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I, Rachel M Kail, hereby submit this original work as part of the requirements for the degree of Doctor of Philosophy in Criminal Justice.

It is entitled:

Perceiving Vulnerability: Evaluating the Impact of Individual Movement Within Environmental Context

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Perceiving Vulnerability: Evaluating the Impact of Individual Movement Within Environmental Context

A dissertation submitted to the Graduate School of the
University of Cincinnati in partial fulfillment of the requirements
for the degree of

Doctor of Philosophy

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College of Education, Criminal Justice, and Human Services.

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Perceiving Vulnerability: Evaluating the Impact of Individual Movement Within Environmental Context

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Abstract

Several areas of research demonstrate an association between how an individual walks and how they are perceived—including how vulnerable they may be. The current project takes the next step to test the association between walking style and the perception of a walker's vulnerability using an experimental design. Walking style is determined using two researcher-manipulated walks characterized by specific patterns of movement: organized and disorganized. To isolate walking style, walkers are presented using point-light displays. This project includes two independent studies and examines (a) the impact of walking style on the perception of walker vulnerability, (b) the methodological impact of using point-light versus full-light, and (c) if contextual factors such as environment and walker sex impact perceptions of the walker. Results from the two studies indicate that walking style can impact an observer's perception of a walker; organized walks are perceived as less vulnerable than disorganized walks. In addition, the results show that point-light videos receive lower scores on vulnerability measures compared to full-light video, and that women are perceived as more vulnerable than men.

Dedication

This one is for me.

Acknowledgments

This dissertation marks the end of my doctoral education and the completion of my longest-running pandemic project! Throughout its development, countless people provided support, encouragement, and guidance–without which, this manuscript would not be what is today. While it would be impossible to name each and every individual that helped shape this document, I wish to acknowledge and express my gratitude to those I can. Without further ado, I wish to thank...

J.C. Barnes, my mentor and the chair of this dissertation, for his enthusiastic support of my wild ideas and consistent confidence in me.

My dissertation committee–Brittany Hayes, John Eck, and Alex Piquero–for their patience and understanding as I mulled, wrote, re-wrote, edited, re-edited, and mulled over this manuscript some more.

Joe Nedelec, for somehow making statistics one of my favorite subjects and for drilling organized code-keeping habits–which made this a much less painful undertaking.

The faculty and staff within the School of Criminal Justice, for sharing their knowledge and time with me.

The department and college within the University of Cincinnati for aiding my research by awarding me the Doctoral Student Research Grant from the School of Criminal Justice, and the Graduate Student and Faculty Mentoring Grant from the College of Education, Criminal Justice, and Human Services.

My friends and family for commiserating with me when I complained and rejoicing with me when I celebrated.

The COVID-19 pandemic for making the writing process both more difficult and more manageable, for providing me the opportunity to be locked away with the final two on this list, and for granting me the ability to call myself a "plague doctor".

My four-legged, fluffy, white, friend, Freyja, for the indecipherable (but surely insightful!) advice, and the diligent reminders to take time to play, go for a walk, or have a cuddle.

David Parks, for the endless support–from innovative writing games to editing this manuscript–and for each and every day.

To those I failed to mention above, thank you. This was not a project that I could have accomplished on my own. I learned so much–about writing, about perception, about myself, and much more. Perhaps the most valuable thing I learned while immersing myself in the concepts of perception and vulnerability, however, was how to better consider others' perceptions of reality and how to change my own. Therefore, I want to thank the opportunity, the process, and the time it took to get here.

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Part I

Background

Chapter 1

Introduction

How do offenders choose whom to victimize?

This question forms the foundation of a large body of research within criminology. The research evaluates how offenders make decisions, whether those decisions are rational, and who offenders choose to target. These areas have contributed relevant information to the relationship between victims and offenders. Despite this, there are still gaps in understanding the factors assessed by an offender in the exact moment when they encounter a potential target. The perception of these factors influence the likelihood of an individual being selected as a victim.

Victim-selection research has identified a common theme: Offenders tend to choose targets they perceive as more vulnerable (Wright and Decker, 1997). Women, children, the elderly, and individuals who are smaller in stature are often described as weaker, less able to defend themselves, or less likely to resist (Finkelhor and Asdigidan, 1996; Jones et al., 2012; Stevens, 1994). Attributes indicative of vulnerability can extend beyond physical and demographic information. Some offenders describe individuals as appearing more vulnerable based differences in body language. These forms of nonverbal communication include things like length of eye contact and walking style (Book, Costello, and Camilleri, 2013; Grayson and Stein,

1981; Wheeler, Book, and Costello, 2009). Put another way, minor differences in how one physically carries or presents themselves may be a cue offenders use to identify victims.

The current project focuses on the relationship between walking style and victim-selection. Previous research has demonstrated that certain walking styles are perceived as more vulnerable (Grayson and Stein, 1981; Blaskovits and Bennell, 2019; Gunns, Johnston, and Hudson, 2002; Johnston, Hudson, Richardson, Gunns, and Garner, 2004). To accurately measure the impact of walking style, movement must be observed independent of other the characteristics associated with vulnerability (i.e., gender, age, height, etc.). An individual's surroundings may also influence perceptions of their vulnerability. To address this in the current study, I represent a subject's walking style as moving points of light. These point-light displays eliminate the contextual information regarding an individual and their environment.

The purpose of the present study is to verify whether subtle movement cues–isolated from other contextual factors–play a role in the offender decision-making process. Specifically, I look at the relationship between a source of nonverbal communication–gait, or the way a person walks–and perceptions of that walker's vulnerability. To accomplish this, I use an experimental design in which participants are randomly assigned to watch short clips of different walking styles. The current study asks participants to rate how easy it would be to overpower the subject in the video. I assert that people will perceive differences in subject vulnerability based on their walking style despite the lack of contextual information.

Useful Information

Before beginning, I want to preemptively introduce some terms and tools that appear throughout this document. Each term is discussed in additional detail within its dedicated section–including an explanation as to how and why they were chosen. This section is included to familiarize the reader with the language used and to begin organizing thoughts

around these concepts.

First, this paper discusses two independent experimental studies. These are identified as *Study 1* and *Study 2*, and are described in additional detail in *Chapter 4 – Methods*. Given the experimental design of the two studies, participants were randomly assigned to the *Organized* and *Disorganized* movement conditions. These concepts are described within the *Movement Organization* section of *Chapter 2 – Literature*. However, for now, a working definition of these experimental conditions would be:

- *Organized* — A walking style characterized by movement one would *expect* to see. This style is efficient and smooth–the entire body works together to accomplish the movement.
- *Disorganized* — A walking style characterized by disjointed, or unexpected movement patterns. This style is less efficient and may appear choppy — movement is accomplished via individual body parts, rather than the entire body.

These terms indicate I will be evaluating the impact of different walking styles. In addition, they introduce a level of complexity regarding *who* I reference within certain sections of the paper. I want to emphasize that this process requires an observer and a subject. Therefore, to delineate these two, I use the terms *Walkers* and *Participants*. *Chapter 4 – Methods* presents the procedures both participants and walkers completed over the course of the study.

- *Walkers* — The individuals (2) who were recorded walking to create the experimental conditions. These individuals are the subjects seen in the video footage by participants.
- *Participants* — The individuals who completed the survey. These are the observers. They watch and score the video footage. The results and discussion sections present their perception of the walkers.

Next, I want to introduce the terms used to describe materials participants observed during

this study. Because my treatment condition involves different styles of *movement*, I needed a way to isolate the movement of a walker. To accomplish this, I created a *point-light video* from traditional, *full-light video* footage (Atkinson, Dittrich, Gemmell, and Young, 2004; Ross, Polson, and Grosbas, 2012; Johansson, 1973).

- *Full-light video* — This is video footage as one would normally see it. There is a background and a subject. No visual information is withheld from the viewer. These videos could also be referred to as traditional video footage because they are unedited versions. However, for the purposes of clarity and to clearly indicate why this footage differs from point-light, I refer to them as full-light.

- *Point-light video* — Video footage in which the majority of the screen is black. The only visual information provided to the viewer is twelve (12) white points of light (hence, point-light) that move together across the screen. The points of light correspond to walkers' primary joints and show movement, stripped of any contextual information.

These terms introduce how I control the amount of information participants are able to use as they form perceptions of the walkers. Research demonstrating the validity and example use cases of point-light video footage is presented in *Chapter 2 – Literature*.

Next, I want to introduce the different contextual information participants will have access to when they view the full-light videos. To evaluate the impact of place, I filmed the experimental walking conditions in two locations. These are identified as *Block A* and *Block B*.

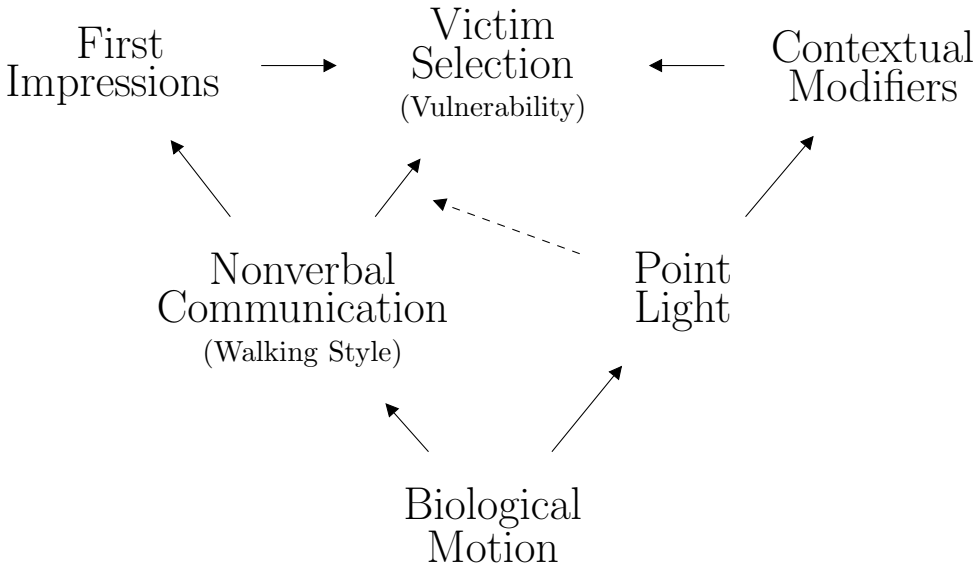
- *Block A* — This location is characterized by low levels of disadvantage. It has maintained homes, cars in lots, a lack of graffiti, and clear guardianship boundaries.

- *Block B* — This location is characterized by higher levels of disadvantage. On this block, one can see graffiti and broken window shutters. It is alley-way like and thus has lower visibility.

How these locations were selected and used is explained in further detail in *Chapter 4 – Methods*.

Finally, I want to briefly present the full-size and miniature versions of the literature map. The current project pulls research from a variety of different disciplines, and understanding how each of the concepts presented within this document work together can be challenging. I include a literature map to demonstrate the interdependent areas of research that work together to build the foundation for the current project. This map is presented in Figure 1.1.

Figure 1.1: Project Map Demonstrating the Connections Between Areas of Research



In addition to this full-size literature map which will be fully presented and discussed in future sections, a smaller version of this map will follow readers through the literature. An example of the mini-map is presented in Figure 1.2 (Next page). Note that the titles of each research area shorten to two letters. This naming convention will also be presented within the main document. In addition, each mini-map will correspond with a footnote describing how that piece of the literature fits within the broader picture.

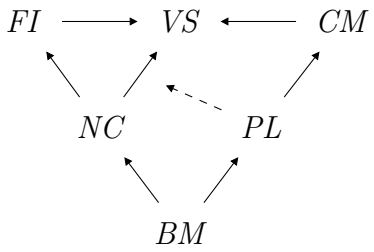


Figure 1.2: Mini Map - *Example*

It is worth noting that these figures do not represent a path diagram and current project is not going to test the relationships between these different areas. Rather, this map demonstrates the multi-layered nature of the current project and emphasizes the variety of variables that must be considered when seeking to evaluate perceptions of vulnerability. Exactly how these areas interconnect unfolds over the course of *Chapter 2 – Literature* and is summarized in *Chapter 3 – Current Study*.

Armed with this information, I hope there are fewer surprises as we proceed through the document. We will now delve into the meat of the literature and begin parsing apart the process of victim selection–beginning with the moment of a first encounter.

Chapter 2

Literature

First Impressions (*FI*)[1]

> Think back to when you first met a long-term friend. What was your initial impression of them? Did you perceive them as confident or shy? Trustworthy or deceitful? Laid-back or high-strung? Over the course of your friendship, have your opinions changed?

Perhaps the best place to begin, is where everyone begins: with a first impression. In the time it takes to blink–approximately 100 milliseconds (Bristow, Frith, and Rees, 2005)–a first impression has already formed (Willis and Todorov, 2006). While this may seem irrelevant, victim selection does not exist within a vacuum. Therefore, I want to start at the beginning, with the first encounter and the formation of an impression.

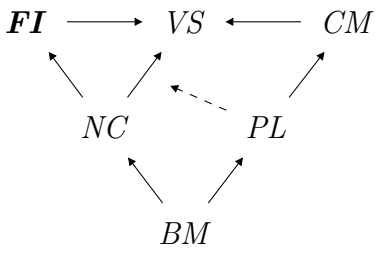


Figure 2.1: Mini Map - *FI*

[1]The focus of this section is to outline how individuals perceive someone they have never met. This section demonstrates that the process of developing an opinion about someone–such as whether or not they would be a good person to rob or attack–relies on the ability to form first impressions.

The Dual Lens Model describes first impressions as judgments made about another person at zero acquaintance–as in, based on no prior interaction between the observer and the subject (Hirschmüller, Egloff, Nestler, and Back, 2013; Kruglanski and Orehek, 2007). These judgments are often fast (Willis and Todorov, 2006; Bar, Neta, and Linz, 2006), reliable across observers (Willis and Todorov, 2006; Thorsen, Vuong, and Atkinson, 2012), and can be consistent with the subject's self-image (Hirschmüller et al., 2013; Carney, Colvin, and Hall, 2007). The characteristics one can perceive include–but are not limited to–traits like attractiveness, extroversion, aggressiveness, competence, and trustworthiness (Todorov, Mandisodza, Goren, and Hall, 2005; Kalma, 1991; J. P. Wilson and Rule, 2015). It is even possible to form these opinions of others based on limited information like a picture of someone's face or a short video clip (N. O. Rule, Adams-Jr, Ambady, and Freeman, 2012; Dhall and Hoey, 2016; Carney et al., 2007).

A tenth of a second may seem like an insufficient amount of time to determine if someone is trustworthy, however more time does not assist in developing a more reliable first impression (Willis and Todorov, 2006). Instead, when provided with additional time–1 second, 5 seconds, or 10 seconds–people simply become more confident in their original guess (Willis and Todorov, 2006). This, along with other research, suggests that first impressions may be intuitive (Winston, Strange, O'Doherty, and Dolan, 2002; Engell, Haxby, and Todorov, 2007; Schiller, Freeman, Mitchell, Uleman, and Phelps, 2009) and difficult to change once formed (Rabin and Schrag, 1999).

First impressions about personality (i.e., extroversion, kindness, etc.) appear to be the easiest to make (Bar et al., 2006; Hirschmüller et al., 2013). Personality judgments maintain the highest correlation between observers (Hirschmüller et al., 2013)–meaning if one person believes someone is extroverted, others likely do as well. Judgments about intelligence, by contrast, are less consistent across observers (Bar et al., 2006). The differences in the reliability of these first impressions is likely due to cue availability. Specifically, cues indicating

personality traits (i.e., clothing choices, eye contact, speaking volume, etc.) may appear more often–or may be easier to identify–than cues indicating intelligence (Bar et al., 2006).

A cue is a piece of information perceived by an observer to form a first impression. The types of cues, and the stimuli used to perceive them, are as varied as the first impressions they shape. Past research studying first impressions have provided participants with descriptions of a person (Kelley, 1950), pictures of neutral facial expressions (Bar et al., 2006), video clips (Thorsen et al., 2012), handshakes (Chaplin, Phillips, Brown, Clanton, and Stein, 2000), and even pictures of someone's room (Gosling, Ko, Mannarelli, and Morris, 2002). Each of these materials result in consistent observer rating, though some methods appear to result in more reliable and accurate ratings than others. These differences may be due to amount and of information gleaned from each. For example, pictures of someone's living space provide less direct information about the individual than a handshake or a video clip. Likewise, watching someone walk in a video does not provide as much information as watching them give speech.

Despite this, first impressions are reliable enough that researchers were able to develop a linear model that can predict first impressions of faces (Vernon, Sutherland, Young, and Hartley, 2014). This does not mean, however, that first impressions are immovable. Small changes–such as wearing a light blue shirt versus a bright blue shirt–can correspond to significant differences in a first impression (Pazda and Thorstenson, 2019). Color may even shape the perception of another individual dramatically enough to impact contests between people (Hill and Barton, 2005). Moreover, although subjects and observers can reach agreements in regards to self-image and judgments, first impressions are not always accurate (Todorov and Porter, 2014; Carney et al., 2007).

The impact of a first impression extends beyond the first meeting. Kelley (1950) demonstrated that a favorable first impression of someone was associated with more warm and enthusiastic treatment of that person. This means that judgments made in the first 100ms of meeting someone can shape real-world behavior events. This may be in the form of

classroom-based settings, such as students forming a first impression of a professor as either warm or cold based on a description, and then perceiving them as a more effective teacher (Widmeyer and Loy, 1988). However, these real-world consequences can also extend to government elections, as perceived levels of competence have predicted several senate elections (Todorov et al., 2005; N. Rule and Ambady, 2010).

First impressions have even been shown to shape criminal justice related outcomes. For example, first impressions can impact court decisions. Defendants with baby-faced features tend to receive more lenient sentences (Zebrowitz and McDonald, 1991). Likewise, defendants perceived as more trustworthy need more evidence to arrive at a guilty verdict (Porter, ten-Brinke, and Gustaw, 2010) while less trustworthy faces may be associated with a higher likelihood to receive a death sentence (J. P. Wilson and Rule, 2015).

The majority of the literature on first impressions does not consider offenders or their first impressions of a potential victim. Despite this limitation, it is unlikely that offenders would not form similar perception-based judgments of someone they just met. Rather, it is more likely that offenders differ in the cues they focuses on and the traits they judge from those cues.

Nonverbal Communication (NC)[2]

> Think back to voiceless childhood cartoons or silent films. How did you know when the characters were thinking? How did you know what they were feeling? With their exaggerated facial expressions and over-the-top gestures, it was likely easy–intuitive, even–to understand the inner-workings of these voiceless-characters. They did not need to *tell* you how they felt, you could perceive it.

The idiom *"Don't judge a book by its cover"*, warns against judging the internal contents of something using external cues. Yet external cues are often the only pieces of information available to form a first impression. Given that first impressions are likely automatic (Winston et al., 2002; Engell et al., 2007) and occur without one's intent (Miller, 1998), is it possible to not judge a book by its cover? Book covers are often intentionally designed to convey something–a feeling, a theme. The cover of a book can help a reader infer the type of story they'll find within its pages. This section discusses the human book cover–the external cues observers use to form inferences about us.

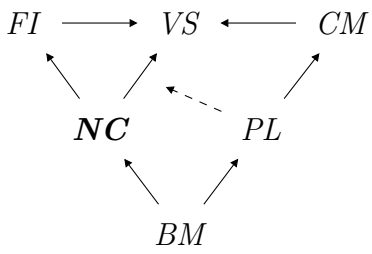


Figure 2.2: Mini Map - NC

In the previous section, I outlined some of the materials used to measure first impressions–video clips, pictures of faces, and handshakes. Now, I want to discuss how (or why) those materials allowed people to form first impressions. Therefore, this section is less concerned with demonstrating that nonverbal communication is real. Rather, this section focuses on demonstrating the implicit use of nonverbal communication and the implications of that use.

[2]This section outlines some of the factors that contribute to the formation of a first impression. It shows how nonverbal communication provides the information an observer uses to form a first impression. In addition, it demonstrates that these impressions form without any verbal exchanges. Given this, this section demonstrates that nonverbal communication impacts first impressions and the victim selection.

The actual words someone says account for only seven percent (7%) of communication (Mehrabian, 1972; Mehrabian and Ferris, 1967).[3] The remaining ninety-three percent (93%) comes from vocal sounding, facial expressions, and body language. Given this, the majority of information communicated from one person to another relies on nonverbal cues.

Mandal (2014) described nonverbal behavior as "all communicative acts except speech" (p. 418). This includes behaviors ranging from gestures, body movements, and posture, to tone of voice, facial expressions, and audible pauses. Depending on the field, researchers may narrow the scope of what constitutes nonverbal communication (Abercrombie, 1968). Despite these differences in classification, however, walks appear to remain a valuable avenue to understand an individual's inner-state (Harper Jr, 2006).

Facial expressions originally were thought to be universal (Ekman, 1970). However, recent evidence suggests cultural differences in the regions of the face people attend to (Jack, Blais, Scheepers, Schyns, and Caldara, 2009). Despite this, facial expressions appear to elicit automatic, unconscious responses from others. Dimberg and colleagues (2000) demonstrated that when observers looked at facial expressions of different emotions, the observers' face often mirrored the subject's. Moreover, these participants were only shown glimpses of happy and angry faces–30 milliseconds, too short of a time to consciously perceive the emotion. This means that people unconsciously mirror the facial expressions of others, even before they have comprehended the emotion they've seen (Dimberg, Thunberg, and Elmehed, 2000).

Nonverbal communication is so second-nature that when provided with conflicting sources of verbal and nonverbal information, people often become uncomfortable (Johnstone, van

[3]The interpretation and accuracy of this statistic has been called into question several times (Lapakko, 2007; Lapakko, 1997). Many of the critiques regarding the limitations in Mehrabian and Ferris's 1967 original work are valid and should be considered. Given this, I want to specifically address the concern that this statistic implies verbal communication (i.e., the actual words) is unimportant in the communication of an idea or feeling. That is *not* the intended take-away from these findings. Instead, these numbers indicate that *how* someone says something (i.e., tone, audible pauses) often tells a listener more about the speakers' perception of that idea than the words themselves. Likewise, this number points to the vast amount of information one can gather about the inner-state of individuals simply by watching them (i.e., body language, facial expressions).

Reekum, Oakes, and Davidson, 2006; De Gelder and Vroomen, 2000; Creed and Beale, 2008). To demonstrate this, Creed and Beale (2008) exposed participants to incongruent verbal and nonverbal stimuli. They used four animated clips depicting four emotion-dimensions (happy, warm, neutral, concerned) and four audio clips corresponding to the same emotion-dimensions. They found the mismatched inputs resulted in participants experiencing cognitive dissonance. They include qualitative reports of participants explicitly disliking the conflicting sources of information.

To understand how uniquely uncomfortable communicating without the help of nonverbal cues is, one need only look at the recent innovations in technological communication. Text messaging, instant messaging, and other text-based communication can be difficult to interpret. If the message includes layers of emotion or sarcasm, it becomes even trickier. As people moved further away from traditional forms of communication (as in, communication where nonverbal cues were present) to these newer communication strategies, they created new ways to communicate emotion and tone (Tang and Hew, 2018). These new text- and image-based forms of nonverbal communication continue to change as technology continues to develop. However, within the last several decades, text-messengers have used a variety of cues like text-based smilies [e.g., >:P and ¯_(ツ)_/¯ and (ノ°□°)ノ ︵ ┻━┻] and emojis [e.g.,  and  and ] to signify tone, all the way to using .png and .gif attachments as an image-based signal of their reactions (Lo, 2008). These non-text, text-based forms of communication can even be used in place of actual words and sentences (Tang and Hew, 2018).

The interpretation of nonverbal communication, however, is not universal. All communication requires a mutual understanding of the symbols, gestures, and language being used (Wiener, Devoe, Rubinow, and Geller, 1972). The acquisition of language (even a nonverbal form) is often unconscious and intuitive. It is through experience that we learn how the body communicates (Mandal, 2014). However, this also means that nonverbal communication is

subjective and depends upon one's past experiences. This can result in the same signal being perceived differently based on culture or up upbringing.

In some cultures are more accepting of physical contact and prefer a shorter distance between themselves and another individual (Remland, Jones, and Brinkman, 1995). In others, that closeness and familiarity may be perceived as an invasion of personal space. Neither interpretation is more or less correct. Differences in the interpretation of nonverbal communication also exist for cues like eye contact (Watson and Graves, 1966) and even smiles (Matsumoto and Kudoh, 1993). Given the differences in decoding, external cues (nonverbal communication) can become misinterpreted or get lost in translation. Therefore, one's perceptions of a situation or person do not always align with reality.

Given that nonverbal communication is dependent upon interactions with other individuals, different people may perceive the same cue differently. These concerns can even extend to within-culture and within-situation differences in the perception of nonverbal communication. Consider, for example, new mothers with depression, anxiety, or post-traumatic stress disorder. When interacting with their new born, they tend to accurately perceive negative emotions, but struggle to identify positive emotions (Webb and Ayers, 2014). Likewise, some individuals in leadership positions are more likely decode neutral and positive cues as signs of social disapproval (Case, Bae, Larsen, and Maner, 2021).

The impact of these small differences in the interpretation become more apparent with offenders. Street culture (Anderson, 2000) is rampant with differently-coded nonverbal communication. Seemingly innocuous signals (i.e., eye-contact, body posture, etc.) can be perceived as significant, personal slights that demand a response. Even the speed at which one walks an be interpreted in different–or opposite–ways (Topalli, 2005). This suggests offenders entrenched within street culture may interpret nonverbal communication differently from non-offenders (Anderson, 2000). Other research has also suggested offenders are more likely to perceive ambiguous stimuli as angry or aggressive (Schönenberg and Jusyte, 2014;

Wegrzyn, Westphal, and Kissler, 2017).

Victim Selection (*VS*)[4]

> It's time to purchase a car. How do you decide which to buy? Perhaps you'll list preferences regarding the style, features, or gas mileage. Perhaps you'll juggle the price and practicality. Like you selecting a car, an offender also has criteria influencing their decision. "Although these offenders [have] little difficulty identifying the characteristics of a perfect victim, it is important to remember that they [are] expressing preferences, not precise selection criteria" (p. 70, Wright and Decker, 1997).

To best discuss the victim selection literature, I have broken this section into several parts. First, I outline two theoretical perspectives. While the current project does not test a specific theory, these theories inform much of victim selection literature and, therefore, will provide a framework for the present work. Moreover, theory can provide a useful framework to understand how and why different variables influence the victim selection process.

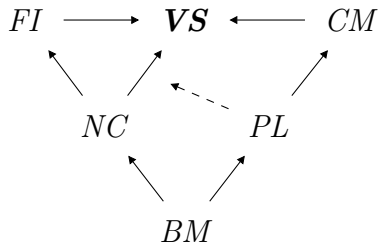


Figure 2.3: Mini Map - *VS*

Following the theoretical overview, I discuss the primary variable of interest for the current project: the perception of vulnerability. To demonstrate the importance of this concept in relation to victim selection, I present the results of past research and center vulnerability in their discussion.

Finally, I outline the impact nonverbal communication has on the victim selection process. In doing so, I provide further evidence of the relationship between movement and perception.

[4]This section discusses the concept of victim selection as a whole. It shows how victim selection depends on nonverbal communication and works through the process of first impressions.

The implications of this association and how it may impact the victim selection process is discussed.

Theoretical Perspectives

Several theoretical perspectives inform the majority of the victim selection literature. These include the structural-choice model (Miethe and Meier, 1990, social interactionism (R. B. Felson, 1993, Luckenbill, 1977), and target congruence (Finkelhor and Asdigidan, 1996, Finkelhor, 2008). To provide a framework for discussing the impact of different variables on the victim selection process, I discuss two of these theories.

The process of selecting a victim for one crime-type likely differs from processes used in other crime-types. This is best demonstrated using the car-shopping example: If someone purchasing a car plans to use it to haul large amounts of material, they are unlikely to begin their search with two-door convertibles. Instead, they may look at a pickup truck or a minivan–depending on their other needs and preferences. Compare their search-pattern to someone who instead wishes to drive fast and make sharp turns: This individual needs to look for something low to the ground and relatively light. Just as these car-shoppers intuitively narrow their selection, offenders steer themselves towards a target based on their purpose. Someone looking to commit identity fraud must first find a target that approximates their physical appearance (Copes and Vieraitis, 2012). Sex offenders, by contrast, may look for a target that meets their sexual preferences (Stevens, 1994; Beauregard, Proulx, Rossmo, Leclerc, and Allaire, 2007).

Given this, the theories developed to explain stranger-based crimes may not generalize to other crime-types (R. B. Felson, 1993; Dugan and Apel, 2005). The current project focuses on zero-acquaintance perceptions of individual's walking-styles. Thus, I summarize those theories most often used when discussing crimes where the offender and the victim have little to no prior acquaintance.

Structural-Choice Model

The structural-choice model (Miethe and Meier, 1990) proposes that victim selection includes 2 steps. As the name suggests, these steps involve (1) a structural component, and (2) a choice component. This model of victim selection builds upon lifestyle and routine activities theories (Hindelang, Gottfredson, and Garofalo, 1978, Cohen and Felson, 1979). As such, the structural-choice model is best suited for explaining predatory stranger crimes. In these types of crimes, offenders are opportunistic and a specific victim is not necessary. Victims are substitutable as long as they meet the criteria an offender is looking for (R. B. Felson, 1993, Dugan and Apel, 2005).

Under the structural-choice framework, to become a victim, one must first come into contact with an offender (Miethe and Meier, 1990). The likelihood of encountering an offender, however, depends on one's proximity and exposure to potential offenders. These two factors (proximity and exposure) make up the structural part of this theory. An individual's proximity (physical closeness) and exposure (physical availability and accessibility) to offenders can depend on their lifestyle, location of residence, and everyday activities (Cohen, Kluegel, and Land, 1981). These factors, however, do not directly impact an offender's decision-making process. Instead, they lay the foundation for an offender and victim to come into contact. Thus, proximity and exposure create the structural opportunity for crime to occur.

The second step in the structural-choice model requires the offender to choose the individual as a victim. In other words, while proximity and exposure may create an opportunity, an offender must exercise choice and select the victim. To make this choice, offenders consider a target's attractiveness and level of guardianship (Miethe and Meier, 1990, Cohen et al., 1981). Guardianship is a unique concept, with a vast amount of literature discussing its impact on the offender decision-making process (refer to Wilcox, Madensen, and Tillyer, 2007; Reynald, 2010; Hollis-Peel, Reynald, and Welsh, 2012). For the purposes of the current project however, I'm going to focus on the concept of target attractiveness.

Target attractiveness, according to Cohen and Felson (1979), refers to the value of a target and the relative difficulty (i.e., likelihood to resist) of a target. The characteristics an offender may consider high-value, or indicative of high-value, can differ (Cohen et al., 1981; Cornish and Clarke, 2008). The characteristics an offender considers indicative of a low-difficulty target, by comparison, appear to be more consistent.

Target Congruence

The target congruence framework was introduced as an alternative to Cohen and Felson's (1979) concept of target attractiveness. This perspective discusses the congruence (or overlap) in what an offender is looking for and the characteristics a potential victim possesses. Target congruence includes three components: (1) target gratifiability, (2) target antagonism, and (3) target vulnerability (Finkelhor and Asdigidan, 1996, Finkelhor, 2008). Similar to the target attractiveness within the structural-choice model, target congruence characteristics may vary by crime type and offender.

Target gratifiability refers to the characteristics or possessions that increase the value of a target (Finkelhor and Asdigidan, 1996). These characteristics may be demographic information like age or sex (Cooper, Selwood, and Livingston, 2008; Miller, 1998). They may also be the valuables an individual has at the time of the crime (Copes and Vieraitis, 2012; Miller, 1998). Regardless, a target perceived to be more valuable, under this framework, is more likely to experience victimization.

Target antagonism refers to an individual's characteristics or behaviors that provoke an aggressive response or reaction from an offender (Finkelhor and Asdigidan, 1996). This does not always refer to victim-instigated crimes. In these cases, these characteristics may be things like race or sexual orientation in the commission of a hate crime (M. M. Wilson, 2014). Likewise, a child's ADHD symptoms may invoke parental abuse (White and Buehler, 2012), and age-related illnesses in an elderly family member may increase the likelihood of

elder abuse (Cooper et al., 2008; Jeary, 2005).[5]

Finally, target vulnerability refers to one's relative ability to deter victimization (Finkelhor and Asdigidan, 1996)–in whatever way that may be. Some examples may include offenders looking for a victim smaller than they are (R. B. Felson, 1996), under the influence (Wright and Decker, 1997), or less assertive (Stevens, 1994, Wright and Decker, 1997). It is important to keep in mind that any single characteristic may fit within several of these categories. Offenders who target children, for example, may do so because they are a high value target. Alternatively children are more vulnerable compared to adults.

Victim Selection and Vulnerability

Offenders juggle a variety of competing goals. When selecting a victim they wish to maximize their reward while minimizing their effort. However, reward and risk can work in different directions. A high-reward target may correspond to a higher risk of getting caught. Many of the cues used to inform an offender's perception of the target's value (i.e., sex, race, etc.) also inform a targets' risk. The current efforts do not test any concepts relating to target value so I do not explore this concept further. The attributes that impact the perception of a targets' vulnerability (i.e., the lack of risk a target poses to an offender) are discussed herein. Rather than present a list of characteristics and how these impact perception, I break this section into themes of vulnerability and discuss some characteristics that can contribute to those perceptions.

