterrence via the physical environment. As such, its subtle nature would not likely convey messages that there is a need for protection, or in other words, that there is something to fear. Resultantly, this study posited that students would have less fear and more sense of safety when viewing CPTED school environments.

3. A positive relationship will exist between students' preference for psychological comfort and physical safety. Moreover, students' preference for schools perceived as psychologically comfortable will be the same as preference for schools perceived as safe.

   If the first two hypotheses were supported and students preferred CPTED school environments for both physical safety and psychological comfort, then this would suggest a positive correlation between these two variables. In turn, this would imply that adherence to CPTED-based school designs would yield optimal outcomes for providing students with a sense of safety and psychological comfort.

4. Students with higher exposure to violence will have less preference for CPTED school designs.

   Because traumatized students often develop fearful and anxious dispositions (Pynoos, Steinberg, & Piacentini, 1999), it was expected that youths with the highest levels of

violence exposure would demonstrate less preference for CPTED schools, since their fear-based internal states would have a greater influence on their sense of safety and comfort than the external environment, regardless of its design.

5. CPTED preferences of students with a history of delinquent behaviors will differ significantly from non-delinquent students.

   Based on past experiences with the punitive consequences of delinquent behavior, it was suspected that students with violent, aggressive, and delinquent behaviors would be more sensitive to specific environments where they felt their negative behaviors might be closely watched or supervised (Reinke & Herman, 2002). This sensitivity would cause them to weigh the risks of engaging in a negative behavior given their current physical context, and would predict that they would feel less threat of punishment in certain spaces.

Exploratory research questions. Using additional demographic information and data from instruments measuring previous exposure to violence, previous delinquent risk behaviors, and school climate perceptions, various exploratory questions were also investigated. For example:

- Are there differences in student preference for CPTED based on gender, race/ethnicity, academic achievement, or socio-economic status?
- How do CPTED preferences relate to perceptions of school climate when controlling for exposure to violence?
- How do CPTED preferences relate to perceptions of school climate when controlling for prior violent/delinquent behaviors?

Summary of Current Study

School safety and security has become a highly salient topic in U.S. education. In response to tragedies such as school shootings, the public has demanded increased school security measures that often result in facilities fortified with security guards, metal detectors, surveillance cameras, and K-9 drug sniffs. However, research indicates that school climate and related factors may shape perceptions of school safety and psychological wellbeing more than the occurrence of violent incidences (Skiba et al., 2004), which are often used as justification for tightened security measures. The architecture and design of school campuses is one promising avenue for supporting an ideal school climate. Crime Prevention through Environmental Design (CPTED) represents a design philosophy that could address both the physical safety and psychological wellbeing of K-12 students. However, investigation into the application of CPTED in schools has been minimal to date. Further, few studies have been conducted to understand student perspectives about the physical safety or psychological comfort afforded by CPTED-based school designs.

The current investigation aims to address this scarcity of knowledge. It is proposed that effective schools should aspire toward a balance of physical safety and psychological comfort in order to maximize student outcomes. Therefore, this study investigated the type of physical and aesthetic school environment that students prefer to feel safe and comfortable. To accomplish this, 7th through 12th grade students were surveyed to discover whether they would feel safer in CPTED school environments or schools lacking CPTED, as represented in photographs. The survey also asked students whether they felt more psychologically comfortable in CPTED or non-CPTED schools. The results provide architects and school planners with important student

perspectives on whether CPTED principles support student sense of safety and psychological comfort, two elements that are key to a school's success.

Chapter 2: Review of Literature

Research has shown that characteristics of the physical environment impact human behavior, emotion, and cognition. Architecture and design aim at manipulating these outcomes via specific design strategies. In particular, school facilities have long been designed with the purpose of providing a safe, functional environment that allows students to focus and learn effectively. However, during the present era of intense media coverage on tragic incidents of school violence, preliminary research is revealing that reactionary decisions to tighten school security measures may be creating physical environments that are antithetical to having an open and comfortable environment for learning (NASP, 2013). Principles of Crime Prevention through Environmental Design (CPTED) may provide a way of creating safe schools while maintaining a positive and comfortable learning environment, yet little attention has been devoted to CPTED's use in schools and its effect on students. The need for further research on the use of CPTED architecture and design for school safety is based on the following conclusions:

1. The physical environment impacts sense of safety at school.
2. Sense of safety impacts academic achievement and mental health.
3. The built environment impacts cognitive function and mental health and may help or hinder the learning process.
4. CPTED offers a viable design philosophy for balancing safety and psychological comfort.
5. The quality of school built environments is positively correlated with student achievement.

Student Sense of Safety at School

Impact of School Security Measures

Security features in the physical environment (e.g., metal detectors, cameras, security personnel) are associated with undesirable effects on students. Schreck and Miller (2003) analyzed data from the School Safety and Discipline portion of the National Household Education Survey, a biannual survey conducted by the National Center for Education Statistics. They found that some forms of physical school security such as locked doors and hall monitors are correlated with higher student worry about crime. However, a notable limitation of the aforementioned study is that it employed a pre-existing data set (circa 1993) intended for different research topics, therefore the data did not allow for detailed conclusions regarding *how* security measures may impact students. Despite this limitation, other studies have since supported Schreck and Miller's conclusions (e.g., Gastic, 2011).

Similarly, a study completed by Perumean-Chaney and Sutton (2013) also demonstrates the impact of highly visible school security measures on students. Based on a data set of 13,386 student responses from the National Longitudinal Study of Adolescent Health, this study tested whether security guards and patrols were associated with enhanced sense of student safety and whether the use of metal detectors and other overt security features would be associated with a decreased sense of safety. Importantly, this study found that metal detectors are associated with increased student concern for their safety, and that student fears are compounded with the addition of increased security measures. This finding corroborates previous research findings indicating that students at schools with metal detectors feel significantly less safe than students at schools without them (Gastic, 2011; Hankin, 2011).

The National Association of School Psychologists (NASP) also warns that universal application of extreme security measures such as armed personnel, metal detectors, and surveillance cameras can potentially undermine the primary goal of schools as institutions of learning. NASP drew on many key research studies to provide several conclusions, among which include the following:

- There is little to no evidence that metal detectors, security guards, or surveillance cameras are an effective means of school violence prevention (Addington, 2009).
- Some research indicates that the use of security guards and metal detectors is associated with higher levels of school crime and disturbance (Nickerson & Martens, 2008).
- Installing security cameras can diminish school climate by implicitly suggesting that students are untrustworthy (Warnick, 2007).

Although current findings are preliminary, the above conclusions have significant implications, suggesting that physical school security measures may be more problematic than beneficial. As a result, understanding student perceptions regarding their safety at school could also provide direction for prioritizing school security initiatives and uncovering the types of environmental variables that contribute to sense of safety.

Factors Affecting Perceived School Safety

Skiba et al. (2004) studied student perceptions in order to understand what factors most contributed to their sense of safety. They developed a comprehensive instrument called the *Safe and Responsive Schools Safe Schools Survey*, which was administered at five middle and high schools and involved the collection of more than 2200 complete student responses. The survey employed a 5-point Likert scale format and it included 43 items asking students to rate their level

of agreement with statements about their perceptions of school climate and safety. Skiba et al. found four primary factors that predicted perceptions of safety, each with internal consistency above .83: Connection/Climate, Incivility and Disruption, Personal Safety, and Delinquency/Major Safety. Interestingly, Connection/Climate accounted for the most variance (28.6%) in students' overall perceptions of the safety of their schools, and the single strongest survey item in predicting overall safety perceptions was "I feel welcome at this school." The authors suggest that this item embodies school connection and school climate, which may be of greater relevance in cultivating students' sense of safety at school. They state that: "feelings about connectedness and climate may be more critical than serious violence in shaping student perceptions of school safety" (p. 150). This notion certainly supports the idea that facility planning and design should focus on providing psychological comfort as much as a sense of physical safety, but further research is needed to support this assertion.

Langhout and Annear (2010) also gathered data on students' perceptions of safety at school in an attempt to understand which school spaces students saw as safe or unsafe. Two hundred twenty-five kindergarten through fifth grade students were given maps and pictures of their school grounds on which they marked spaces where they felt unsafe. Additionally, post-survey focus groups were conducted to gather additional qualitative data. Although student identification of unsafe spaces varied widely and no single location was deemed unsafe by a majority of respondents, there were several spaces that a sizeable minority of students agreed were unsafe. Generally, these were places where injury occurred or discipline referrals were given, as well as areas that lacked adult supervision. Notably, student responses across multiple focus groups revealed a trend in which students often defined safety as a feeling of comfort stemming from the presence of a supportive adult. This finding suggests that students' sense of

safety may depend on feeling comfortable and at ease in the school environment, a concept that integrates well into Reeves et al.'s definition of psychological safety: "…the climate and relationships within the building and measures that ensure that students feel safe at school and view it as a place where they can learn…, are free from emotional or psychological harm…[and] are available for learning" (pp. 10-11). Langhout and Annear's study also highlights the utility of gathering information on *student* perceptions to inform decisions regarding school safety.

Maxwell (2000) conducted an exploratory study that relates closely to the topics that were explored in the previous studies. Maxwell sought to reveal top priorities for a safe and welcoming school environment by surveying teachers, parents, and students. A total sample of 261 participants from one school facility participated. The questionnaire asked respondents to pick items from a list of environmental features that were perceived as contributing to their school feeling welcoming and safe, respectively. Items that received the highest consensus relating to the school being *welcoming* were: student work was displayed, cleanliness/maintenance, visitor policy in place, bulletin boards (for artwork display), and location of administration office. Items that received the highest consensus regarding *safety* were: visitor's sign in, visitor policy enforced, locked outside doors, location of main office, and presence of hall monitors. Although the findings are novel and interesting, the overall study is lacking in empirical rigor and results only reflect conditions at one school facility, which limits the generalizability of findings. Additionally, results were expressed using simple response consensus as the main measurement statistic, as opposed to the use of statistical analysis to determine the significance of their results.

Based on current findings, school connectedness and positive climate may contribute to school safety as much as physical security measures do (Skiba et al., 2004), which challenges

notions of tightening school security measures in response to school shooting incidents. Thus, a focus on making schools feel more welcoming, positive, and psychologically comfortable may yield better results than overly restrictive approaches to school safety. Through studying welcoming and safe features of the school environment, Maxwell (2000) found that cleanliness, visitor policies, and location of administration offices in the school's layout were some of the top contributing factors for a welcoming environment selected by teachers, parents, and students. Explicitly asking students to identify school spaces where they feel unsafe, as was done in the aforementioned study by Langhout and Annear (2010), has yielded tentative conclusions including the observation that spaces with adult supervision were perceived as most safe. Finally, student interviews from the Langhout and Annear study revealed that students associate a sense of safety with feelings of comfort, both of which can be influenced by the design of the school's physical environment.

Impact of Sense of Safety on Student Outcomes

One crucial reason for the need to understand the impact of the physical environment on student sense of safety is the association of this variable with academic achievement. Milam, Furr-Holden, and Leaf (2010) utilized an instrument called The Neighborhood Inventory of Environmental Typology (NIfETy) to measure the correlation between achievement and the presence of violence, alcohol, and drugs in neighborhood environments. As a subjectively measured variable, the research also collected self-reported sense of safety at school and in the neighborhood as indicated by students, staff, and parents in Baltimore City public schools' annual school climate survey. Individuals from 116 of Baltimore's elementary schools participated in the study. After controlling for socio-economic status, Milam et al. (2010) found that increased neighborhood violence exposure and student self-reported sense of safety were

both significantly correlated with Math and Reading achievement scores. Based on their findings, the authors suggest that students' ability to focus on academics can be diminished when they are worried or fearful for their safety, which corroborates prior research findings (see Bowen & Bowen, 1999).

Nijs et al. (2014) found that perceived school safety is also correlated with risk for mental health and psychosocial difficulties. Using a very large sample of 11,130 Dutch students (aged 11 – 20 years), the researchers analyzed students' sense of safety at school, how often they are victimized or victimize others, number of absences, and other potentially confounding factors. Student mental health was determined by the Strengths and Difficulties Questionnaire (SDQ), a 25-item, validated self-report screening tool (Goodman, Meltzer, & Bailey, 1998), which assessed their level of psychosocial functioning. When comparing the groups of students with normal SDQ scores, borderline scores, and clinical (abnormal) scores, Nijs et al. found that perceived safety at school was the single strongest predictor of mental health difficulties among adolescent participants. In particular, perceived school safety was most strongly associated with the Peer Relationship Problems and Emotional Symptoms subscales of the SDQ, corroborating the need for focusing on aspects of school climate that increase sense of safety.

Because data suggest that fearful students often have lower achievement and more mental health challenges, and given that most school shooters have had poor mental health (i.e. suicide attempts), research is needed to explore effective methods for promoting students' sense of safety and mental wellbeing. Thus far, empirical literature indicates that connected, positive, and welcoming school climates are perceived as safer; as some studies have found higher student fear in schools with more visible security measures, it may be the case that such schools' physical environments are not conducive to positivity and warmth. Empirical investigation could help

with understanding what architectural features of the built environment contribute to a welcoming and safe school, but few studies have attempted to answer such questions, and with limited conclusions.