Offenders tend to select victims based on the assumption that they would be vulnerable, or an easy target. For example, the perception of a target's vulnerability was more important to rapists than other attributes like appearance (Stevens, 1994). When describing an "easy

[5]It is worth noting that none of these findings or theoretical perspectives support victim blaming. Rather, these things can provide explanations as to *why*, or how, an offense occurred. These explanations do not shift the blame from an offender to a victim. An individual's behavior and characteristics do not excuse another person from offending against them. For more information on victim blaming, refer to Eigenberg and Garland (2008).

victim", offenders tend to concentrate on four things. According to offenders, an easy victim is someone who (1) is unlikely to resist (Wright and Decker, 1997; Stevens, 1994), and even if they resist, (2) is easy to intimidate or overpower (Brookman, Mullins, Bennett, and Wright, 2007; Stevens, 1994). Moreover, an easy victim is someone who (3) is unlikely to call the police (Wright and Decker, 1997; Jacobs, 2000; Miller, 1998), and (4) is easy to manipulate given their situation or behavior (Wright and Decker, 1997; Piquero and Hickman, 2003; Egan and Perry, 1998).

Someone unlikely to resist.

Victim resistance is, by and large, one of the key things offenders wish to avoid (Wright and Decker, 1997, Shrover, 2018, Jacobs, 2000). After all, "there is nothing to be gained and potentially much to be lost by having to struggle with a resistant victim" (p. 87, Wright and Decker, 1997). Victim resistance threatens the goals of the offender in several ways. Resistance increases the likelihood of passer-by intervention, being spotted or caught, and physical injury to the offender by forcing offenders to spend more time on a crime event. Given this, many offenders look for those individuals they believe will be compliant and cooperative (Wright and Decker, 1997; Jacobs, 2000; Beauregard et al., 2007). Moreover, in the event an offender cannot find someone unlikely to resist, research suggests offenders preemptively address and respond to resistance with higher levels of violence and aggression (Lindegaard, Bernasco, and Jacques, 2015).

On average, white individuals are characterized as less likely to resist compared to people of color. In both street robberies and prison environments, offenders described white victims as less prone to resistance than black victims (Wright and Decker, 1997; Human Rights Watch, 2001). Some robbers attribute this to the difference in socio-economic status. They suggested that white people can regain whatever was stolen from them more readily than people of color (Wright and Decker, 1997). When considering sex, some offenders believe

that women resist less often than men (Wright and Decker, 1997). However, there is variation here, as some offenders suggest women become hysterical and get too loud when they panic. Finally, both younger and older age groups are described as less likely to resist (Wright and Decker, 1997; Miller, 1998; Jeary, 2005). This may be due to a variety of factors including the victim's dependence on the caregiver/offender (Cooper et al., 2008; Finkelhor and Asdigidan, 1996; Daly, Merchant, and Jogerst, 2011). Children, especially, are less likely to resist due to their social power imbalance (Piquero and Hickman, 2003) and the social conditioning to obey the commands of adults (Stevens, 1994).

Offenders also pointed to behaviors that decrease one's ability or likelihood to resist. Intoxicated individuals, or people under the influence of some substance, tend to lack the capacity to fight back for example (Wright and Decker, 1997). Given this, offenders would sometimes target drug users (Wright and Decker, 1997). Finally, offenders sometimes target individuals they perceive as less assertive or having a compliant personality (Stevens, 1994). These two characteristics, however, are perception based and thus require the offender to make a judgment.

Someone easy to intimidate or overpower.

Many of the same characteristics that influenced the perception of resistance can also apply here. However, how those characteristics impact this form of vulnerability differs. This form of vulnerability almost serves as a back-stop if an offender failed to identify a victim that wouldn't resist. In other words, in the event that a victim does resist, an offender wants to mitigate the potential consequences of that resistance. To do this, offenders tend to select victims they perceive to be smaller or weaker than themselves (R. B. Felson, 1996; Wright and Decker, 1997). If this proves difficult, offenders also increase their relative power by using a weapon (Wright and Decker, 1997).

On average, women, children, and the elderly are perceived as more vulnerable than men.

Many offenders describe these groups as easier to intimidate and overpower (Stevens, 1994, Wright and Decker, 1997; Jones et al., 2012). However, this may violate an offender's moral code (Wright and Decker, 1997; Brookman et al., 2007), and they may instead rely on weapons to target individuals that pose more of a threat to them. Given the association between victim resistance and offender weapon use (Lindegaard et al., 2015), the inclusion of a weapon in an offense corresponds to an offender's desire to more easily intimidate or overpower their victims (Kleck and DeLone, 1993; Luckenbill, 1981).

Someone unlikely to call the police.

Another defining feature of an easy victim are those individuals unwilling (or unable) to call the police (Wright and Decker, 1997; Jacobs, 2000; Miller, 1998). Other offenders, for example, are unlikely to call the police even if they've been victimized. In addition to the subculture pressure to not 'snitch' (Anderson, 2000), offenders often do not want police involved due to their own criminal behavior (Wright and Decker, 1997). By targeting drug dealers, robbers can easily avoid police investigation. Criminal behavior can also interact with other characteristics. Some robbers state they target white drug users in predominately black neighborhoods. The logic here is that the victim would have trouble explaining to police why they were in that neighborhood without also incriminating themselves. Thus, deterring the likelihood of calling the police.

In some situations, men were considered less likely to call the police, making them a vulnerable target. For example, a married man hiring a sex worker provides an easy target for female robbers and prostitutes (Wright and Decker, 1997). Moreover, some of these women indicated that men were less likely to call the police simply due to the fact that they were victimized by a woman (Wright and Decker, 1997; Brookman et al., 2007).

However, there is a caveat to the vulnerability of criminal behavior. While offenders are less likely to call the police, they are much more likely to retaliate against an offender

(Wright and Decker, 1997; Jacobs, 2000). Given this, some offenders prefer to target non-criminals. This was due to the perception that non-offenders are less dangerous than their criminal counterparts. This evidence suggests that different offenders may find different characteristics indicative of higher vulnerability.

Someone easy to manipulate.

Finally, offenders suggest that some people may be more vulnerable due to their situations or behaviors making them easier to manipulate. For example, rapists specifically targeted some women by setting up a scenario in which they (the offender) appeared injured (Stevens, 1994). When their target (often a woman) came to help, they use the opportunity to attack them. The victim was manipulated into a dangerous situation because of their inclination to provide aid and assistance. Other examples include luring a victim to a car to save an animal trapped inside and threatening the victim's loved ones (Stevens, 1994).

Individuals with limited reasoning skills (i.e., young children, those with mental illness or disabilities) are also easier to manipulate (Jeary, 2005). Finally, as mentioned previously, some female robbers would target men because it was easier to manipulate them into a vulnerable position (Wright and Decker, 1997; Brookman et al., 2007; Miller, 1998).

Many of the characteristics mentioned can influence the perception of an individual in a variety of ways. Sometimes a single attribute can impact vulnerability in opposing directions. For example, while criminals may be less likely to call the police, they are also much more likely to resist victimization (Jacobs, 2000; Wright and Decker, 1997). Other times, attributes can stack multiple layers of vulnerability. For example, in addition to the perception that elderly individuals are less likely to resist (Wright and Decker, 1997), they may also be easier to overpower. Mover, their age may have made them dependent upon a caregiver, which may result in a decreased likelihood to call the police.

Despite the emphasis placed on identifying an easy target, however, it is important to keep in mind that these are preferences–not requirements. Overall, offenders appear willing to offend against almost anyone and are "drawn to exploit the vulnerability of others" (p. 71)–regardless of the form of that vulnerability (Wright and Decker, 1997).

Of course, possessing the characteristic associated with vulnerability does not guarantee victimization. Individual differences exist within every group. Offenders often try to target the most vulnerable individual within any group. As discussed previously, children are, on average, more vulnerable than adults for a variety of reasons. However, even among this vulnerable population, offenders most often target those children they perceive as the most vulnerable–specifically looking for those children with low self-esteem, had problems at home, or otherwise provided a way for the offender to manipulate them (Elliott, Browne, and Kilcoyne, 1995). How they identify who, within a group, is more or less vulnerable than another person, is the next point of discussion.

Victim Selection and Nonverbal Communication

Previous sections established that nonverbal communication can provide information about an individual (Mandal, 2014; Wiener et al., 1972). However, the literature focused on the interpretation of nonverbal communication within non-offending populations. I want to shift that focus and discuss nonverbal communication, its impact on the perception of vulnerability, and victim selection. Recall that the interpretation of nonverbal communication cues is intuitive (Willis and Todorov, 2006; Winston et al., 2002; Dimberg et al., 2000), culturally dependent (Remland et al., 1995; Watson and Graves, 1966), and not always accurate (Webb and Ayers, 2014; Case et al., 2021; Carney et al., 2007). Therefore, the cues discussed within this section may not apply to every situation or offender. Despite this, examining the way offenders' interpret nonverbal communication cues may provide insight to their decision-making process.

Many of the nonverbal cues offenders mention indicate some form of vulnerability. For example, individuals who appear distracted or as lacking situational awareness are often perceived as easier targets (Wright and Decker, 1997; Stevens, 1994). At times, this lack of situational awareness is the result of substance use. Other forms of nonverbal communication indicate to offenders a lower likelihood of resistance. For example, rapists describe individuals that avoid eye contact as being less likely to fight back (Stevens, 1994). Some robbers suggest that less street-savvy individuals are unlikely to resist. To gauge street-savviness, they describe looking at a subject's clothing and how they carry themselves (Wright and Decker, 1997; Richards, 1991).

One of the most studied forms of nonverbal communication brought up by offenders is the way a potential victim walks (Grayson and Stein, 1981; Blaskovits and Bennell, 2019; Book et al., 2013; Ritchie, Blais, and Forth, 2019). If one considers the amount of contact an offender often has with a potential victim, this seems logical. In zero-acquaintance stranger offenses (e.g., robbery) an offender likely cannot interact with a victim before the crime occurs. Given that many of the opportunistic, zero-acquaintance crimes occur in public spaces, where one can observe the presence of others but not interact, the way one walks is the primary source of information an offender can use to gauge vulnerability.

How offenders describe the way someone walks varies. For example, one predatory rapist described someone "walk[ing] on [their] heels and not [their] toes" (p. 425) as a signal they would be less likely to resist (Stevens, 1994). Some offenders focus on how individuals tilt their heads (Ritchie et al., 2019). Others described a nervous walk as an indicator of the valuables someone has on them, or as a signal that they would be easy to intimidate (Wright and Decker, 1997).

The earliest evaluation of the relationship between walking and victim selection, was conducted by Grayson and Stein (1981). Their work used a sample of inmates convicted of zero-acquaintance stranger assault. In this study, Grayson and Stein (1981) recorded ran-

dom civilians on the streets of New York City.[6] Inmates then watched these videos and rated the civilians on their assault potential.[7] It was found that more than half of the sample agreed on who was an easy potential victim. Based on this information, Grayson and Stein (1981) used Laban's (Laban, 1971) movement analysis code to compare the civilian's walks. They found significant differences in the walking style of those individuals identified as easy targets.

This study built the foundation of the walk-vulnerability relationship for subsequent research to expand upon. Since then, research has demonstrated that non-offending populations can accurately identify individuals who have experienced victimization by the way they walk (Denardo-Roney, Falkenbach, and Aveson, 2018). Research points to lower levels of movement synchrony (or organization) as a predictor of higher perceived vulnerability and lower perceived confidence (Winkel and McCormack, 1997; Gunns et al., 2002; Johnston et al., 2004). These findings suggests that the perception of an individual's vulnerability may correspond to how smoothly and naturally they carry themselves. Higher movement organization (or synchrony), therefore, may signal to offenders higher levels of confidence, athleticism, health, or energy–all of which may impact the likelihood of that individual to resist or cooperate. Furthermore, when provided the opportunity to explain what shaped their perceptions of vulnerability, Book and colleagues (2013) found offenders most often mentioned gait.

This evidence suggests that gait can influence perceptions of vulnerability. Unfortunately, due to the presence of confounding variables, much of this research is subject to threats to internal validity. For example, many of these studies used raw video footage to capture a subjects' walking style (Grayson and Stein, 1981; Wheeler et al., 2009; Book et al., 2013). This poses a variety of challenges. For example, it is not possible to ensure vulnerability

[6]The civilians were not aware they were being recorded

[7]The rating system was developed using a separate focus group of inmates asked to describe the videos in their own words. These descriptions were then synthesized to create a scale ranging from 1 (a very easy rip off) to 10 (Would avoid it, too big a situation. Too heavy.). This scale was the one inmates used to rate assault potential.

ratings based on gait were not influenced by other information in the video. This means that the subject's other characteristics (beyond their walk) may impact vulnerability ratings. As discussed earlier, attributes like sex, age, and physical stature can impact perceptions of vulnerability (Finkelhor and Asdigidan, 1996, Wright and Decker, 1997, R. B. Felson, 1996).

Some studies have started to address these concerns using point-light displays (Johnston et al., 2004; Gunns et al., 2002). By isolating the concept of movement, research continues to provide further evidence supporting the movement-perception relationship. These technological advancements and results coming from them are discussed in the following section.

Point Light (*PL*)[8]

> The human eye transmits nearly 10 million bits of information to the brain each second–approximately the same amount as an Ethernet connection. Light, motion, color. What happens when that information is controlled–limited to only movement? No color, no depth, no perception of location or identity. Would you still be able to perceive *what* was moving? Even if you couldn't *see* that thing?[9]

The previous section discussed nonverbal communication and its relationship with victim selection. In the current study, the relationship between movement and victim-selection focuses on gait–or how someone walks. Because movement is rarely seen in isolation, when someone observes walking they see the person and their characteristics. This means an observer has information beyond how the subject walks–they know the subject's sex, relative size, dress, and age, among a variety of things. This extra information may confound the impact of movement on perception and victim selection. To address this limitation, the current study uses point-light displays to isolate a subject's movement.

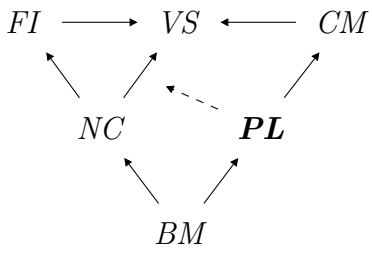


Figure 2.4: Mini Map - *PL*

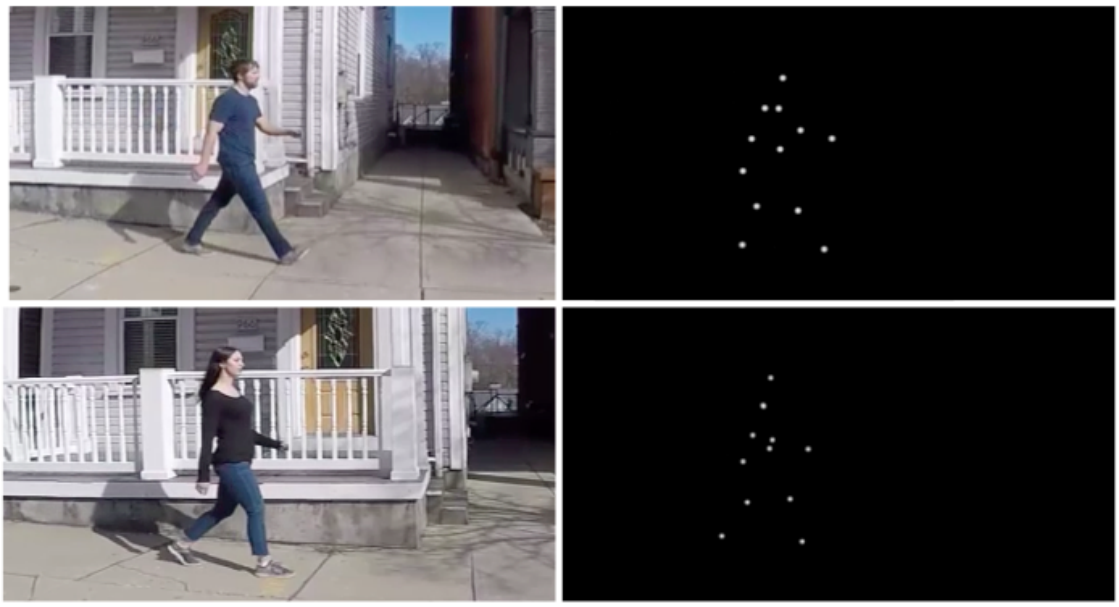
Developed by Johansson (1973; 1975), point-light displays reduce subject-specific information while retaining movement-specific information. Figure 2.5 presents an example of the differences between a full-light video (left) and a point-light video (right). In a point-light display, light points highlight the subject's joints and limbs against a black background. The

[8]Previous sections demonstrated how the relationship between nonverbal communication and victim selection has been explored. Much of that work is subject to threats from a variety of confounding variables. This section demonstrates how point-light displays can address many of these confounding variables by removing the contextual information from a video. Therefore, this section impacts the relationship between nonverbal communication and victim selection as well as the contextual modifiers (*CM*).

[9]This comparison was originally made by Koch and colleagues in 2006. Since then, technology has vastly improved. In 2021 an ethernet connection transmitting 10 million bits of information would be considered quite slow.

number and location of light points can vary depending on the intended use of the point-light display. For example, Tartter and Knowlton 1981 used 27 light points to capture dynamic displays of American Sign Language. By contrast, the point-light subject displayed in Figure 2.5 uses only 12 light points.

Figure 2.5: Comparison of Full- and Point-light Displays



By using point-light technology, researchers control the amount of information study participants can see. This process effectively isolates walking styles from other confounding factors. However, when one limits access to information, the concern becomes: how much information is too little?

Point-light displays can convey emotions such as grief, fear, and joy (Dittrich, Troscianko, Lea, and Morgan, 1996; Atkinson et al., 2004). To be effective, a point-light display requires movement (Atkinson et al., 2004). Observers who watch dynamic point-light displays of men and women walking can accurately identify the biological sex of the walker (Kozlowski and Cutting, 1977; Pollick, Kay, Heim, and Stringer, 2005). By contrast, static images of point-light displays do not provide sufficient information for observers to identify walker's sex (Kozlowski and Cutting, 1977). However, it makes sense for point-light displays to require movement. By removing all other contextual information, movement is the only

remaining form of information point-light displays can present. Additionally, because point-light displays include only dots and do not create a picture, they become ineffective when presented in a static form.

The amount of movement information needed to be effective depends on the concept being measured. For example, Kozlowski and Cutting (1977) demonstrated that dynamic point-light displays (i.e., videos) were necessary to distinguish the sex of a subject. Whats more, they found that by using a dynamic point-light display, only the light-points located on subjects' ankles were absolutely necessary. To accomplish this, Kozlowski and Cutting (1977) presented observers with multiple versions of a point-light display. Each version contained a different number of light-points. Some included light-points on the hands, elbows, knees, and ankles. While others only included light-points on the ankles. Based on this experiment, they found observers could differentiate walker sex using only 2 light-points. However, in this study, the outcome of interest was the accurate recognition of the walkers' sex. If the outcome of interest is sign language recognition, the point-light display requires many more light points (Poizner, Bellugi, and Lutes-Driscoll, 1981).

The number of light-points required to accurately depict a concept depends on its complexity. Point-light displays can convey enough movement-information for observers to distinguish their own walking and that of their friend's from strangers' (Cutting and Kozlowski, 1977). This suggests that movement is a rich concept with enough depth to allow viewers to form reliable judgments about subjects. Given the evidence demonstrating the validity of point-light displays, this technology is a viable tool to study victim selection. Several studies have looked at perceptions of vulnerability using walking and produced promising results.

In the first, Gunns and colleagues (2002) identified several walking-characteristics associated with higher vulnerability ratings. Walkers who took short strides, walked slower, and didn't swing their arms were rated more vulnerable by observers. By contrast, walkers who took longer strides, walked faster, and swung their arms were rated less vulnerable (Gunns et

al., 2002). A later study compared the walking-styles of three groups of women. These groups included: (1) women who had never taken a self-defense course, (2) women who had completed a self-defense course in the past six weeks, and (3) women who had completed a self-defense course in the past six months (Johnston et al., 2004). In this study, each woman was recorded walking twice. First, she would walked and receive no instructions. Then, the woman would be asked to imagine walking alone at night in the local park. With this imagined scenario in mind, she would be recorded a second time. When these recordings were compared, the researchers found that observers rated the walking-in-the-park as less vulnerable.

Recall that the women were not instructed to change how they were walking (Johnston et al., 2004). They were only told to imagine walking in a potentially less safe environment. This may suggest that the changes between the first and the second walk, were made intuitively. These intuitive changes resulted in measurable differences in observer-rated vulnerability. This findings suggest people may be somewhat aware of the nonverbal cues that can be expressed via walking. Furthermore, the individual-level adjustments in walking resulted in differences in perceived vulnerability. This provides further evidence to the movement-perception relationship and the validity of using point-light displays to measure said relationship.

Biological Motion (*BM*)[10]

> Extend your arm straight out in front of you so your arm and hand is parallel with the ground. Now bend at the elbow. This movement likely brought your thumb closer to your torso. *Why?* The simple answer is: Because that is how the elbow joint works, and there are *rules* to how bodies can move.

I have discussed how dynamic point-light displays remove contextual information from a video. This process leaves only the movement of a figure behind. However, the previous section only provides an explanation of the tool used to isolate movement. Now, I want to touch on how and why point-light displays work. Not how point-light displays function, per say, but why point-light display figures are recognizable and why their movements are understandable. To do this, the current section discusses biological motion. This is defined as the motion patterns characteristic of living organisms in locomotion (Johansson, 1973). In other words, the structure (how a body is put together) and function (the purpose that body part is intended to serve) of a body determines the path it can take through space (Johansson, 1973; Johansson, 1975).

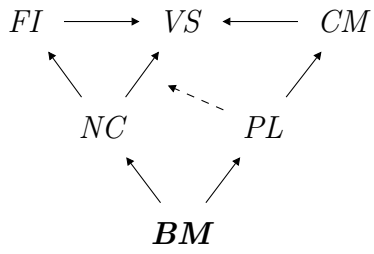


Figure 2.6: Mini Map - *BM*

Structure, here, refers to the shape of the bones that create a skeleton. The shape of a hip's ball-and-socket joint, for example, differs from the hinge-like structure of the knee. However, if one were to compare a hip's ball-and-socket joint to a shoulder's, they would observe more similarities in the shape of these joints. These similarities and differences correspond to the structure and function of that body part. Specifically, a ball-and-socket joint is "a partially spherical end lies in a socket, allowing multidirectional movement and rotation" (Ball-and-

[10]This section shows that biological motion is the underlying concept that allows point-light videos and nonverbal communication to work. Biological motion allows point-light videos to be perceived by an observer as something other than light-points moving across a screen. In addition, the ingrained ability to perceive and interpret biological motion allows for the complex and nuanced understanding of nonverbal communication.

socket joint, 2021). This structure creates the opportunity for certain movements that may not be available to other types of joints (i.e., hinge-joints like the knee or elbow).

Function, is defined as the "practical use or purpose in design" or the "activity that is natural to or the purpose of" a thing (Function, 2021). The function of hands, for example, is to grasp things (Seyffarth and Denny-Brown, 1948). This grasping behavior can change over time–from grasping a caregiver's hand, to grasping a tool. And the function of a body part can be adapted or applied to other activities–using one's hands to play a piano. By comparison, the function of legs is to carry a body forward.

The directionality in the relationship between structure and function, however, is unclear. Just as structure can shape function, function can shape structure. Great tits (*Parus major*) provide an excellent example of physiological structure changing to meet functional needs–through natural selection. Researchers observed that in the last several decades, great tit's beaks have naturally adapted to changes in their environment (Bosse et al., 2017). The variation in the structure of the birds beaks, they concluded, was due the much higher presence of bird feeders in the United Kingdom. In other words, great tits in the United Kingdom had more access to bird feeders than those in the Netherlands. This resulted in the birds in the United Kingdom naturally selecting for longer beak morphology (Bosse et al., 2017). While this process was also described by Darwin (1845), these recent changes in bill morphology demonstrate how much structure and function depend on one another.

While the structure of the human skeleton has not dramatically changed much in the past 200,000 years (Hershkovitz et al., 2018) [11], the concepts of structure and function still go hand in hand. To further illustrate the relationship between structure and function, Google's DeepMind AI provides an example of a humanoid figure learning to walk (Heess, TB, et al.,

[11]Preliminary evidence suggests the human skeleton may have begun undergoing slight changes in the past several decades. Namely, researchers observed a decline in the skeletal robustness in children born near the turn of the century (Scheffler, 2011, Rietsch, Eccard, and Scheffler, 2013). In addition to this, recent generations are more likely to have developed a small bump on the back of the head, just above the neck (Shahar and Sayers, 2018). These changes may be due to changes in lifestyle, including lower levels of exercise and spending extreme periods of time on technology devices.

2017; Heess, Merel, and Wang, 2017). In this project, researchers built an AI's physical form and structured it based on the human body.[12] Given this, the AI's figure must follow the same structural-rules as a human form (i.e., a ball-and-socket joint can move in multiple directions and rotate, while other joints cannot). The researchers incentivized the AI to move from one side of its computer-world to the other. Then, they set it free.

In this initial study, at no point was the AI taught or shown how to walk. But with enough time, and the computer's ability to learn from mistakes, it eventually learned to move (Heess, Merel, and Wang, 2017). And, given the structure of the AI's form, it learned an approximation of a human's walk.

Biological motion provides a framework to understand that movement is not random, but predictable. When movement aligns with predictions, observers can recognize the subject and the activity (Pinto and Shiffrar, 2009). The recognition of biological motion extends to other species and across age groups (Pinto and Shiffrar, 2009, Fox and McDaniel, 1982, Pavlova, Krägeloh-Mann, Sokolov, and Birbaumer, 2001, Ishikawa, Mills, Willmott, Mullineaux, and Guo, 2018). Children as young as three years old can identify and recognize humanoid figures versus from four-legged and winged creatures (Pavlova et al., 2001). Dogs recognize and attend to point-light displays of humanoid figures when the figure faces them (Ishikawa et al., 2018); and people can recognize a friend based on only their walk (Cutting and Kozlowski, 1977). These findings suggests that the perception of biological motion is an intuitive process, and recognition is not limited to distinguishing human-forms from non-human creatures.

These concepts of structure and function result in predictable patterns of movement. Biological motion provides a framework to discuss the relationship between movement and perception. The predictable nature of movement, and the intuitive process of perceiving that movement, I posit, shape how perceptions form.

[12]Google's DeepMind AI conducted these procedures using multiple figures. For the purpose of this discussion, I focus on the humanoid figure.

Movement Organization

(Excerpt from a scene in Monty Python's Fly Circus[13]*)*

Minister of Silly Walks: Good morning. I'm sorry to have kept you waiting, but I'm afraid my walk has become rather sillier recently, and so it takes me rather long to get to work. [*Sits at desk*] Now then, what was it again?

Mr. Pudey: Well sir, I have a silly walk and I'd like to obtain a government grant to help me develop it.

Minister: I see. May I see your silly walk?

Pudey: Yes, certainly, yes. [*Demonstrates walk*]

Minister: That's it, is it?

Pudey: Yes, that's it, yes.

Minister: Mmhmm. It's not particularly silly, is it? I mean, the right leg isn't silly at all, and the left leg merely does a forward aerial half-turn every alternate step.

Thus far, I've discussed the formation of first impressions, the use of nonverbal communication, and how these relate to victim selection. I introduced point-light displays to mitigate confounding variables, and that these work by relying on human's intuitive recognition of biological motion. However, the primary hypothesis of this project is that *different* walking styles impact the perception of vulnerability. In this section, I introduce the concept that creates these differences.

I discuss how and why a particular walk is predictable. Using this framework, I demonstrate a variety of ways one's predictions can be incorrect. Finally, I describe the concepts of movement organization and disorganization.

[13]This excerpt was compiled using the varying scripts presented by Another Bleedin' Monty Python Website, N.D. and TranscriptDB, N.D.. To watch this scene, refer to YouTube, 2016.

Mathematics of a Walk

In this section, I use the term correlation. This can be generally understood as the "a mutual relationship or connection between two or more things" (Correlation, 2021). However, the statistical definition of this term is also relevant for this discussion. Given this, a correlation coefficient is a summary value calculated using a large set of data that represents the level of of a linear association between two variables (Taylor, 1990). This measure tends to range between -1 and +1. A value of 0 indicates no correlation between the variables, while a value of 1 (positive or negative) indicates a perfect correlation.

On average, the majority of people walk in approximately the same way. One foot swings forward, then the other, followed by the original foot, and so on–left, right, left, right. At the same time, a person's arms swing back and forth on either side of their torso. People also tend to walk in the direction their shoulders are facing (i.e., walk forward, not backwards). While this description may seem obvious, the underlying mathematical components that allow this movement to occur efficiently are less so.

The correlation between certain body parts is stronger than others. Consider, for example the left and right foot. When one foot is moving the other is not. This results in nearly 0 correlation in their movement. If one considers the left foot and the left knee, however, its a different conclusion. Here, the left knee and left foot are physically attached via the shin-bones. Therefore, when one moves forward, so must the other. In this case, both objects (knee and foot) move in the same direction at the same time. This creates a positive (+) correlation between these body parts.

Now lets compare the left hand and the right hand. While one might assume a similar correlation as the left and right feet, this would be incorrect. In the case of feet, one foot must remain stationary to provide a basis of support. This way, when the non-stationary foot swings forward, the person's weight can shift from one foot to the next. By contrast, the left and right hands do not have to pause or stop moving. They also rarely move in the

same direction. For example, if someone's left hand is in-front of their mid-line, the right is often either down by their side or slightly behind them. When the left hand moves to swing backwards then, the right hand swings forward, the elbow bends, and now the right hand is in-front of their mid-line. These body parts move roughly at the same time, but in opposite directions. Therefore, for many people the left and right hand would likely have a strong, negative (-) correlation.

Finally, think about someone's right hand and left foot. These body parts are located on opposite sides of the body (left and right). Despite this, they often move in the same direction at the same time, and are thus positively (+) correlated. This is because as the foot on the left-side of the body swings forward, the hand on the right-side serves as a counter-balance to the shift in weight. In other words, the left foot has a positive (+) correlation with the right hand, and a negative (-) correlation with the left hand.

Imagine, for a moment, someone walking. Except, rather than their left-hand following the same movement-path as their right foot, they move both their right hand and right foot in unison. This imagined individual may appear unsettling or look odd. This may be due to the organization of the body parts' movements conflicting with what is expected of those body parts. It also happens to be 26% less efficient than the traditional (natural) form of walking (Collins, Adamczyk, and Kuo, 2009). It should be apparent, then, that just because something is contradictory or inefficient does not mean it is not possible.

With the understanding that there is a predictable mathematical relationship between body parts comes the realization that those predictions can be wrong. Some people naturally swing their arms less–this results in a weaker correlation between their feet and hands. Others may only swing one arm, which creates an asymmetrical correlation between the left-foot–right-hand and right-foot–left-hand. Some people may drag their feet, or favor a particular foot. These slight variations correspond to organized and disorganized movement patterns.

Organized and Disorganized Movement

Laban (Laban, 1971) provided a thorough framework for analyzing and describing movement. This framework guided several studies' interpretation of subjects walking (Grayson and Stein, 1981; Gunns et al., 2002; Johnston et al., 2004). In these studies, researchers watched and coded subject walking-styles (walks) based on a variety of movement categories. This process resulted in a variety of conclusions on what shaped a perceived vulnerable walk from a less vulnerable walk.

Vulnerable walks were characterized by motions where the limb or body part that was doing the movement (i.e., stepping forward) remained isolated to that body part. By contrast, walks perceived as less vulnerable involved motions that engaged the entirety of the body (Gunns et al., 2002; Grayson and Stein, 1981; Winkel and McCormack, 1997). The disconnectedness associated with vulnerable walks appeared in a variety of ways, including imbalances on the left and right side of the body, or as taking strides that were too-short or too-long for the individual's physiological structure

The specific characteristics associated with these walks is discussed in *Chapter 4 – Methods*. Within the current section, however, I want to emphasize that these studies–and Laban (1971)–often described movement with varying levels of synchrony (Grayson and Stein, 1981, Gunns et al., 2002, Winkel and McCormack, 1997). While this term (sycnhrony) may be a useful description within dance and mime, the term did not lend itself well to the current study. Therefore, I instead adopt Winkel and McCormack's (1997) use of the word organized. Therefore, **organized movement** (or, organized walks) is movement that follows the predicted, natural path of movement. Organized movement would, based on Laban's (1971) description, be high in movement synchrony. By contrast, **disorganized movement** is movement that deviates from the predicted, natural path of movement.

The predictable, natural path of movement would be the path that, on average, is most

efficient (Collins et al., 2009; Bruijn, Meijer, Beek, and van Dieën, 2010).[14] Given this, the term disorganized accurately describes that something within a walk is out of place. This may be the speed of the walk, or the foot-lift as a subject takes a step, or a mismatch between foot-hand pairings. Regardless, the moving object does not align with expectations.