The Impact of the Built Environment

Many of the most iconic tourist destinations are monuments of architecture; the Empire State Building, Big Ben, the Eiffel Tower, the Sydney Opera House, the pyramids of Giza, and the Taj Mahal are just a few examples. Visitors often leave these destinations with a sense of expansion, contemplation, inspiration, and a longing to return. By contrast, this can seldom be said for institutions of learning. Schools are not typically spaces that are noted for their architectural significance or for the feelings that they invoke in visitors.

Although architects and planners have always sought to create quality school facilities according to the standards of their era (Baker, 2011), the success stories of truly innovative and inspiring K-12 campuses are the exception rather than the rule. Even in terms of mere condition and functionality, many of today's schools are inadequate. The average school building in 2006 was approximately 40 years old, highlighting a deplorable situation for U.S. schools (Filardo, Vincent, Sung, & Stein, 2006). Most students likely lead successful academic careers regardless of their school facilities; however, preliminary research indicates that the quality of school facilities is correlated with higher achievement (Uline & Tschannen-Moran, 2008; Barrett, Davies, Zhang, & Barrett, 2015), suggesting that even if students are doing well in today's schools, they could be doing better. To understand how to optimize student achievement in a physical context, research must continue to investigate how the environment impacts student cognition and overall functioning in order to conceptualize the key features of comfortable, effective school facilities.

Cognitive Function and the Physical Environment

Choi, Van Merrienboer, and Paas (2014) posit that the comfort of the physical environment is an important variable impacting the efficiency of students' cognitive functioning. Citing a framework called cognitive load theory (CLT), they review findings pointing to how environmental conditions can impact factors that interact with learner-specific traits and learning task demands to create a "cognitive load." As a result, Choi et al. (2014) posit that characteristics of the physical environment (i.e. classroom design) can either constrain or support learning depending on whether they contribute to cognitive load. Hence, the design of the built environment can impact learning in subtle yet measurable ways, such as with students' long-term and short-term/working memory. Extraneous environmental factors that affect working memory efficiency (i.e. noise, distracting sensory stimuli) would impose a cognitive load and diminish the learner's performance. One important implication of CLT is that a more psychologically comfortable learning environment allows students to be mentally available to learn and to function optimally, as suggested in the definition of psychological safety outlined by Reeves et al. (2010). Although this review by Choi et al. (2014) represents a model of learning that has not yet been directly supported by research, investigation concerning the effects of environmental cognitive load indirectly corroborates their theory.

Environmental impact on stress and mental health. Empirical literature is replete with findings that highlight how stress impacts physiological, psychological, behavioral, and psychosocial functioning. Moreover, research is also beginning to describe how elements of the physical environment influence stress. An extensive literature review by Rashid and Zimring (2008) discusses empirical findings on how several factors relating to indoor environmental quality may converge to impact stress levels. Specifically, the review cites numerous sources

suggesting the negative effects of poor indoor air quality, noise levels, inadequate lighting, ambient temperature, and overall indoor environmental quality, all of which can be sources of physical and psychological discomfort and all of which are influenced by the design of built space. Similarly, Evans (2003) indicates that there are six direct correlates with sufficient empirical support tying mental health to the built environment, four of which are directly applicable to school settings: crowding, noise, indoor air quality, and lighting.

Regarding crowding, Halpern (1995) cites research indicating that higher social densities, or more people in a single room, tend to produce negative affective states associated with the unpleasantness of such situations. Also, many studies have found that higher school density and less classroom space per child are associated with lower academic achievement and higher rates of disruptive behavior (Maxwell, 2003). Evans (2003) cites research showing that sustained exposure to noise is associated with higher psychological distress in students, and Halpern (1995) indicates that exposure to adjacent traffic noise has been correlated with poorer auditory discrimination and reading ability among students, in addition to higher blood pressure. These studies highlight the importance of designing campuses and classrooms with ample space, effective acoustic isolation, and noise-reducing installations.

Airborne pollutants and lighting quality also impact psychological functioning. Originating from building materials, behavioral toxins such as heavy metals, pesticides, and solvents can impact concentration, anxiety, and depression, as well as impair children's self-regulatory capacities, thus heightening aggression and negative behaviors (Evans, 2003). Further, research indicates that unpleasant odors produce elevated negative affect (Evans, 2003) and knowledge about hazardous exposure to harmful materials can lead to psychological trauma (Edelstein, 2002). Evans (2003) also states that individuals with consistent, minimal exposure to

daylight experience more sadness and fatigue. Other preliminary studies demonstrate a significant correlation between levels of classroom daylight and student achievement (Heschong Mahone Group, 2003). Additionally, Halpern (1995) asserts that increasing light levels is one of the best-documented ways to reduce fear of crime. In short, current research encourages the careful selection of non-toxic building materials, provision of optimal light levels, and use of natural daylight in classrooms.

Conversely, designing schools with restorative spaces, such as gardens and attractive landscaping, is an example of how physical environments can *improve* wellbeing. Restorative green spaces have been associated with several physical and mental health benefits. Scholars have found that exposure to nature can reduce stress, increase positive affect, and replenish mental energy (Evans, 2003). For example, work done by Tyrvainen et al. (2014) measured participant stress levels in a city center, park, and forest area, and found that the forest environment and urban park had notable stress relief benefits, as indicated by participant cortisol levels and self-reported stress. Evans (2003) adds that other environmental features besides nature may have restorative effects, including architectural elements that inspire curiosity and fascination, aquariums, landscape art, and private places for quiet retreat.

By reducing school crowding, minimizing environmental noise, providing optimal lighting and daylight exposure, eliminating environmental toxins, and providing restorative spaces, students will experience greater psychological comfort due to minimized cognitive load. Enhancing these outcomes, in turn, may enhance students' cognitive functioning and academic achievement. Importantly, the architecture and design of school facilities can assist in accomplishing each of the aforementioned goals: to reduce crowding, one should design classrooms, hallways, and campuses that provide an ample ratio of square footage per student.

Similarly, to meet ideal lighting standards, classrooms can be designed with large windows or skylights and anti-glare precautions. To eliminate environmental toxins, conducting extensive research on selected building materials could reveal any such dangers, warranting an alternative choice in materials. Finally, owing to the significant amounts of social, cognitive, and academic stress inherent in student life, restorative spaces and architectural features could significantly reduce student stress, thus improving cognitive and behavioral functioning and cultivating a positive school climate. With substantial consequences tied to these environmental influences, one must carefully approach the design of school security so as not to interfere with desired outcomes related to psychological comfort.

Balancing Physical Safety and Psychological Comfort

Based on the potential contribution of inadequate school facilities to cognitive load placed on learners, it is probable that overly secured schools may place additional environmental burdens on its students, such that security measures and other visual cues increase fear, anxiety, and agitation. An overemphasis on school security may also result in school environments that devalue psychological comfort, in that these types of schools are less visually pleasant or attractive. Consequently, one design priority for school planners, architects, and administrators should be the minimization of cognitive load (i.e. fear of crime/victimization, distraction, and stress) via cultivation of sense of safety and psychological comfort. It is thus necessary to utilize a school design philosophy that balances the needs of physical safety and psychological comfort.

Crime Prevention through Environmental Design. In light of the research findings on how schools with tight security measures can impact students, and given the insightful call by Reeves et al. (2010) to strike a balance between providing physical safety and psychological safety (or psychological *comfort* for the purposes of the present study) on school campuses, what

is the solution to creating an ideally balanced school facility? One potential solution in this regard lies in the use of CPTED characteristics. Based on the idea that the physical environment influences human choice and behavior, this design philosophy has been conceptualized and used in various settings for many years (Cozens & Love, 2015). However, CPTED has only recently begun to receive attention from school planners. For example, the state of Arizona's School Facilities Board officially adopted and issued a report recommending CPTED safety measures in 2007 (Arizona School Facilities Board, 2007). Schneider (2010) adapts the CPTED framework specifically for schools and cites three of five broad CPTED principles for use in school design: natural surveillance, access control, and territoriality/maintenance.

Schneider (2010) explains that *natural surveillance* includes the use of open layouts and maximizing sight lines in order to provide easy, constant observation of important spaces. The rationale for natural surveillance is that individuals will be less likely to commit crimes or engage in antisocial behavior if they sense they are being observed (Schneider, 2010). Examples of natural surveillance in school facilities might include the liberal use of windows to maximize the number of campus areas that can be watched (i.e. hallways, courtyards, adjacent streets, sidewalks, etc.), use of see-through fencing to limit hidden areas on the school campus, using plants and landscaping that are low to the ground and do not obstruct views, and blocking access to "blind" areas of the campus that lack supervision or surveillance (Philpott & Kuenstle, 2007; Schneider, 2010).

The concept of *access control* refers to selecting who is allowed in and out of the school. Primarily, this means limiting the number of entry points to the school, and many schools are already implementing this particular principle by keeping doors locked or monitored, and by requiring visitors to enter through front offices (Robers et al., 2015; Schneider, 2010). Other

suggestions for access control include using automatic locks on entry/exit doors so they lock behind someone when he/she leaves the building, modifying operable classroom windows so they cannot be used to gain entry, and giving the receptionist the ability to remotely lock doors in the case of lockdown. One important caveat, however, is that every occupied space should have at least two points of entry in case one is blocked by a threat (Schneider, 2010), suggesting that limiting access can be problematic if taken to an extreme.

The principle of *territoriality* advises the clear delineation of distinct spaces via visual environmental cues (Hellman, 2015). Examples include use of prohibitory signage as well as plants, hedges, and other landscaping elements to create visual barriers between areas with different functions or purposes (Schneider, 2010). Architects assert that by visually demarcating the school's spaces, this communicates a sense of ownership and it also makes intruders stand out (Hellman, 2015). Further, adequate *maintenance* of facilities supports the concept of territoriality, as dirty and deteriorating spaces send a message that no one feels a sense of ownership or concern about the spaces (Schneider, 2010). Such spaces are presumed to invite clandestine acts and misbehavior.

Several studies have tested the effectiveness of CPTED design principles, and a minimal number of studies have been devoted specifically to school settings. Cozens and Love (2015) conducted a sizeable literature review on this topic, and most individual empirical findings suggest that CPTED is an effective method for reducing crime and violence in various settings. Also, Casteel and Peek-Asa (2000) conducted a meta-analysis of correlational studies that found that the implementation of CPTED-based design features corresponded with a significant decrease in robberies among retail and public settings. Regarding school settings, Johnson et al. (2017) studied the influence of CPTED-related factors on school violence, revealing that school

illumination may have an indirect effect on student violence levels, presumably because adequate lighting supports the surveillance of negative behaviors. Further, findings from Johnson et al. (2017) suggest that changes in the physical environment may exert an effect on school violence when those changes alter student perceptions of the environment. Similarly, Bradshaw, Waasdorp, Debnam, and Johnson (2014) indicate that physical comfort and cleanliness are important elements of school climate and propose that broken windows, trash, and graffiti (i.e. aspects of territoriality/maintenance) foment student perceptions of social disorder, thereby minimizing the ability to learn and perform successfully. Clearly, student perceptions are key to understanding the potential influence of CPTED design on school climate and learning outcomes. To this end, Vagi, Stevens, Basile, and Simon (2013) are currently studying the relationship between student perceptions of safety and CPTED by evaluating facilities on their level of adherence to CPTED and gathering student ratings of school climate. However, results have not been published, and the alternative methodology used in the present study will provide a useful means of comparison.

Despite the limited replication of research findings and scarcity of school-based studies, there are several advantages of CPTED principles that make them ideal for addressing both physical safety and psychological comfort in school design. One advantage is that they are mostly discreet, covert features of the environment (as opposed to overt measures associated with fortified schools such as metal detectors and surveillance cameras). As a result, if CPTED principles were employed, the likelihood of student fear, stress, and cognitive load increasing because of cues in the physical environment would be marginal. For instance, maximizing natural surveillance would allow teachers and staff to monitor more spaces, thus promoting sense

of safety by supporting student preference for adult presence and supervision (Langhout & Annear, 2010).

Also, a substantial body of literature has been devoted to the practical application of CPTED to school planning and design, which is another advantage. The collective knowledge and guidance of various school CPTED resources, such as Philpott and Kuenstle's (2007) *Educational Facility Security Handbook,* constitutes a pre-established set of recommended practices that would minimize ambiguity regarding methods of implementation.

A third advantage of using CPTED for balancing safety and comfort is its potential cost effectiveness. CPTED principles do not require expensive security equipment purchases such as metal detectors and surveillance camera systems. Apart from providing extensive windows for natural surveillance and adequate outdoor lighting, the costs of building new schools with CPTED would likely be very similar to current construction expenditures (Philpott & Kuenstle, 2007). Although CPTED principles have already received acknowledgement and adoption by state school facilities boards, as is the case in Arizona, the relationship between CPTED utilization and student attitudes, preferences, and outcomes is not known.

Research on the Impact of Quality School Facilities

If research identifies improvements in student safety and psychological wellbeing associated with the use of CPTED designs, the reasons for adopting these design elements would be undeniable. Thus, considering the importance of design elements on students' achievement more generally, the next step in research on physical school environments ought to consider CPTED designs. Currently, awareness is growing that design elements matter, but the ways that these elements matter await further elucidation.

For the present, broad findings suggest that well-designed school facilities have a substantial impact on student learning and academic achievement. For example, research indicates that ratings of movement/circulation spaces are significantly correlated with standardized achievement scores on reading comprehension, language arts, math, and science; in addition, use of natural daylight is significantly correlated with scores on reading vocabulary and science, and quality of window views is significantly correlated with scores on reading vocabulary, language arts, and math (Tanner, 2009). Similarly, other research suggests that seven specific classroom design features can account for up to 16% of the variance in student academic progress (Barrett, Davies, Zhang, & Barrett, 2015). These features include natural light, room temperature, air quality, ownership (e.g. classroom comfort and personalization), flexibility of space, complexity (e.g. visual diversity), and use of color (Barrett et al., 2015). However, these findings do not explain *how* school design and achievement are intertwined.

Uline and Tschannen-Moran (2008) propose one potential mechanism for how school design influences student achievement. Their findings indicate that school climate plays a significant mediating role in the relationship between school facility quality and student achievement, suggesting that facility quality may enhance academic achievement by way of a positive influence on school climate. The results of this study are exciting, and consistent with other literature highlighting the importance of school climate over physical security measures (see Reeves et al. [2010] and Phaneuf [2009]). Thus, it is possible that a focus on architecture and design to promote a comfortable, welcoming, positive climate would result in safer, higher-achieving schools than would a focus on security features.

As research continues to support the findings of these important studies, important implications arise. First, school planners and architects should ensure that security measures are

not over-prioritized to the extent that they impinge on the broad design principles that correlate with student achievement scores, as revealed by Tanner (2009). Second, findings from a study by Barrett et al. (2015) emphasize the benefits of designing quality schools that prioritize comfort, aesthetics, and functionality to support successful learning. Third, higher quality school facilities are associated with more positive school climate, as noted by Uline and Tschannen-Moran (2008). By extension, using CPTED to improve facility design might support students' feelings of safety and comfort, which are tied to school climate.

Conclusions

As noted in the present review, school safety is a high priority for parents, educators, the public, and researchers, but psychological comfort at school also merits further research. Several studies have investigated how school security measures impact students and preliminary evidence suggests that security features in the school environment may increase student fear and worry. Also, it is unclear whether school security measures are effective in reducing school crime and violence (NASP, 2013; Phaneuf, 2009). What is certain is that the use of overt, physical deterrents such as surveillance cameras, metal detectors, and school resource officers has increased in the past 15 years. Due to the increasing prioritization of security in school environments, there is a risk of neglecting other priorities such as comfort if school safety is taken to an extreme. Thus, a need exists to reveal how a balance of priorities might be achieved. CPTED design principles are one method of securing the physical environment while avoiding the "fortification" of school campuses and leaving room for comfort and aesthetics. The research proposed here was conducted to compare student preferences for CPTED-designed schools and non-CPTED schools in terms of their psychological comfort and safety.

Chapter 3: Methods

Participants

The population of interest in this study was public school students in grades seven through twelve, from varying demographic and socioeconomic backgrounds. The rationale for selecting students in higher grade levels was based on requisite metacognitive skills and self-awareness sufficient to determine where one might feel safer or more comfortable based solely on images. In addition, many older students would likely have attended and visited more school campuses than younger students, thereby providing a more diverse foundation of experiences and thoughts on which to base their survey responses. According to a priori calculations using G*Power software, the sample size needed to include a minimum of 325 participants in order to obtain a small effect (e.g. $ES \geq 0.3$) with acceptable statistical power (e.g. 95%, $p < .05$). Thus the target sample size was a minimum of 350 students in order to increase the likelihood of finding a significant effect and to compensate for missing data and invalid survey responses. For a period of approximately one-year from January 2016 to February 2017, southern Arizona school districts were recruited for research participation. Four districts from the greater Phoenix and Tucson areas gave approval for the research to be conducted and seven different middle and high schools participated.

After obtaining consent to conduct research through the processes dictated by the local school districts, school principals were emailed to request their assistance in recruiting students to participate in the survey. With the cooperation of administrators and other school liaisons (i.e. teachers, staff), dates and times were identified for specific classes to participate. Copies of the parent consent form and a letter describing the research study were then delivered to the participating schools so students could obtain parent permission in advance of their survey

participation. Spanish versions of the parent consent documents were also provided to schools as needed. Since the researcher recruited whole classes, those students who were not able to obtain signed parent consent were instructed by their teachers to work quietly on school assignments on the day of their classmates' survey participation.

Nine hundred and thirty-two students of varying ages participated in the electronic survey (see Table 1), and all were enrolled in grades 7 through 12. A total of 900 responses remained after data cleaning. Approximately 44% were male, 54% were female, 0.7% selected "Other," and 1.2% did not indicate their sex. Most racial and ethnic groups were included in the survey but the sample was not representative of the general U.S. population (see Table 2). The Caucasian and Hispanic/Latino groups were the two largest groups surveyed and constituted 79% of the sample, while approximately 11% were of mixed race and other groups had minimal representation (see Table 2). Socio-economic status was defined by whether the student received free or reduced price lunch; 33.2% indicated that they received free or reduced lunch, 54.3% indicated they did not, and 12.4% selected "Unsure."

Table 1.

Ages of Survey Participants

Age	Frequency (*n*)	Percent
11 yrs	1	.1%
12 yrs	54	6.0%
13 yrs	135	15.0%
14 yrs	205	22.8%
15 yrs	173	19.2%
16 yrs	166	18.4%
17 yrs	122	13.6%
18 yrs	36	4.0%
19+	3	0.3%
Unknown	5	0.6%

Table 2.

Race/Ethnicity of Survey Participants

Race/Ethnicity	Frequency (*n*)	Percent
Caucasian	394	43.8%
Hispanic/Latino	316	35.1%
African American	36	4.0%
Native American	23	2.6%
Asian	20	2.2%
Native Hawaiian/ Pacific Islander	13	1.4%
Mixed/Other	96	10.7%
Unknown	2	0.2%

Regarding school level characteristics, seven total schools participated, three of which were middle schools (grades 6-8) and four of which were high schools (grades 9-12). All three middle schools were Title I schools for the 2014-2015 reporting year, and schools were located in a variety of rural, urban, and suburban communities.

Table 3.

School Level Characteristics of Participating Schools

	*Community Type	*School size (Total # students)	*Percent Minority	*Percent Free/Reduced Lunch	^Grades (mode)	^Survey Participants (*n*)
Middle School 1	Urban	433	87%	88%	Mostly A's	11
Middle School 2	Urban	901	87%	84%	A's and B's	78
Middle School 3	Suburban	651	61%	Unavailable	A's and B's	199
High School 1	Rural	2,066	38%	46%	A's and B's	123
High School 2	Suburban	1,929	43%	38%	A's and B's	293
High School 3	Rural	620	34%	23%	A's and B's	99
High School 4	Rural	1,028	57%	21%	A's and B's	91

*Statistics taken from NCES Common Core of Data, 2014-2015 reporting year
^Statistics taken from the present study's survey data

Procedures

Data collection. The researcher arrived at each school on the pre-determined dates of participation and utilized school computer labs or school laptops to facilitate mass simultaneous participation. The survey was administered electronically with Qualtrics online software and participating students were given the survey URL to enter into their web browser.

For the school design portion of the survey, twelve pairs of images were presented twice: the first presentation asked students in which space they would feel more physically safe, and the second presentation asked where they would feel more "psychologically comfortable"; both

terms were defined in the survey's instructions (see Appendix A for definition of terms). Thus there were 24 total items on the Preferable School Design Measure. Using the same pairs of stimuli for each subdomain (i.e. safety and comfort) allowed for a more direct comparison and stronger conclusion when comparing preferences for safety versus comfort. The PSDM subdomains were presented in random order, and non-PSDM items were inserted between the subdomains in order to separate the second iteration of each stimuli pair from its first presentation; this was intended to reduce the chance that a student's selections on the *safety* items influenced his/her decisions on the *comfort* items, or vice versa. Completion time for the entire survey ranged from approximately 15 to 30 minutes.

Measures

The survey used for data collection consisted of the following components: (1) eight demographic and background questions, (2) four subscales of the School Climate Measure (SCM; Zullig, Koopman, Patton, & Ubbes, 2010), (3) the Children's Report of Exposure to Violence (CREV; Cooley, Turner, & Beidel, 1995), (4) the violence-related behaviors subscale of the Youth Risk Behavior Survey (YRBS; Everett, Kann, & McReynolds, 1997), and (5) a novel tool entitled the Preferable School Design Measure (PSDM; Lamoreaux, unpublished). All five components were included in one aggregate survey administered to respondents. When completing the survey, students first agreed or disagreed with terms of an informed assent page, and upon agreement they were taken to the demographics section of the questionnaire. Demographic and background questions asked for age, sex, ethnicity, grade level, name of school, typical grades, and use of free and reduced price lunch. Each piece of information was later used to explore its potential relationship with safety and comfort preferences.

School Climate Measure (Zullig, Koopman, Patton, & Ubbes, 2010)**.** Recently revised, the SCM is a self-report questionnaire for children and youth that addresses 10 school climate factors, four of which were used in the present study: Positive Student-Teacher Relationships, Order and Discipline, School Physical Environment, and Academic Support. Because it was found that these four subscales accounted for 36% out of 45.7% of the variance in the original study (Zullig et al., 2010), the other subscales were excluded from the present study's survey in order to reduce survey fatigue. The SCM was initially developed and validated by Zullig, Koopman, Patton, and Ubbes (2010) and has continued to demonstrate good reliability and validity, having received strong results from confirmatory factor analysis (Zullig et al., 2014). Further, the SCM was chosen over similar measures because it distills school climate items from five widely-used measures into one strong tool; it has demonstrated a Goodness of Fit index of .94 and coefficient alphas between .82 and .93 (Zullig et al., 2014). Analyses from the present investigation produced a Cronbach's alpha of .94 for the SCM items, which is consistent with alphas from prior studies (Zullig et al., 2014). For each of the 26 SCM questions, children were asked to rate their agreement on a 5-point scale from Strongly Disagree to Strongly Agree. Measuring school climate allowed the researcher to observe if there was a relationship between preference for CPTED or non-CPTED schools and the positivity of school climate perceptions.

Children's Report of Exposure to Violence (Cooley et al. 1995). The CREV has been cited and used by dozens of original investigations dealing with child and adolescent psychology, psychiatry, and health over the past 20 years. It is a self-report questionnaire that measures exposure to community violence with 58 total questions, all of which are 5-point Likert items rated from 0 (never) to 4 (every day) (Cooley et al., 1995). The measure addresses 4 types of violence exposure including direct victimization, firsthand witnessing, hearsay, and exposure via

visual media (e.g television). The original validation study revealed good test-retest reliability (r = .75) and internal consistency (α = .78) (Cooley et al., 1995). The present study's CREV data produced an alpha of .96, which is stronger than the original study's alpha. The CREV was used in order to explore relationships between adolescent exposure to violence, school climate, and preference for certain types of school facilities.

Youth Risk Behavior Survey (YRBS; Everett et al., 1997). The YRBS is a survey of adolescent health risk and health protective behaviors such as smoking, drinking, drug use, diet, and physical activity. Originally developed by the Centers for Disease Control and Prevention, it is one of the major sources of information about these risk behaviors and it is used by state and federal agencies to track drug use, sexual behavior, and other risk behaviors. The YRBS was chosen for its psychometric strength, as most items have yielded high reliability with Cohen's kappas greater than 61%. The present study did not use the full YRBS; only items from the *Violence-Related Behaviors* section of the YRBS were utilized in order to measure delinquency. The six YRBS items used in this investigation produced an overall alpha of .67, which is a comparable statistic to that of past Cohen's kappas above 61% (Everett et al., 1997). This data was useful in analyzing the response patterns of students on the PSDM items as a function of their involvement in delinquent activity.

Preferable School Design Measure (PSDM; Lamoreaux, 2017). To assess student preference for the safety and comfort of school facilities, the PSDM tool was constructed using photographic stimuli of scenes within school built environments. Consisting of 12 total pairs of images (24 individual photographs), there were four pairs for each of the three CPTED principles: access control, natural surveillance, and territoriality/maintenance. For each pair, respondents were asked to select the setting in which they would feel safer and more

psychologically comfortable, respectively. Physical safety and psychological comfort were defined in the survey's instructions (see Appendix A for definition of terms). Each pair included one image that depicted a school scene representing a CPTED design principle and one image depicting a scene of similar content, but without the presence of CPTED design. For example, to represent the CPTED principle of access control, one pair of photos included a picture of the outside perimeter of a school campus with a fence, while the other image depicted a perimeter lacking a fence. Thus, each photo within a pair contained uniquely characterized content in order to provide the participants with two distinct but related options from which to select. Additionally, an open-ended response item followed each subdomain block to give respondents an opportunity to articulate what specific features of the images they liked or disliked for psychological comfort and safety. This feedback helped explain *why* students preferred certain images and assisted in the interpretation of results following data analysis.

PSDM development. Development of the PSDM involved finding a sufficient number of adequate photographic stimuli, reducing the pool of stimuli, and establishing preliminary reliability of the measure through a piloting process. The author used three methods to obtain initial images: (1) extensive web searches using the Google search engine, (2) requesting images from contacts in the architectural community, and (3) taking photographs of local school campuses. An initial batch of 72 photos was obtained, with 20 – 25 images representing each of the three CPTED principles. To minimize confounding aspects of each photograph's individual differences, selection of the initial batch of photographs was based on the following criteria:

1. Depiction of one of fifteen categories of scenes determined by the researcher to be ideal for demonstrating the application of CPTED principles. Examples of such scenes included hallways, classrooms, outdoor courtyards, front entrances, etc.