To envision these concepts, look at examples of experts in movement-based professions– dancers, Olympic competitors, professional martial-artists. These individuals represent examples of extreme efficiency and high movement organization. For example, recent developments in motion capture technology allowed researchers to compare an Olympic runner to a unprofessional (hobbyist) runner (Mark, 2019). In doing so, they demonstrated differences in speed, stride-length, and posture. Motion capture technology is so useful in sports training that it and other fitness technology have become widely available (Zenia, 2021; Geroch, 2004).

Professional martial artists are another example of movement experts. When a boxer throws a punch for example, the movement involves far more than their hand. Instead, a professionally-thrown punch involves the shoulder, hips, and legs (Ishac and Eager, 2021; Gu, Popik, and Dobrovolsky, 2018). This, inter-connected, flowing organization of movement that uses the entirety of the body (hand, arm, torso, leg) creates organized movement.

To envision the concept of disorganized movement, by contrast, one might look at examples of individuals under the influence of alcohol. Excessive alcohol use can cause cerebellar ataxia which impacts the function of the cerebellum and causes impaired stability and declines in coordination (Fitzpatrick, Jackson, and Crowe, 2012). These individuals often exhibit disjointed, or jerky movements, and find it difficult to maintain their balance. This type of movement exhibits disorganization because it is unpredictable and diverges from natural movement patterns.

Keep in mind that these are extreme examples of movement dis/organization. Offenders

[14]This path likely includes slight variation for every individual due to individual differences in height, skeletal structure, etc.

are unlikely to encounter an Olympic runner when looking for a victim. The current work is interested in evaluating if small variations in the level of dis/organization correspond to differences in the perception of vulnerability. Given this, one must ask: What is organized movement a signal of? And likewise, what is disorganized movement a signal of?

Currently, it is not possible to conclude exactly what disorganized movement signals to offenders. However, past research may provide a preliminary understanding. Earlier, I outlined four themes of vulnerability. Accompanying this outline, was a discussion on the use of nonverbal cues in the victim selection process. This literature, can provide a framework for discussing potential explanations of how and why movement organization impacts the perception of vulnerability.

Organized movement may signal to offenders a level of physical capability. Because organized movements involve the whole body the walker may appear lighter on their feet, faster, or more alert. These characteristics could dissuade an offender looking for a person easy to overpower. Organized movement may indicate higher levels of self-confidence or assertiveness. If this is the case, disorganized walkers may appear to be individuals less likely to make noise or resist. Finally, it could be that disorganized movement is a signal of one's stress or fatigue in that moment. If disorganized walkers appear too tired, distracted, or upset to respond when put in a stressful situation offenders may perceive them as less likely to resist or easier to intimidate.

To conclude, based on previous research and the concepts discussed previously, the current project proposes that disorganized walks will signal higher levels of vulnerability. By contrast, organized walks will be considered less vulnerable.

Contextual Modifiers (*CM*)[15]

> If the color of someone's shirt can shape a first impression, wouldn't someone's surroundings color an offender's perceptions of that individual's vulnerability? Think back to your first time meeting someone. Would you have had a different first impression of them if you met at a library? Or a sports game?

Thus far, the discussion focused on how individual-level factors can shape victim selection. By individual-level, I mean the variable pertains to a person–either a subject/victim or a observer/offender. These variables include things like walking style (Gunns et al., 2002; Blaskovits and Bennell, 2019), gender (Wright and Decker, 1997; Stevens, 1994), and age (Finkelhor and Asdigidan, 1996; Jeary, 2005). Other examples include offender perceptions (Stevens, 1994; Grayson and Stein, 1981) and the type of crime committed (Cornish and Clarke, 2008; Copes and Vieraitis, 2012).

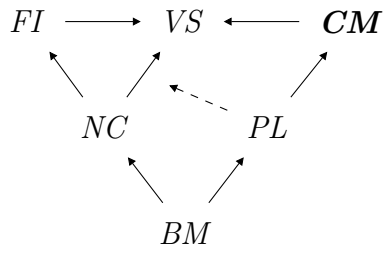


Figure 2.7: Mini Map - *CM*

Now I want to introduce another layer offenders may use to gauge an individual's vulnerability. Recall, from previous sections, the point-light study used to compare the vulnerability of womens' walks before and after they were prompted to think about walking alone in the park (Johnston et al., 2004). In this study, the women adjusted how they walked based on an imagined scenario. These adjustments resulted in significant differences in the perception of their vulnerability. This study demonstrates just one way that location may impact perceptions of vulnerability. Given the evidence indicating that walkers may understand certain locations can be more risky than others, this understanding may generalize to offenders as well. Put another way, an observer might perceive someone as more vulnerable when they're

[15]This section focuses on the potential confounding variables that may impact the victim selection process. It focuses on the environmental contexts, and characteristics beyond an individual's walking style. These are controlled for using the point-light displays.

walking alone at a park compared to walking through a store.

The criminology of place is an expansive literature that cannot be covered in its entirety here. Despite this, a brief overview should provide a framework for discussing the impact of context in the present study.

In interviews with armed robbers, Wright and Dekker (1997) found that in addition to deciding who to rob, offenders make decisions regarding where to look for offenders. In these interviews, offenders pointed to several factors they considered. These included (1) the risk of getting caught or seen, (2) whether they will stand out or appear suspicious, and (3) the likelihood of potential guardians to intervene.

To address the concern of getting caught or seen, offenders resorted to offending in places with lower visibility (Wright and Decker, 1997; Beauregard and Leclerc, 2007; Bennet and Wright, 1984). For robbers, this looked like offending at night in poorly lit areas. Burglars sought physical locations with obscured line-of-sight. To avoid appearing suspicious, offenders seek out areas where they fit in. A study using 12,872 Chicago-based robberies, found that robbers offend in census tracks where the population mirrors their own ethic background (Bernasco and Block, 2009). These preferences may be due to physical barriers (Brantingham and Brantingham, 1981; Lejeune, 1977) and offender's corresponding routines and awareness space (Bernasco and Kooistra, 2010). However, these preferences may also be due to social barriers (Bernasco and Block, 2009), and offenders may target those areas because they are less likely to be perceived as suspicious.

A variety of theories explain the relationship between places and the crimes that occur there, each garnering their own level of empirical support. These can be summarized as theories that posit that the physical characteristics of a location shape how that space is perceived and used. Broken windows theory (J. Q. Wilson and Kelling, 1982), optimal foraging theory (Bernasco, 2009), crime pattern theory (Brantingham and Brantingham, 1981), and defensible space theory (Newman, 1972) are all examples of this line of criminological thought. Of

these, Reynald (2015) provides a useful summary regarding the applicability of these theories to the current project. She describes the intervention opportunities of environmental design through two inter-related mechanism. First, environmental design can change an offender's perception of the effort or risk involved to commit a crime. Alternatively, environmental design can change the opportunity for preventative action or intervention–regardless of if this is perceived by offenders or not.

To demonstrate the different ways context may shape perceptions, consider the following example:

> Imagine someone is walking down the street. They are in a location with clear indicators of ownership or guardianship (i.e., fencing, well-kept, high visibility). These characteristics may inform an observer's perception of the subject's vulnerability. Perhaps these characteristics signal to the observer that someone is more likely to intervene or call the police. Likewise, if the subject perceives higher odds of intervention, it may increase their likelihood to resist–which may inform an observer's perception of the subject's vulnerability.

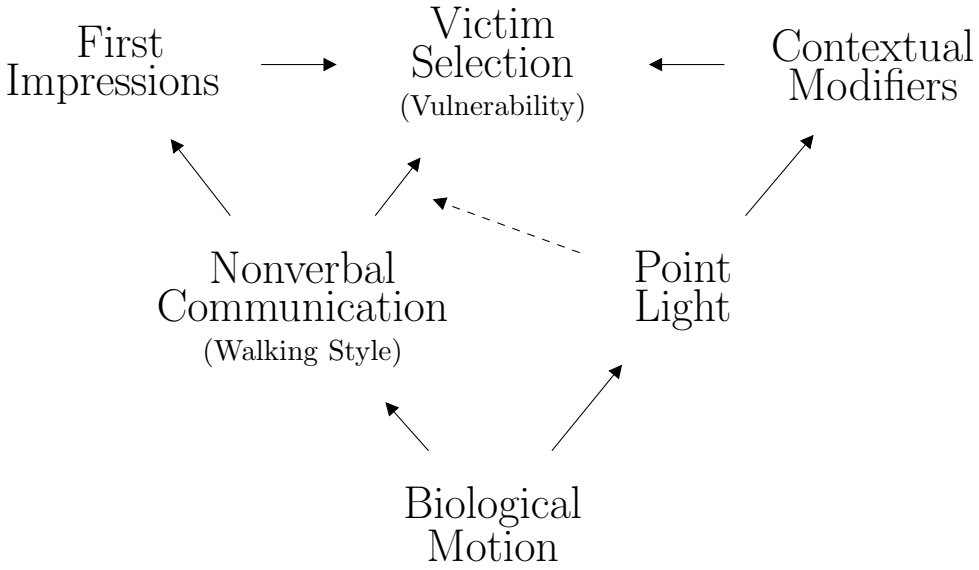
Individuals move in and out of contexts on a daily basis. These contexts may impact the perception of the individuals within those environments. Given this, the current project incorporates context within the design. I plan to test how these contexts change the perception of subjects' of vulnerability. However, the current project does not attempt to identify an active ingredient within an environment. In other words, given the project's design, I will not draw conclusions on a specific environmental characteristic (e.g., graffiti). Instead, I focus on whether any differences between contexts impacts the perception of vulnerability.

Chapter 3

Current Project

The present work pulls literature from a variety of different areas and disciplines. These areas, and how they fit together, are presented in Figure 3.1.

Figure 3.1: Project Map Demonstrating the Connections Between Areas of Research



When considered together, the literature demonstrates how nonverbal communication can impact victim selection through the development of a first impression. The current project takes the next step to test the relationship between nonverbal communication and victim

selection by focusing specifically on walking style and perceptions of vulnerability. However, the association between these concepts (walking style and vulnerability) is confounded by a variety of different contextual information (i.e., a subject's physical characteristics or the environment they are in). To address these confounding variables, point-light displays remove a subject's contextual information–leaving only their movement, or walking style, behind. These point-light displays, and the complex understanding of nonverbal communication, rely on the intuitive recognition of biological motion.

Note that Figure 3.1 is not a path diagram–it does not depict hypothesized relationships between concepts or variables. Rather, it demonstrates the various areas of research and the multi-layered dependencies needed to explore the questions within the current project.

Based on this information, the current project takes the next step to test the movement-perception relationship. It builds upon past works by using an experimental design. The design assigns participants to view researcher-manipulated walking conditions to influence their perceptions. To address some of the limitations associated with experimental designs, I conducted two independent studies with slightly differing randomization procedures. Using these, I aim to answer three primary questions. These questions are presented below.

1. *Do researcher-manipulated differences in how a subject walks shape an observer's perception of their vulnerability?*

Previous research has demonstrated walks can shape perceptions of vulnerability (Gunns et al., 2002; Johnston et al., 2004; Grayson and Stein, 1981), dominance (N. O. Rule et al., 2012; Kalma, 1991), and self-confidence (Winkel and McCormack, 1997). However, much of this research did not use researcher-controlled walk conditions. Instead, the observed subjects carried themselves as they normally would. Moreover, these studies have been unable to show a causal link between walks and perception.

The current study will answer this question using researcher-controlled walk conditions. By comparing observers' perceptions of subjects wherein the stimulus has been manipulated, I

will more rigorously test the movement-perception relationship.

2. Do perceptions of vulnerability informed by point-light displays differ from perceptions informed by full-light displays?

Point-light videos limit the amount of information an observer can use to inform perceptions to movement-only information. Much of the previous research has failed to compare perceptions of subjects using both point- and full-light videos. One of the concerns associated with point-light videos is that they exclude so much information that they are no longer able to generalize to reality. To evaluate the differences between the perceptions of full-light scenarios and point-light scenarios, I will compare across the video types as well.

By answering this question, the current project can help bridge between the previous research using only full-light or point-light videos. Likewise, answering this question should help show how movement shapes our perceptions of vulnerability independent of other characteristics.

To answer this question, I will use two different methods. First, I expose participants to both point-light and full-light videos in each study. Participants' perceptions will be compared to determine how ratings of vulnerability change as they move from one video format to another. This will show the within-individual differences in full-light and point-light videos. Secondly, Study 1 includes a randomization procedure to address potential instrumental effects. In other words, Study 1 randomly assigns participants to see either point-light or full-light videos first. I will use this randomization to show the between-group differences in full-light and point-light videos.

3. Do the perceptions of a subject's vulnerability differ based on context or the environment they are observed in?

This final question will provide evidence on impact of the contexts. Context and environment, here, refers to anything other than how an individual walks. To answer this questions, all walks were filmed in two locations with two walkers. By comparing the perceptions of

these subjects in two locations, I will be able to demonstrate the impact of contextual factors (i.e., neighborhood and subject sex) on perceptions of vulnerability. This will be tested by comparing the ratings of the full-light videos. In Study 1, participants see both filming locations. Then it will be tested by comparing the vulnerability ratings of the full-light videos in Study 2. Study 2 includes an additional randomization procedure to randomly assign participants to one of the two filming locations.

Chapter 4

Methods

The current work discusses two independent, but interrelated, studies. Study 1 took place in the Fall of 2019 and Study 2 took place in the Spring of 2021. Many of the procedures, materials, and measures were consistent across both studies. Given the similarities between Study 1 and Study 2, I present the methods within a single section. Any differences in the two studies' procedures are discussed within the appropriate subsections.

Design

The current project uses two independent experimental studies. Experimental designs offer the highest confidence in internal validity (Shadish, Cook, and Campbell, 2002; Holland, 1986), but are subject to a variety of limitations. The price of higher internal validity often comes at the expense of external validity. However, I wanted to conduct the most robust test of movement's impact on the perception of vulnerability. Therefore, the current study prioritized internal validity.

To address some of the external validity concerns, I conducted two experimental studies. These studies differed somewhat in their methods and measures. Therefore, Study 2 cannot

serve as a direct replication of Study 1. Despite this, using two studies and comparing the results should assist in identifying valid effects.

An experimental design is a valuable elaboration on the existing knowledge base. Previous research has demonstrated a relationship between nonverbal communication and victim selection (Stevens, 1994; Wright and Decker, 1997). Moreover, research demonstrated a correlation between walking style and perceptions of vulnerability in a non-experimental setting (Grayson and Stein, 1981). This correlation has since been replicated using point-light displays (Gunns et al., 2002; Johnston et al., 2004). These regression-based designs paved the way to an experimental test of the proposed relationship.

Given this, the current project uses a within-participant experimental design. I present a description of the experimental conditions, how these were created, and the randomization procedures used.

Experimental Conditions

In the previous sections, I explained the concepts of biological motion and movement organization. These concepts allow people to recognize common motions even when only presented limited information. However, there are varying levels of movement synchrony and organization. This concept (organization) shapes the current project's formation of the experimental conditions.

To test the relationship between movement and perceptions, the current study needed to address the following questions:

1. What characteristics of walking styles are important for shaping perceptions of vulnerability?

2. How can those characteristics be simulated realistically?

This is to say, the experimental conditions needed to exhibit characteristics associated with vulnerability, while appearing natural enough to not alert participants to the intervention.

The literature provided several studies used to guide the answers to these questions. In these, researchers compared the walks of individuals perceived as less vulnerable to those perceived as more vulnerable (Johnston et al., 2004; Gunns et al., 2002; Grayson and Stein, 1981). The overlap in their results builds a solid foundation to base the experimental conditions on.

These studies found that individuals perceived as more vulnerable tended to have more gestural movements (movement remains isolated to a limb or body part), as opposed to postural movements (movement engages the entirety of the body) (Gunns et al., 2002; Grayson and Stein, 1981). This disconnectedness of vulnerable individual's walks translated into other forms of isolated movement. For example, vulnerable walkers had unbalanced movement on the left and right sides of their body. This is described as unilateral (one side) or contralateral (both sides) movement. Vulnerable walkers tended to swing only one arm, did not swing their arms at all, or would swing the same arm as the foot they were lifting (Johnston et al., 2004; Gunns et al., 2002; Grayson and Stein, 1981).

In terms of stride length and foot-lift, individuals rated as more vulnerable often took either too-long or too-short of strides for their height (Johnston et al., 2004; Gunns et al., 2002; Grayson and Stein, 1981). In addition, they preferred to lift their feet (Johnston et al., 2004; Gunns et al., 2002; Grayson and Stein, 1981)–rather than swing a foot forward in a more flowing, connected motion. These factors, in addition to the unilateral movement, create a difference in the vulnerable walkers' weight-shift compared to their less vulnerable counterparts. Specifically, when one walks, the majority of their weight shifts using the pelvis. Walkers perceived as less vulnerable tended to have a three-dimensional weight-shift. This means their pelvis creates a figure-eight motion with each step. By contrast, walkers perceived as more vulnerable were characterized by two-dimensional weight-shifts.

Based on these findings, I created the *organized* and *disorganized* experimental conditions.

Organized walks, as described previously, incorporate the entirety of the body and create a continuous flow of movement. Disorganized walks, by contrast, appear disjointed, use only certain body parts at a time, and lack fluidity.

I should note that organized movement and disorganized movement is not a binary concept. Instead, movement organization exists on a spectrum, and individuals may fluctuate in where they fall on that spectrum. And, as Johnston and colleagues (2004) demonstrated, where someone falls along that spectrum may change depending on setting (real or imagined).

To effectively expose participants to one of these conditions, I recorded a series of videos. Video footage guaranteed each participant would see the same stimulus and avoided requiring participants to read a vignette describing the walk. The procedures used to create the videos for the experimental conditions follow.

Materials

To create the experimental conditions, I recruited two volunteers (also referred to as walkers), one male and one female. Volunteers were recorded as they walked down a street after receiving brief instructions. These instructions differed based on walk-condition.

> **Organized walk:** For this walk, imagine you feel like you're on top of the world. Maybe you just got some good news. Your posture appears confident–eyes forward, head up, shoulders back. Walk with energy. Let your arms swing naturally at your sides.
>
> **Disorganized walk:** For this walk, imagine you're not having a great day. Maybe you feel under the weather. Your posture is likely lacking–focus your eyes on the ground a few feet in front of you, relax your shoulders. Walk with less energy. Let your arms hang at your sides or swing one arm while the other remains still.

To ensure consistency, volunteers were given the same instructions each time we filmed a walk.

Location

Recording took place on two streets local to Cincinnati, Ohio. The two locations were selected to provide starkly contrasting environmental contexts. Figure 4.1 depicts a side-by-side comparison of what will be referenced hereafter as Block A and Block B.

Figure 4.1: Comparison of Block A (Top) and Block B (Bottom) Filming Locations

As shown in the figure, Block A (top panel) has high visibility. Everything is well maintained, including the street and pathways. There are multiple fences to distinguish property lines, trees, and a vehicle parked in a drive way. These characteristics, considered together, show clear signs of ownership and care. These physical conditions suggest low disadvantage in

that area. By contrast, Block B's (bottom panel) physical characteristics suggest a higher level of disadvantage. Block B appears to be an alley-like location. The street is in disrepair, there's graffiti on the walls, and damaged window shutters. Its unclear who, if anyone, owns or maintains the location. To conveniently recall Block A as the more advantaged block, remember A = Advantage and B = Disadvantage.[1]

I should note the current study did not focus on specific contextual modifiers. The purpose is not to identify how much graffiti, for example, impacts perception. Rather, this component of the project focuses on demonstrating that vulnerability does not exist within a vacuum. I accomplish this by evaluating how general (i.e., "big picture") contexts impact perception. Thus, I do not evaluate the impact of individual contextual cues on the perception of vulnerability. Instead, I evaluate how different contexts/locations as a whole shift perception. By including two filming locations I am positioned to answer the question: If the same person walks the same way down two different streets, does the street change the perception of their vulnerability?

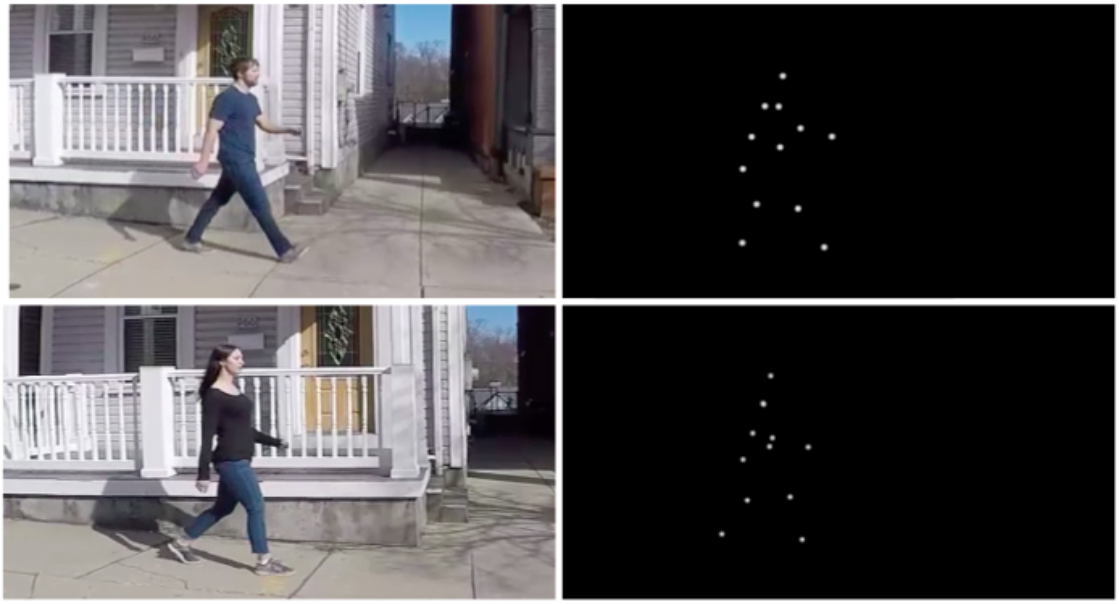
Filming two walkers, in two locations, using two walking styles, resulted in a total of eight unique scenes. However, these scenes included all the contextual information (i.e., location, walker's sex, time of day, etc.). The current project aimed to test the impact of walking style, independent of contextual factors. Therefore, my next step required isolating movement with point-light videos.

[1]The selection of the filming locations was not based on official measures of disadvantage. Instead, filming location were selected based on the visible indicators of disadvantage.

Light Format

To isolate movement, I edited the eight original (full-light) videos to create point-light display versions of each scene. To turn the full-light versions into point-light versions, I used Premiere Pro, a video editing software. To see a visual depiction of the differences between the full-light (left) and point-light (right) versions of the video, refer to Figure 4.2.

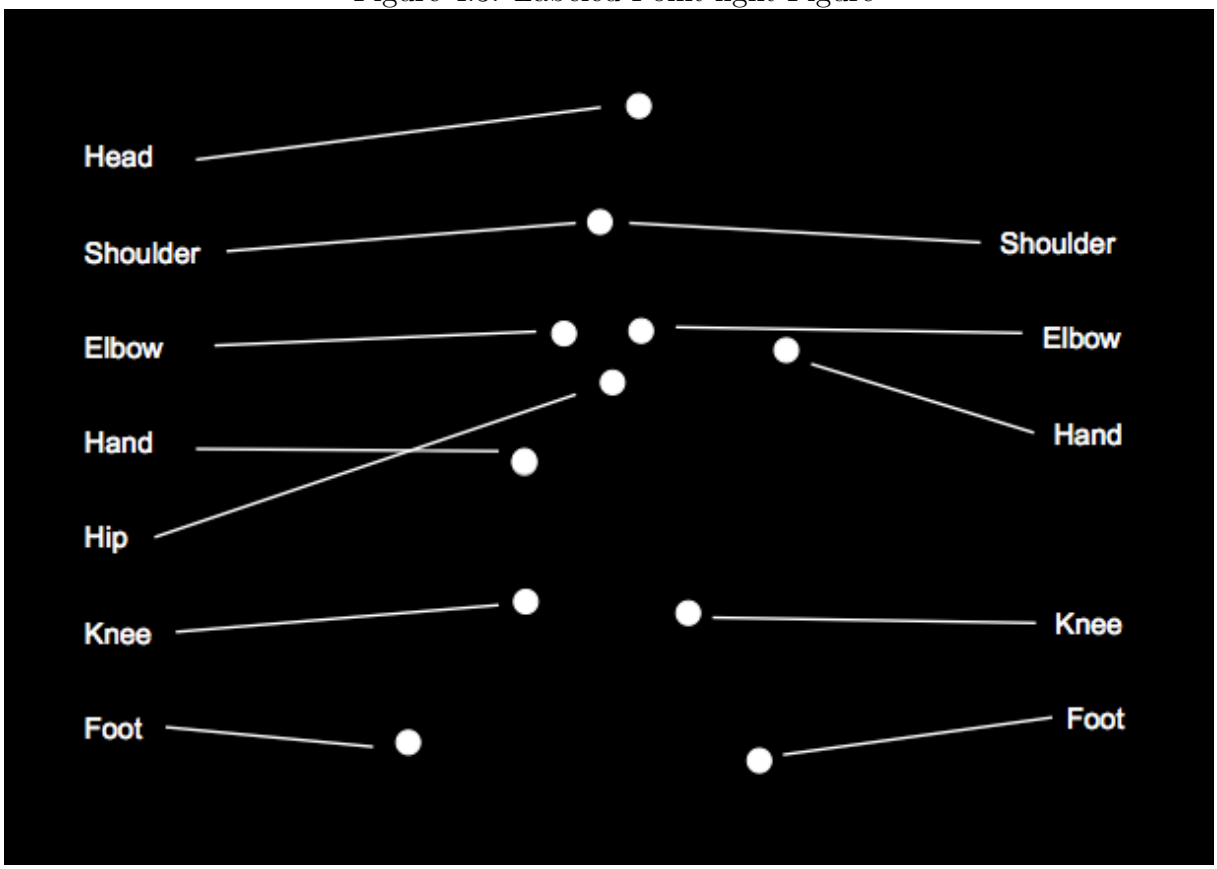
Figure 4.2: Examples of the Male and Female Walkers in Full- and Point-light



In each scene the figure walks across the screen (left to right), perpendicular to the eye-line of a stationary viewer (the participant). This means, in a full-light version, the viewer first sees the walker's front, then side, then back, as they move across the screen. To create the same experience in a point-light format, I placed white dots on the walker's head (1), shoulders (2), elbows (2), hands (2), hip (1), knees (2), and feet (2). This resulted in a total of 12 light-points. Figure 4.3 (Next page) presents a labeled version of the point-light display. Here, you can see which body part each dot corresponds to.[2]

[2]Figure 4.3 presents a side-view of the walker. This means only 11 dots appear in the picture. This is due to the light-points corresponding to the figure's shoulders overlapping. To address this, the shoulder light-point is labeled twice. Keep in mind that these are separate lights-points, however (as depicted in Figure 4.2).

Figure 4.3: Labeled Point-light Figure



To animate the light-points, I used a multi-step approach. First, I identified which dots changed their trajectory as the figure moves. For example, even as the walker moved across the screen, their hand would swing forward and then swing back, crossing the mid-line of the body. By contrast, the walker's head did not move forwards and backwards–it had a consistent left-to-right trajectory. Dots with the most volatile trajectories included the hands (2) and feet (2). These had the most amount of movement. Less-volatile dots were the elbows (2) and knees (2). Finally, the dots that changed trajectories the least included the head (1), shoulders (2) and hip (1) dots.

For those dots with volatile trajectories, I identified each moment the dot changed directions (up or down, left or right). These key frames helped draft the path each dot needed to take. For each of these frames, I moved the dot to the appropriate position on the figure's body. Based on the dot's starting position and ending position in each of these frames, Premiere

Pro estimated the path the dot would take. Using this method, the software created the approximate path each dot followed. However, this was only an approximation, and the software's estimated path for each dot needed to be adjusted.

Premiere Pro assumed a fixed acceleration through each of the key-frame points. However, the acceleration for different body parts is not consistent. For example, people pick up and put down a foot much slower than the time it takes their foot to travel that distance. To create a more fine-tuned path of travel, I watched the videos to identify the frames where the dot predicted path did not align with the joint's actual path. In these, I adjusted the dot to the correct location. Each time a change was made, the software would adjust its calculations to reduce the error in the dot's travel.

This process created point-lights that traveled with the same velocity and acceleration as the body-part they were associated with. This process was conducted for each light-point. Finally, to remove the background, I separated the original video footage from the file–leaving only the white dots behind. These videos were then saved and used as the point-light version of each scene.

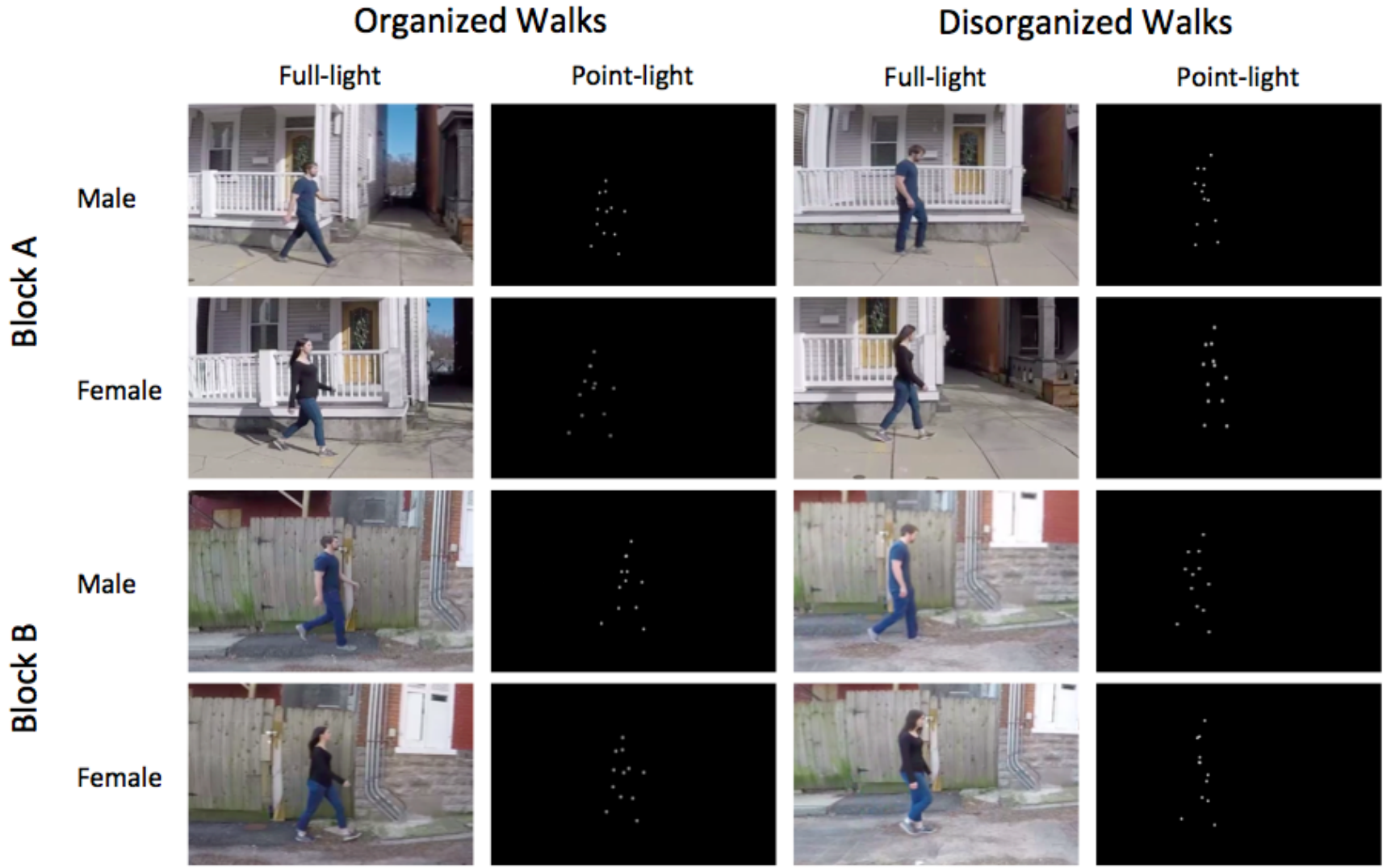
Final Product

To summarize, two volunteers (male and female) were recorded under two walking conditions (organized and disorganized) in two different locations (Block A and Block B). This resulted in eight unique scenes. Disorganized walks were characterized by low energy and nonsynchronous movement patterns. Organized walk, by contrast, were marked by high energy and synchronous movement. The eight original videos–corresponding to each of the eight scenes–were then duplicated and edited to create point-light versions of each scene. This resulted in a total of sixteen videos, associated with eight unique scenes, to be used as study materials. These videos are used in both Study 1 and Study 2 and are presented in Table 4.1. In addition, Figure 4.4 provides a visual breakdown of the sixteen different videos and each video variable.

Table 4.1: List of Scenes and Videos

		Video Variables			
Scene	**Video**	**Walker Sex**	**Location**	**Walk**	**Format**
		Female	Block A	Organized	Point-Light
		Male	Block B	Disorganized	Full-Light
I	1	F	A	O	PL
	2	F	A	O	FL
II	3	F	A	D	PL
	4	F	A	D	FL
III	5	F	B	O	PL
	6	F	B	O	FL
IV	7	F	B	D	PL
	8	F	B	D	FL
V	9	M	A	O	PL
	10	M	A	O	FL
VI	11	M	A	D	PL
	12	M	A	D	FL
VII	13	M	B	O	PL
	14	M	B	O	FL
VIII	15	M	B	D	PL
	16	M	B	D	FL

Figure 4.4: Screen-captures of the 16 Videos Demonstrating the Different Video Variables



Notes: The screen-captures included in this figure were taken at as close to the same frame as possible for each scene in point- and full-light. These images show zoomed-in versions of the walkers. Readers should not assume that participants saw exactly these images within the survey.

Randomization Procedures

To conduct the current project, I used the Qualtrics online survey platform. Given the University of Cincinnati's endorsement of Qualtrics as a resource for survey research (University Cincinnati, 2020) and the features included within the survey platform, Qualtrics was the best choice for the current work. The features of note included (a) the ability to embed video content within survey questions, and (b) the ability to assign participants to experimental conditions. Therefore, using the researcher-input logic parameters, Qualtrics conducted all random assignment procedures.

Study 1

Each participant in Study 1 was randomly assigned to four of the eight final scenes. To control for sex, assignment procedures required participants see two scenes featuring the female walker and two scenes featuring the male walker. To control for location, participants were also guaranteed to see both walkers in both Block A and Block B. In each of these walker-block combinations, participants were randomly assigned to the organized or disorganized walk-conditions.

Randomization procedures occurred on a per-scene basis–resulting in a total of four independent random assignments. This resulted in some participants seeing only organized walks, only disorganized walks, or–most often–a combination of the two. Participants watched each scene twice: once in point-light and once in full-light. These procedures resulted participants watching a total of eight videos.

Between watching the point- and full-light versions of their assigned scenes, participants answered a series of questions unrelated to the video footage. This intermission was included to decrease potential contamination effects when transitioning between video formats. Furthermore, to address potential instrumental effects, the survey randomly assigned participants

to a starting video format. This means some participants watched the point-light videos first while others started with full-light.

To provide further clarity, Figure 4.5 and Table 4.2 present the randomization procedures in Study 1. Figure 4.5 provides a road map of the possible paths a participant could have taken through the survey. Table 4.2 presents the guaranteed-characteristics of the eight videos participants watched and emphasizes that the walk-condition was the only video characteristic that varied. Figure 4.5 and Table 4.2 do not indicate the randomization procedures used to control for potential instrumentation effects.

To depict the four independent random assignments, Figure 4.5 is divided into four rows. The numbers in the top-left corner of each row indicate the randomization. Additionally, these rows correspond to specific video characteristics. For example, the first row in Figure 4.5 corresponds to point-light videos of the female walker in Block A. From here, a participant could be randomly assigned to either the top-path and watch the organized walk, or the bottom-path and watch the disorganized walk.

Figure 4.5: Study 1 Survey Flow and Random Assignment Diagram

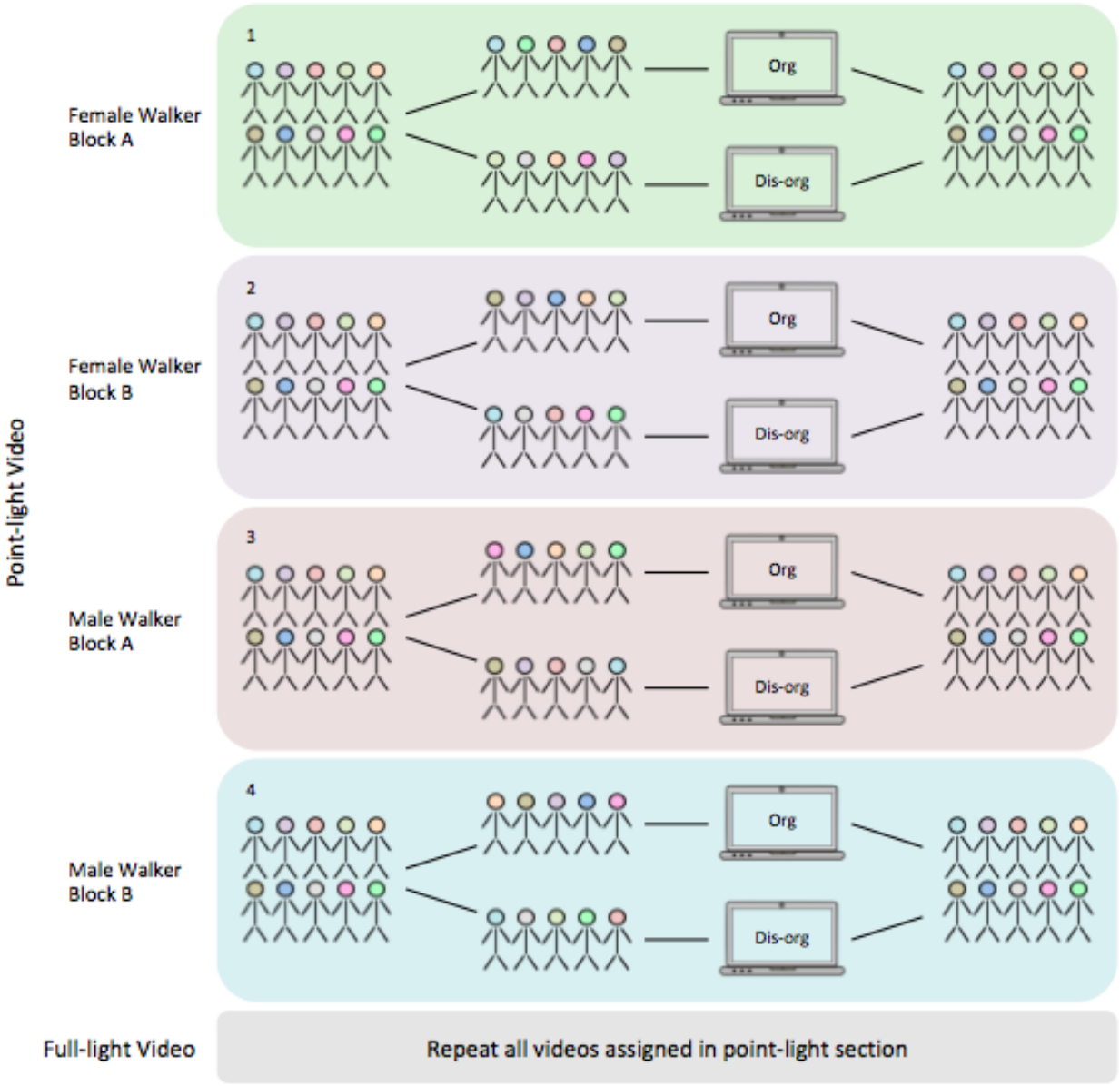


Table 4.2 also indicates each random assignment using numbers. These numbers correspond to those in Figure 4.5 and are indicated using a superscript R followed by a number. To indicate that participants watched the full- and point-light versions of each scene, Table 4.2 indicates a video's walk-condition is dependent upon a previous randomization using a superscript colon followed by a number (:#).

Table 4.2: Study 1 Video Characteristics and Random Assignment

Video Variables			
Walker Sex	**Location**	**Walk***	**Format**
Female	Block A		Point-Light
Male	Block B		Full-Light
F	A	W^{R1}	PL
F	B	W^{R2}	PL
M	A	W^{R3}	PL
M	B	W^{R4}	PL
F	A	$W^{:1}$	FL
F	B	$W^{:2}$	FL
M	A	$W^{:3}$	FL
M	B	$W^{:4}$	FL

Notes: The asterisks (*) indicate that variable includes a random assignment procedure. When this randomization occurs is indicated using the superscript R labels (^{R}). If more than one randomization occurs for that variable, the R is followed by a number. The superscript colon followed by a number ($^{:\#}$) indicates that variable references the corresponding random assignment to meet the specified criteria.

Study 2

The random assignment procedures used in Study 2 differed in three key ways from those used in Study 1. First, Study 2 did not include any checks for instrumentation effects. All participants watched point-light videos in the first half of the survey and full-light videos in the second half. Second, rather than assign participants to walk-conditions four independent times, Study 2 assigns participants to video pairs twice. Finally, Study 2 introduces an additional random assignment in the full-light portion of the survey to assign participants to a block-condition.

Recall that in Study 1 some participants saw four dis/organized walks. While this outcome was rare, it reduced the working sample size. To address this issue, Study 2 assigns participants to video pairs. Video pairs were created by varying the block- and walk-conditions while holding walker sex constant (see Table 4.3). This process guaranteed that if a participant first saw a disorganized walk, they would then be exposed to an organized walk.

This random assignment occurred twice–once for the female walker and a second time for the male walker.

Video pairs were only used in the point-light section of the survey. Given that point-light displays hide contextual information from the participants, walker-sex and block location are not visible when transitioning between videos. This means that participants received no indication of the changing contextual information as they watch the four point-light videos.

Table 4.3: Demonstration of Video Pairs

	Block A	**Block B**
Pair 1	Organized	Disorganized
Pair 2	Disorganized	Organized

Notes: Walker sex is held constant.

Between the point- and full-light sections of the survey, participants answered questions to provide a brief break from watching videos. Like Study 1, this break was included to reduce potential contamination effects.

Study 1 had participants re-watch each of their assigned videos in full-light. However, in Study 2, I wanted test the impact of location on perceptions of vulnerability. Therefore, rather than have participants re-watch each video, Study 2 randomly assigns participants to either Block A or Block B. Based on this assignment, participants watch only those full-light videos that correspond to their assigned block. This results in participants watching a total of two full-light videos.

Figure 4.6 and Table 4.4 present the randomization procedures used in Study 2. Figure 4.6 provides a road map of the possible paths a participant could take through the survey. Table 4.4 demonstrates that participants in Study 2 watched a total of six videos and lists the fixed and varying characteristics corresponding to each of these videos.

Figure 4.6 presents the three random assignment procedures used in Study 2 in a series of rows and columns. Each random assignment corresponds to a number in the top-left

corner of the row/column. The point-light section of the survey is indicated using the two rows labeled 1 and 2, while the full-light section is depicted using the column labeled 3. Participants could be assigned to either of the paths depicted in each of these sections. For example, a participant could start the survey and be assigned to the top path in Row 1. They would watch an organized walk, followed by a disorganized walk. The column corresponds to the full-light section of the survey and participants' assignment to either Block A or Block B. This depicts that participants re-watch the videos they were previously assigned that also meet the block-assignment criteria.

Figure 4.6: Study 2 Survey Flow and Random Assignment Diagram

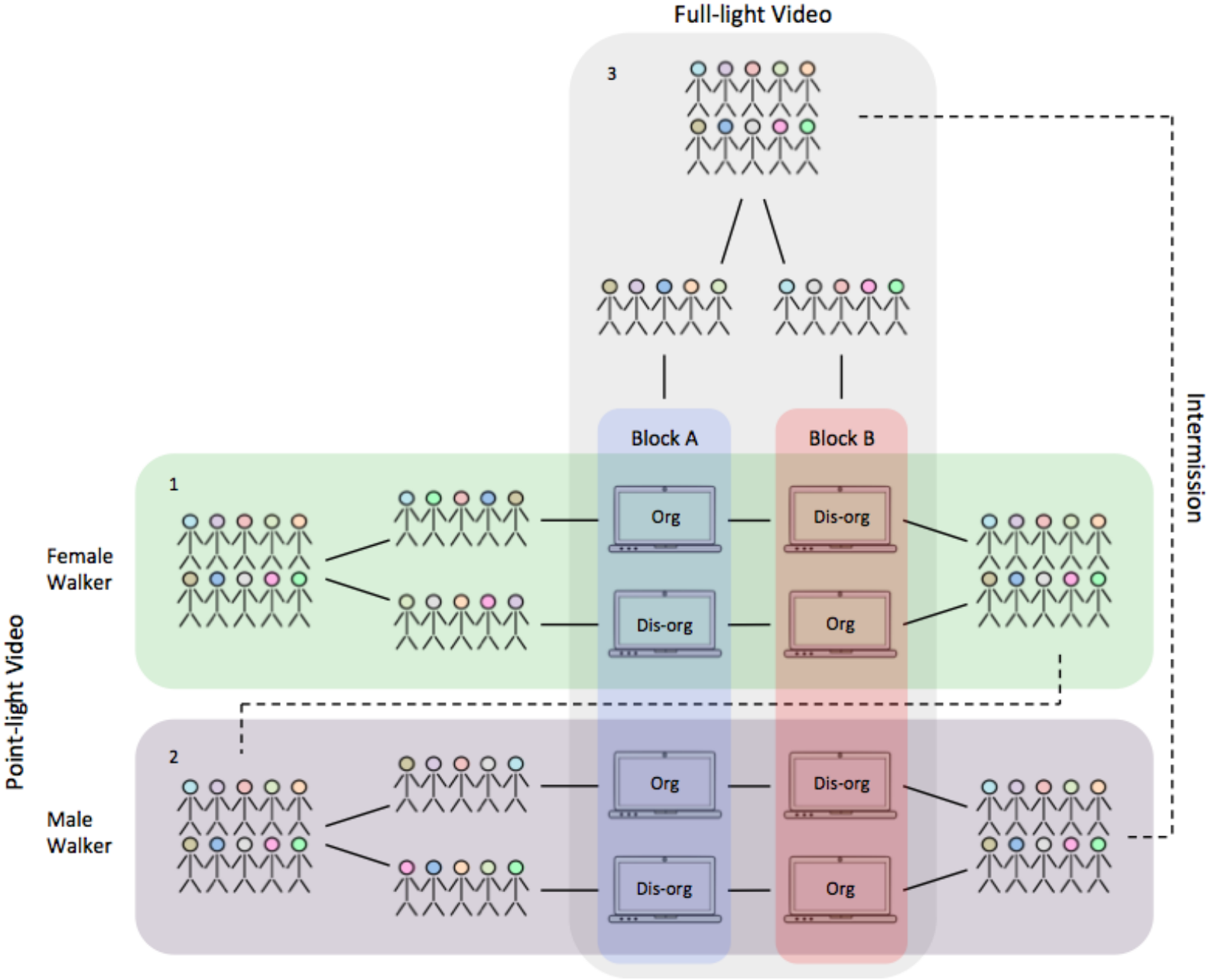


Table 4.4, by contrast, lists the fixed and varying characteristics associated with each video participants watched. Here, random assignments are indicated using a superscript R followed by a number. The prime labels depict the dependencies associated with the video-pairs in each of these randomization. To indicate that participants were randomly assigned to Block A or Block B, Table 4.4 includes a superscript R within the location column. This, and the superscript colon followed by a number in the Walk column, note that the walk-condition for that video is dependent on the location a participant was assigned to and the video pair they saw in the point-light section. For example, imagine a participant is randomly assigned to watch the Block A condition. This means that when they start to watch their 5th video, the survey will reference the video pair they were assigned to in the first randomization (R1). The survey would then shows the participant the full-light version of the point-light video corresponding to Block A.

Table 4.4: Study 2 Video Characteristics and Random Assignment

	Video Variables		
Walker Sex	**Location***	**Walk***	**Format**
Female	Block A		Point-Light
Male	Block B		Full-Light
F	A	W^{R1}	PL
F	B	$W^{R1\prime}$	PL
M	A	W^{R2}	PL
M	B	$W^{R2\prime}$	PL
F	L^{R3}	$W^{:1\text{-}3}$	FL
M	L^{R3}	$W^{:2\text{-}3}$	FL

Notes: Asterisks (*) indicate that variable includes a randomization. When this assignment occurs is indicated using the superscript R labels (^{R}). If more than one randomization occurs for that variable, the R is followed by a number. Prime labels indicate that video is dependent upon the outcome of the previous video's randomization. In these cases, participants see the opposite condition of whatever they previously watched. The superscript colon followed by two numbers ($^{:\#\text{-}\#}$) indicates that variable references those random assignments to meet the specified criteria.

Sample

Both studies used a sample of undergraduate students at a large university located in the mid-west and used an opt-in recruitment strategy. Study 1 took place over the 2018-2019 academic year. To recruit participants for Study 1, invitations were sent out to all faculty and staff teaching undergraduate criminal justice courses. The faculty then extended the study-invite to their students who could self-select into participating. Study 2 took place over the 2020-2021 academic year. To recruit participants for Study 2, I sent several rounds of recruitment emails to the undergraduate list-serve email associated with a particular department of the university.

The resulting samples were relatively similar. After cleaning the data for missing values, both Study 1 and Study 2 had samples consisting of 70 to 90 respondents. The majority of both samples were women (Study 1: 70%; Study 2: 56%) and individuals who identified as white (Study 1: 68%; Study 2: 85%). The average age for both samples was approximately 25 years old. Table 4.5 presents the descriptive statistics for Study 1 and Study 2's samples.

Table 4.5: Sample Demographics (Study 1 and Study 2)

	Study 1			***Study 2***		
	$\overline{X}$	*SD*	*Range*	$\overline{X}$	*SD*	*Range*
Age	24.05	7.53	19-60	25.34	10.02	18-55
Sex (1 = male)	30%			41%		
Race (1 = white)	68%			85%		
Height (cm)	167.03	12.13	121.92-193.04	171.52	9.89	142.24-187.96
Weight (lbs)	168.99	45.51	95-300	180.27	43.67	115-300
Gender (1 = man)				41%		
Gender (2 = NB)				3%		
N	79			74		

Notes: Study 1 did not include questions pertaining to participants' gender identity. NB indicates non-binary.

To evaluate how the project samples compared to the population from which they were drawn, I looked at the demographic information for the college. The population demographics for the college showed that undergraduates in the 2018-2019 academic year were on average 27 years old, 69% white, and 48% male. Likewise, undergraduates in the 2020-2021 academic year, were approximately 25 years old, 68% white, and 49% male.

Missing Data

Both Study 1 and Study 2 resulted in samples with some missing data. First, both studies experienced some attrition. Those without enough data available to be useful in analysis were dropped from the sample. This included participants who only responded to the consent questions at the beginning of the survey and one or two videos.

In addition, because Study 1 conducted four random assignments, some participants saw only one walk condition. This was due to random chance. However, this means that the analytic sample sizes are not perfectly consistent across all analyses.

Study 2 addressed this limitation with a different random assignment process. This ensured all participants saw two disorganized and two organized videos. However, several participants dropped out of the survey after the first section of videos. This resulted in several participants having valuable perception data on the point-light videos while lacking data on the control, full-light, and demographic sections. Once again, these participants remain in the sample for all analyses where their data can be used.

These decisions result in the analytic sample sizes throughout the document fluctuating slightly.

Measures

To provide a clear picture of the differences between Study 1 and Study 2, this section is presented in two parts. By separating the measures into (1) Perceptions and (2) Controls I draw a distinction in the type of information collected within these sections. The first section presents how each study measures perceptions of vulnerability. In these questions, participants were asked to rate each unique video. By contrast, when asked to respond to questions measuring control variables, participants provided information about themselves as individuals. These questions were asked between the point- and full-light sections of the survey. This break provided a pause for participants to reset and should assist in avoiding contamination effects as participants transition from point- to full-light videos. For a side-by-side comparison of the questions asked in each of these studies, refer to Table 4.6.

Table 4.6: Measures - Question Details

Question	**Study 1**	**Study 2**
Perceptions[1]		
Instructions: Consider the scenario below, watch the video, and answer the following questions. *Imagine you needed money badly, right now. You cannot ask your friends or family for assistance, and you see this person walking alone on this street.*	☐	☒
How easy would it be for someone to attack this individual?	☒	☐
How likely is it that the attack will be successful?	☒	☐
If you robbed this person, how easy or difficult would it be to overpower them?	☐	☒
If you robbed this person, how likely or unlikely is it you would get arrested?	☐	☒
How much do you agree or disagree with the following statement: The person in the video appears confident.	☐	☒
Delinquency		
Instructions: Please indicate how many times over the past 12 months you engaged in any of these behaviors.	☒	☐
Instructions: How many times have you ever...	☐	☒
Painted graffiti or signs on someone else's property or a public place	☒	☐
Deliberately damaged property that did not belong to you	☒	☐
Lied to your parents or guardians about where you had been or who you were with	☒	☐
Stole something worth more than $50	☒	☐
Sold marijuana or other drugs	☒	☐
Stole something worth less than $50	☒	☐
Took part in a fight where a group of your friends was against another group	☒	☐
Were loud, rowdy, or unruly in a public place	☒	☐
Took something from a store without paying for it	☒	☒
Went into a house or building to steal something	☒	☒
Drove a car without the owner's permission	☒	☒
Got into a serious physical fight	☒	☒
Hurt someone badly enough to need bandages or care from a doctor or nurse	☒	☒
Used or threatened to use a weapon to get something from someone	☒	☒
Been arrested for a crime	☐	☒

Question	**Study 1**	**Study 2**
Low Self-control		
I often act on the spur of the moment without stopping to think.	☐	☒
I often do whatever brings me pleasure here and now, even at the cost of some distant goal.	☐	☒
I frequently avoid projects I know will be difficult.	☐	☒
I try to look out for myself first, even if it means making things difficult for other people.	☐	☒
I lose my temper pretty easily.	☐	☒
When I'm really angry, other people better stay away from me.	☐	☒
Cognitive Reflection		
A bat and a ball cost $1.10 in total. The bat costs $1.00 more than the ball. How much does the ball cost?	☐	☒
If it takes 5 machines 5 minutes to make 5 widgets, how long would it take 100 machines to make 100 widgets?	☐	☒
In a lake, there is a patch of lily pads. Every day, the patch doubles in size. If it takes 48 days for the patch to cover the entire lake, how long would it take for the patch to cover half of the lake?	☐	☒
Demographics		
Age	☒	☐
How old are you (in years)?	☐	☒
Height	☒	☐
How tall are you?	☐	☒
Weight	☒	☐
Approximately how much do you weigh?	☐	☒
Race	☒	☐
Select your racial identity.	☐	☒
Sex	☒	☐
Select the sex you were assigned at birth.	☐	☒
Select your preferred gender identity.	☐	☒

Notes: [1] Perception questions were asked for each video participants watched.

Perceptions

Study 1

To study perception in Study 1, I asked participants to watch several videos and respond to questions. The instructions did not ask participants to report how likely it was that they (the participant) would attack the individual in the video. Instead, participants reported how easy it would be for *someone* to attack the individual. Likewise, participants received no instructions regarding what they should focus on in the videos. This allowed participants to come to their own conclusions on what to pay attention to and where to pull information from in the videos. Both of these decisions aimed to reduce bias.

Vulnerability. To measure the perception of vulnerability, I first needed to identify what we mean when we say someone is vulnerable. Often, "vulnerability" implies it would be *easier* for something bad to happen, or that it is more *likely* for something bad to happen. These two facets (ease and likelihood) became the guide to measure the perception of vulnerability in Study 1.

Given this, Study 1 included two questions to measure the perceived vulnerability of each video:

1. How easy would it be for someone to attack this individual?
2. How likely is it that the attack will be successful?

Response options to the first question used a 7-point Likert scale ranging from Extremely difficult (-3) to Extremely easy (3). This created the clear neutral midpoint, Neither easy nor difficult (0). Higher values indicate higher levels of perceived vulnerability.

The second question encouraged participants to consider probabilities. Therefore, response options could range from 0% to 100% percent. The percentage values reflected participants' perception of likelihood of success. Higher percentages indicate a higher probability of suc-

cess.

Participants answered these two questions for each video they watched–4 point-light and the 4 corresponding full-light. To create the variables to be used in analyses, I averaged participant responses based on walk-condition. In other words, I calculated the average vulnerability of all the organized walks participants watched, and the average vulnerability of all the disorganized walks participants watched. This process was conducted twice: first using participant responses to point-light videos, then using participant responses to full-light videos.

Table 4.7 presents a video-by-video breakdown of participants' perceptions of vulnerability by walk condition and the aggregated vulnerability scores.

Table 4.7: Perceptions of Vulnerability (Study 1)

	Point-light Videos						**Full-light Videos**					
	Disorganized			**Organized**			**Disorganized**			**Organized**		
	$\overline{X}$	*SD*	*N*	$\overline{X}$	*SD*	*N*	$\overline{X}$	*SD*	*N*	$\overline{X}$	*SD*	*N*
Ease (-3=Extremely difficult, 3=Extremely easy)												
Block A, F	0.43	1.55	44	1.00	1.28	41	1.80	1.17	41	1.53	1.37	38
Block B, F	0.45	1.49	44	0.45	1.48	38	2.05	0.90	43	2.08	1.18	36
Block A, M	0.29	1.66	41	0.33	1.32	39	0.54	1.60	41	0.74	1.57	39
Block B, M	0.20	1.63	45	0.06	1.63	35	1.49	1.38	45	0.86	1.57	35
Average	0.41	1.39	78	0.31	1.24	77	1.55	1.20	75	1.23	1.35	74
Success Likelihood (0=0% Chance of success)												
Block A, F	51.56	18.92	43	60.49	17.40	41	70.22	18.51	41	69.47	21.12	38
Block B, F	52.61	17.81	44	56.24	21.05	37	75.88	15.63	43	81.08	15.12	36
Block A, M	51.93	20.78	41	52.41	18.34	39	55.87	19.34	41	57.03	20.25	39
Block B, M	51.84	21.35	45	48.06	20.53	35	65.38	19.76	45	60.63	22.04	35
Average	52.88	17.13	77	52.47	17.09	76	68.04	16.95	75	66.04	19.04	74

Study 2

Study 2 took a different approach to measure participants' perceptions of video footage. In Study 2, I did not ask participants to think of someone else attacking the individual in the video. Instead, I asked participants to put themselves in the position of the offender. This removed the separation from the situation participants were being asked to consider. To help participants imagine (approximately) the same scenario, I provided the following instructions:

> Consider the scenario below, watch the video, and answer the following questions.
>
> > Imagine you needed money badly, right now. You cannot ask your friends or family for assistance, and you see this person walking alone on this street.

Participants received this prompt with each video–4 point-light and 2 full-light. Based on this prompt, participants were asked 3 questions to measure their perceptions of the walker. Consistent with Study 1, participants received no instructions regarding what to focus on within the video footage.

Vulnerability. Similar to Study 1, I conceptualized the perception of vulnerability as a combination of perceived ease and perceived success. However, as with the changes to the prompt, I wanted to ask more immersive questions in Study 2. Therefore, rather than try to avoid participants bringing their personal perspectives in to the measurement of vulnerability, I decided to guide them towards a common scenario.

To evaluate the two facets of vulnerability Study 2 asked participants two questions[3]:

1. If you robbed this person, how easy or difficult would it be to **overpower** them?
2. If you robbed this person, how likely or unlikely is it you would get **arrested**?

[3]Emphasis included in original survey.

Both questions used a 5-point Likert scale. Response options to the first question ranged from Difficult (-2) to Easy (2). Larger values indicate higher levels of perceived ease. Response options to the second question ranged from Unlikely (-2) to Likely (2). By contrast, lower values to this question indicate higher levels of perceived likelihood of success.

Confidence. Finally, Study 2 measured the concept of confidence the perception of the walkers' confidence. This measure provides the opportunity to evaluate how related the concepts of vulnerability and confidence are in the perception of other people. Confidence was measured using a single item:

1. How much do you agree or disagree with the following statement: The person in the video appears **confident**.

Like the previous two questions, this item used a 5-point Likert scale. Response options ranged from Disagree (-2) to Agree (2). Higher values indicate higher rates of walker confidence.

Once again consistent with Study 1, participants answered these three perception questions for each video they watched. These responses were then used to create the variables used in analyses. Specifically, I calculated the average perceptions of ease, risk, and confidence for organized and disorganized videos participants watched. However, because Study 2 exposes participants to only 2 full-light videos, this process was only conducted for the point-light footage.

For a video-by-video breakdown of participant perceptions, refer to Table 4.8. (See next page.)

Table 4.8: Perceptions of Vulnerability (Study 2)

	Point-light Videos						**Full-light Videos**					
	Disorganized			**Organized**			**Disorganized**			**Organized**		
	$\overline{X}$	*SD*	*N*	$\overline{X}$	*SD*	*N*	$\overline{X}$	*SD*	*N*	$\overline{X}$	*SD*	*N*
Ease (-2=Difficult to overpower, 2=Easy to overpower)												
Block A, F	-0.30	1.20	37	-1.12	1.01	34	1.06	1.29	16	0.45	1.29	11
Block B, F	-0.04	1.28	52	-0.52	1.11	54	1.05	1.15	20	0.37	1.28	27
Block A, M	-0.40	1.17	40	-0.65	1.00	40	-0.55	1.19	20	-0.38	1.36	16
Block B, M	-0.55	1.13	38	-0.95	1.13	40	-0.37	1.45	16	-1.17	0.83	23
Average	-0.25	1.02	89	-0.76	0.93	88	0.35	1.35	58	-0.20	1.24	60
Risk (-2=Unlikely to get arrested, 2=Likely to get arrested)												
Block A, F	1.00	1.11	37	1.35	0.88	34	0.44	1.36	16	0.45	1.21	11
Block B, F	0.69	1.26	52	0.93	1.24	54	0.75	1.48	20	0.81	1.24	27
Block A, M	0.65	1.37	40	1.08	1.00	40	1.30	1.03	20	0.75	1.18	16
Block B, M	0.87	1.04	38	0.97	1.05	40	0.94	1.12	16	1.09	0.90	23
Average	0.75	1.06	89	1.02	1.05	88	0.84	1.25	58	0.81	1.12	60
Confidence (-2=Disagree, does not appear confident, 2=Agree, appears confident)												
Block A, F	0.03	1.21	37	1.06	1.04	34	-1.43	0.72	16	0.82	1.25	11
Block B, F	-0.15	1.36	52	1.06	1.00	54	-0.70	1.13	20	0.96	0.94	27
Block A, F	0.15	1.39	40	1.05	0.88	40	-0.40	1.10	20	0.81	1.42	16
Block B, F	0.05	1.11	38	1.33	0.86	40	-0.75	1.00	16	1.09	0.67	23
Average	-0.01	1.00	89	1.11	0.77	88	-0.81	1.05	58	1.00	0.92	60

Notes: Each "*V*" followed by a number indicates a video. *V1* and *V2* correspond to the female walker, while *V3* and *V4* correspond to the male walker. Odd number videos (*V1* and *V3*) correspond to videos filmed on Block 1 (Low Disadvantage) while even number videos (*V2* and *V4*) correspond to Block 2 (High Disadvantage).

Controls

Study 1

Delinquency. Study 1 included 14 items used to measure delinquent behavior in the last year. Delinquent behavior ranged from minor crimes (i.e., graffiti, being rowdy in public, lying to a guardian/parent) to more serious offenses (i.e., using a weapon, seriously injuring someone, participating in a group fight). Response options included never (0), 1 or 2 times (1), 3 or 4 times (2), and 5 or more times (3). To create the delinquency variable, I averaged the 14 items, including the entire range of behaviors. For a complete list of the delinquency questions, refer to Table 4.6.

Sex. Binary variable coded 0 for females and 1 for males.

Age. Participants self-reported their age in years using a drop down menu.

Race. Participants self-reported their racial identity. Given that the majority of the sample reported identifying as white, I recoded race as a binary variable coded 0 for people of color and 1 for white.

Height. To measure height, participants selected their height from a drop-down menu ranging from less than four feet tall to greater than seven feet tall. The drop-down menu included the entire range of heights between four and seven feet (in feet and inches). Each height option included the corresponding length in centimeters to assist any participants who do not use imperial measurements.

Weight. Participants selected their approximate weight from a drop-down menu. This menu listed weights in 10 pound (lbs) intervals ranging from less than 40 lbs to greater than 300 lbs. Participant responses were recoded to select the midpoint of each 10 lb interval.

Study 2

Delinquency. In Study 2, I cut the number of delinquency items in half by removing less-severe offenses. Response options remained the same and included never (0), 1 or 2 times (1), 3 or 4 times (2), and 5 or more times (3). In addition to changing the number of items, I increased the time-interval for participants to reflect on from *the past year* to *ever*. Therefore, participants reported if they had ever engaged in a variety of delinquent behaviors including getting into a serious fight, shoplifting and/or burglary, and using a weapon. To create the delinquency scale, I averaged the seven items. For a complete list of the delinquency questions, refer to Table 4.6.

Low self-control. To create the low self-control measure I used 6 items from the full Grasmick et al. (1993) scale. The questions asked participants to report how much they agree (2) or disagree (-2) with a variety of behaviors. Behaviors include losing one's temper, avoiding difficult projects, and acting on the spur of the moment. To create the low self-control scale, I averaged responses to the six times. Higher scores indicate lower levels of self-control.

Cognitive Reflection. The cognitive reflection test is a standardized measure often used to evaluate how much an individual relies on intuitive reasoning. I used the original 3-item version of this test (Frederick, 2005; Sirota and Juanchich, 2018). A variety of different coding techniques exist for this measure (Pennycook, Cheyne, Koehler, and Fugelsang, 2016). For the purposes of the current study, each item was coded as a binary variable based on if participants got the question correct (1) or incorrect (0). These items were then summed. Participants' cognitive reflection scores ranged between 0 and 3. Higher scores indicate higher levels of reflective reasoning, or lower levels of intuitive reasoning.

Sex. In Study 2, I separated the concepts of sex and gender. To do so, I asked participants to report the sex they were assigned at birth. Coded 0 for females and 1 for males.

Gender. To measure gender, I asked participants to report their preferred gender identity.

Coded 0 for women, 1 for men, and 2 for non-binary.

Age. Participants self-reported their age in years using a drop down menu.