2. Exclusion of human subjects in the photographs to minimize non-architectural confounds in the images and limit bias that might result from extraneous stimuli.
3. Sufficient visual angle to provide a sense of context to the image (i.e. not just a photo of surveillance camera, fence, or sign, but its immediate surrounding context as well).
4. Technical quality of the photo, as determined by:
    a. Moderate to low visual complexity (avoidance of "busy" scenes, clutter, etc.), as cluttered and overly-busy images may be perceived as unpleasant when compared to cleaner, simpler scenes.
    b. Adequate lighting levels in the photograph (not too dim, not too bright).
    c. Minimal "pixilation," with all images falling within a range of 500 pixels wide to 4000 pixels wide.
5. Perceived representativeness of CPTED principles or lack thereof.

All images were originally color photographs and were converted to black and white and edited to produce comparable levels of contrast in each image; this was done because color preference might sway subjective preferences for an environment and would detract from this study's purpose of gathering perceptions of security design features (i.e. natural surveillance, access control, territoriality).

After collecting 72 initial images, 28 graduate students and faculty participated in a pre-pilot sorting task to reduce the total image pool from 72 to 24 photographs, or twelve pairs. First, each participant was provided with a stack of 20 - 25 printed images and a response sheet. The response sheet defined one of the three CPTED principles. The response sheet also provided instructions for the task and spaces for responses to be recorded. Each sheet listed five scenes (perimeter fencing, hallways, classrooms, etc.). Next, respondents were asked to create five piles

of photos, with one for each of the five scenes; each pile was to consist of pictures that represented the CPTED principle that was defined on their response sheet as well as pictures that represented a lack of the design principle. Finally, participants were instructed to select one photograph to represent the most effective use of the CPTED principle from each of the five piles, as well as one that was least representative of the design principle.

After materials and response sheets were returned to the researcher, responses were entered in Microsoft Excel to determine which photos were most frequently selected. Photos that were selected most often were used as the stimuli on the final survey. However, one pair of photos selected by participants for the access control item set did not demonstrate sufficient differences in terms of their visible adherence to CPTED so these pictures were not included on the final survey. Subsequently, to maintain an equal number of survey items (4 items) for each of the three CPTED principles, the author also excluded one pair of photos from both the natural surveillance and territoriality/maintenance item sets. Thus, the final number of stimuli pairs was reduced from 15 to 12, making a total of 24 survey items on the PSDM tool.

The PSDM survey was also piloted with the help of a convenience sample of participants drawn from a list of the author's personal contacts. The pilot survey data were used to establish preliminary agreement rates, thus providing a forecast of what the final student response data might look like. Based on the pilot results, no adjustments to the PSDM stimuli, instructions, or overall structure were necessary for improving validity and reliability.

PSDM Internal Consistency. The CPTED items used for the PSDM demonstrated varying degrees of internal consistency (alphas between .12 – .71). When all 24 items were grouped together, they produced a Cronbach's alpha of .71. When separated by subdomain, the 12 psychological comfort items had an alpha of .52 and the 12 physical safety items yielded an

alpha of .48. Further, because three different CPTED design principles (i.e. natural surveillance, access control, and territoriality/maintenance) were addressed by 4 items each, alpha reliabilities were also calculated at the CPTED principle level (see Table 3). The natural surveillance items demonstrated moderate internal consistency as did the access control items, while the territoriality/maintenance items had low alphas.

Table 4.

Internal Consistency of PSDM Items at the CPTED Principle Level

PSDM Subdomain	CPTED principle	Cronbach's Alpha
Psychological Comfort	Natural Surveillance	.53
	Access Control	.62
	Territoriality/Maintenance	.13
Physical Safety	Natural Surveillance	.60
	Access Control	.67
	Territoriality/Maintenance	.12

Rationale for PSDM. Creation of the PSDM was viewed as being most appropriate for this investigation when compared to existing methods of preference research. For example, one major alternative that was explored was choice-based conjoint analysis, which is commonly used in marketing research to uncover the influence of specific attribute components on overall preferences for certain product designs (Cunningham et al., 2009). This method has been successfully used in education research (see Cunningham et al., 2009) but would not have been appropriate for the present study. The conjoint analysis method would have required the presentation of overtly leading design characteristics from which to choose. For example,

students would have been asked: “Do you prefer the picture with the fence around campus, or the picture without the fence around campus?” This would have forced subjects to choose between discrete, explicit options and would have tapped an analytic process that required students to formulate explicit opinions about topics they may not have previously considered (i.e. school design).

This study’s purpose, however, was to uncover implicit attitudes, not explicit ones. Psychological research has consistently shown that implicit attitudes are more accurate predictors of later explicit preferences when individuals are undecided or uninformed on an issue (Greenberg, 2015). In this case, it was very unlikely that students had pre-formed opinions about the benefits of using CPTED or not using CPTED in school design (the undecided issue). Thus, it would have been inappropriate to use conjoint analysis and explicitly ask students about which aspects of natural surveillance, access control, and territoriality/maintenance made them feel safer or more comfortable.

Further, sense of safety and comfort are emotion-based constructs, therefore the goal of the PSDM was to explore the diffuse emotional perceptions that students experienced when viewing the photographic stimuli. By presenting innocuous images without pointing to the specific design features of interest (CPTED principles), participants made gut-level judgments based on their implicit attitudes. In short, their non-verbalized (implicit) preference for the presence or absence of CPTED in the images more accurately reflected where they would feel safer or more pleasant.

Data Analysis

Once all survey responses were collected, data were exported from Qualtrics software as an SPSS (version 24) data file so they could be reviewed for accuracy and cleaned. Upon

reviewing participant responses, two outlier cases were identified in which the respondents selected the most extreme response options for all Likert items in the survey (i.e. “Very Poor,” “Always,” etc.). These two outlier cases were deleted from the data set given the obvious pattern of response bias. In addition, 30 cases had responses to 25% or less of the survey items and only the beginning portions of the survey were completed. This suggested that data were not missing at random for these cases and these 30 cases were eliminated from the data set as they were viewed as voluntary discontinuation. The researcher used this modified version of listwise deletion because the exclusion of 30 cases out of 930 was unlikely to unduly influence parameter estimates.

Next, PSDM item responses were converted to composite scores. To do this, a value of 1 was assigned to each selection of a CPTED design image and a value of 0 was assigned for the non-CPTED selections, after which these values were summed separately for the safety items and psychological comfort items. CPTED composite scores ranged from 0 to a maximum of 12, as there are 12 items in each subdomain of the PSDM. Thus, a CPTED Preference for Physical Safety composite score and a CPTED Preference for Psychological Comfort composite score were calculated to describe the degree to which each student preferred the CPTED images. CPTED composite scores were treated as continuous dependent variables when analyzed.

Composite scores for the other survey instruments were calculated by summing each item response in the block. For instance, responses to all 58 Likert items in the CREV were summed to create an overall CREV score. Composite scores were also calculated for the YRBS questions, which addressed students’ previous engagement in violent or delinquent behaviors, and for the SCM, which assessed students’ views of their schools’ social environments. The CREV scores and YRBS scores were treated as independent variables, as they were expected to influence

CPTED preference scores, while SCM scores were treated as a dependent variable in exploratory analyses.

First, demographic data were used to investigate whether there were significant differences in school design composite scores based on age, gender, race/ethnicity, socio-economic status, and self-reported academic achievement. Regression analyses were run after dummy coding the nominal demographic variables, and each was assessed individually to reveal whether there were any individual differences based on demographic characteristics. Academic achievement was measured by a single item that asked the following question: "What kind of grades do you get?" Response options included Mostly A's, Some A's and Some B's, Mostly B's, Mostly C's, Mostly D's, and Mostly F's. This item was treated as ordinal level data and Spearman's rho was used to determine if a correlation existed between CPTED preference scores and self-reported academic achievement.

To test the primary hypotheses (i.e., Students will prefer CPTED designs over non-CPTED school designs for the perceived physical safety/psychological comfort they afford.), the researcher determined whether students more often preferred the CPTED images or non-CPTED images for perceived psychological comfort and safety, respectively. A one-sample *t*-test was used to compare means of CPTED Safety composite scores and Psychological Comfort composite scores to a cutoff parameter. The cutoff parameter was 6.0, a composite score that indicates 50% of the chosen images were CPTED and 50% were not CPTED. The one-sample *t*-tests addressed the researcher's first two hypotheses. The third hypothesis, that students will prefer CPTED schools for both safety and psychological comfort to a similar degree, was tested with a Pearson's *r.* This revealed whether safety and comfort composite scores varied together.

This study also hypothesized that there were differences in student preference for CPTED schools based on previous exposure to violence. Students with CREV scores greater than one standard deviation above the mean were labeled as the "elevated exposure to violence" group and all others were labeled as "non-elevated exposure to violence." An independent samples *t*-test indicated whether CPTED scores for the elevated exposure group were significantly lower than the non-elevated exposure group. Next, the researcher used the same approach to divide cases into "elevated delinquent behavior" and "non-elevated delinquent behavior" groups, after which a *t*-test addressed whether these two groups had significantly different CPTED preferences.

Finally, this study's exploratory question concerned whether CPTED preference influenced perceptions of school climate while controlling for exposure to violence and prior delinquent behavior; this required the use of multiple regression. CPTED composite scores derived from the PSDM, as well as CREV and YRBS scores, comprised the independent variables, and SCM scores (a continuous variable) were used as the dependent variable. Following each of the statistical procedures outlined above, interpretation of the statistical results provided final conclusions in answering this study's exploratory questions.

Chapter 4: Results

Data Cleaning

First, data were checked for completeness in SPSS to identify patterns of missingness. Because the data appeared to be missing at random, the researcher used multiple imputation to replace missing data and five different imputation models were calculated following procedures described by Li, Stuart, and Allison (2015). Once multiple imputation was complete, composite variables were computed for the Preferable School Design Measure (PSDM), Children's Report of Exposure to Violence (CREV), the Youth Risk Behavior Survey items (YRBS), and the School Climate Measure (SCM). Descriptive statistics for these variables are found in the table below.

Table 5.

Descriptive Statistics for All Main Variables

	Mean	Standard Deviation	Range (Min. – Max.)
CPTED Psych. Comfort	7.47	2.10	0 - 12
CPTED Physical Safety	7.76	2.10	0 - 12
CREV Composite	108.72	26.80	58 - 257
YRBS Composite	7.28	2.75	5 - 32
SCM Composite	61.49	15.31	26 - 130

After calculating and obtaining all composite scores to conduct primary analyses, assumptions of normality of variable distributions were explored. Frequency distributions of all independent and dependent variables revealed that most variables appeared to be nearly normally distributed with minor skew and kurtosis deviations. However, one exception was the YRBS composite score, which was highly non-normal (see Figure 1), yet distributional transformations

were determined to be unnecessary because subsequent multivariate analyses with the YRBS produced nearly normal residual distributions (see Figure 2 [Field, 2009]).

Figure 1.
Non-Normal Distribution of YRBS Composite Scores

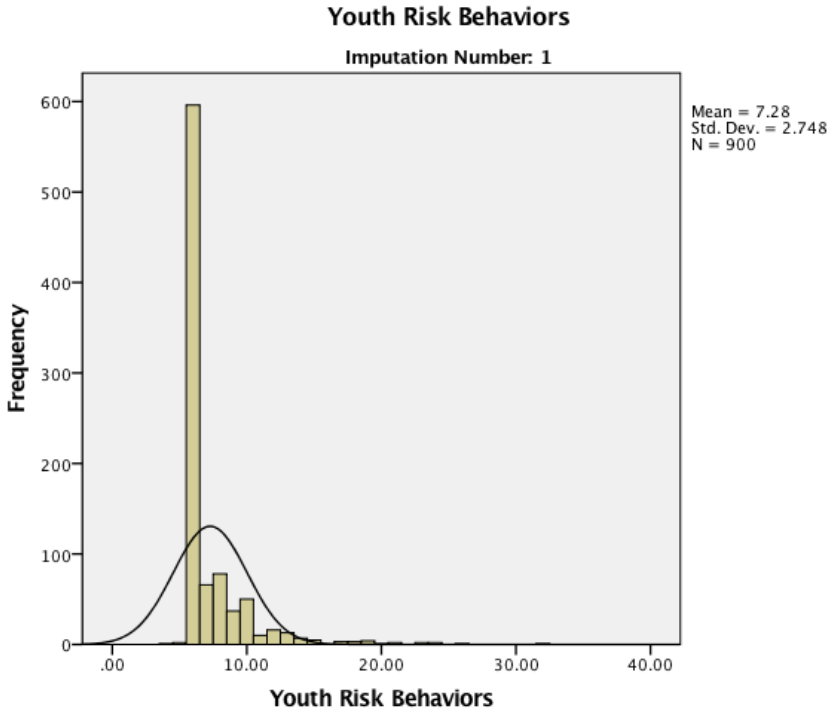
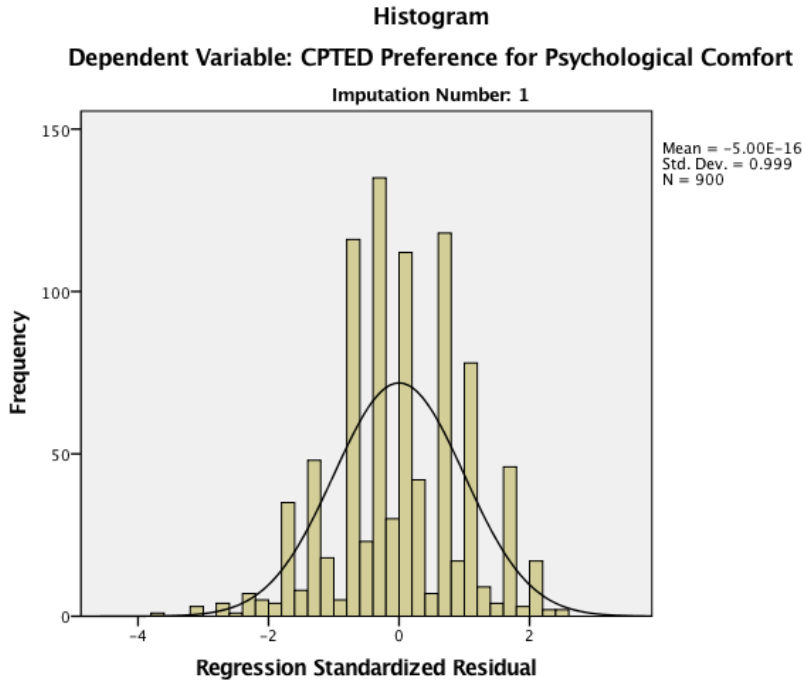