Race. Participants self-reported their racial identity. Given that the majority of the sample reported identifying as white, I recoded race as a binary variable coded 0 for people of color and 1 for white.

Height. To measure height, participants selected their height from a drop-down menu ranging from less than four feet tall to greater than seven feet tall. The drop-down menu included the entire range of heights between four and seven feet (in feet and inches). Each height option included the corresponding length in centimeters to assist any participants who do not use imperial measurements.

Weight. Participants selected their approximate weight from a drop-down menu. This menu listed weights in 10 pound (lbs) intervals ranging from less than 40 lbs to greater than 300 lbs. Participant responses were recoded to select the midpoint of each 10 lb interval.

Table 4.9: Control Variables (Study 1 and Study 2)

	Study 1			***Study 2***		
	$\overline{X}$	*SD*	*Range*	$\overline{X}$	*SD*	*Range*
Delinquency	0.17	0.26	0-1.36	0.29	0.40	0-2.43
Low Self Control				-0.59	0.81	-2-1.5
Cognitive Reflection				1.04	1.15	0-3
N		79			76	

Notes: Questions regarding participants' level of low self control and the cognitive reflection test were not asked in Study 1.

Analytic Plan

Experimental designs use random assignment to sort participants into at least two groups. These groups are then exposed to differing stimuli or interventions (Shadish et al., 2002). Using this design, one can assume any differences observed between the groups is due to the intervention. However, this assumption depends on the random assignment procedures. Therefore, to test the efficacy of the randomization, I will check basic demographic differences (i.e., age, sex, race) between the experimental groups in Study 1 and Study 2. To avoid the inflated likelihood of Type I errors when conducting multiple t-tests, I plan to check only two assignments in both studies.

Because Study 1 and Study 2 used very similar designs, many of the planned analyses will be conducted for both studies. These include:

1. Compare perceptions of Organized and Disorganized walks
2. Compare perceptions of Point- and Full-light videos
3. Compare perceptions of Block A and Block B
4. Compare perceptions of of the male walker and the female walker

These analyses will use a within-individual t-test (i.e., a paired t-test), and will be conducted using each of the perception measures outlined earlier. Moreover, each analysis will help identify the impact of movement on the perception of walk-conditions, with and without contextual information.

To test for heterogeneity in treatment effects, I plan to conduct a series of regression analyses evaluating the relationship between perception and the control variables. Finally, because I will be conducting many independent t-tests, I plan to use the Bonferonni p-value adjustment to minimize Type I errors.

Part II

Findings

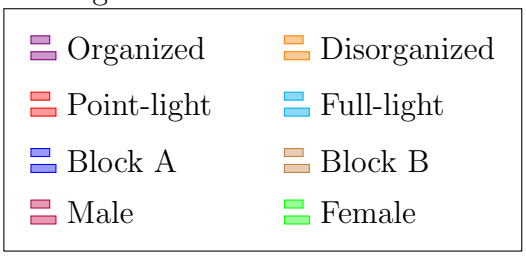
Chapter 5

Results

This following sections present the results from Study 1 and Study 2 in four parts: (1) walk effects, (2) light effects, (3) block effects, and (4) sex effects. These sections correspond to the research questions outlined in *Chapter 3 – Current Study*.[1]

Each section compares different variables to evaluate their impact on participant perceptions. To distinguish between these variables, eight different colors are used. Each figure within the results section includes a legend with the colors and labels. In addition, Figure 5.1 introduces all the colors used in the analyses.

Figure 5.1: Master Legend of the Colors Used in the Results Sections



[1]Note that the sections on block effects and sex effects both correspond to the third research question presented in *Chapter 3 – Current Study* pertaining to impact of context.

Walk Effects

The first research question the current project sought to answer was: *Do researcher-manipulated differences in how a subject walks shape an observer's perception of their vulnerability?* This section presents the analyses used to compare perceptions of two walking styles–Organized and Disorganized. Based on the literature, I hypothesized the disorganized walking style would be perceived as more vulnerable.

Study 1 and Study 2 measured perceptions of vulnerability in slightly different ways. To recall the specific questions corresponding to these concepts, refer to Table 4.6. The impact of these walking styles on perception are evaluated in point- and full-light.

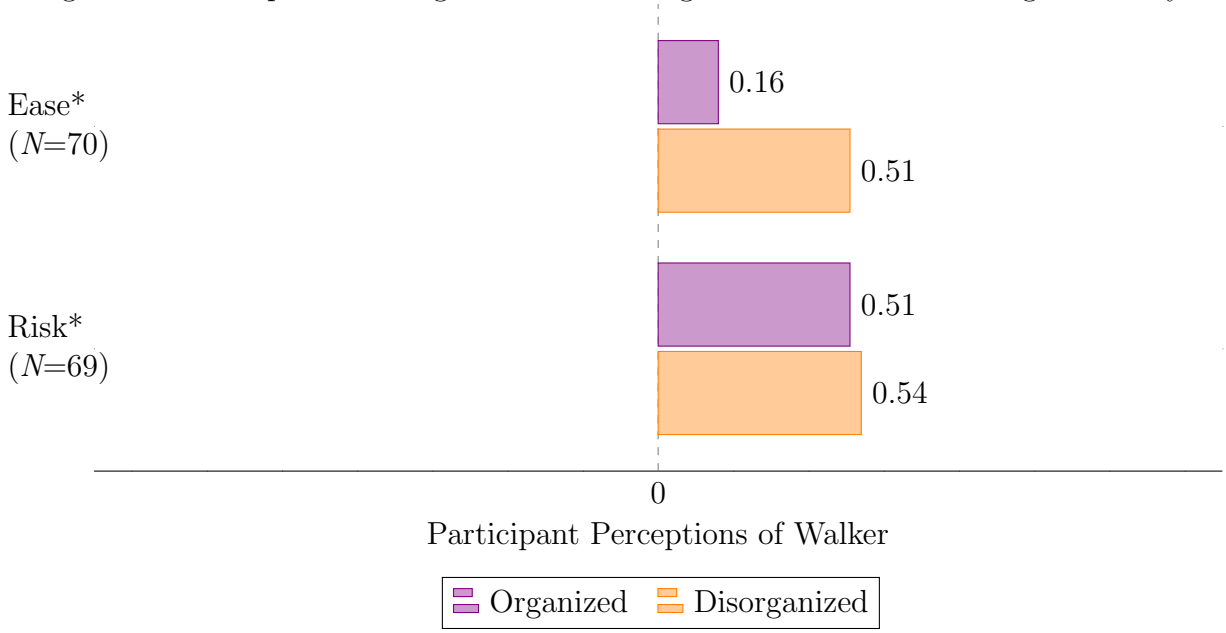
Study 1

Impact of Walking Style in Point-light

The first step to evaluate the impact of walking style required comparing perceptions of the organized and disorganized walks. This was accomplished using point-light videos which present only a subject's movement. For the current project, this movement is the subject's walk. This means one can assume differences between the organized and disorganized walking styles are due to changes in how the subject moves. Figure 5.2 presents the results of the two t-tests used to evaluate the impact of walking style in point-light.

The results showed significant differences in the perceptions of the organized and disorganized walking styles. Disorganized walks were rated easier for someone to attack ($\overline{X}$=0.51) than organized walks ($\overline{X}$=0.16; p<0.05). In addition, attacking a disorganized walker was more likely to succeed (54% chance) than attacking an organized walker (51% chance; p<0.05). These results suggest that an observer can distinguish differences in walking style. These differences impact the perception of a point-light subject. In other words, people can ascribe

Figure 5.2: Perceptions of Organized and Disorganized Walks in Point-light – Study 1



Notes: $^{*}p<0.05$, $^{**}p<0.01$, $^{***}p<0.001$. Figure presents mean scores of participant responses to the questions *"How easy would it be for someone to attack this individual?"* (Ease) and *"How likely is it that the attack will be successful?"* (Risk). Results also presented in Table 6.1.

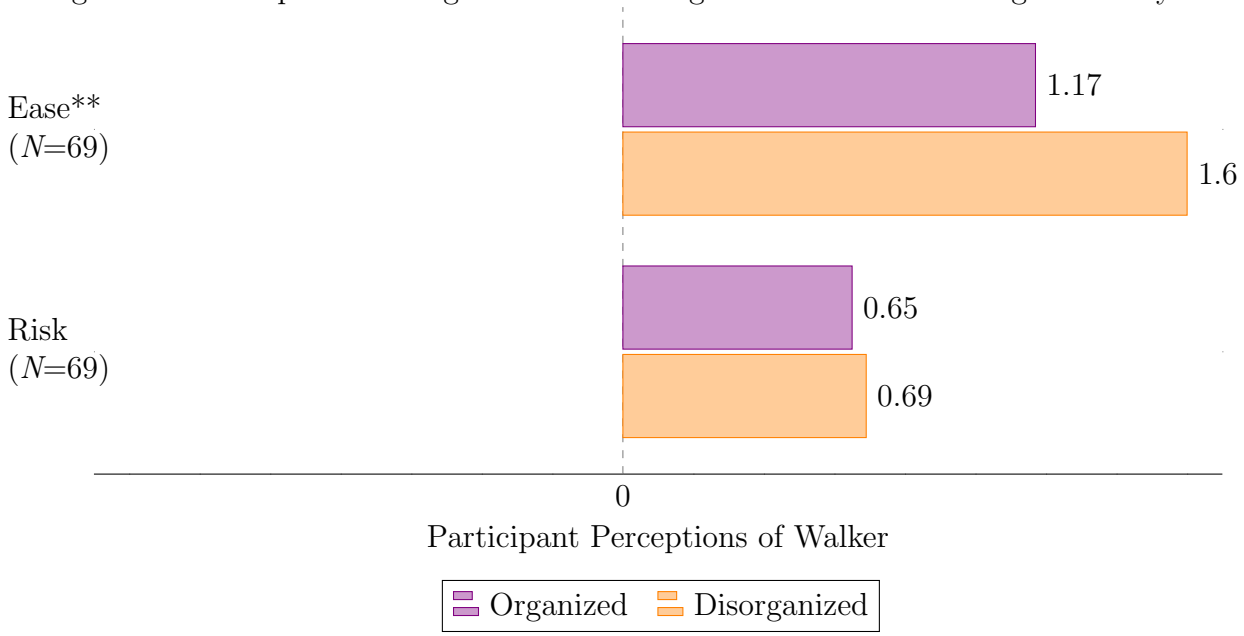
differences in vulnerability based on how a subject moves.

Impact of Walking Style in Full-light

To expand on those findings, the next step involved evaluating perceptions of organized and disorganized walks in full-light. Full-light footage provides participants with more information to form their perceptions. Recall that participants in Study 1 watched each video they were assigned to in both point- *and* full-light. The only difference between the point- and full-light analyses is the light-format of the video. Figure 5.3 presents the results of comparing the perceptions of walking styles in full light.

Analyses using the full-light video data revealed that walk effects were observed for the ease variable. Disorganized walks were perceived as easier for someone to attack ($\overline{X}$=1.6) than organized walks ($\overline{X}$=1.17; $p<0.01$). There were no differences, however, in the perceived probability of success.

Figure 5.3: Perceptions of Organized and Disorganized Walks in Full-light – Study 1



Notes: $^{*}p<0.05$, $^{**}p<0.01$, $^{***}p<0.001$. Figure presents mean scores of participant responses to the questions *"How easy would it be for someone to attack this individual?"* (Ease) and *"How likely is it that the attack will be successful?"* (Risk). Results also presented in Table 6.1.

These results indicate that how someone carries themselves can impact perceptions of their vulnerability–how easy they appear to attack. The presence of walk effects in full-light suggests that movement remains an important cue in forming perceptions of a subject.

Overall, Study 1 found evidence of walk effects in point-light and full-light. It is unclear why Study 1's risk variable showed evidence of walk effects in point-light but not in full-light. The inconsistencies in the perception between the light formats will be discussed in future sections. However, given the findings discussed, results from Study 1 indicate that walking style can impact perceptions of a walker.

Study 2

Impact of Walking Style in Point-light

In Study 2, point-light walk effects were even more pronounced. Figure 5.4 presents the results of analyses used to evaluate the impact of walking style in point-light.

Figure 5.4: Perceptions of Organized and Disorganized Walks in Point-light – Study 2

Notes: $^{*}p<0.05$, $^{**}p<0.01$, $^{***}p<0.001$. Figure presents mean scores of participant responses to the questions *"If you robbed this person, how easy or difficult would it be to overpower them?"* (Ease), *"If you robbed this person, how likely or unlikely is it you would get arrested?"* (Risk), and *"How much do you agree or disagree with the following statement: The person in the video appears confident."* (Confidence). Results also presented in Table 6.2.

Subjects with a disorganized walk were perceived as easier to overpower ($\overline{X}$=-0.27) than organized subjects ($\overline{X}$=-0.76; p<0.001). Attacking an organized walker was perceived as more likely to result in arrest ($\overline{X}$=1.06) than attacking a disorganized walker ($\overline{X}$=0.76; p<0.001). Finally, while the disorganized walker was not perceived as particularly confident or not-confident ($\overline{X}$=0.01), the organized walker was perceived to be quite confident ($\overline{X}$=1.11; p<0.001).

These results provide further evidence to the conclusions drawn from Study 1. Namely, Study 2 results show pronounced differences in the perceptions of organized and disorganized walking styles. Because these results use point-light footage, differences in perceptions of the walks are based on how the subjects moves. These results provide additional support to the conclusion that people can ascribe differences in a subject's vulnerability based on movement cues.

Impact of Walking Style in Full-light

In full-light, the relationship between walking style and perceptions appears to shift. Disorganized walkers were no longer perceived as easier to overpower or less likely to result in arrest. This suggests that walking style did not impact perceptions of ease or risk when participants watched the full-light footage. However, the perception of walker's confidence became became more polarized in full light. While participants continued to rate the organized walk as confident ($\overline{X}$=1.07), the disorganized walk was perceived as much less confident in full-light ($\overline{X}$=-0.88; p<0.001). Figure 5.5 presents the results of the t-test comparisons using the full-light footage.

It is unclear why analyses using full-light footage did not find significant differences in the perceptions of ease and risk. However, there are several potential explanations. For example, Study 2's full-light analyses saw a substantial drop in sample size. This is partly due to participant attrition. This drop in sample size is also, partly, due to the additional random

Figure 5.5: Perceptions of Organized and Disorganized Walks in Full-light – Study 2

Notes: $^{*}p<0.05$, $^{**}p<0.01$, $^{***}p<0.001$. Figure presents mean scores of participant responses to the questions *"If you robbed this person, how easy or difficult would it be to overpower them?"* (Ease), *"If you robbed this person, how likely or unlikely is it you would get arrested?"* (Risk), and *"How much do you agree or disagree with the following statement: The person in the video appears confident."* (Confidence). Results also presented in Table 6.2.

assignment protocols used in Study 2's full-light section of the survey. This drop in sample size, and the additional variance around the full-light results (see Table 6.2), means a lower likelihood of finding significant effects. Given these limitations, there is the potential that Study 2 did not have a sufficient sample size in the full-light portion of the survey.

Wider error bands may also indicate that perceptions of full-light subjects are more variable than the perceptions of the point-light subjects. The contextual information provided by full-light videos may result in more variation in participant perceptions, and thus responses.

Overall, the results from Study 2 provide additional evidence supporting conclusions from Study 1. Participants perceived differences in walking styles, which then impacted their

perceptions of the subjects. In full-light, the observation of walk effects was limited to walker confidence. This may suggest that walk effects are more prevalent–or easier to observe–in point-light, where the information available to participants is limited to how a subject moves. Regardless of video format, however, there is evidence that walking style impacts perceptions of a walker.

Light Effects

In the previous section on walk effects, several discrepancies appeared in the analysis of the point- and full-light footage. This prompts the second research question asked in *Chapter 3 – Current Study* and the topic of this section: *Do perceptions of vulnerability informed by point-light displays differ from perceptions informed by full-light displays?* Given that several walk-effects observed in point-light were not observed using full-light footage, the format videos are presented in has potential methodological implications. If different footage-types can impact a study's results, researchers must make conscious decisions about the type of video they use in perception studies. Therefore, the current section explores the differences in how participants perceived and rated the point- and full-light video.

In the following analyses, organized and disorganized walks are no longer the primary variables of interest. Instead, this section compares the perceptions of the point-light dis/organized walk to the perceptions of the full-light dis/organized walk. These analyses will demonstrate the impact of video format on participant perceptions of walking style.

Finally, readers should note that this variable did not include an experimental design. All participants saw both video formats. Given this, it is not possible to form causal conclusions regarding the impact of point- and full-light footage. By examining how participant responses change based on video format future research can determine if there is a need to further examine the impact of showing participants contextual information beyond an individual's walking style.

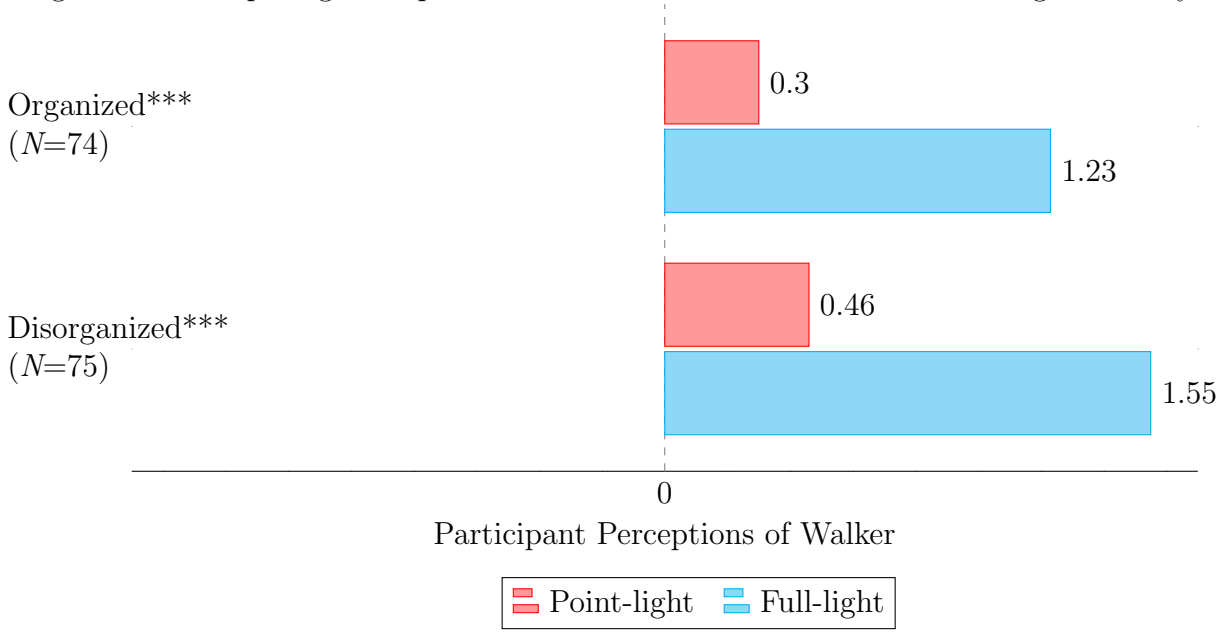
Study 1

Study 1 participants watched four videos in both the point- and full-light formats. This process guaranteed that differences in the perception of the point- and full-light videos correspond to the change in video formats–as opposed to changes in the video content.

Ease to Attack

Figure 5.6 presents the results of Study 1's ease variable–how easy it would be for someone to attack the subject. The results show dramatic shifts in how participants rated the organized and disorganized walks in point- and full-light. An organized walk presented in full-light ($\overline{X}$=1.23) was rated substantially easier for someone to attack than an organized walk presented in point-light ($\overline{X}$=0.30; p<0.001). Disorganized walks show the same trend, with full-light walks rated easier for someone to attack ($\overline{X}$=1.55) compared to point-light ($\overline{X}$=0.46; p<0.001).

Figure 5.6: Comparing Perceptions of Ease to Attack in Point- and Full-light – Study 1



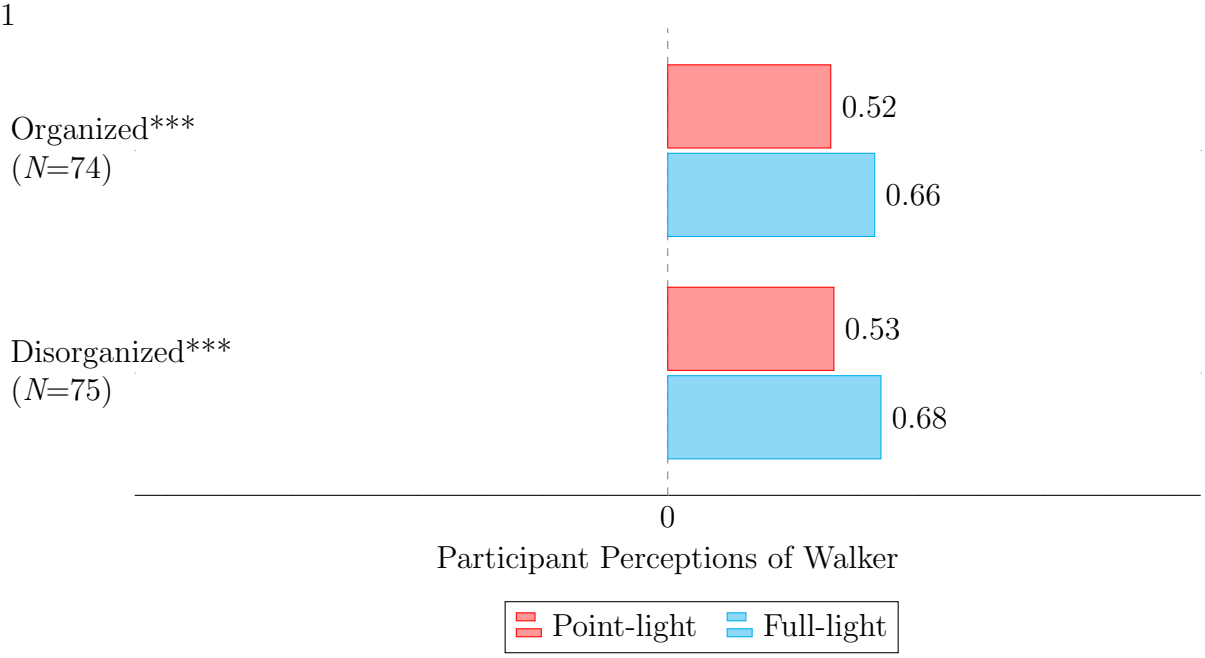
Notes: *p<0.05, **p<0.01, ***p<0.001. Figure presents mean scores of participant responses to the question *"How easy would it be for someone to attack this individual?"*. Results also presented in Table 6.3.

The results show that perceptions of organized and disorganized walks shift nearly an entire response-option higher. In other words, if a participant rated a walker as "somewhat easy" to overpower in point-light, their response often shifted to "easy" in full-light. This trend occurred for both the organized and disorganized walking styles. This evidence suggests that there are meaningful differences in how participants perceive and interact with point-light and full-light displays.

Likelihood of Success

The risk variable in Study 1–likelihood of the attack being successful–follows a similar pattern. Figure 5.7 presents the mean scores of the likelihood of a success for organized and disorganized walks in point- and full-light. Looking at organized walks, participants rated attacking a full-light subject as more likely to succeed (66% chance) than attacking the same subject presented in point-light (52% chance, $p<0.001$). Likewise, attacking a subject with a disorganized walk presented in full-light was rated more likely to succeed (68% chance) than a disorganized walk presented in point-light (53% chance, $p<0.001$). This means that regardless of walking style, attacking a full-light subjects was perceived as nearly 15% more likely to succeed compared to a point-light subject.

Figure 5.7: Comparing Perceptions of Likelihood of Success in Point- and Full-light – Study 1



Notes: $^{*}p<0.05$, $^{**}p<0.01$, $^{***}p<0.001$. Figure presents mean scores of participant responses to the question *"How likely is it that the attack will be successful?"*. Results also presented in Table 6.3.

These results provide further evidence that there are substantial differences in how participants perceived point- and full-light videos. Overall, subjects in full-light videos are rated as easier to attack and attacking full-light walkers is perceived as more likely to succeed. The

primary difference between point- and full-light video is the amount of information provided to viewer. In addition, participants saw the same subjects the same walking styles in each video. Given this, the additional information is likely driving the differences in how point- and full-light video scores.

Study 2

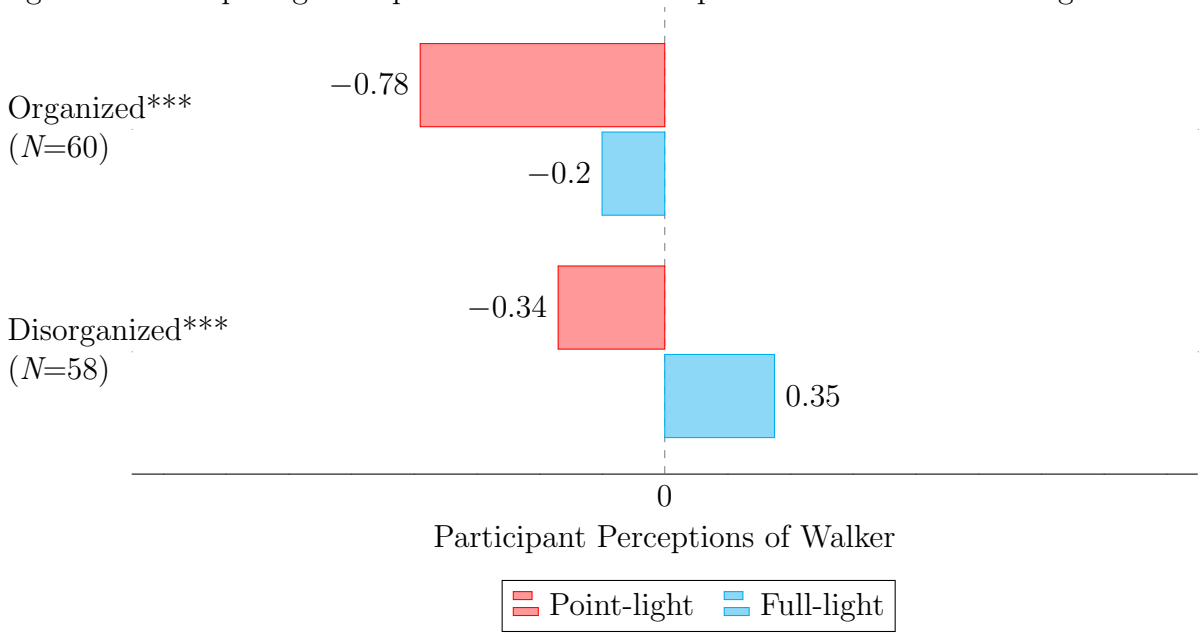
Study 2 made a key changes in how it handled the transition from point- to full-light footage compared to Study 1. Specifically, participants in Study 2 were randomly assigned to see either Block A or Block B. This reduces the number of full-light videos participants were exposed to from four (in Study 1) to two. Therefore, participants in Study 2 watched four point-light videos and two full-light videos. Despite this, participants in Study 2 were still guaranteed to see the point- and full-light versions of the block they were assigned to while walk styles remained constant. This means that the only difference in compared videos is the format its presented in.

Ease to Overpower

The first perception concept measured in Study 2 was ease to overpower. Figure 5.8 present the results of the t-tests used to compare perceptions of point- and full-light videos for each walking style. The analyses show substantial differences in how participants rated the point- and full-light subjects. Consistent with results from Study 1, participants rated full-light subjects as easier to overpower than point-light subjects. This was consistent for both the organized ($\overline{X}_F$=-0.20>$\overline{X}_P$=-0.78, p<0.001) and disorganized ($\overline{X}_F$=0.35>$\overline{X}_P$=-0.34, p<0.001) walking styles.

Similar to the previous trends, these results show that participants appear to perceive full-light subjects as more vulnerable–or more specifically, easier to overpower. Furthermore,

Figure 5.8: Comparing Perceptions of Ease to Overpower in Point- and Full-light – Study 2



Notes: $^{*}p<0.05$, $^{**}p<0.01$, $^{***}p<0.001$. Figure presents mean scores of participant responses to the question *"If you robbed this person, how easy or difficult would it be to overpower them?"* Results also presented in Table 6.4.

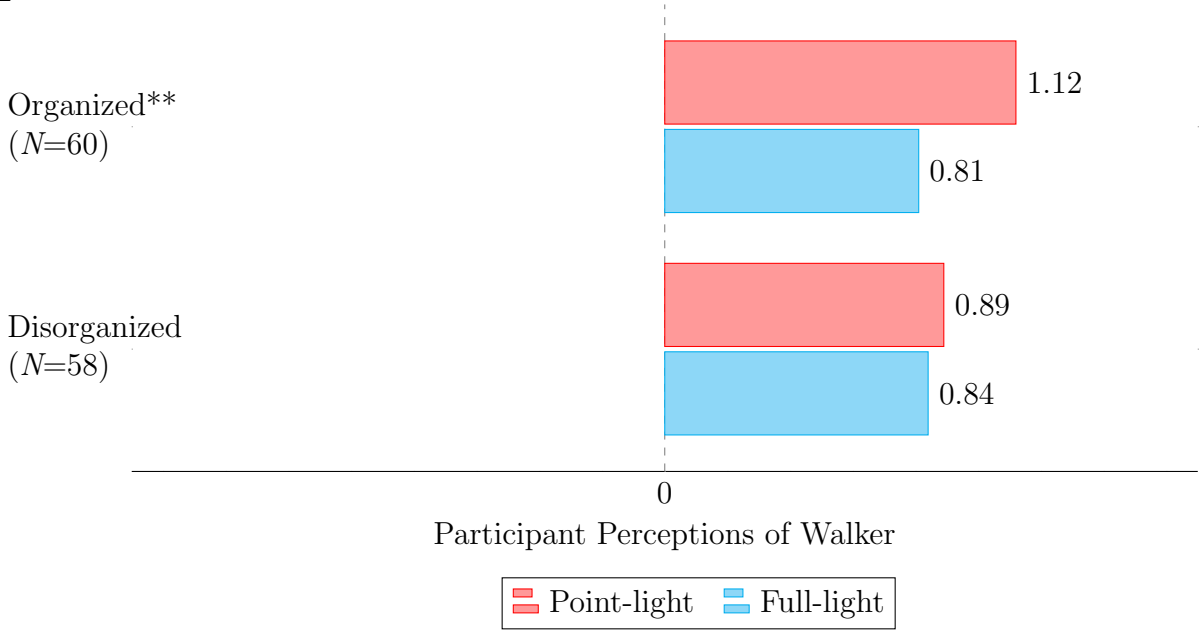
while the differences in the perception of point- and full-light footage no longer appears to be an entire response option, Figure 5.8 shows a relatively consistent light effect. Both the organized and disorganized walking styles were rated approximately 0.7 points easier to overpower in full-light. These results provide further evidence supporting the impact of video format and the presence of light effects.

Likelihood of Arrest

The second perception variable of interest was likelihood of arrest. Figure 5.9 present the results of the analyses used to compare perceptions of the point-light and full-light videos for both walking styles. These results revealed that likelihood of arrest did not appear to follow the same trend as the previous perception variables. Robbing a full-light organized walker was rated as less likely to result in arrest ($\overline{X}$=0.81) compared to attacking a point-light organized walker ($\overline{X}$=1.12; $p<0.01$). This is consistent with previous trends suggesting that

full-light subjects are perceived as easier or more vulnerable. However, the analysis found no differences in how the disorganized walker was perceived in point- and full-light.

Figure 5.9: Comparing Perceptions of Likelihood of Arrest in Point- and Full-light – Study 2



Notes: $^{*}p<0.05$, $^{**}p<0.01$, $^{***}p<0.001$. Figure presents mean scores of participant responses to the question *"If you robbed this person, how likely or unlikely is it you would get arrested?"* Results also presented in Table 6.4.

It is unclear why differences in the perception between point- and full-light only emerge for the organized walker. These results may suggest that certain movement cues indicating a higher likelihood of arrest (i.e., additional physical capability) may be easier to observe in point-light. This would explain why the disorganized point-light walker received similar scores to the disorganized full-light like walker because they would not have exhibited those movement cues with a disorganized walking style. Alternatively, the lack of consistent light effects when transitioning between point- and full-light may suggest that participants focus on things other than movement to determine the risk of arrest. If the factors impacting participant perceptions of arrest risk in full-light depend more on a subject's surroundings, rather than how they carry themselves, that could explain the inconsistent light effects. Regardless, these results suggest that some characteristic of point-light displays lead to

organized walks perceived as more likely to result in an arrest.

It is important to note that these results may be unique to the undergraduate sample. People, on average, have a faulty understanding of the likelihood of being arrested (Claster, 1967; Apel, 2013). Often, non-offending populations overestimate the likelihood of arrest. This miss-estimation of the arrest risk may skew these results. Future research may consider trying to parse out sampling effects and the impact of movement on the perception of arrest risk within full- and point light environments.

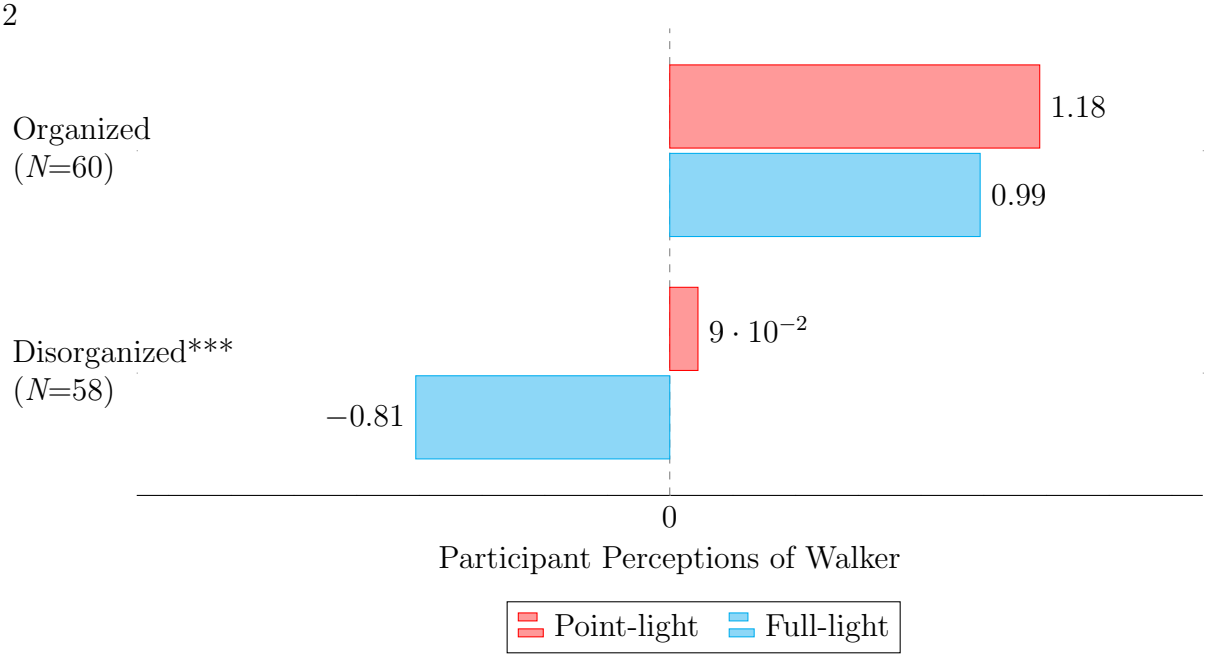
Walker Confidence

The final perception variable evaluated in Study 2 is walker confidence. Figure 5.10 presents the comparisons of the point- and full-light videos for the organized and disorganized walking styles. Similar to the likelihood of arrest perception variable, walker confidence exhibits inconsistent light effects depending on walking style. Specifically, perceptions of subjects with an organized walk did not differ between the point- and full light footage. However, disorganized walkers were rated less confident when presented in full-light ($\overline{X}$=-0.81) compared to the same footage presented in point-light ($\overline{X}$=0.09; p<0.001).

These results suggest that the movement cues indicative confidence are easy to perceive when they are present. This is implied by the lack of light-effects present for the organized walk. However, the movement cues present in disorganized walks appear to result in a more neutral perception of walker confidence. This might indicate that the additional context provided by full-light footage are required to determine a lack of confidence. These context cues include characteristics like the angle of a person's head (i.e., are they looking down at the ground or straight ahead), or the slump in their shoulders.

In this way, confidence may be demonstrating the complex relationship between point- and full-light video formats and walking style. Namely, it appears that the perception of a concept is sometimes easily identified and perceived by an observer based solely on walk-

Figure 5.10: Comparing Perceptions of Walker Confidence in Point- and Full-light – Study 2



Notes: $^{*}p<0.05$, $^{**}p<0.01$, $^{***}p<0.001$. Figure presents mean scores of participant responses to the question *"How much do you agree or disagree with the following statement: The person in the video appears confident."* Results also presented in Table 6.4.

information (i.e., observing high levels of confidence in an organized point-light walker). However, at times, the additional nonverbal communication available in full-light is vital to forming perceptions about a concept (i.e., observing low levels of confidence in a disorganized full-light walker but not a disorganized point-light walker).

It is also worth noting the differences in how the concept of ease to overpower is perceived compared to the the concept of walker confidence (see Figure 5.8). The differences in how these two variables were perceived and rated by participants suggests that confidence is not synonymous with vulnerability.

Overall, Study 2 found more variation in the impact of video format. The goal of the current project was not to evaluate why point- and full-light videos are perceived differently. Rather, the goal was to identify if video format impacts the participants perceptions of the presented walking styles. Given the results from Study 1, and now Study 2, it appears that point- and full-light footage are perceived differently.

This conclusion is not a critique on the use of point- or full-light footage. Rather, there are benefits and drawbacks to both footage types. Researchers need to make intentional decisions regarding what video format and the types of material they wish to use in their research. The current work demonstrates that these two video formats are not perceived the same. Additional research may look into when it is best to use one footage type over the other. However, these results also indicate that point-light videos are a viable tool to studying the perception of individuals based on movement cues and walking style.

Context - Block Effects

The following two sections both address the third and final research question the current study sought to answer: *Do perceptions of a subject's vulnerability differ based on context or the environment they are observed in?* The goal in asking this question was to evaluate the impact of contextual factors on how individuals are perceived. The contextual variable of interest in this section is that of Blocks.

The previous sections have demonstrated that walking style impacts perceptions of walkers. In addition to these walk effects, point- and full-light videos receive significantly different ratings, suggesting that video format impacts perceptions of walkers. The primary difference between point- and full-light video is the amount of information available to the participant. Full-light video provides contextual information about the walker and the setting they are in.

In this section, I explore the impact of these settings by comparing the two filming locations (Block A and Block B). These comparisons are conducted using both the point-light and full-light videos. The point-light comparisons serve as a baseline evaluation of walkers' vulnerability in Block A and Block B when no contextual information is available. The full-light results then demonstrate the impact of the environmental information associated with Block A and Block B and how that impacts perceptions of the walkers' vulnerability.

Study 1

Study 1 participants were exposed to both Block A and Block B. Therefore, they could directly compare the appearance of the blocks in the full-light videos. Given this, the t-test comparisons and corresponding results for Study 1 are *not* experimental.

Ease to Attack

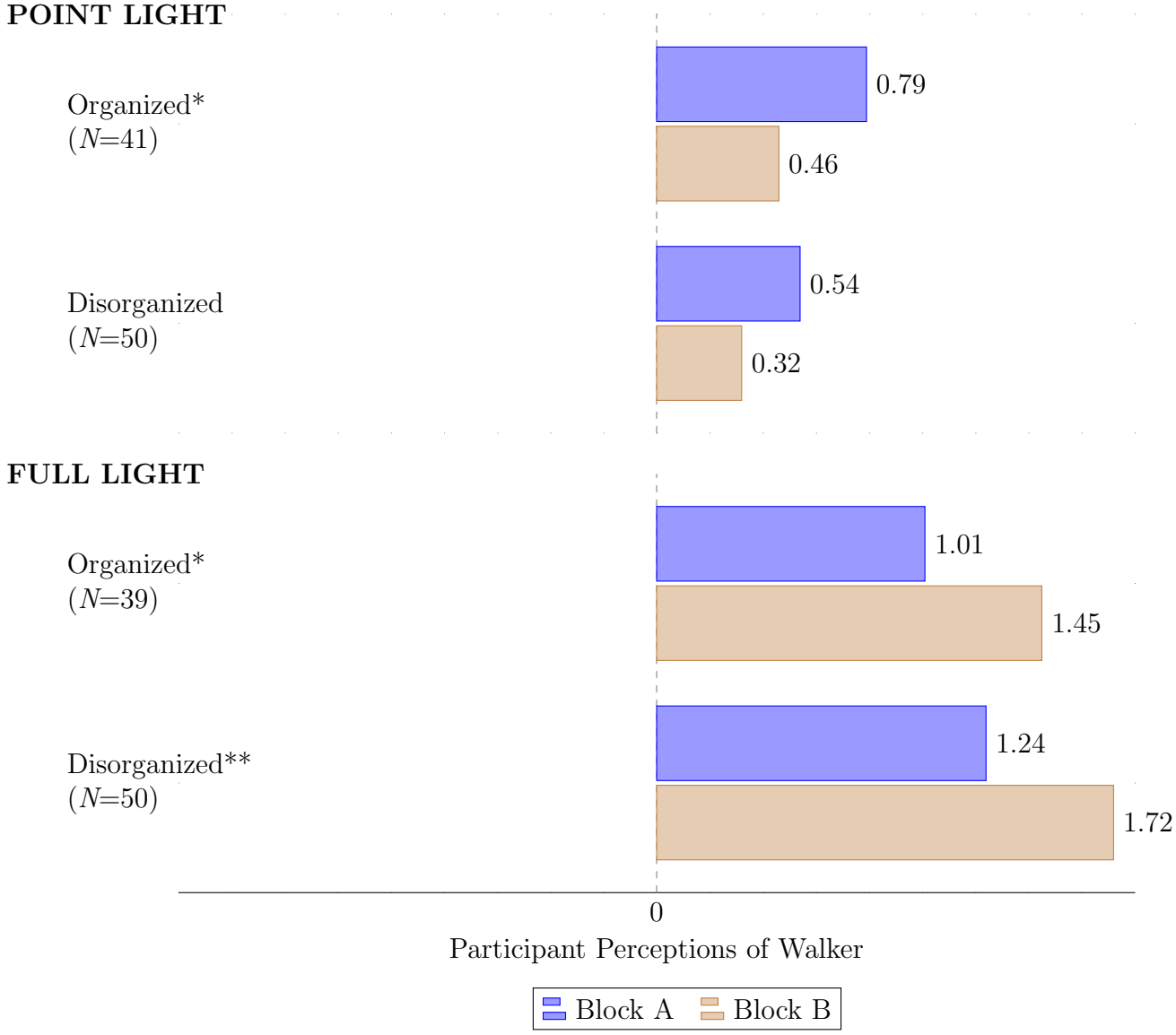
Study 1's first perception variable was ease to attack. Figure 5.11 presents the results of the t-test analyses comparing participant perceptions of organized and disorganized walks in Block A and Block B. These analyses revealed a surprising result: Study 1 participants perceived a difference between Block A and Block B in point-light. Specifically, participants rated attacking an organized walker in Block A as easier for someone to attack ($\overline{X}$=0.79) than an organized walker in Block B ($\overline{X}$=0.46; p<0.05).

This was a surprising result because in point-light, participants would have no contextual information available to them. Despite this, the point-light subject in Block A was considered a more vulnerable subject. However, when participants have access to all the contextual information, Block B appears to be associated with additional vulnerability. In full-light, participants rated organized walkers in Block B as easier for someone to attack ($\overline{X}$=1.45) than organized walkers in Block A ($\overline{X}$=1.01; p<0.05). Disorganized walkers in Block B were likewise considered easier to attack ($\overline{X}$=1.72) than their disorganized Block A counterparts ($\overline{X}$=1.24; p<0.01).

It is unclear why Study 1 shows a block-effect in point-light for this perception variable. Some explanations for this unexpected result include the potential for statistical artifacts, contamination of the experimental condition, or that this result is a false positive. However, it is also possible that the two volunteers recruited as walkers experienced some contamination effects from the environment. Because the volunteers knew the purpose of the project, they may have been primed to focus more on their walks during filming.

Previous research indicates that merely asking women to think about walking alone in a park at night changes how they carry themselves (Johnston et al., 2004). Given this, there is the potential that the volunteers had slightly different walks in Block A and Block B–especially if the environmental contexts of one filming location made them feel more or less comfortable than the other. This would explain why the organized Block A walk was perceived as easier

Figure 5.11: Comparing Perceptions of Ease to Attack in Block A and Block B – Study 1



Notes: $^{*}p<0.05$, $^{**}p<0.01$, $^{***}p<0.001$. Figure presents mean scores of participant responses to the question *"How easy would it be for someone to attack this individual?"* Results also presented in Table 6.5.

to attack than the organized Block B walk. If the volunteers felt less safe in Block B, they may have unintentionally made their organized walk *more* organized than when in Block A. This explanation also helps put into perspective the switch in effect-directions–where in point-light subjects in Block A were perceived as more vulnerable, while in full-light subjects in Block B were perceived as more vulnerable.

Overall, the current study cannot provide a explanation as to why ease of attack finds

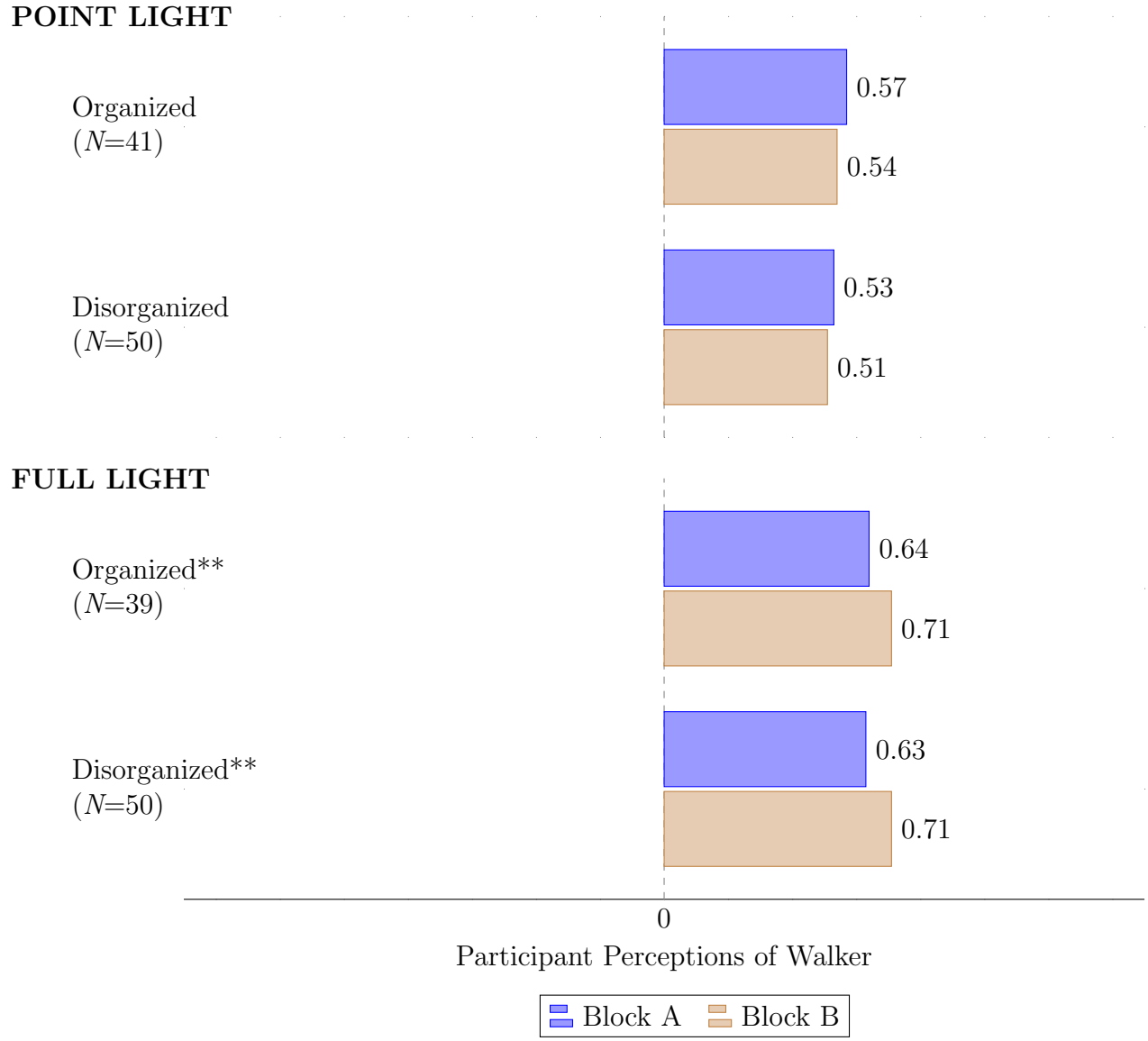
block effects in point-light. However, the results from the full-light comparisons suggest that contextual information can impact the perception of the subject within that context–independent of walking style. Future research is needed to confirm and further evaluate the impact of environments on the perceptions of individuals within them.

Likelihood of Success

The second perception variable evaluated in Study 2 was the likelihood of an attack being successful. Figure 5.12 present the results examining the impact of Block A and Block B on perceptions of walking style and the likelihood of an attack to be successful (See next page). For this perception variable, there were no observable differences in perceptions between Block A and Block B in point-light. However in full-light, Block A and Block B received significantly different ratings. The full light analyses found that attacking an organized walker in Block B was perceived as more likely to succeed (71% chance) compared to an organized walker in Block A (64% chance; $p<0.01$). Likewise, attacking a disorganized walker in Block B was rated more likely to succeed (71% chance) than attacking a disorganized walker in Block A (63% chance; $p<0.01$).

These results provide additional evidence suggesting that environmental context impacts the perception of individuals within it. The current research cannot conclude *exactly* which characteristics in Block B contribute to higher levels of perceived subject vulnerability. Rather, the results indicate that context can nudge an observer's perception of a subject. Previous research on victim selection and the theoretical explanations outlined by place-based criminologists may help put these results in perspective.

Figure 5.12: Comparing Perceptions of Likelihood of Success in Block A and Block B – Study 1



Notes: $^{*}p<0.05$, $^{**}p<0.01$, $^{***}p<0.001$. Figure presents mean scores of participant responses to the question *"How likely is it that the attack will be successful?"* Results also presented in Table 6.5.

For example, previous research finds that offenders perceive individuals who do not appear to "fit in" as easier targets (Wright and Decker, 1997). This includes white individuals within predominately black neighborhoods, to people of color in predominantly white neighborhoods, to neuro-divergent youth in a school system built for neuro-typical children (Jeary, 2005; Wright and Decker, 1997). Given this, one may conclude that the subjects used in the current study did not appear to fit in within the settings of Block B, thus increasing their

vulnerability relative to Block A.

Likewise, the two blocks were selected based on concepts outlined within environmental criminology such as indicators of ownership and the implication that informal social controls may be present. In this case, the broken shutters, graffiti, torn up street, and other contextual characteristics depicted in Block B may correspond to the assumption that attacking the subject in Block B would be easier and more likely to succeed.

Study 2

As mentioned previously, the block effect results from Study 1 were not based on an experimental design. This means that the differences in the perception of Block A and Block B that were observed in Study 1 could be due to testing effects. To address this potential limitation, Study 2 made several changes to the full-light portion of the study.

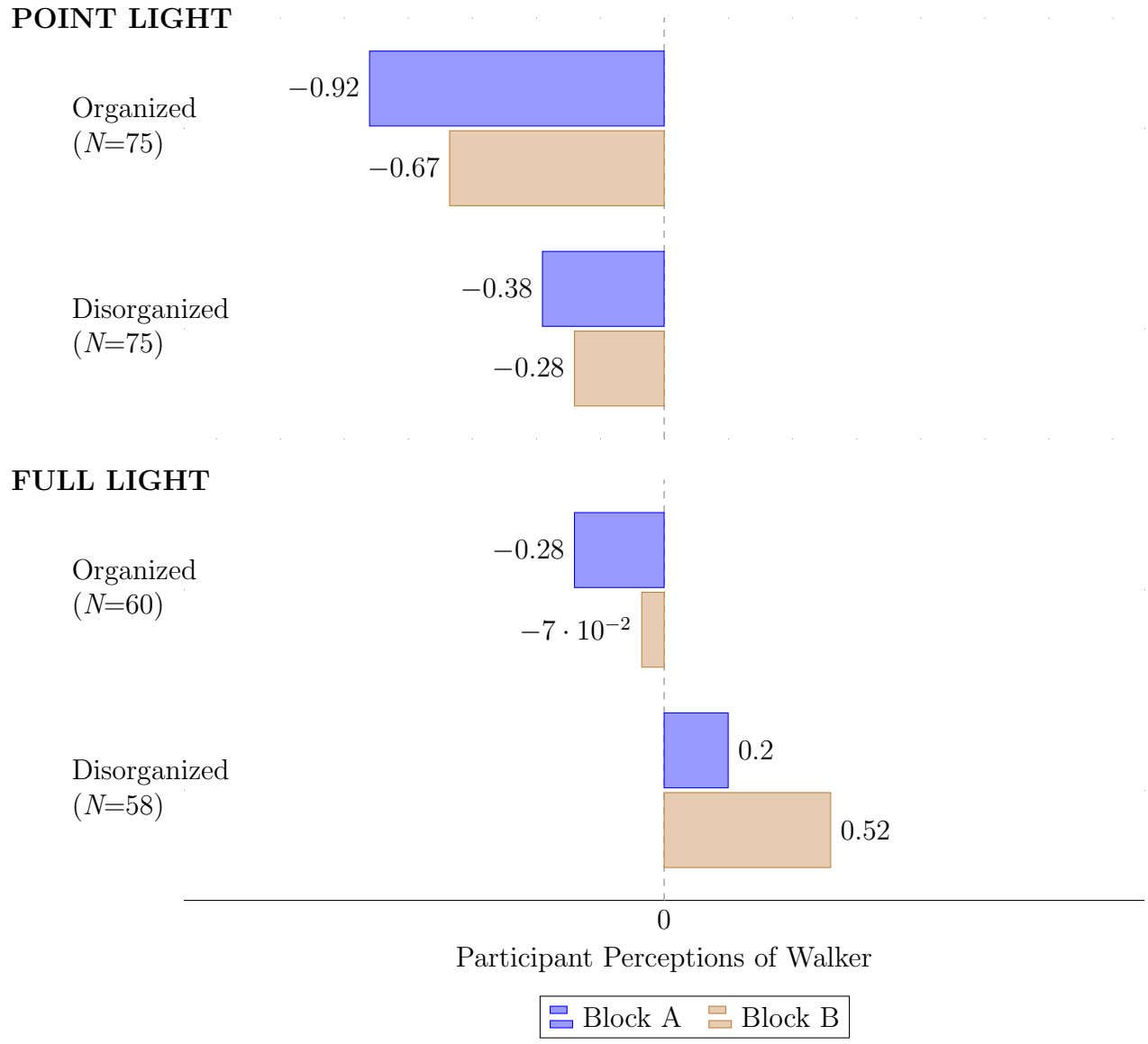
In Study 2, each participant was randomly assigned to either Block A and Block B. Based on this assignment, participants only saw the full-light videos corresponding to their block assignment and therefore participants in Study 2 could not make comparisons between the two filming locations. We can assume that any differences observed between Block A and Block B in Study 2 can be attributed to the impact of the contextual information. This study design decision impacted the type of t-test analyses. Whereas Study 1 used paired t-tests to evaluate the impact of blocks, Study 2 used unpaired t-tests.

Ease to Overpower, Likelihood of Arrest, and Walker Confidence

In the previous sections, each perception variable was discussed independently. However, Study 2 found no significant differences in how participants perceived Block A and Block B–in point- and full-light–for any of the three perception question. Given the consistency of the null findings, I've combined the three perception variable sections into this single section.

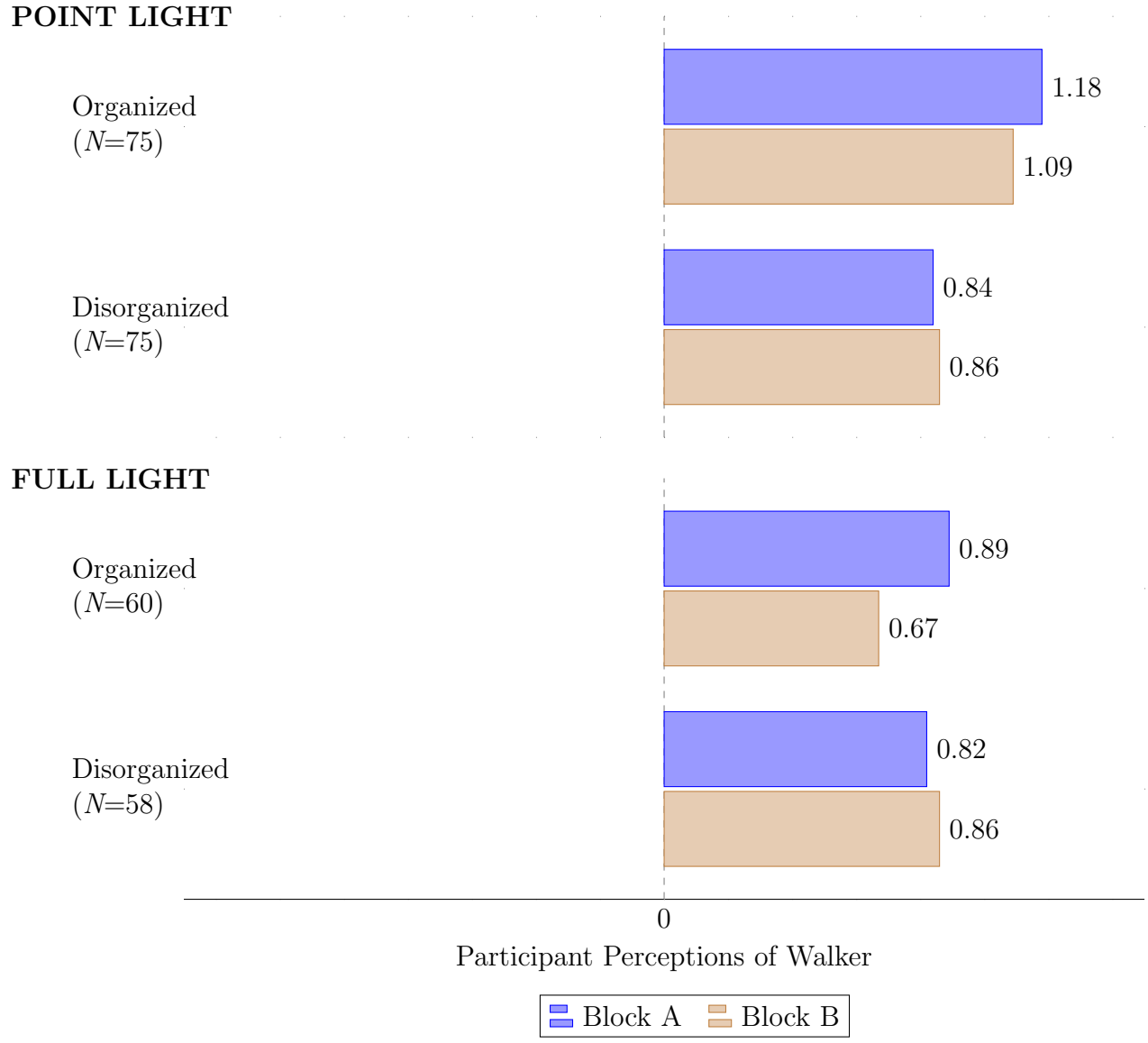
Figure 5.13 presents participant perceptions of how easy it would be to overpower the walker. Figure 5.14 presents participant perceptions of how likely they would be arrested. Finally, Figure 5.15 presents how much participants agreed that the walker appeared confident. In each, participants perceived no differences between organized and disorganized walks in Block A or Block B, regardless of footage-type. These results present a deviation from those found in Study 1. And often, a lack of significant findings would result in not discussing those findings. However, null effects are particularly relevant to the current study. Given this, these results and their implications are briefly discussed herein.

Figure 5.13: Comparing Perceptions of Ease to Overpower in Block A and Block B – Study 2



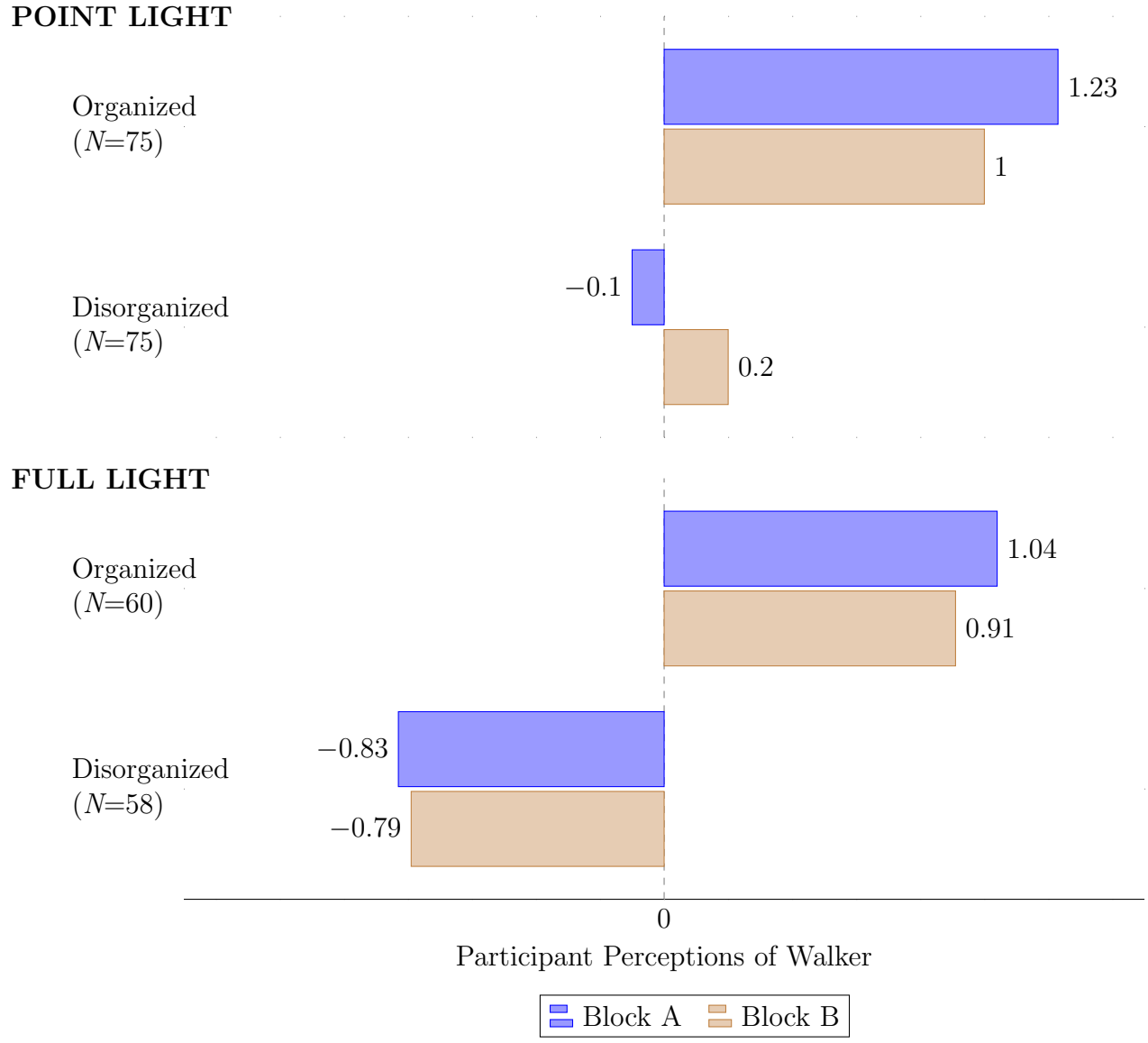
Notes: *p<0.05, **p<0.01, ***p<0.001. Figure presents mean scores of participant responses to the question *"If you robbed this person, how easy or difficult would it be to overpower them?"* Results also presented in Table 6.6.

Figure 5.14: Comparing Perceptions of Likelihood of Arrest in Block A and Block B – Study 2



Notes: *p<0.05, **p<0.01, ***p<0.001. Figure presents mean scores of participant responses to the question *"If you robbed this person, how likely or unlikely is it you would get arrested?"* Results also presented in Table 6.6.

Figure 5.15: Comparing Perceptions of Walker Confidence in Block A and Block B – Study 2



Notes: *$p<0.05$, **$p<0.01$, ***$p<0.001$. Figure presents mean scores of participant responses to the question *"How much do you agree or disagree with the following statement: The person in the video appears confident."* Results also presented in Table 6.6.

These results indicate that environmental context has no impact on the perception of the subjects. The physical characteristics Block A and Block B did not impact perceptions of individuals within them. This implies that perceptions of individuals are relatively consistent, and do not change when moving from context to context.

It is important to note that this conclusion directly contradicts the conclusions presented in Study 1. This difference in observed block effects is likely due to methodological differences between the two studies. As mentioned previously, participants in Study 1 watched full-light videos of both Block A and Block B. This means each participant was exposed to both filming locations. Study 2, by contrast, randomly assigns participants to a block condition. This means that the participants were exposed to only one filming location–Block A or Block B.

These differences in the studies' designs suggest that primary reason Study 1 observed block effects is because participants could compare between the two locations. When the ability to compare Block A to Block B is taken away–as it is in Study 2–the effect disappears.

This is an important finding. And it becomes even more important when considering the backdrop of the studies' design. On one hand, one might look at these results and conclude that because Study 2 used an experimental design and did not find a block effect, that the environment has no impact on the perception of an individual within it. On the other hand, one may also look at these results and conclude that the findings suggest the only reason an environment has an impact on the perception of a subject is because participants are able to compare between one environment and the other. Based on the knowledge that people in the real-world are exposed to multiple locations as they go through life and can make comparisons in the relative safety between those locations, one may decide that the results from Study 2, while experimental, are not an accurate depiction of the true impact environments can have on subjects within them.

The study design inconsistencies between Study 1 and Study 2, therefore, becomes a po-

tential source of trouble. The results from Study 1 may be subject to testing effects. If participants in Study 1 saw Block A and perceived subjects within that environment as having a specific vulnerability value, they may have felt compelled to adjust the subject's vulnerability rating when seeing them in Block B. This, arguably, has very different implications from the conclusion that differences in environment inherently impact the perception of individuals within them.