Figure 2.
Standardized Residuals are Near-Normal when YRBS Composite is Regressed with CPTED Preference for Psychological Comfort



A Kolmogorov-Smirnov (*KS*) test and Levene's test of homogeneity of variance were conducted to further assess the normality of variable distributions as well as homogeneity of variance in data. *KS* statistics for all dependent and independent variables, including the CPTED composite variables, were significant at the $p < .01$ level (see Table 6). Levene's test of homogeneity of variance also yielded statistically significant results at the $p < .01$ level for the YRBS, CREV, and SCM data, but not for the CPTED composite scores (see Table 7). The significance levels of the *KS* and Levene's tests suggest non-normal and heteroscedastic data; however, frequency distributions of the CPTED variables, the CREV, and the SCM appeared nearly normal. In light of this (as well as the fact that this study employed a large sample [$N = 900$]), typical hypothesis testing procedures employed in this study were expected to be relatively robust to deviations in distributional properties that unduly influence studies with smaller sample sizes and less parametric distributional comparisons (Field, 2009).

Table 6.

Test of Normality for Dependent and Independent Variables

Variable	KS Statistic	df	*p* value
CPTED Preference for Psych Comf	.096	634	< .001
CPTED Preference for Physical Safety	.111	634	< .001
YRBS Composite	.335	634	< .001
CREV Composite	.094	634	< .001
SCM Composite	.075	634	< .001

Table 7.

Homogeneity of Variance for Dependent and Independent Variables

Variable	Levene Statistic	*df1*	*df2*	*p* value
CPTED Preference for Psych Comf	1.286	7	626	.254
CPTED Preference for Physical Safety	1.373	7	626	.214
YRBS Composite	14.049	7	626	.000
CREV Composite	8.380	7	626	.000
SCM Composite	2.538	7	626	.014

Preliminary Analyses

To test for the potential effects of individual differences among respondents, demographic variables of ethnicity, sex (male, female, other), age, and socio-economic status were dummy coded and regression analyses were conducted. Race/ethnicity did not account for a significant portion of the variance in CPTED preference scores for either Psychological Comfort, $R^2 = .01$, $F(6, 792) = 1.38$, $p = .22$, or for Physical Safety, $R^2 = .008$, $F(6, 784) = 1.07$, $p = .38$. Furthermore, no individual race group was significantly different in their CPTED preference scores when compared to the Caucasian reference group.

However, regarding differences based on sex, female students displayed higher scores on the CPTED Preference for Psychological Comfort composite, $b_{pooled} = .30$, $t_{pooled}(897) = 2.05$, $p = .04$ and on the Physical Safety composite, $b_{pooled} = .36$, $t_{pooled}(897) = 2.39$, $p = .02$. However, being female as compared to male explained only 0.6% of the variance in CPTED Preference for Psychological Comfort scores, and only 0.9% of the variance in CPTED Preference for Physical Safety scores; this suggests that the difference between male and female CPTED preferences was

not meaningful. Since only 0.7% of the sample selected "other" sex, there was not a sufficient number of cases to compare with male and female responses.

Student age, which the researcher treated as a continuous variable, did not predict CPTED Preference for Psychological Comfort scores, b_{pooled} = -.07, t_{pooled} (898) = -1.60, p = .11, or explain a significant amount of variance in these scores, R^2 = .003, F(1, 898) = 2.63, p = .11 Additionally, age did not predict CPTED Preference for Physical Safety scores, b_{pooled} = -.04, t_{pooled} (898) = -0.86, p = .39, or account for a significant amount of variance in these scores, R^2 = .001, F(1, 898) = 1.59, p = .21. Regarding socio-economic status, students who received free or reduced price lunch did not have significantly different CPTED Preference for Psychological Comfort scores, b_{pooled} = -.06, t_{pooled} (897) = -0.35, p = .72, and free/reduced lunch status did not explain a significant amount of variance in Psychological Comfort scores, R^2 = .001, F(2, 897) = 0.59, p = .56. In addition, receiving free or reduced price lunch did not predict Physical Safety scores, b_{pooled} = -.12, t_{pooled} (897) = -0.74, p = .46, or explain a significant amount of variance in these scores, R^2 = .003, F(2, 897) = 1.14, p = .32.

A Spearman's rho analysis revealed that self-reported academic achievement (e.g. "What kind of grades do you get?") did not significantly correlate with CPTED Preference for Psychological Comfort scores, r_s(898) = .03, p = .46, nor was it correlated with CPTED Preference for Physical Safety scores, r_s(898) = .02, p = .51.

Given the typical differences between the social and physical environments of middle and high schools, in addition to the added life experience and maturity level of older students, it is possible that middle school students and high school students might have differential preference levels for CPTED design. Thus the researcher used independent samples *t*-tests to reveal whether high school students varied significantly from middle school students in their CPTED

preferences. For perceived psychological comfort, high school students did not differ significantly from middle school students in their preference for CPTED design, $t(791) = -.99$, $p = .32$, two-tailed; this suggests that both groups preferred CPTED over non-CPTED images to a similar degree. Likewise, high school students did not differ significantly from middle school students for the perceived physical safety afforded by CPTED, $t(784) = .07$, $p = .94$, two-tailed.

Primary Analyses

To test main hypotheses (i.e., students will prefer CPTED-based school designs for both psychological comfort and physical safety), a one-sample *t*-test determined whether the average CPTED preference score was significantly higher than a median score of 6.0, a value that represents neutral preferences. For the Psychological Comfort composite, the mean difference between observed CPTED preference scores ($M_{pooled} = 7.47$, $SD_{pooled} = 2.10$) and the cutoff parameter was 1.47. Essentially, CPTED-based images were preferred significantly more often than were the non-CPTED images and the magnitude of this difference was moderately large ($d = .70$), $t(900) = 20.94$, $p < .001$, two-tailed. For the Physical Safety composite, the cutoff of 6.0 was again used, and the mean difference between observed CPTED preference scores ($M_{pooled} = 7.76$, $SD_{pooled} = 2.10$) and the cutoff value was 1.76. This difference was significant and produced a large effect size ($d = .84$), with CPTED-based images being preferred over the non-CPTED images, $t_{pooled}(900) = 25.08$, $p < .001$, two-tailed. This study's third hypothesis was also supported (i.e. A positive relationship will exist between students' preference for physical safety and psychological comfort); CPTED Preference for Psychological Comfort scores and CPTED Preference for Physical Safety scores were strongly correlated, $r_{pooled}(898) = .66$, $p < .001$, one-tailed.

The impact of students' previous exposure to violence and past delinquent behavior on their CPTED preferences was also investigated. An independent samples *t*-test compared the mean CPTED Psychological Comfort scores of the non-elevated previous exposure to violence group (M_{pooled} = 7.50, SD_{pooled} = 2.06) and elevated violence exposure group (M_{pooled} = 7.27, SD_{pooled} = 2.33). The elevated violence exposure group had Psychological Comfort scores that were an average of 0.22 points less than the non-elevated exposure group, but this was not statistically significant (see Table 8). For CPTED Physical Safety preferences, the elevated exposure group (M_{pooled} = 7.44, SD_{pooled} = 2.47) had scores that were an average of 0.36 points less than the non-elevated exposure group (M_{pooled} = 7.80, SD_{pooled} = 2.03), which was not statistically significant (see Table 8).

Regarding previous delinquent behavior, the elevated delinquent behavior students (M_{pooled} = 6.96, SD_{pooled} = 2.34) obtained Psychological Comfort scores that were an average of 0.55 points lower than the non-elevated students (M_{pooled} = 7.51, SD_{pooled} = 2.08), and this difference was significant (Table 8). For CPTED Preference for Physical Safety, students with elevated delinquent behaviors (M_{pooled} = 7.21, SD_{pooled} = 2.40) had significantly less preference for CPTED images than did the non-elevated delinquent behaviors group (M_{pooled} = 7.80, SD_{pooled} = 2.07). The mean difference was 0.59.

Table 8.

Comparison of CPTED Preferences by Level of Violence Exposure and Delinquent Behavior

	CPTED Preference for…	*t*	*df*	*p* value	95% CI, mean difference	Cohen's *d*
Elevated Prior Exposure to Violence vs. Non-Elevated	Psychological Comfort	1.08	5063	.28	-0.18 – 0.63	.11
	Physical Safety	*1.43	192.37	.16	-0.14 – 0.86	.16
Elevated Prior Delinquent Behavior vs. Non-Elevated	Psychological Comfort	2.02	456	.04	0.02 – 1.09	.25
	Physical Safety	*1.96	2392.86	.05	-0.001 – 1.18	.26

Note. CI = Confidence Interval
**Equal variances not assumed*

Exploratory Analyses

This study also investigated whether CPTED preferences predicted school climate perspectives while controlling for previous exposure to violence and delinquent behaviors (SCM scores). Multiple regression analyses revealed that when controlling for previous exposure to violence (i.e. CREV scores), CPTED Preference for Psychological Comfort scores significantly predicted SCM scores ($M = 61.49$, $SD = 15.31$) and accounted for 9% of the variance in scores. An increase of one point on Psychological Comfort scores was associated with a half-point decrease in SCM scores (see Table 9), which is a small yet significant effect. Likewise, when CREV scores were held constant, CPTED Preference for Physical Safety scores significantly predicted SCM scores and accounted for 9% of the variance, though a one-point increase in Physical Safety scores was associated with only a half-point decrease in SCM score. When controlling for past engagement in delinquent behaviors (YRBS scores), CPTED Preference for

Psychological Comfort scores also significantly predicted SCM scores and accounted for nearly 6% of the variance in scores; a one-point increase in Psychological Comfort scores was associated with a half-point decrease in SCM scores. Finally, when YRBS scores were held constant, CPTED Preference for Physical Safety scores significantly predicted 6% of the variance in SCM scores at the $p < .05$ level.

Table 9.

Degree to which CPTED Preference Scores Predict School Climate Scores

Variable held constant	CPTED Preference for…	*B*	*t*	*df*	*p* value	R^2
CREV Score	Psychological Comfort	-.57	-2.37	897	.02	.090
	Physical Safety	-.62	-2.48	897	.01	.091
YRBS Score	Psychological Comfort	-.58	-2.36	897	.02	.057
	Physical Safety	-.60	-2.33	897	.02	.057

To further clarify the aforementioned relationship between SCM composite scores and CPTED preference scores, the SCM items were split into their four individual subscales originally formulated by Zullig et al. (2014). The subscales were (1) Positive Student-Teacher Relationships, (2) Academic Support, (3) Order and Discipline, and (4) School Physical Environment. Each subscale composite was then added to a correlational model to determine if particular subscales were more strongly related to the CPTED preference scores and therefore more likely to be the cause of the observed negative relationship. The correlation matrix in Table 10 displays the correlation coefficients (Pearson's *r*) for the relationships between each SCM subscale and both CPTED preference scores. All eight SCM-CPTED relationships were negative (increase in CPTED preference score was associated with a decrease in each SCM subscale

score) and five out of eight were statistically significant at the .01 and .05 levels; however the coefficients indicate a weak effect that is negligible in most cases. The strongest relationships were found between the Order and Discipline scores and CPTED Psychological Comfort scores, $r_{pooled}(898) = .14$, $p < .01$, two-tailed, and between the Order and Discipline scores and CPTED Physical Safety scores, $r_{pooled}(898) = .11$, $p < .01$, two-tailed.

Table 10.

Pearson's r Correlations between SCM Subscales and CPTED Preference Scores

	CPTED Preference for Psychological Comfort	CPTED Preference for Physical Safety	Positive Teacher/ Student Relationships	Academic Support	Order and Discipline	Physical Environment
CPTED Preference for Psychological Comfort	1	.663**	-.068	-.088**	-.144**	-.045
CPTED Preference for Physical Safety	.663**	1	-.084*	-.104**	-.110**	-.052
Positive Teacher/Student Relationships	-.068	-.084*	1	.676**	.649**	.444**
Academic Support	-.088**	-.104**	.676**	1	.604**	.388**
Order and Discipline	-.144**	-.110**	.649**	.604**	1	.502**
Physical Environment	-.045	-.052	.444**	.388**	.502**	1

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

Qualitative Analysis

To explore students' reasons for selected safety and comfort preferences, PSDM survey respondents provided open-ended responses to the following two questions:

(1) What were some specific things that you saw in any of these photos that led you to choose one over the other for its *psychological comfort*?

(2) What were some specific things that you saw in any of these photos that led you to choose one over the other for its *physical safety*?

Responses revealed wide-ranging concerns and varying opinions in favor of, and against, elements of the CPTED images. Informal thematic analysis aided in identifying trends in the open-ended responses, and several of the most common topics were directly related to CPTED's three design principles.

Psychological comfort. Out of 745 psychological comfort responses, 178 included comments on openness, 157 contained opinions about windows, 39 about views, and 33 included remarks about natural light. Each of these are directly related to design features espoused by natural surveillance. Regarding the CPTED principle of access control, 79 responses contained comments about feelings of confinement, being trapped/stuck, and enclosure; 121 included opinions about gates; and 66 commented on fences and walls. Regarding territoriality/maintenance, 65 responses revolved around the use of prohibitive signs ("Drug-free, gun-free"); 91 comments spoke to cleanliness, maintenance, or "up-keep"; 56 commented on the age or modernity of the facilities; and 24 remarked on organization and tidiness. In summary, 41% of all responses mentioned design elements tied to natural surveillance, 26% included comments on aspects of access control, and 22% contained ideas related to territoriality/maintenance. Particularly insightful reasons for choosing certain images for psychological comfort included the following:

- "There were a lot of plants and glass windows that had beautiful views; they didn't look like jail cells. They looked very clean and sophisticated like any other professional place one can go to. Schools should be designed with this mentality."
- "Comfort came from a mixture of safety and the overall calmness that each setting presents. The pictures where I felt had good protection and yet were clean and open made me feel more comfortable."

- "One of the major benefits to the pictures I chose was how open they were. You could see inside and out of the building, and it allows natural sun light in. I feel the ones I didn't choose are very secluded and don't look welcoming or friendly. I really felt more comfortable with the pictures that didn't show gates. It gives off a feeling that you are trapped, and you can't leave."
- "How much nature and open space is around the point of location. It gives me that sense of comfort knowing that I can feel at peace instead of being shoved into close knit rooms and hallways."

Physical Safety. A total of 717 participants responded to the question about physical safety. Regarding natural surveillance, 138 responses discussed the use of windows, 7 mentioned the ability to visually monitor activity on campus, and 119 commented on openness. Relating to access control, 164 participants remarked on fences or walls, 155 discussed the use of gates, 58 mentioned keeping people out of school grounds, and 35 talked about feelings of enclosure or confinement. Responses related to territoriality/maintenance included 82 comments about cleanliness and maintenance, 105 mentioned the use of prohibitive signage, 36 discussed the age or modernity of the facilities, and 22 commented on the organized or tidy nature of the depicted schools. Overall, 32% of responses regarding physical safety preferences discussed one or more topics related to natural surveillance, 45% discussed one or more topics related to access control, and 28% discussed one or more topics concerning territoriality/maintenance. Noteworthy comments regarding reasons for choosing certain images for physical safety included the following:

- "The ones with the windows were safer to me because I could see if anyone is coming by looking through the windows. The ones with the security, gated basketball court,

and closed road was safer because it would make someone who was trying to get in have to work harder."

- "How open it is, the more open it is = harder to bully someone without getting caught."
- "Open environments with clear lines of sight."
- "There were a lot of pictures containing fences and walls. These automatically made me feel safer as the school would be more secure… There were also pictures that had signs saying "drug free" or "gun free" zones. This makes the school more secure and safe."
- "I tended to chose the pictures that showed the school in a defined area (especially by a fence), with a lot of windows and an open feel. I also chose the images where there were signs that enforced rules and that showed a school that was kept in good condition."

In summary, the qualitative data gathered from these two open-ended questions elucidated preferences that students had for specific design elements, as well as for broad style preferences as well. Importantly, many students remarked that they admired certain schools depicted in the CPTED photographs for their "professional" or "cool" appearance, stating that they wished more schools were designed this way or that they could attend such a school. Conversely, many others emphasized dislike for schools that appeared overly restrictive or sterile, using descriptions such as "jail cells," "prison-like," and other similar descriptors. Overall, these response trends imply that students care substantially about the appearance and aesthetics of school campuses.

Chapter 5: Discussion

This investigation explored fundamental questions about how students perceive school facilities designed with Crime Prevention through Environmental Design (CPTED) principles. Preliminary analyses indicated whether individual differences in demographic factors accounted for variability in CPTED preferences. Self-reported age, academic achievement, ethnicity, and socio-economic status (represented by free/reduced lunch status) were not predictive of preferences for CPTED school designs for either psychological comfort or physical safety. Additionally, high school students did not have significantly different CPTED preferences from middle school students for either psychological comfort or physical safety. Regarding sex, however, female preferences for the CPTED images were significantly higher than males, though the mean difference between male and female scores was less than half of one point (range: 0 – 12) and sex explained only 0.6% – 0.9% of the variance in scores. This suggests that the real effect of sex on preferences for CPTED may not be meaningful in real-world applications. Therefore, though females may be more sensitive to differences in the physical environment, that sensitivity may not be different enough from males to warrant differential design choices.

It was hypothesized that students would prefer images of CPTED-based school designs over non-CPTED schools for their perceived psychological comfort and physical safety; study results support this hypothesis. When compared to a neutral CPTED preference score of 6, the mean preference scores for both psychological comfort and physical safety were significantly higher and indicated that students more often preferred the images of CPTED designed schools. For psychological comfort preferences, the mean score was 1.47 points (range: 0 – 12) higher than neutral, and for physical safety the mean score was 1.76 points higher (effect sizes were .70 for psychological comfort and .84 for physical safety), suggesting a substantial preference for

CPTED school design. The third primary study hypothesis was also supported, because data suggest that student preferences for psychological comfort were positively correlated with physical safety preferences (r = .66). Essentially, these results imply that the use of CPTED design elements for physical safety may coincide with design elements that also offer students a sense of psychological comfort.

These simple findings provide empirical support for the notion that students have positive feelings toward the principles of natural surveillance, access control, territoriality, and maintenance that are used in school built environments. Although CPTED has gained popularity in school facilities design, there has been insufficient exploration of how it may impact user perceptions such as sense of safety and comfort. Studies have found that student sense of safety is significantly related to academic achievement (Milam, Furr-Holden, & Leaf, 2010), thus it is crucial to provide students with schools that engender a *perceived* sense of safety (not only *actual* safety from harm). Furthermore, a significant amount of research has been devoted to how characteristics of the physical environment affect mental health, cognition, and learning, which highlights the need for spaces that promote psychological wellbeing. Some investigations are beginning to quantify the impact of school architecture on learning, with early findings revealing significant factors such as natural daylight, adequate circulation spaces, window views, flexibility of space, and other design elements (Tanner, 2009; Barrett, Davies, Zhang, & Barrett, 2015). Indeed, higher quality school facilities are associated with improved school climate and, in turn, higher academic achievement (Uline & Tschannen-Moran, 2008). Given the potential for safety priorities in school design to impinge on student comfort and thereby hinder learning, a specific approach must be employed to ensure that these priorities are balanced when designing the physical environment. In light of the present study's findings, CPTED may be an effective

design solution for creating high quality schools that simultaneously promote a sense of physical safety *and* psychological comfort, both of which are necessary for an ideal learning environment.

Further analyses revealed that the level of previous exposure to violence experienced by survey respondents did not significantly impact preferences for the type of school facility they perceived as more psychologically comfortable or physically safe. Students with high violence exposure and students with average violence exposure both preferred CPTED school images over non-CPTED images to a similar degree. This suggests that prior violence exposure may not necessarily affect how students feel in response to cues in the school's built environment. Though the precise reason for this relationship is unclear, perhaps the appeal of certain architectural safety precautions (such as natural surveillance, access control, etc.) is independent of a student's level of fear or trauma in life. This would suggest that regardless of how much violence a student has witnessed, he or she still intuits the benefits and/or visual appeal of CPTED design approaches. If this were confirmed via future research, architects could continue to employ CPTED in school design with confidence that it would provide an improved sense of safety and psychological comfort for students, regardless of prior violence exposure.

Concerning the influence of prior delinquency, students who reported having the most instances of conduct-related offenses (e.g. getting in fights, bringing weapons to school, etc.) also displayed significantly lower preferences for CPTED-based school images. Moreover, this finding held for both psychological comfort preferences and physical safety preferences, which were approximately half of one point lower on average than students with non-elevated delinquent histories. Although effect sizes were relatively small ($d_{PsyComf}$ = .25; $d_{PhySafety}$ = .26), this finding was significant and supports one of this study's secondary hypotheses (i.e. "CPTED preferences of students with a history of delinquent behaviors will differ significantly from non-

delinquent students."). Regarding this observed relationship between prior delinquency and less CPTED preference, it is possible that delinquent students are more accustomed to prohibitive or restrictive environments, such that they have become desensitized to environmental design elements related to safety and comfort. Alternatively, perhaps certain personality and demographic factors of students with delinquent histories contribute to worldviews that are less preoccupied with the qualities of the physical environment; for instance, delinquent students may be more preoccupied with maintaining social status or power when at school, such that regard for the physical environment is neglected. There are many potential explanations, and future research should be carried out to help clarify this phenomenon.

Another important goal of the present investigation was to explore whether student preferences for CPTED designed schools were related to school climate perceptions. When controlling for prior exposure to violence and delinquent behaviors, both higher psychological comfort preference and higher physical safety preference for CPTED schools were associated with a significant *decrease* in the degree to which students reported their school's climate as positive. The decrease in school climate score predicted by CPTED preference scores (both psychological comfort and physical safety) was only around half of one point on average (SCM range: 26 – 130). When the SCM was divided into its four subscales, three out of four subscales showed a significant but weak relationship with either CPTED Psychological Comfort scores, CPTED Physical Safety scores, or both. These results seem to suggest that no particular subscale of the SCM was primarily responsible for the significant negative relationship found between student CPTED preferences and their school climate perceptions. The School Physical Environment subscale was the only subscale that was not significantly correlated with either CPTED composite score; this may be because it consisted of only four items, whereas the other

subscales included 6-9 items each. Though unexpected, the reason that greater preference for CPTED designs predicts poorer perceptions of school climate may be due to this study's high statistical power (i.e., large sample size), suggesting that it is a non-meaningful finding. Alternatively, this finding may have resulted from an unknown artifact of the survey structure or design; perhaps the PSDM questions cued students to ruminate on negative and uncomfortable topics (i.e. violence, school shootings, etc.), which in turn lead them to consider the negative aspects of their school environments more than the positive ones. If this were the case, they would be less inclined to have positive thoughts about their current school environments when presented with the School Climate Measure items. Further investigation is required to clarify the nature of this relationship.

Open-ended questions asked survey participants to consider which elements of the pictures caused them to choose one option over the other, and participant responses to such questions provided valuable insights. Many students admired the schools in the CPTED images and expressed praise for their "professional" or "cool" appearance. Specific reasons cited by students regarding their preferences were often related to aspects of CPTED design, though many opinions disagreed with one another. For instance, one divisive topic was that many felt vulnerable to attack from intruders when viewing images that depicted "open" spaces with windows or absent fences, while a comparable number of students felt safest in those same open spaces because of their desire to visually monitor activity and flee dangerous situations. Thus, comments also demonstrated that many students intuited the rationale behind many design features associated with CPTED, such as the use of openness and windows to provide natural surveillance. Furthermore, the frequent mention of CPTED-related design features in student responses suggests that they often recognized the presence and absence of the specific features

that were not explicitly pointed out to them. This lends support for the face validity of the PSDM and its goal to embody CPTED school design in photographs.

Broad Implications

First and foremost, study results indicate that elements of environmental design matter to students. Many students expressed distaste for "prison-like" school designs as well as a desire for more progressive, high-quality design elements in their own schools. Apart from showing that a school's visual environment matters to students, study results support a model of school security that may not require the creation of fortified campuses and prison-like learning environments. Instead, schools can offer security and safety while making use of visual appeal and aesthetic embellishments that enhance the comfort of the environment. For instance, windows could be appropriately used to provide natural surveillance to meet security needs, as well as offer natural daylight and nature views to support psychological wellbeing and comfort. Given that student sense of safety and psychological wellbeing are critical to successful learning and academic achievement, school architecture and design should contribute to these in a way that promotes positive outcomes. These results suggest that CPTED elements may be a viable alternative to school fortification and could meet the goals of both school security and student psychological needs. If schools were designed with these two goals in mind, they would likely see improved school climate, less stress among students and teachers, and reduced crime and violence—all of which are critically important for student success.