Finally, there is the potential that a sample drawn from other populations may produce different results. Both Study 1 and Study 2 used a sample of college students. On average, college students are less delinquent and come from more affluent backgrounds. Thus, they are often less likely to attack or rob individuals on the street. A sample of offenders may have produced very different results. In addition, Study 2 used unpaired t-tests to evaluate the impact of contextual environments, the sample size for these analyses dropped. There is the potential that with a larger sample researchers could find block effects even when individuals are unable to compare the two locations.

Given the inconsistent results, the variety of potential limitations, and the novelty of the current study, future research exploring these questions is prudent.

Context - Sex Effects

The final set of analyses presented examine the second contextual variable used to answer the question: *Do perceptions of a subject's vulnerability differ based on context or the environment they are observed in?* In this section, t-test comparisons evaluate impact of a subject's sex on how they are perceived. Previous research has found that women are often perceived as easier to overpower and easier to intimidate (Stevens, 1994; Wright and Decker, 1997; Jones et al., 2012). Given this, evaluating the impact of walker sex on the perception of the walker's vulnerability was prudent. To test this, I compare the perceptions of the male and female walker for each walking style.

Similar to the previous contextual variable (Blocks), all analyses are conducted using both the point- and full-light footage. Previous research indicates that a subject's sex is sometimes distinguishable in dynamic point-light displays (Kozlowski and Cutting, 1977). Given this, there is the potential that perceptions of the male and female walker may differ in point-light. However, the point-light comparison is primarily included to demonstrate how perceptions of walkers' sex changes when participants transitioned to full-light videos where walker sex is clearly distinguishable.

The results for Study 1 and Study 2 are presented in their corresponding sections below. It is worth noting that the experimental designs used for Study 1 and Study 2 did not guarantee that participants saw both walking styles for both sexes. This results in a decrease in the sample sizes used for these comparisons.

Study 1

Each participant in Study 1 was guaranteed to see two videos of the female walker and two videos of the male walker. Given this, all the t-tests conducted using Study 1 data are paired t-tests.

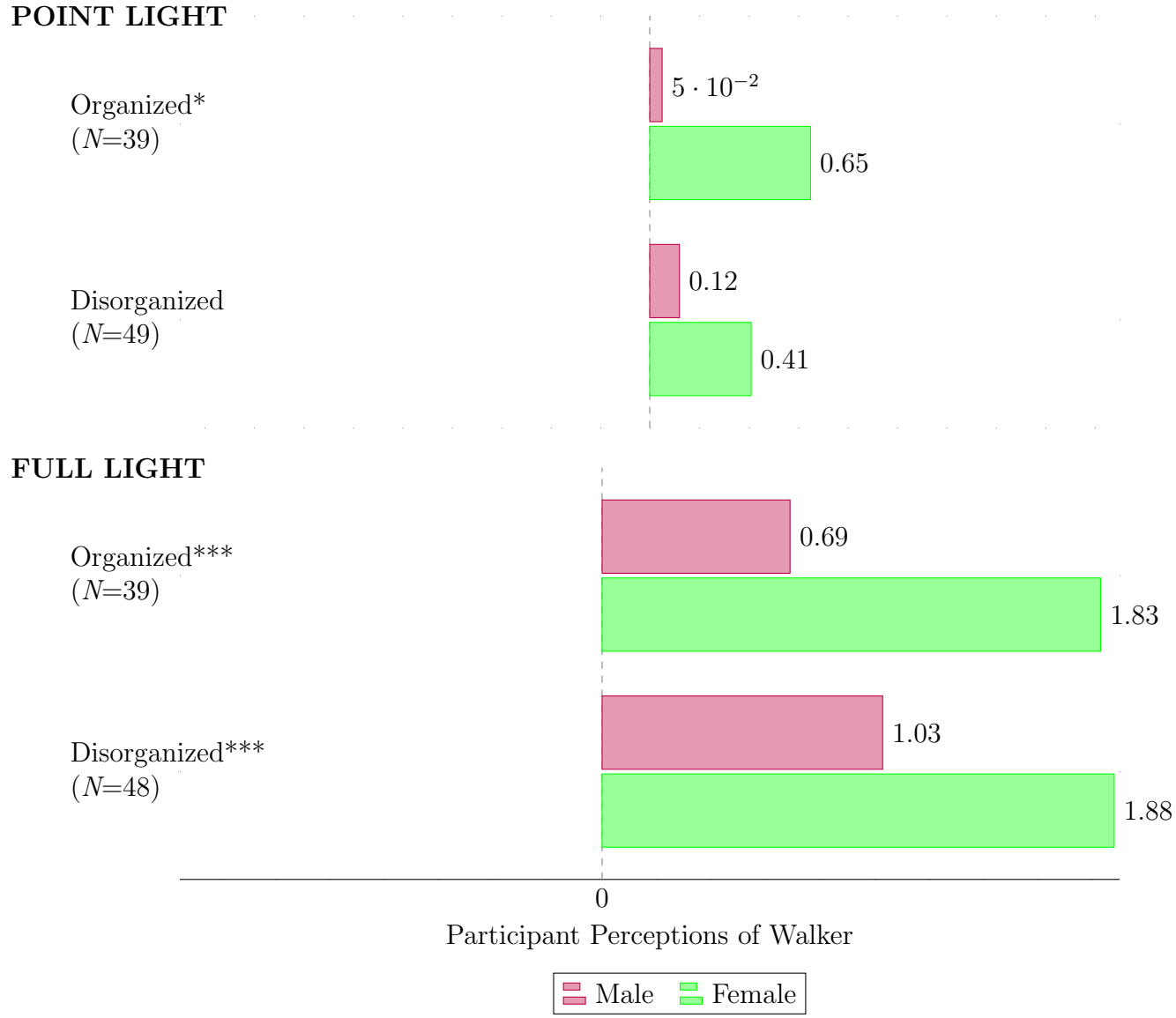
Ease to Attack

Consistent with previous sections, the first perception variable participants were asked evaluated how easy it would be for someone to attack the walkers. Figure 5.16 present participants' average rating of organized and disorganized walks for the male and female walkers. The analyses found that Study 1 participants tended to rate the female walker as easier for someone to overpower than the male walker.

The first set of t-tests compared perceptions of the male and female walkers in point-light. These indicated that an organized female walker was rated as easier to attack ($\overline{X}$=0.65) than her male counterpart ($\overline{X}$=0.05; p<0.05). This effect was not observed for the disorganized walking style.

When presented in full light, by comparison, there is a clear and pronounced difference in the perception of the male and female walkers. When the walkers had an organized walking style, the female walker was rated substantially easier for someone to attack ($\overline{X}$=1.83) than the male walker ($\overline{X}$=0.69; p<0.001). Likewise, when the walkers had a disorganized walking style, the female walker was perceived as easier to attack ($\overline{X}$=1.88) than the male walker ($\overline{X}$=1.03; p<0.001).

Figure 5.16: Comparing Perceptions of Ease to Attack between Male and Female Walkers – Study 1

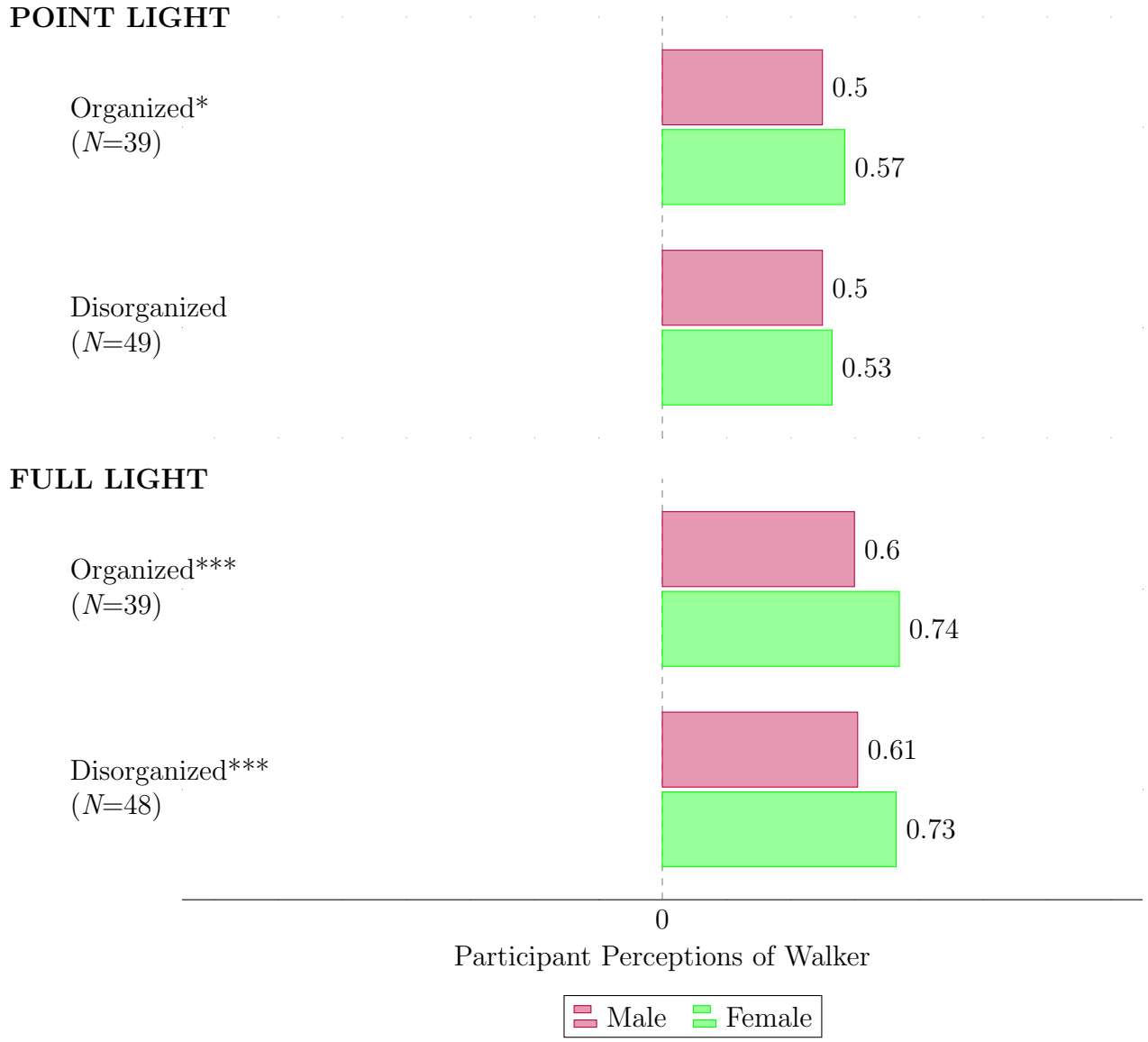


Notes: $^{*}p<0.05$, $^{**}p<0.01$, $^{***}p<0.001$. Figure presents mean scores of participant responses to the question *"How easy would it be for someone to attack this individual?"* Results also presented in Table 6.7.

Likelihood of Success

The second perception variable measured in Study 1–the likelihood of an attack being successful–showed a very similar pattern. Figure 5.17 presents the results of the *t*-tests used to compare perceptions of the male and female walkers in both walking styles.

Figure 5.17: Comparing Perceptions of Likelihood of Success between Male and Female Walkers – Study 1



Notes: *$p<0.05$, **$p<0.01$, ***$p<0.001$. Figure presents mean scores of participant responses to the question *"How likely is it that the attack will be successful?"* Results also presented in Table 6.7.

In point-light, participants did not perceive a difference between the disorganized male and

female walkers. However, attacking a female organized walker was perceived as more likely to succeed (57% chance) compared to attacking a male organized walker (50% chance; $p<0.05$).

In full-light, attacking the female walker was perceived as more likely to succeed regardless of walking style. Participants rated someone attacking an organized female walker as a 74% likelihood of success–14% more likely to succeed than attacking an organized male walker (60% chance; $p<0.001$). Likewise, someone attacking a disorganized female walker was perceived to have a 73% chance of success–12% higher than attacking a disorganized male walker (61% chance; $p<0.001$).

The results from Study 1 clearly indicate that the female walker was perceived as more vulnerable. They were rated easier for someone to attack, and these attacks were rated as more likely to succeed. These results were primarily present when comparing perceptions of the male and female walker using the full-light footage. This suggests that explicit knowledge of the walker's sex is important.

Keep in mind that when presented in point-light, participants were unable to distinguish any primary or secondary sex characteristics associated with the walkers. Given this, these results may indicate that Study 1 participants could distinguish between the male and female walker in point-light. If so, this distinction could contribute to differences in the perception of ease.

However, the current project did not ask participants to indicate their perception of the walker's sex. Given this, it is unclear if the differences in the perceptions of the male and female organized walkers is a conscious distinction or an unconscious one. Given that these differences did not emerge for the disorganized point-light walkers, there is the potential that the perceived differences between the organized male and female walkers is a statistical artificial. However, it may also be that walker sex is more difficult to distinguish (consciously or unconsciously) when the walker has a disorganized walking style.

These results suggest that feminine-presenting individuals, on average, are perceived as easier

to attack. This finding is consistent with previous research indicating that women are often perceived as more vulnerable than men (Stevens, 1994; Wright and Decker, 1997; Jones et al., 2012). The current project demonstrates that these perceptions of womens' additional vulnerability exist within a sample of college students.

Study 2

As mentioned within the Block Effects section, Study 2 includes a random assignment that limits the number of full-light videos participants watched. Participants in Study 2 only saw one video of a female walker and one video of a male walker in full-light. However, participants in Study 2 still watched 2 videos of the female walker in point light and two videos of the male walker in point light. Given this, the current section uses both paired and unpaired t-tests to evaluate the impact of walker sex on the perception of the walker's vulnerability.

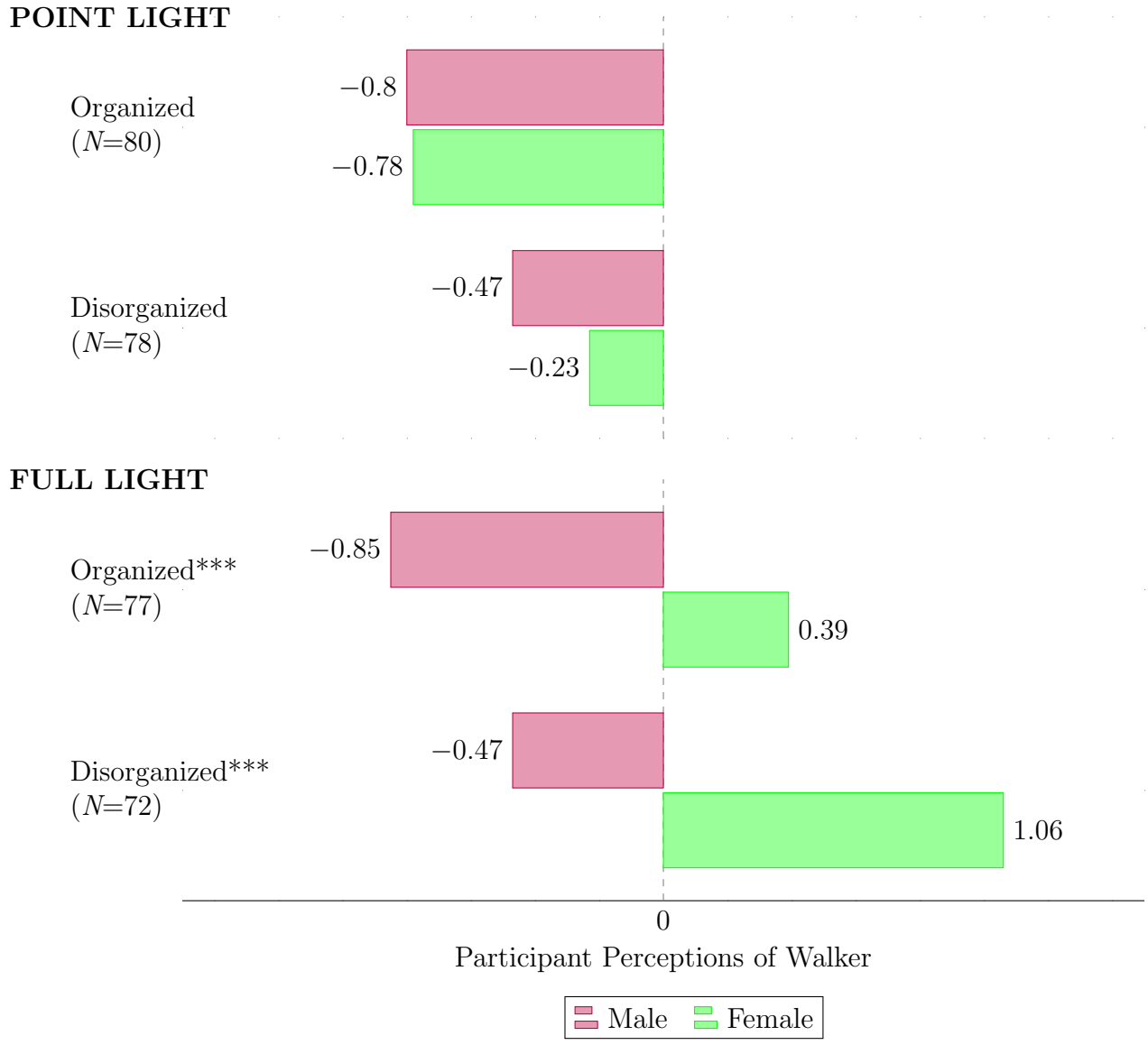
The analyses use paired t-tests when comparing the point-light footage and unpaired t-tests are used when comparing the full-light footage. However, it should be noted that, when comparing the male and female walkers in full-light, these are not truly between-group comparisons. In other words, even though the full-light analyses use unpaired t-tests, it does not mean that one group saw only the female walker and the other group saw only male the walker. Rather, the use of the unpaired t-tests here simply means that participants are not being used as their own control.

Ease to Overpower

The first perception variable examined was ease to overpower. Figure 5.18 presents the results of the t-test analyses used to compare perceptions of the male and female walkers for both walking styles (See next page). These analyses found that participants perceived

no differences between the male and female walkers when they were presented in point-light. This means that when participants could not see the primary and secondary sex characteristics of the walker, a subject's sex had no impact on participant's perceptions of them.

Figure 5.18: Comparing Perceptions of Ease to Overpower between Male and Female Walkers – Study 2



Notes: $^{*}p<0.05$, $^{**}p<0.01$, $^{***}p<0.001$. Figure presents mean scores of participant responses to the question *"If you robbed this person, how easy or difficult would it be to overpower them?"* Results also presented in Table 6.8.

In full-light, by comparison, Figure 5.18 shows pronounced differences in the perception of

the male and female walkers. When presented in full-light, the female walker was rated as much easier to overpower. An organized female walker, when presented in full-light, was rated as easier to overpower ($\overline{X}$=0.39) than an organized male walker ($\overline{X}$=-0.85; p<0.001). Likewise, a disorganized female walker, when presented in full-light, was perceived as much easier to overpower ($\overline{X}$=1.06) than a disorganized male walker ($\overline{X}$=-0.47; p<0.001).

These results provide clear evidence that a subject's sex impacts how vulnerable they are perceived to be. Interestingly, the findings presented in 5.18 show that perceptions of the male walker do not appear to substantially differ between the point-light and full-light comparisons. Keep in mind that these analyses are not direct comparisons (i.e., the point-light results used paired t-tests while the full-light results used unpaired t-tests to preserve sample size). Despite this limitation, there are clear indications of walk effects (i.e., the male disorganized walker was rated as easier to overpower than the male organized walker, and the female disorganized walker was rated as easier to overpower than the female organized walker), but there are clear indicators of sex effects (i.e., regardless of walking style, a female walker is perceived as easier to overpower).

Study 2 appears to support the presence of sex effects. This means that the contextual information of someone's sex or gender identity can impact an observer's perception of the individual's vulnerability–in this case, how easy they would be to overpower.

Likelihood of Arrest and Walker Confidence

The two remaining perception variables from Study 2–perceptions of the likelihood of arrest, and perceptions of walkers' confidence–found no evidence of sex effects. Therefore, the discussion of these two variables are combined and presented here. Figure 5.19 compares perceptions of the likelihood of arrest for attacking the male and female walkers. Figure 5.20 compares perceptions of subject's confidence for the male and female walkers.

For both variables, participants did not perceive differences in the likelihood of arrest or in walker confidence. In point- and full-light the male walker and female walkers were perceived as approximately the same.

Keep in mind, the current study is not attempting to explain or identify why sex differences emerge. Rather, the goal of these analyses was to identify if the contextual information of subject sex impacts the perception of said subject. Given this, these results suggest that walker sex does not impact perceptions of confidence or the likelihood of arrest.

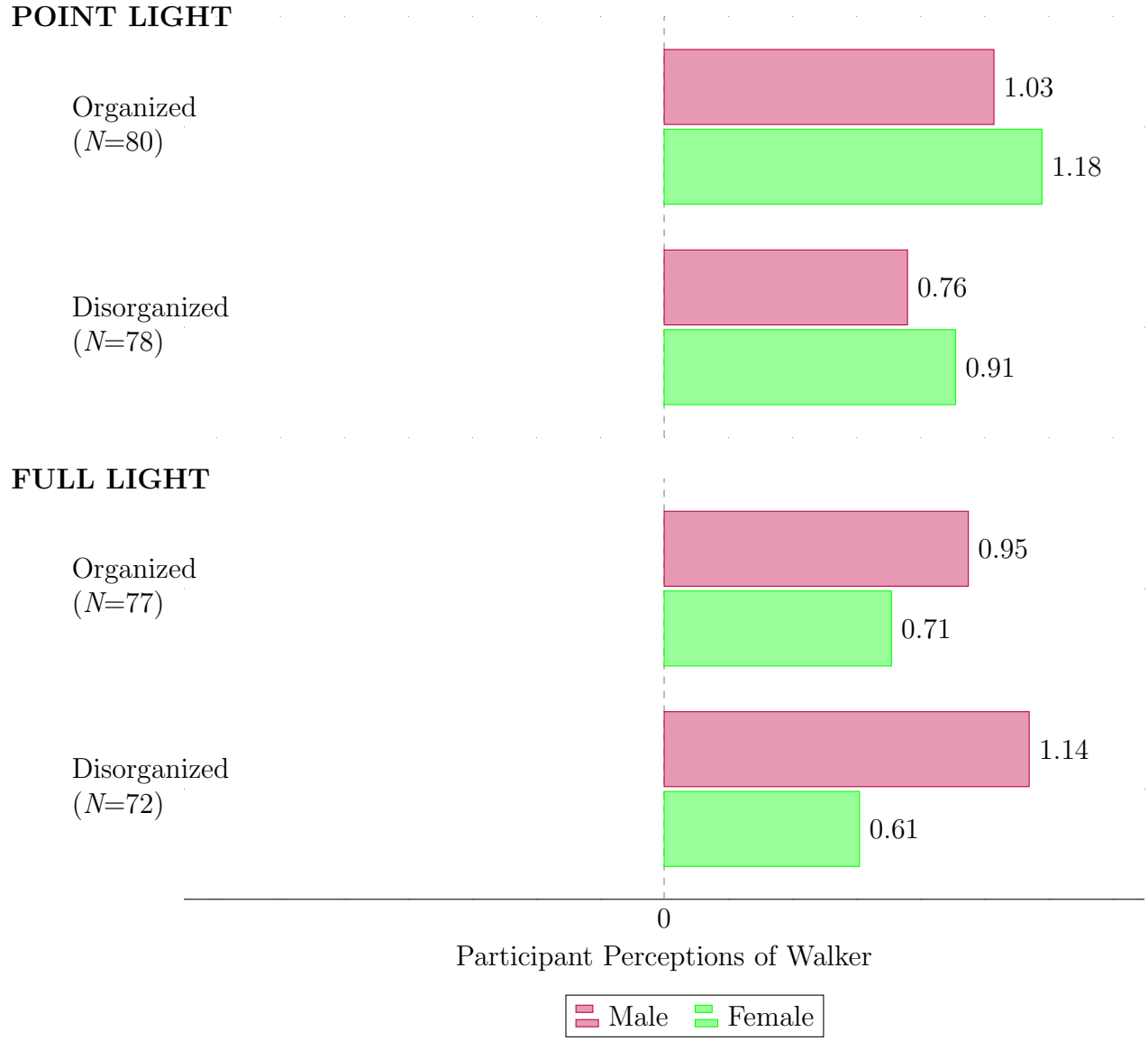
It is unclear why female walkers in Study 2 were perceived as easier to overpower but were not perceived as more or less likely to result in arrest or as more or less confident. It may be that the perception of confidence is relatively gender-neutral. This may explain why both walkers were rated so similarly. This would provide further evidence suggesting that while walker confidence may correlate with perceptions of walker vulnerability, they are unique concepts. Likewise, given the assumption of a relatively objective police force, there is relatively little reason to assume that robbing a man or woman would result in a higher likelihood of arrest. In addition, perceptions of arrest likelihood are often inaccurate in non-offending samples. Given these potential explanations, these results may suggest that perceptions of arrest risk are also gender neutral.

Despite the lack of sex effects observed for the final two perception variables, the results from Study 2 clearly indicate that women, on average, are perceived as easier to overpower. Previ-

ous research shows offenders describe women as easier to overpower and easier to intimidate (Stevens, 1994; Wright and Decker, 1997; Jones et al., 2012). These beliefs are also reflected in these results. The reasoning driving the impact of these sex effects may be ascribed to differences in physical stature. However, it is likely there are a variety of contributing factors leading to sex differences in the perception of vulnerability.

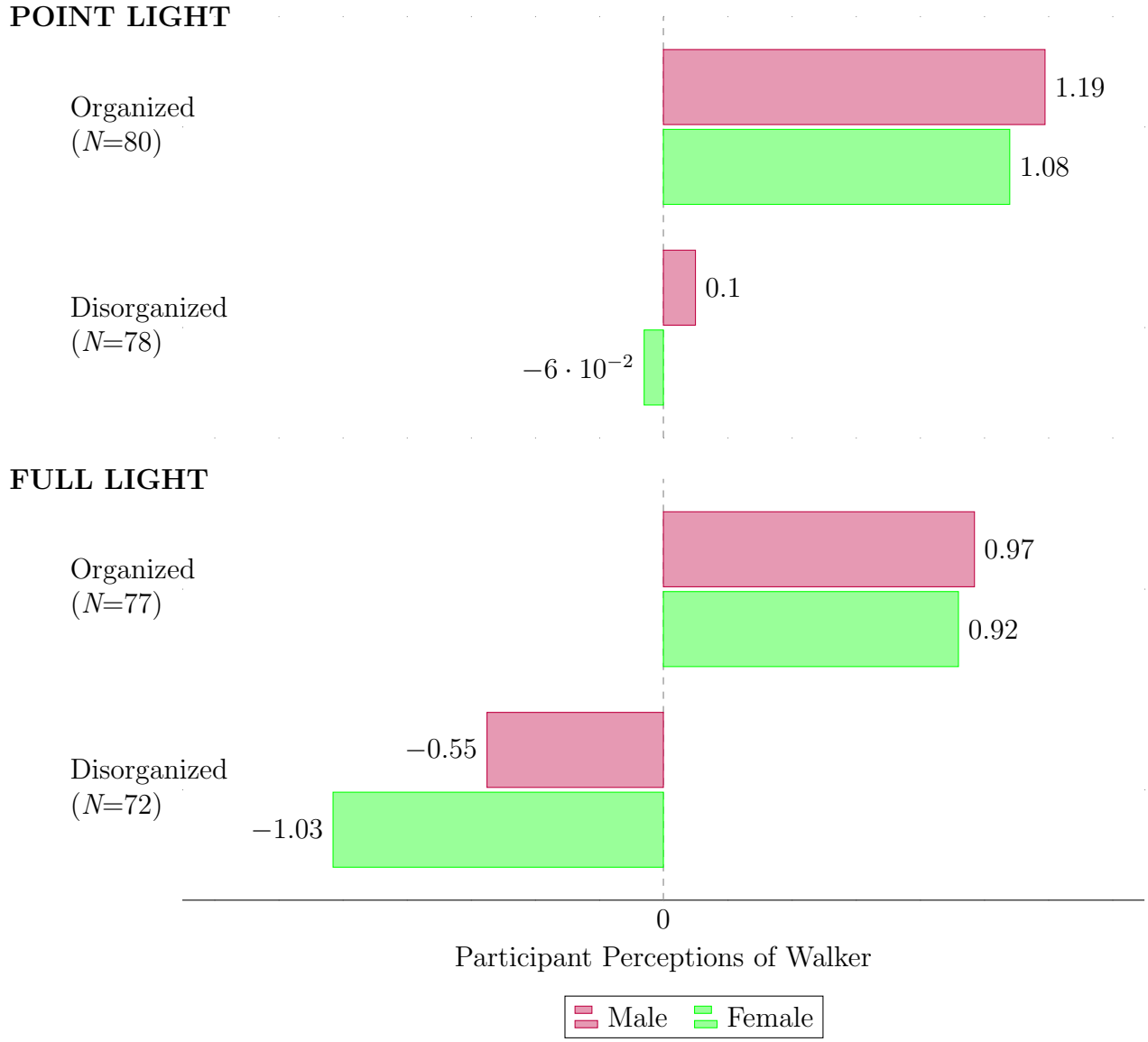
Regardless, the results indicate that sex, or a person's presenting gender identity may be an important factor for researchers to consider when discussing vulnerability. In addition, the results suggest a nuanced and intricate relationship between concepts of vulnerability that are gender-neutral and types of vulnerability associated with sex/gender presentation.

Figure 5.19: Comparing Perceptions of Likelihood of Arrest between Male and Female Walkers – Study 2



Notes: $^{*}p<0.05$, $^{**}p<0.01$, $^{***}p<0.001$. Figure presents mean scores of participant responses to the question *"If you robbed this person, how likely or unlikely is it you would get arrested?"* Results also presented in Table 6.8.

Figure 5.20: Comparing Perceptions of Walker Confidence between Male and Female Walkers – Study 2



Notes: *$p<0.05$, **$p<0.01$, ***$p<0.001$. Figure presents mean scores of participant responses to the question *"How much do you agree or disagree with the following statement: The person in the video appears confident."* Results also presented in Table 6.8.

Checks and Controls

The previous sections presented the results of analyses conducted to answer the present work's primary research questions. To provide further clarity and confidence in those results, the current section presents the analyses conducted to (a) evaluate the impact of control variables, and (b) check the robustness of the results.

Control Variables

Study 1

Study 1 included several measures to control for demographic variables (age, sex, race, height, and weight) and a behavioral variable (delinquency). To evaluate how these factors may have impacted participant perceptions of the videos, I conducted a series of regression analyses. Due to the structure of the data, each walk- and light- combination was tested independently. In other words, I conducted four regression analyses to evaluate the impact of the control variables on average participant perceptions of (1) organized point-light walks, (2) disorganized point-light walks, (3) organized full-light walks, (4) disorganized full-light walks. This process occurred for each perception variable in Study 1–ease for someone to attack the subject, and the likelihood that attacking that subject would be successful. For readability purposes, Table 5.1 presents the significant effects of the control variables from Study 1.

These analyses revealed that only one of the control variables had an impact on how participant perceptions. Specifically, analysis of the Study 1 control variables revealed that weight had a small impact on perceptions of the likelihood of success when the organized walks were presented in point-light. On average, as participant weight increased, they considered attacking the organized subject as less likely to succeed.

Table 5.1: Significant Effects from Study 1 Control Variables

	Ease to Attack				**Likelihood of Success**			
	Point-light		Full-light		Point-light		Full-light	
	Org.	Disorg.	Org.	Disorg.	Org.	Disorg.	Org.	Disorg.
Delinquency	–	–	–	–	–	–	–	–
Height	–	–	–	–	–	–	–	–
Weight	–	–	–	–	-0.13*	–	–	–
Age	–	–	–	–	–	–	–	–
Sex (1=male)	–	–	–	–	–	–	–	–
Race (1=white)	–	–	–	–	–	–	–	–

Notes: *$p<0.05$, **$p<0.01$, ***$p<0.001$. Cells with a – indicate that the regression coefficient did not reach statistical significance. Full results presented in Table 6.10.

Participant age, height, race, and sex did not impact responses to the perception questions in Study 1. Likewise, participant delinquency did not impact perceptions of the walkers. Table 6.10 presents the full results of these analyses in the appendix.

Study 2

Study 2 included several additional control variables. In addition to the demographic variables from Study 1 (age, sex, race, height, and weight), Study 2 controlled for gender. Furthermore, in addition to controlling for delinquency, Study 2 controlled for participant's self-control, and their level of cognitive reflection/intuition.

Once again, due to the structure of the data, I conducted a regression analysis for each walk- and light- combination. This process was carried out for each of the perception variables measured in Study 2–ease to overpower, likelihood of arrest, and walker confidence. To make these findings easier to consume, Table 5.2 (see next page) presents only the significant results of all the regression analyses. For full versions of these results, refer to Table 6.11 in the appendix.

Table 5.2 shows Study 2 found no evidence of participants' cognitive reflection/intuition impacting how they perceive or rated the different walking styles. In addition, Study 2 found no differences in perceptions between white participants and participants of color. Given this, these variables are not discussed any further.