Limitations

Several methodological limitations are worth mentioning to provide adequate context for the aforementioned findings. One limitation relates to a lack of demographic diversity in the

sample and individual differences in participants' personal background. Due to convenience sampling, this study was unable to obtain a demographically representative sample and findings are not generalizable to the broader U.S. school population. In addition, this study could not account for the individual background and past experiences of each participant regarding their experiences with different school facilities and built environments; each student may perceive or prefer different environments based on his or her past experiences at different schools.

Potential confounds in this research also stem from the construction of the PSDM and selected photographic stimuli. First, the PSDM has not been externally validated. Second, within the instrument itself it is possible that elements in the images apart from CPTED design features exerted an unintended influence on the viewers' preferences, thus potentially confounding the study results. Based on analysis of participants' open-ended comments, potential influential elements include the perceived age of the school building, the use of monochrome images rather than color, and the variable presence of nature and landscaping. More careful selection of photographic stimuli or the creation of images using computer-aided design (CAD) software would aid in minimizing the effect of these particular methodological issues.

Survey comments also revealed that the constructs of psychological comfort and physical safety may not be orthogonal. The strong correlation (r = .66) between the CPTED Psychological Comfort scores and CPTED Safety scores supports this notion. Further, when discussing why certain images were perceived as more psychologically comfortable, many students mentioned that they would have felt *safer* in those spaces. Similarly, some respondents commented on feelings of comfort when describing why they chose certain images for their perceived safety. This may have occurred because of conceptual overlap (i.e. sense of safety may be a major component of psychological comfort, or vice versa) or because the definitions of each construct

used in the survey were not adequately discrete in the minds of respondents. Another explanation is that because respondents viewed the same pairs of photographs and were asked to reflect on two different constructs (i.e. psychological comfort and physical safety), answers from the first open-ended question may have influenced their answers on the second open-ended question, which would indicate a carryover bias. In other words, participants may have subconsciously referred back to their rationales for the first item block's open-ended question when attempting to conceptualize their rationale for the second item block. Further research is needed to determine whether the strong correlation between physical safety and psychological comfort is a result of conceptual overlap, a byproduct of method effects such as weak operational definitions and carryover bias, or a combination of both. To mitigate the aforementioned method effects in future studies, an independent-groups design could be employed in which one group of students gives preferences for psychological comfort and a separate group gives preferences for physical safety.

Psychometric considerations may also have adversely affected the results of this research. As mentioned in the results section of this manuscript, the natural surveillance and access control item sets demonstrated moderate internal consistency, but the territoriality/maintenance item set had much lower internal consistency for both psychological comfort and physical safety preferences. One possible explanation is that territoriality/maintenance was a broader construct and necessarily contained photographs that represented a more diverse array of concepts compared to the other two CPTED principles. To illustrate, if a respondent favored the visual appeal of territoriality elements but not maintenance, this would have led to inconsistent responding within the four items, thus leading to low internal consistency.

Another minor psychometric flaw in this study's survey was the lack of validity or screening items (e.g. "I fly space shuttles for NASA every weekend."), which could have aided in identifying and excluding invalid data from respondents who arbitrarily selected response options or did not answer honestly. Such screening items would have enhanced the data cleaning process and strengthened the validity of the final data set used for statistical analyses.

In addition to the various methodological limitations listed above, the exploratory and correlational nature of this study implies that findings must be interpreted with caution and do not establish causality. These results are intended to /provide a foundation on which to base future research that investigates narrower questions regarding *how* CPTED design influences student perceptions and preferences. Thus, this study's findings are tentative and preliminary but they are a much-needed precursor to more tightly focused research.

Conclusions and Future Directions

As widespread media coverage of tragic school-based violence continues to alarm educators, parents, and the general public, swift preventive action is often taken without sufficient thought for adverse outcomes. The use of overt physical security measures in the built environment is one method of school safety that lacks substantial evidence for its efficacy and may even harm school climates. Further, research stresses the importance of a positive school atmosphere to maximize learning, yet little research has been devoted to how the design of the physical environment might support or hinder such an atmosphere. Given that CPTED is already used in school facilities design, it is important to know what students' reactions are to this design approach and whether it provides a solution to the need for balancing safety and comfort in the school environment. The present study sought to answer these questions by asking 7th through 12th grade students to indicate whether CPTED or non-CPTED designed schools appeared to

offer more psychological comfort and physical safety, respectively. Participants demonstrated a significant preference for the images of schools that exemplified CPTED principles, both in terms of the perceived psychological comfort and physical safety they afforded. These preliminary findings support the use of CPTED elements to design schools that appropriately balance security with student sense of comfort and safety. Further, qualitative survey data suggest that some students intuit the benefits of CPTED design features associated with natural surveillance, access control, and territoriality/maintenance. If supported by future research, these conclusions can inform educators and architects that safety and psychological wellbeing are not mutually exclusive design priorities. Additionally, CPTED may be an ideal approach to school design that permits students to feel at ease in a highly secure environment. More importantly, these results reveal that students may be more sensitive to cues in the school's built environment than previously realized.

With hope, perhaps future studies will use rigorous research methods to validate and build upon the foundational and noteworthy results of this investigation. Forthcoming research might consider the following questions:

- How can school design meet the needs of different personality types and differing preferences for sense of safety and comfort?
- Do schools designed with greater implementation of CPTED principles demonstrate lower rates of student discipline? Bullying and Violence? Do such schools have higher overall academic achievement than non-CPTED schools?
- How does student sense of safety and psychological comfort differ when students attend schools with high CPTED implementation versus low implementation?

- What other design elements besides CPTED-related features impact sense of safety and comfort, and what do students believe contributes the most? Examples include the use of "green space" and natural landscaping, space for displaying student work, "soft" spaces and furniture, and nooks for study and retreat.
- How much impact does the physical environment have on reducing delinquent behaviors and violence, compared to policy-based factors? How might these two preventive approaches leverage one another to maximize positive outcomes?

Countless questions remain concerning the potential for architecture and design to have a measurable impact on school violence rates, student learning, and psychosocial climate. What is certain, however, is that to maximize these outcomes we must leverage all influential factors—not the least of which is the built environment. It is true that many students achieve great academic success despite subpar school facilities, but how many more students could achieve similarly if they were given additional support from the built environment? At present, one can only guess. It is imperative that future investigations dedicate more energy to this topic to provide a knowledge base that architects, designers, and facilities planners can use to inform their decisions and provide optimized learning spaces for tomorrow's students. Without such endeavors, the predominantly uninspiring design paradigms of today's schools will continue to proliferate, leaving a vast potential unexploited and untapped.

Appendix A: Definition of Terms

CPTED schools: As represented in photographs, any school imagery that adequately reflects the use of architecture or design to support access control, natural surveillance, or territoriality/maintenance.

Non-CPTED schools. As represented by photographs, any school imagery that lacks important physical elements of the school's architecture or design to support access control, natural surveillance, or territoriality/maintenance.

Safety. Safety is defined as feeling protected from, or simply not being afraid of, crime, bullying, attacks, or other physical harm.

Psychological Comfort. In the absence of a pre-existing definition appropriate for the present research topic, this author's definition of psychological comfort adopts Reeves et al.'s (2010) definition of psychological safety (i.e. a need for students to feel safe and comfortable at school as well as free from fear and psychological harm) and expands it to reflect features of the built environment that impact student learning and success. Hence, *psychological comfort* was defined as:

> "A state of positive wellbeing in which students are mentally available to learn. It results from having low stress, being in nice physical surroundings, and being free from negative emotion."

Appendix B: Preferable School Design Measure

SECTION 1: PSYCHOLOGICAL COMFORT

Instructions: The following pairs of photos will ask you to select the school that looks more psychologically comfortable. Please go with your first impression or "gut reaction" when viewing the pairs of photos.

Psychological comfort is defined as a state of positive wellbeing in which students are mentally available to learn. It results from having low stress, being in nice physical surroundings, and being free from negative emotion.

1. From the following two photos, please select the school setting in which you would feel more psychologically comfortable.

2. From the following two photos, please select the school setting in which you would feel more psychologically comfortable.

3. From the following two photos, please select the school setting in which you would feel more psychologically comfortable.


4. From the following two photos, please select the school setting in which you would feel more psychologically comfortable.

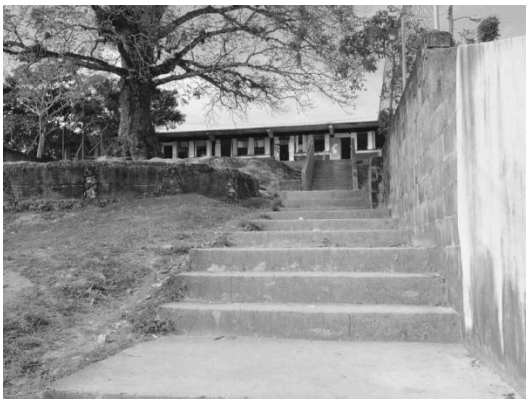

5. From the following two photos, please select the school setting in which you would feel more psychologically comfortable.


6. From the following two photos, please select the school setting in which you would feel more psychologically comfortable.

7. From the following two photos, please select the school setting in which you would feel more psychologically comfortable.

8. From the following two photos, please select the school setting in which you would feel more psychologically comfortable.

9. From the following two photos, please select the school setting in which you would feel more psychologically comfortable.




10. From the following two photos, please select the school setting in which you would feel more psychologically comfortable.


11. From the following two photos, please select the school setting in which you would feel more psychologically comfortable.


12. From the following two photos, please select the school setting in which you would feel more psychologically comfortable.

SECTION 2. PHYSICAL SAFETY

Instructions: The following pairs of photos will ask you to select the school in which you would feel safer. Please go with your first impression or "gut reaction" when viewing the pairs of photos.

Safety is defined as feeling protected from, or simply not being afraid of, crime, bullying, attacks, or other physical harm.

1. From the following two photos, please select the school setting in which you would feel safer.

2. From the following two photos, please select the school setting in which you would feel safer.


3. From the following two photos, please select the school setting in which you would feel safer.


4. From the following two photos, please select the school setting in which you would feel safer.

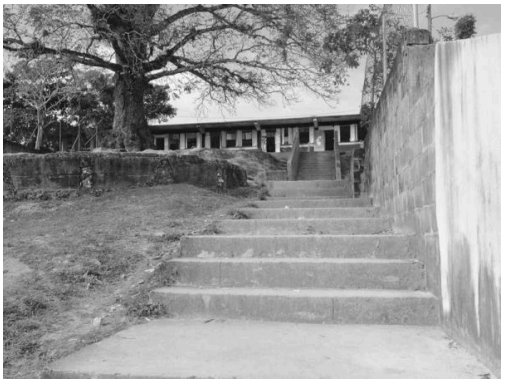

5. From the following two photos, please select the school setting in which you would feel safer.


6. From the following two photos, please select the school setting in which you would feel safer.


7. From the following two photos, please select the school setting in which you would feel safer.


8. From the following two photos, please select the school setting in which you would feel safer.


9. From the following two photos, please select the school setting in which you would feel safer.




10. From the following two photos, please select the school setting in which you would feel safer.


11. From the following two photos, please select the school setting in which you would feel safer.

12. From the following two photos, please select the school setting in which you would feel safer.

References

Addington, L. A. (2009). Cops and cameras: Public school security as a policy response to Columbine. *American Behavioral Scientist, 52*(10), 1426-1446.

Arizona School Facilities Board. (2007). Building Arizona's 21st century schools: Ensuring innovative school facilities for the digital age. Phoenix, AZ. Retrieved from https://sfb.az.gov/21st-century-schools

Baker, L., & Bernstein, H. (2012). The impact of school buildings on student health and performance: A call for research. *McGraw-Hill Research Foundation, New York, NY.* Retrieved from *http://mngreenschools.org/wp-content/uploads/2012/09/McGrawHill_ImpactOnHealth.pdf*

Barrett, P., Davies, F., Zhang, Y., & Barrett, L. (2015). The impact of classroom design on pupils' learning: Final results of a holistic, multi-level analysis. *Building and Environment*, *89*, 118-133.

Bickford, D. J. (2002). Navigating the white waters of collaborative work in shaping learning environments. *New directions for teaching and learning, 92*. Hoboken, NJ: Wiley.

Bosworth, K., Ford, L., & Hernandaz, D. (2011). School climate factors contributing to student and faculty perceptions of safety in select Arizona schools. *Journal of School Health, 81*(4), 194-201. doi:10.1111/j.1746-1561.2010.00579.x

Bowen, N.K. & Bowen, G.L. (1999). Effects of crime and violence in neighborhoods and schools on the school behavior and performance of adolescents. *Journal of Adolescent Research, 14*:319–342.

Bracy, N. L. (2011). Student perceptions of high-security school environments. *Youth & Society, 43*(1), 365-395. doi:10.1177/0044118X10365082

Bradshaw, C. P., Waasdorp, T. E., Debnam, K. J. and Johnson, S. L. (2014). Measuring school climate in high schools: A focus on safety, engagement, and the environment. *Journal of School Health, 84*: 593–604. doi: 10.1111/josh.12186

Casteel, C., & Peek-Asa, C. (2000). Effectiveness of crime prevention through environmental design (CPTED) in reducing robberies. *American Journal of Preventive Medicine, 18*(4), 99-115.

Centers for Disease Control and Prevention. (2013). Methodology of the Youth Risk Behavior Surveillance system. *Morbidity and Mortality Weekly Report*, *62*(1): 1-18.

Centers for Disease Control. (2014). *Youth violence: Using environmental design to prevent school violence*. Retrieved from http://www.cdc.gov/violenceprevention/youthviolence/cpted.html

Choi, S., Guerin, D. A., Kim, H. Y., Brigham, J. K., & Bauer, T. (2014). Indoor Environmental Quality of Classrooms and Student Outcomes: A Path Analysis Approach. *Journal of Learning Spaces, 2*(2).

Choi, H. H., Van Merriënboer, J. J., & Paas, F. (2014). Effects of the physical environment on cognitive load and learning: towards a new model of cognitive load. *Educational Psychology Review, 26*(2), 225-244.

Cooley, M. R., Turner, S. M., & Beidel, D. C. (1995). Assessing community violence: The children's report of exposure to violence. *Journal of the American Academy of Child & Adolescent Psychiatry*, *34*(2), 201-208.

Cozens, P., & Love, T. (2015). A review and current status of crime prevention through environmental design (CPTED). *Journal of Planning Literature, 30*(4), 393-412. doi:10.1177/0885412215595440

Cunningham, C. E., Vaillancourt, T., Rimas, H., Deal, K., Cunningham, L., Short, K., & Chen, Y. (2009). Modeling the bullying prevention program preferences of educators: A discrete choice conjoint experiment. *Journal of abnormal child psychology*, *37*(7), 929-943.

DeAngelis, K. J., Brent, B. O., & Ianni, D. (2011). The hidden cost of school security. *Journal of Education Finance*, *36*(3), 312-337.

Earthman, G. I. (2002). School facility conditions and student academic achievement. *UCLA's Institute for Democracy, Education, & Access*.

Edelstein, M.R. (2002). Contamination: the invisible built environment. In: Bechtel, R.B., Churchman A. (Eds.). *The Handbook of Environmental Psychology*. 2nd ed. New York, NY: Wiley, 559–588.

Evans, G. W. (2003). The built environment and mental health. *Journal of Urban Health*, *80*(4), 536-555.

Evans, G. W. (2006). Child development and the physical environment. *Annual Review of Psychology, 57*(1), 423-451. doi:10.1146/annurev.psych.57.102904.190057

Everett, S. A., Kann, L., & McReynolds, L. (1997). The youth risk behavior surveillance system: Policy and program applications. *Journal of School Health*, *67*(8), 333-335.

Ewton, M. (2014). Student safety: Parents' and school principals' perceptions. *New Waves, 17*(1), 109.

Fales, C. L., Barch, D. M., Burgess, G. C., Schaefer, A., Mennin, D. S., Gray, J. R., & Braver, T. S. (2008). Anxiety and cognitive efficiency: Differential modulation of transient and sustained neural activity during a working memory task. *Cognitive, Affective & Behavioral Neuroscience*, *8*, 239–253. doi:10.3758/CABN.8.3.239

Field, A. (2009). *Discovering Statistics Using SPSS*, 3rd ed. London: Sage.

Figueiro, M. G., & Rea, M. S. (2010). Lack of short-wavelength light during the school day delays dim light melatonin onset (DLMO) in middle school students. *Neuro endocrinology letters*, *31*(1), 92.

Filardo, M. W., Vincent, J. M., Sung, P., & Stein, T. (2006). Growth and Disparity: A Decade of US Public School Construction. *21st Century School Fund*.

Gastic, B. (2011). Metal detectors and feeling safe at school. *Education and Urban Society, 43*(4), 486-498. doi:10.1177/0013124510380717

Goodman, R., Meltzer, H., & Bailey, V. (1998). The strengths and difficulties questionnaire: A pilot study on the validity of the self-report version. *European Child and Adolescent Psychiatry, 7*(3), 125–130.

Greenberg, J. (2015). *Social psychology: The science of everyday life*. New York: Worth Publishers, a Macmillan Education Imprint.

Halpern, D. (1995). Mental Health and the Built Environment. London: Taylor and Francis.

Hankin, A., Hertz, M., & Simon, T. (2011). Impacts of metal detector use in schools: Insights from 15 years of research. *Journal of School Health, 81*(2), 100-106. doi:10.1111/j.1746-1561.2010.00566.x

Hellman, G.V. (2015). Developing a comprehensive approach to school safety. *School Business Affairs,* July/August 2015: 27 - 29.

Heschong Mahone Group (2003). Windows and classrooms: A study of student performance and the indoor environment. *California Energy Commission*. Fair Oaks, CA. Retrieved from http://www.h-m-g.com/downloads/Daylighting/order_daylighting.htm

Higgins, M., Ishimaru, A., Holcombe, R., & Fowler, A. (2012). Examining organizational learning in schools: The role of psychological safety, experimentation, and leadership that reinforces learning. *Journal of Educational Change, 13*(1), 67-94.

Jankowska, M., & Atlay, M. (2007). Use of creative space in enhancing students' engagement. *Innovations in Education and Teaching International, 45*(3): 271–79.

Jerome, D. C. (2012). School Facility Design: Are We Asking the Right People? Dissertation submitted to Olivet Nazerene University.

Johnson, S. L. (2009). Improving the school environment to reduce school violence: A review of the literature. *Journal of School Health, 79*(10), 451-465. doi:10.1111/j.1746-1561.2009.00435.x

Johnson, S., Waasdorp, T., Cash, A., Debnam, K., Milam, A., & Bradshaw, C. (2017). Assessing the association between observed school disorganization and school violence:

Implications for school climate interventions. *Psychology of Violence, 7*(2), 181-191. doi:10.1037/vio0000045

Küller, R., & Lindsten, C. (1992). Health and behavior of children in classrooms with and without windows. *Journal of Environmental Psychology*, *12*(4), 305-317.

Langhout, R. D., & Annear, L. (2010). Safe and unsafe school spaces: Comparing elementary school student perceptions to common ecological interventions and operationalizations. *Journal of Community & Applied Social Psychology, 21*(1), 71-86.

Leach, J., & Griffith, R. (2008). Restrictions in working memory capacity during parachuting: A possible cause of "no pull" fatalities. *Applied Cognitive Psychology*, *22*, 147–157. doi:10.1002/acp.1364

Li, P., Stuart, E. A., & Allison, D. B. (2015). Multiple Imputation: A Flexible Tool for Handling Missing Data. *JAMA*, *314*(18), 1966–1967. http://doi.org/10.1001/jama.2015.15281

Marchand, G., Nardi, N., Reynolds, D., & Pamoukov, S. (2014). The impact of the classroom built environment on student perceptions and learning. *Journal of Environmental Psychology, 40*, 187-197. doi:10.1016/j.jenvp.2014.06.009

Maxwell, L. E. (2000). A safe and welcoming school: What students, teachers, and parents think. *Journal of Architectural and Planning Research*, 271-282.

Milam, A. J., Furr-Holden, C. D. M., & Leaf, P. J. (2010). Perceived school and neighborhood safety, neighborhood violence and academic achievement in urban school children. *The Urban Review*, *42*(5), 458-467.

National Association of School Psychologists. (2013). Research on school security: The impact

of security measures on students. *NASP,* Bethesda, MD. Retrieved from http://www.audioenhancement.com/wp-content/uploads/2014/06/school-security-by-NASP.pdf

National Center for Education Statistics. (2017). *Common core of data public school data 2014-2015, 2016-2017 school years*. Retrieved from https://nces.ed.gov/ccd/schoolsearch/index.asp?ID=040831000778

Nickerson, A. B., & Martens, M. R. (2008). School violence: Associations with control, security/enforcement, educational/therapeutic approaches, and demographic factors. *School Psychology Review*, *37*, 228-243.

Nijs, M. M., Bun, C. J., Tempelaar, W. M., de Wit, N. J., Burger, H., Plevier, C. M., & Boks, M. P. (2014). Perceived school safety is strongly associated with adolescent mental health problems. *Community mental health journal*, *50*(2), 127-134.

Perumean-Chaney, S. E., & Sutton, L. M. (2013). Students and perceived school safety: The impact of school security measures. *American Journal of Criminal Justice, 38*(4), 570-588. doi:10.1007/s12103-012-9182-2

Phaneuf, S. W., 1971. (2009). *Security in schools: Its effect on students*. El Paso: LFB Scholarly Pub. LLC.

Philpott, D., & Kuenstle, M. W. (2007). Education facility security handbook. Lanham, MD: Government Institutes.

Pulvers, K., Hood, A., Bachand, J., Spady, T. J., & Kliebenstein, A. (2015). Anxiety mediates the effect of acute stress on working memory performance when cortisol levels are high:

A moderated mediation analysis. *Anxiety, Stress, & Coping, 28*(5), 545-562. doi:10.1080/10615806.2014.1000880

Pynoos, R. S., Steinberg, A. M., & Piacentini, J. C. (1999). A developmental psychopathology model of childhood traumatic stress and intersection with anxiety disorders. *Biological psychiatry*, *46*(11), 1542-1554.

Rashid, M., & Zimring, C. (2008). A review of the empirical literature on the relationships between indoor environment and stress in health care and office settings: Problems and prospects of sharing evidence. *Environment and Behavior, 40*(2), 151-190. doi:10.1177/0013916507311550

Reeves, M. A., Kanan, L. M., & Plog, A. E. (2010). Comprehensive planning for safe learning environments: A school professional's guide to integrating physical and psychological safety, prevention through recovery. New York: Routledge.

Reinke, W. M., & Herman, K. C. (2002). Creating school environments that deter antisocial behaviors in youth. *Psychology in the Schools*, *39*(5), 549-559.

Robers, S., Zhang, A., Morgan, R.E., and Musu-Gillette, L. (2015). *Indicators of School Crime and Safety: 2014.* National Center for Education Statistics, U.S. Department of Education, and Bureau of Justice Statistics, Office of Justice Programs, U.S. Department of Justice. Washington, DC.

Robinson, S. J., Sünram-Lea, S. I., Leach, J., & Owen-Lynch, P. J. (2008). The effects of exposure to an acute naturalistic stressor on working memory, state anxiety and salivary cortisol concentrations. *Stress: The International Journal on the Biology of Stress*, *11*,

115–124. doi:10.1080/10253890701559970

Schneider, T. (2010) CPTED 101: Crime prevention through environmental design — The fundamentals for schools. *National Clearinghouse for Educational Facilities.* Retrieved from http://www.ncef.org/pubs/cpted101.pdf.

Schreck, C. J., & Miller, J. M. (2003). Sources of fear of crime at school: What is the relative contribution of disorder, individual characteristics, and school security? *Journal of School Violence, 2*(4), 57-79.

Scott-Webber, L., Strickland, A., & Kapitula, L. R. (2013). Built environments impact behaviors: Results of an active learning post-occupancy evaluation. *Planning for Higher Education, 42*(1), 28.

Shaw M. (2004). Housing and public health. *Annual Review of Public Health, 25,* 397–418.

Skiba, R., Simmons, A.B., Peterson, R., McKelvey, J., Forde, S., & Gallini, S. (2004). Beyond guns, drugs and gangs: The structure of student perceptions of school safety. *Journal of School Violence, 3*(2), 149-171. doi:10.1300/J202v03n02_09

Tanner, C. K. (2009). Effects of school design on student outcomes. *Journal of Educational Administration, 47*(3), 381-399.

Taylor, R. (2002). Crime prevention through environmental design (CPTED): Yes, no, maybe, unknowable, and all of the above.' In Bechtel, R. & Churchman, A. (Eds) Handbook of Environmental Psychology, 413–26. New York: John Wiley.

Tyrväinen, L., Ojala, A., Korpela, K., Lanki, T., Tsunetsugu, Y., & Kagawa, T. (2014). The influence of urban green environments on stress relief measures: A field experiment. *Journal of Environmental Psychology*, *38*, 1-9.

Uline, C., & Tschannen-Moran, M. (2008),"The walls speak: the interplay of quality facilities, school climate, and student achievement", *Journal of Educational Administration, 46*(1), 55-73.

U.S. Department of Education, Office of Safe and Drug-Free Schools (2003). Practical information on crisis planning: A guide for schools and communities. Washington, D.C.

Vagi, K.J., Stevens, M., Basile, K., & Simon, T.R. (2013). CPTED: Principles of crime prevention through environmental design assessed in the middle school setting. Proceedings from: Society for Prevention Research 22nd Annual Meeting 2013. Washington, D.C.

Vossekuil, B., Fein, R. A., Reddy, M., Borum, R., & Modzeleski, W. (2002). The final report and findings of the Safe School Initiative: Implications for the prevention of school attacks in the United States. *US Secret Service and Department of Education,* Washington, DC.

Winterbottom, M., & Wilkins, A. (2009). Lighting and discomfort in the classroom. *Journal of Environmental Psychology*, *29*(1), 63-75.

Zullig, K. J., Collins, R., Ghani, N., Patton, J. M., Scott Huebner, E., & Ajamie, J. (2014). Psychometric support of the school climate measure in a large, diverse sample of adolescents: a replication and extension. *Journal of School Health*, *84*(2), 82-90.

Zullig, K. J., Koopman, T. M., Patton, J. M., & Ubbes, V. A. (2010). School climate: Historical review, instrument development, and school assessment. *Journal of Psychoeducational Assessment, 28,* 139–152. http://dx.doi.org/10.1177/0734282909344205