Study 2 did, however, find evidence that control variables impacted the ease to overpower a subject, the likelihood of getting arrested, and subject confidence–in at least one of the four regression analyses corresponding to each perception variable. This means that participant perceptions were impacted by their unique experiences or personal characteristics. The focus of the current project is not on identifying what observer characteristics may impact how they perceive subjects. Therefore, while I do not provide a lengthy discussion of participant experiences or characteristics, the significant results are outlined briefly below.

First, analyses of the control variables showed that participants with higher levels of delinquent behavior rated the disorganized, full-light walker as easier to overpower. This suggests that participants with a history of offending perceived the disorganized walker as more vulnerable than non-offending participants. Wheeler and colleagues (2009) reported that in a presumably nonpsychopathic sample, higher levels of psychopathic traits was associated with more accurate estimations of subject vulnerability. Given this, this finding may be consistent with previous research.

Table 5.2: Significant Effects from Study 2 Control Variables

	Ease to Overpower				**Likelihood of Arrest**				**Walker Confidence**			
	Point-light		Full-light		Point-light		Full-light		Point-light		Full-light	
	Org.	Disorg.	Org.	Disorg.	Org.	Disorg.	Org.	Disorg.	Org.	Disorg.	Org.	Disorg.
Delinquency	–	–	–	0.91*	–	–	-0.11*	-0.16**	–	–	–	–
Low Self-control	–	–	–	–	–	–	–	–	-0.37**	–	–	–
Intuition	–	–	–	–	–	–	–	–	–	–	–	–
Height	–	–	–	-0.06*	–	–	–	0.06*	–	–	–	–
Weight	–	–	–	–	–	–	–	–	–	-0.01*	–	–
Age	–	–	–	–	–	–	–	–	–	0.03*	–	–
Sex (1=male)	–	–	–	–	–	–	–	-0.90*	–	–	–	–
Race (1=white)	–	–	–	–	–	–	–	–	–	–	–	–

Notes: *$p<0.05$, **$p<0.01$, ***$p<0.001$. Cells with a – indicate that the regression coefficient did not reach statistical significance. Full results presented in Table 6.11.

Next, participants with higher levels of delinquent behavior tended to perceive a lower likelihood of arrest when walks were presented in full-light. This effect was observed for both the organized and disorganized walking styles in full-light. However, there was no observed effect for delinquency impacting perceptions of arrest likelihood in point-light, or for other perception variables. Without further information, the most likely explanation for this effect is that increased participation in delinquent and criminal behavior provides individuals with a better understanding of the actual likelihood of arrest. More likely than not, this finding is showing the bias of a sample made up of primarily non-offenders who overestimate the likelihood of arrest.

In addition to delinquency, Table 5.2 shows that participants' height and sex impacts their perceptions of ease to overpower and the likelihood of arrest–specifically for full-light, disorganized walkers. Interestingly, taller participants perceived attacking a disorganized walker as difficult to overpower and more likely to result in arrest. The impact of this effect, however, was a quite small. Given this, it is likely more relevant to consider what this finding means in relation to the participant, rather than what it means substantively.

The result showing that taller participants considered disorganized walkers more difficult to overpower and themselves as more likely to be arrested means that they likely were considering their physical stature when forming a perception. This suggests that participants were genuinely putting themselves in the position of considering what would happen if they attacked the individual.

The final variable that impacted perceptions of arrest was participant sex/gender.[2] On

[2]For clarity, the variable I used to evaluate the impact of Study 2 controls on participant perceptions was participant's self-reported sex. This is a dichotomous variable coded 0 (female) or 1 (male). I chose to use this variable, rather than participant's self-reported gender, for a number of reasons. First, only two participants identified as non-binary in Study 2. I have perception data for only one of those non-binary participants. Given the limited number of observations, non-binary individuals could not be analyzed as a unique gender identity. In addition to the small sample count, both of the non-binary individuals were assigned female at birth. Therefore, rather than use the gender variable and statistically combine non-binary participants with women, I chose to avoid erasing their self-identified gender by using the sex variable. Substantively speaking, this had little impact on the interpretation of the results and when interpreting the results of this analysis I can still refer to participants by their gender identity.

average, men perceived a lower likelihood of arrest than women and non-binary participants.

The final perception variable–perceptions of walker confidence–also found evidence of control variables impacting participant responses. These effects were limited to the point-light organized and disorganized walks. For example, participants with lower levels of self-control rated the organized point-light walker as less confident. It is currently unclear why self-control may impact perceptions of confidence when an organized walk is presented in point-light. By contrast, evaluating the impact of control variables on the disorganized point-light walk found that participants' weight and age impacted how they perceived the confidence of the disorganized walker. The effect size of these control variables once again is small and showed that participants who weighed more rated the point-light disorganized walker as slightly less confident. Likewise, older participants perceived the disorganized walker as slightly more confident. In full-light, no control variables impacted perceptions of walker confidence.

It is important to note that by this point in the survey, Study 2 has experienced a fair amount of participant attrition and the estimates provided in this section may be subject to additional limitations. Regardless, these results provide preliminary evidence that individual-level differences can impact an observer's perception of a subject. This fits within the context of previous literature. For example, while most offenders describe women as being easier to overpower and easier to intimidate–and thus, more vulnerable–female offenders often reported men being more vulnerable due to the increased ease in getting men alone, isolated, and into a potentially incriminating scenario. This is an example of how an offender's individual-level characteristic (sex) impacts how they perceive a situation or subject.

Robustness Checks

To ensure the most accurate representation of my results I conducted several robustness checks. This involved (a) evaluating the efficacy of the various random assignment pro-

cedures, (b) evaluating potential instrumentation effects, and (c) conducting a Bonferroni p-value adjustment. The results of each of these checks are presented in their corresponding sections below.

Random Assignment and Variable Distribution

One of the primary characteristics of an experimental design is the process of randomly assigning participants to experimental conditions. The assumption is that by randomly assigning participants to experimental conditions, it is possible to create two equivalent groups. Equivalent, here, does not necessarily mean the same. Instead, it simply means that the group assigned to one experimental condition does not systematically differ from the group assigned to the other experimental condition. By making this assumption, experimental designs can be more confident that the effect of an intervention is independent of any individual-level differences.

Both Study 1 and Study 2 use an experimental design–sometimes with more than one random assignment procedure. To evaluate the distribution of participant characteristics across the experimental groups, I conducted a series of t-tests. I completed this process for each control variable and compared the distribution in each random assignment trial. Table 5.3 presents the significant findings of these t-tests.

Overall, the random assignment procedures appeared to result in an equal distribution of participant characteristics. Only two trials showed significant differences in the assignment of participants. Neither result remained significant after conducting a Bonferroni correction to address the multiple t-tests.

Table 5.3: Significant Differences in the Distribution of Control Variables Across Random Assignments

	Significant Differences Observed							
	Study 1					**Study 2**		
	Trial 1	Trial 2	Trial 3	Trial 4	Order	Trial 1	Trial 2	Blocks
Height	☐	☐	☐	☐	☐	☐	☐	☐
Weight	☐	☐	☐	☐	☐	☐	☒	☐
Age	☐	☐	☐	☐	☐	☐	☐	☐
Sex	☐	☐	☒	☐	☐	☐	☐	☐
Race	☐	☐	☐	☐	☐	☐	☐	☐
Delinquency	☐	☐	☐	☐	☐	☐	☐	☐
LSC						☐	☐	☐
Intuition						☐	☐	☐

Notes: Analyses used unpaired t-tests. Minimum significance threshold was $p<0.05$, based on a two-tailed t-test.

Instrumental Effects

In addition to an experimental design, Study 1 controlled for instrumentation effects. Participants in Study 1 were randomly assigned to watch either the point- or full-light videos in the first half of the survey. They would then watch the opposite video format in the second half of the survey. To evaluate if this assignment impacted participant responses, I conducted several t-tests. These analyses compared participant responses to the point- and full-light videos based on which video format they were first exposed to. The analysis indicated that the order participants watched the footage-types did not impact their perceptions of the point- or full-light subjects. Table 6.9 in the appendix presents these results. Given there were no observable instrumentation effects, I proceeded to conducted the t-tests comparing organized and disorganized walks.

Study 2 did not incorporate any checks for potential instrumentation effects.

Bonferroni Correction

Finally, the current project conducted multiple t-tests to evaluate the impact of several variables on the perception of vulnerability. Conducting multiple t-tests corresponds to an increased likelihood of finding significant results (Etymologia: Bonferroni Correction, 2015). This manifests itself as a higher potential Type I error, or false positives. To temper this risk, I conducted a Bonferroni p-value adjustment. The formula used for this correction is presented as Formula 5.1, where α represents the original p-value (0.05) and n represents the number of t-tests performed.

$$p = \frac{\alpha}{n} \tag{5.1}$$

The current project used two independent studies, tested three hypotheses, and included multiple perception variables. To count towards the number of t-tests performed (n), therefore, t-tests needed to be part of the same study and testing the same hypothesis. Using this rule, I calculated the appropriate p-value threshold to determine statistical significance. This resulted in the corrected p-values presented in Table 5.4.

Table 5.4: Original and Adjusted p-values Using a Bonferroni Correction

	Study 1		Study 2	
	Original	Adjusted	Original	Adjusted
Walk Effects	$p<0.05$	$p<0.0125$	$p<0.5$	$p<0.0083$
Light Effects	$p<0.05$	$p<0.0125$	$p<0.05$	$p<0.0083$
Block Effects	$p<0.05$	$p<0.00625$	$p<0.05$	$p<0.0042$
Sex Effects	$p<0.05$	$p<0.00625$	$p<0.05$	$p<0.0042$

Using the adjusted p-values, several of the statistically significant findings reported in previous sections were no longer significant. However, many of the results continued to meet the necessary significance threshold. To clearly depict the continuity of findings before and after

the Bonferroni correction, Table 5.5 and Table 5.6 present an overview of all the significant results.

Table 5.5 (see next page) demonstrates that in Study 1, only the walk effects observed using full-light data remained significant. In Study 2, however, all the observed walk effects remained significant. In addition, all the light effects observed in Study 1 and Study 2 continued to meet the adjusted significance threshold.

Table 5.5: Overview of Results that Reached Statistical Significance – Walk and Light Effects

	Study 1		Study 2	
	$p<0.05$	$p<0.0125$	$p<0.05$	$p<0.0083$
Walk Effects				
Point-light				
Ease	☒	☐	☒	☒
Risk	☒	☐	☒	☒
Confidence			☒	☒
Full-light				
Ease	☐	☐	☐	☐
Risk	☒	☒	☐	☐
Confidence			☒	☒
Light Effects				
Ease				
Organized	☒	☒	☒	☒
Disorganized	☒	☒	☒	☒
Risk				
Organized	☒	☒	☒	☒
Disorganized	☒	☒	☐	☐
Confidence				
Organized			☐	☐
Disorganized			☒	☒

In addition, Table 5.6 (see next page) shows that many of block effects observed in Study 1 were no longer significant. At the adjusted significance level, differences in the perception of

subjects in Block A and Block B were only observed for the full-light disorganized walker. Study 2 observed no block effects at the original p-value, thus there is no change with the adjusted p-value. Finally, Study 1 and Study 2 continued to find significant differences in perceptions of the male and female walkers when presented in full-light.

Overall, the Bonferroni correction slightly reduced the number of significant results. Despite this, the results continue to show evidence of walk effects, light effects, and sex effects. The current project was subject to several limitations including small sample sizes and participant attrition. Therefore, this correction may not indicate that the previous results are incorrect. Rather, it ensures the current project does not overestimate the impact of the variables considered.

Table 5.6: Overview of Results that Reached Statistical Significance – Block and Sex Effects

	Block Effects				**Sex Effects**			
	Study 1		Study 2		Study 1		Study 2	
	$p<0.05$	$p<0.00625$	$p<0.05$	$p<0.0042$	$p<0.05$	$p<0.00625$	$p<0.05$	$p<0.0042$
Ease								
Point-light								
Organized	☒	☐	☐	☐	☒	☐	☐	☐
Disorganized	☐	☐	☐	☐	☐	☐	☐	☐
Full-light								
Organized	☒	☐	☐	☐	☒	☒	☒	☒
Disorganized	☒	☐	☐	☐	☒	☒	☒	☒
Risk								
Point-light								
Organized	☐	☐	☐	☐	☒	☐	☐	☐
Disorganized	☐	☐	☐	☐	☐	☐	☐	☐
Full-light								
Organized	☒	☐	☐	☐	☒	☒	☐	☐
Disorganized	☒	☒	☐	☐	☒	☒	☐	☐
Confidence								
Point-light								
Organized			☐	☐			☐	☐
Disorganized			☐	☐			☐	☐
Full-light								
Organized			☐	☐			☐	☐
Disorganized			☐	☐			☐	☐

Chapter 6

Discussion

This project began with the (seemingly) simple question of: *How do offenders choose whom to victimize?* By exploring the literature, it became clear that offenders use a variety of characteristics to identify a victim. Included in these was how someone walks. Based on this information, the current project developed three research questions (See *Chapter 3 – Current Study*). To answer these questions and test the idea that walking style can impact an observer's perception of subject vulnerability, I used point-light technology and two independent experimental studies. Now, I revisit those questions and the results presented in the previous chapter to clearly demonstrate the conclusions and contributions of the current project.

1. *Do researcher-manipulated differences in how a subject walks shape an observer's perception of their vulnerability?*

The primary goal of the current project was to conduct an experimental evaluation of the relationship between walking style and perceptions of vulnerability. I used two independent studies and developed an organized and disorganized walking style. To isolate the walking style, videos of walks were presented in point-light and full-light. Participants were randomly assigned to watch several of these videos and rate how they perceived the walker.

Overall, the current project found evidence that walking style can impact an observer's perceptions of a subject. Observers consistently rated the disorganized walking style as easier to attack/overpower, and attacking a disorganized walker was perceived as more likely to succeed or less likely to result in arrest. Furthermore, in Study 2, organized walks were perceived as more confident. The primary difference in organized and disorganized walking styles was the amount of movement synchrony and energy.

It is worth noting that these trend were often more pronounced and more consistent in point-light than in full-light. This is likely due to the amount of information provided in each light format. When movement/walk information is the only available input, that variable is the only factor that can shift participant perceptions of the subject. In full-light, by contrast, participants have access to additional information to inform their perceptions with. This additional information may introduce more variation in responses and create less consistent participant perceptions. The following section will discuss the potential impact of light format in further detail.

Overall, the results from Study 1 and Study 2 are consistent with previous research (Gunns et al., 2002; Johnston et al., 2004; Grayson and Stein, 1981). The results provide further evidence that observers (participants) can perceive differences in how a subject carries themselves. These differences may be small unintentional body language cues–such as the energy and length of a subject's stride or their weight-shift as they step forward. Based on these cues, an observer can form an impression about the subject. These impressions include concepts like how easy it would be to overpower the walker, or the likelihood of getting away with it.

The results from Study 1 and Study 2 provide concrete evidence that individuals existing in their daily lives behave and move in ways that signal their viability as an opportunity. And when prompted, non-offending populations can distinguish between someone who they think would be easy to attack based on how they walk.

It is important to note that the present work cannot conclude exactly why less synchronous (disorganized) walks correspond to increased perceptions of vulnerability. However, looking at the literature, there are several possible explanations. First, less synchronous movement may indicate lower levels of physical capability. For example, consider how someone walks after a recent lower-body injury–often, they limp. Limping is an inherently unsynchronous movement because it favors one leg/foot, or one side of the body–often to avoid pain on the injured side. There is the possibility that movements lower in synchrony are perceived and interpreted by the brain as indicating a subject is injured or less physically capable of resisting. Another common example of disorganized movement is the walking pattern of intoxicated individuals. People under the influence of alcohol are often perceived as easier targets by offenders (Wright and Decker, 1997). Likewise, wandering slowly through a location and looking around because one's lost may appear disorganized. Even walking down the street, enraptured in one's own mind and fuming over a bad day of work, may show enough signals of disorganization and distraction.

To conclude, exactly what constitutes a disorganized walk can vary widely. However, by demonstrating the validity of walk effects using two experimental designs, the current project builds on previous research suggesting that walking styles can impact perceptions. This opens a broad area of study for victim selection and offender decision-making research.

2. Do perceptions of vulnerability informed by point-light displays differ from perceptions informed by full-light displays?

In addition to evaluating the impact of walking style, the current project evaluated the impact of light formats and methodology. Several studies have explored impact of walks on victim selection (Gunns et al., 2002; Johnston et al., 2004; Grayson and Stein, 1981). In these, some have used point-light displays to present subjects (Gunns et al., 2002; Johnston et al., 2004) while others have used full-light videos (Grayson and Stein, 1981; Wheeler et al., 2009; Book et al., 2013). However, relatively few studies have used both point- and full-light

footage. This makes it difficult to compare across studies that use different footage types. In addition, using only one light format makes it difficult to identify if participants perceive subjects differently when they are presented in point-light or full-light.

One study did use both footage types to while exploring how an observer's selection of targets for sexual advances differs in point- and full-light (Sakaguchi and Hasegawa, 2006). They found that when selecting someone to approach, observers relied on different information when the subject was presented in point- or full-light. In point-light, individuals selected potential romantic interests based on a subject's movement–specifically, shorter and slower strides. In full-light, by contrast, individuals selected potential romantic interests based on characteristics such as grooming, choice of clothing, and attractiveness (Sakaguchi and Hasegawa, 2006). This suggests that the characteristics visible in full-light were more important than the movement information presented in point-light in selecting a target. Moreover, this study provided preliminary evidence that point- and full-light videos are engaged with differently.

Given this, the current project wanted to control for potential light effects. Offenders typically do not select victims based on how attractive they appear as romantic partners. However, characteristics only visible in full-light may impact perceptions of subject vulnerability. Therefore, I compared the perceptions of the walks in point- and full-light to see how perceptions of the different concepts changed when participants were able to interact and rate both versions.

It is important to note, however, that interpreting comparisons of point- and full-light footage is not always a straight-forward process. The process of turning full-light videos into point-light videos removes *all* contextual information.

This presents a challenge. Currently, it is not possible to determine if *invisible* contextual information imparts a different effect on perceptions than explicit levels of context. For example, in point-light, a subject's stature (i.e., height and weight) is not visible to an

observer. Therefore, a subject's stature may be assumed by an observer or it may not be considered at all. In full-light, by comparison, an observer can visually approximate subject stature. The question, then, is: Does the impact of unknown/invisible subject stature differ from knowing a subject is small in stature or large in stature? Likewise, within an environment, there is the potential that the impact of unknown/invisible levels of guardianship differs from the impact of visible indicators of low guardianship or indicators of high guardianship. The purpose of using point-light displays is to evaluate perceptions of vulnerability when people have access to a very limited stream of information–movement. However, there is little information on how (or whether) observers impute or ignore the hidden contextual information.

Overall, the analyses examining light effects demonstrated that the format in which a subject is presented impacts an observer's perception of them. Subjects presented in full-light videos were consistently rated as easier to attack/overpower. In addition, attacking full-light walkers was often considered more likely to succeed and less likely to result in arrest. These results suggest that, on average, full-light video results in participants rating the subject as more vulnerable.

At this point, it is unclear exactly why a subject is perceived as more vulnerable in full-light than point-light. While it is clear that these differences likely emerge due to the additional information provided by full-light videos, it is not clear how that additional information is impacting participant perceptions. For example, it may be that the contextual information provided by full-light videos impact participants' confidence in their perception, thus shifting their response to the perception questions. Alternatively, the additional information may genuinely make attacking the subject seem easier–thus impacting participant's actual perception of vulnerability, rather than their confidence in their perception of the vulnerability.

Consider the differences in how participants rated the point-light subject's confidence compared to the full-light subject's confidence in Study 2, for example. The organized walk

was rated approximately the same in point- and full-light. However, the disorganized walker was rated substantially less confident when presented in full-light. This demonstrates how the additional information provided by the full-light footage made the subject appear less confident. It may be that the information provided by full-light footage also made subjects appear more vulnerable.

Interestingly, the impact of walking style on perceptions of vulnerability does not substantially differ when walks are presented in point- or full-light. Disorganized walks are often perceived as more vulnerable than organized walks in point and full-light. The relative difference between the walking styles remains approximately the same. Disorganized walks are not rated more vulnerable than organized walks in full-light than when presented in point-light. This suggests that light format does not impact the effect of walking style on perception. Rather, light format appears to impact overall perception of the subject, and subjects presented in full-light footage tend to be perceived as easier and less risky.

It should be noted that some walk effects observed in point-light were not observed in full-light. This may suggest that a subject's walking style becomes less important in determining vulnerability when participants have access to more information. Other characteristics such as subject sex or stature may be more relevant in determining a subject's vulnerability than their walking style. Since these characteristics are only visible in full-light observers needed to default to using walking style to determine vulnerability in point-light.

Note that these are preliminary findings. Additional research is needed to understand the different patterns emerging in point- and full-light videos. The goal of the current project was to evaluate if differences exist in how point- and full-light videos are perceived. Both Study 1 and Study 2 provide evidence of light effects. The significant changes in participant perceptions support the conclusion that video format can impact perceptions. Given this, researchers need to make intentional decisions regarding the type of videos and light formats they wish to use in study designs.

It is also worth nothing that these results are not based on an experimental design. All participants saw the point-light and full-light footage. This means they were able to compare between the two video types. These comparisons may have created artificial differences in participant responses. Future research may want to explore whether differences in perceptions between point- and full-light footage remains present when participants only see one type of video.

3. Do the perceptions of a subject's vulnerability differ based on context or the environment they are observed in?

The present work considered two different contextual variables: location and subject sex. These were identified in previous sections as Block Effects and Sex Effects. By comparing subjects in Block A and Block B, the current project aimed to demonstrate how the general environment could impact perception. Likewise, by comparing a male walker and female walker, the project aimed to evaluate how subject sex impacted perceptions of their vulnerability. Both these contextual factors are discussed in further detail below.

At this point, it is not possible to form any conclusions regarding block effects. The results from Study 1 suggest that the location a subject is observed within can impact how they are perceived. However, the results from Study 2 were unable to replicate these findings. The lack of consistency between Study 1 and Study 2 is likely due to differences in how these two studies handled full-light videos. In Study 1 all participants were able to see subjects in Block A and Block B. In Study 2, by contrast, participants were randomly assigned to see only Block A or Block B. This additional random assignment procedure was incorporated to minimize potential contamination effects of being able to compare between one environment to the other.

Study 2 found no evidence that location impacts perceptions of subjects when using an experimental design. This may indicate that environmental characteristics do not impact perceptions of vulnerability. The results from Study 2 may not provide an accurate represen-

tation of reality. This is often a valid critique levied against experimental designs. Therefore, while the random assignment of Study 2 participants to Block A or Block B may be highly controlled and free of potential contamination effects, the results from Study 2 may not be generalizable to the everyday real world.

It is useful to know that when participants can only see one block location, they do not perceive differences in the subjects within them. However, this is not how daily life in the world operates. People move in and out of different contexts on a regular basis. In doing so, they make comparisons between one location to the next–often adjusting their behavior accordingly for each of these contexts. Study 1, in some ways, demonstrated this ability to compare one location to the other. It showed that the environmental characteristics associated with Block B correspond to subjects being perceived as easier to attack and attacking them as more likely to succeed.

The present work provides preliminary evidence that people can compare between locations. These comparisons may impact the perceptions of individuals within them, but there is also evidence that when observers are not given the opportunity to see the alternative, subjects are perceived as having approximately the same level of vulnerability. Given the inconsistent results, future research may continue to explore the relationship between environments and how individuals within them are perceived.

The final variable that Study 1 and Study 2 examined was walker sex. Overall the current project found substantial evidence indicating that subject sex impacts perceptions of vulnerability. In Study 1, female walkers were rated easier for someone to attack, and attacking a female walker was rated more likely to succeed. In Study 2, female walkers were rated easier to overpower. However, Study 2 found no evidence indicating that attacking a female walker was perceived as being more or less likely to result in arrest. Likewise, female walkers were not considered more or less confident than male walkers. These results suggest that subject sex may impact observer perceptions of concepts closely related to vulnerability, while

concepts less related to vulnerability (i.e., arrest risk and confidence) are less influenced by subject sex.

The presence of sex effects was most pronounced using the full-light data. In point-light, participants rarely perceived differences between the walkers. This indicates that using point-light displays sufficiently hid subject sex from participants. When the contextual information of subject sex is visible in full-light however, perceptions shift.

These results are consistent to that of previous research. Offenders describe women as easier to overpower (Wright and Decker, 1997; Stevens, 1994). Study 1 and Study 2 show that perceptual differences in vulnerability based on subject sex is also present among a college students. These differences perceptions likely can be attributed to differences in physical stature between men and women. On average, women are approximately five inches (13 centimeters) shorter than men and weigh approximately 30 pounds (13 kilograms) less than men[1] (Center for Disease Control, 2021). These difference in stature may create objective differences in power and/or vulnerability between the sexes. It is also possible that the volunteers used to create the videos for this project skewed participant perceptions. Additional research is needed to identify how men and women are perceived, on average, to begin to further understand the complex relationship between sex, vulnerability, and perception.

Limitations

All research is subject to limitations. Traditionally, these limitations are broken into two categories: (1) threats to external validity and (2) threats to internal validity. These categories exist to help distinguish the impact a particular limitation has on a study's results. External validity corresponds to how well a study's findings can generalize beyond it's sample. Internal validity, by comparison, corresponds to how trustworthy a study's findings are–or

[1]Note that the sex difference in weight correspond to three levels of weight class differences in some competitive sports (Association of Boxing Commissions, 2022)

if there is an alternative explanation.

In the following sections, I address both forms of validity and the various limitations that may impact the current work's results. Where applicable, this discussion includes how I tried to address this limitations to mitigate their impact.

External Validity

Experimental Design

One of the primary critiques of experimental designs is their propensity for high internal validity at the expense of external validity. More specifically, experimental designs exert a great deal of control over concepts and interventions. This control exerted by the researcher is often not present in the real world, and there is the potential that this control creates a study environment that is unrealistic compared to the outside world. Given this, results found within experimental studies are not always able to be observed or replicated within the real world–and vice-versa.

As an example, consider the inconsistent results the current project reported for block effects. In Study 1 subjects in Block A were not perceived the same as subjects in Block B. However, in Study 2, when an additional experimental design was incorporated to evaluate the impact of blocks, participants perceived no differences between subjects in Block A and Block B. There is the potential that the experimental design in Study 2 created an study environment so controlled that it was no longer representative of the real world. Given this, there is the potential that location can exert an impact on subjects within that place.

Inconsistent block effects are not the primary concern associated with this limitation. Rather, the concern with the experimental design is that the primary variable/effect of interest–walk effects–may not generalize beyond the project's findings. To mitigate this concern, I used two independent studies–Study 1 and Study 2–with slightly differing experimental designs.

While this does not completely address the concern of generalizability, replicating the impact of walk effects within two studies provides additional confidence in the studies' results.

Sample

Another common threat to external validity is sample representativeness. Study 1 and Study 2 both used a sample of college students. Convenience samples and college samples are subject to a variety of limitations (Henrich, 2020). Namely, there is the potential that findings observed within a sample predominated by 18-25 year olds who decided (and were able) to continue their education, may not be observable within the general population. Unfortunately, there was relatively little I could do to directly mitigate this threat to external validity. However, there is a variety of evidence indicating that these concerns are not research-breaking.

For example, one of the concerns with using a college sample is that non-offenders may not perceive or engage with stimuli the same as offenders. Research has found, however, that offenders and non-offenders tend to weigh the risks and rewards of crime similarly (Decker, Wright, and Logie, 1993). The primary differences between an offending sample and a non-offending sample, rather, is the willingness to commit a hypothetical crime. This suggests that using a college sample to study perceptions of vulnerability may still generalize beyond the immediate sample.

In addition to this, the process of observing someone walk and perceiving differences in their walk is not unique to offenders. As discussed in *Chapter 2 – Literature*, there is a vast amount of first impression literature indicating people can perceive nonverbal cues and form opinions about an individual prior to ever speaking to them (Willis and Todorov, 2006; Kelley, 1950; Bar et al., 2006). There is no reason to assume that a college sample would not be able to perceive differences in how someone walks. The primary difference between this sample and the population the current project is trying to generalize to, then, is expertise.

Expertise can substantially change perceptions of a situation (Carroll and Weaver, 2017; Hockey and Honey, 2013; Topalli, 2005). Offenders who had never been apprehended had very different scripts (mental checklists for burglarizing a house) from convicted offenders (Hockey and Honey, 2013). Likewise, experienced shoplifters describe different techniques than amature shoplifters (Carroll and Weaver, 2017). Given this, failing to consider experienced offenders in research efforts, can impact the conclusions and implications of a study. However, once again, this does not appear to be a substantial threat to the current work and its evaluation of walk effects.

Specifically, additional expertise in offending within the context of the current study is unlikely to see the impact of walk effects disappear. The organized and disorganized walking styles used in the current study were developed based on previous research interviewing offenders showing an association between walks and vulnerability (Grayson and Stein, 1981). One would assume that this association is best tested among a sample of offenders and that testing the association between walks and vulnerability outside of an offending population would be less likely to show effects. Given this, it is most likely that using a sample of undergraduate college students would result in an underestimation of the impact of walk style–rather than an overestimation.

There is the potential that the walk effects observed in Study 1 and Study 2 may not perfectly generalize to other populations. However, this does not mean that the observed walk effects are isolated to the current project. When attempting to generalize to other samples and populations, future research may see variation in effect sizes. In particular, examining walk effects in a sample of offenders may result in larger/stronger effect sizes.

Finally, I want to touch on the potential impact of the Covid-19 pandemic (Fauci, Lane, and Redfield, 2020). Study 1 took place over the 2018-2019 academic year and data collection ended before the discovery of Covid-19. Study 2, however, took place over the 2020-2021 academic year. During this time the university transitioned to remote and online classes.

Therefore, data collection began and ended during quarantine efforts. The data collection materials–the videos and questionnaire–were designed to be taken online prior to the pandemic. Given this, data collect efforts continued as planned and it did not impact the overall timeline of the project. This does not, however, mean that the pandemic did not impact the individuals who completed the survey.

There are two primary ways the Covid-19 pandemic may have impacted participants in such a way to bias the results of the current project. Specifically (1) the pandemic may have impacted *who* participated in the study, or (2) the pandemic may have impacted *how* participants engaged with the study concepts. To reduce the spread of Covid-19, many institutions–both within the university and at the governmental level–required people to participate in quarantine and social distancing efforts. This limited social interaction and may people felt isolated during the pandemic. The transition to online-only interactions may have created an environment more conducive to individuals self-selecting into online surveys. If this systematically impacted who participated in Study 2 *and* those individuals substantively differ from those who would participate pre-Covid-19, it may prove difficult to replicate some of the findings in future samples not impacted by the pandemic.

In addition to potentially impacting who would participate in Study 2, Covid-19 may have impacted *how* participants engaged with the project's concepts. Many peoples' financial stability was negatively impacted by Covid-19, prompting the government to provide of stimulus packages (Alpert, 2022). Students likely also experienced additional financial hardship during this time. Therefore, students may have been more desperate and may have engaged with Study 2's prompt of "pretend you're desperate for money and need it now" differently from how they would if Covid-19 had not occurred. Whether or not these factors impacted how participants responded to the questions asked in Study 2, however, is unclear.

Unfortunately, there is no way to know if Covid-19 had an impact on Study 2 or its participants. Future research may investigate how the Covid-19 pandemic impacted individual and

their likelihood of engaging in online surveys and/or their responses to questions. Despite the unclear impact of Covid-19, because the current study used an experimental design, in an ideal situation, differences between participants should be controlled for in the random assignment process. Therefore any historical effects from Covid-19 should be mostly independent of the effects observed in Study 2.

Materials

One of the strengths of the current project was that it allowed participants to interact and engage with a stimulus–the walk videos. This was necessary to allow participants to organically form a perception of the subject they watched. However, the decision to use video materials also introduced potential generalizability concerns.

The full-light videos show participants two different block locations (to see these again, refer to Figure 4.1). While these two locations are different enough to allow participants to form unique perceptions of each place, they both present a very Midwestern backdrop to the subjects. In addition, both of the locations shown in the study would be described as urban or suburban. While this does not likely threaten the internal validity of the results, there is the potential that the studies' findings cannot generalize to samples outside of the Midwest. Additionally, there is the potential that the impact of other types locations does not behave the same way as two Midwestern sub/urban landscapes.

Because the current project took place in the Midwest, there was no feasible way to address this potential limitation. Moreover, there is the potential that certain signals of guardianship and care/ownership remain consistent across different settings. For example, fences are a consistent signal of ownership throughout the United States and other countries. Despite this, additional research examining regional and cultural differences in environmental design may be prudent. Additionally, future research may consider evaluating regional and cultural differences in the perception of ownership/guardianship signals.

Vulnerability is Crime Specific

The final threat to external validity I want to discuss is the concept of vulnerability. Namely, I want to emphasize that the current project examined perceptions of a very specific type of vulnerability: vulnerability to being robbed or attacked. Given this and the design of the study surveys, the results from the present work likely only generalize to a specific type of crime. Specifically, crimes that are (a) outside, (b) involve a zero (0) acquaintance observer/offender and subject/target dyad, and (c) involve taking personal possessions or forms of physical assault.

This has clear implications on the generalizability of these results. Victim selection research must consider what cues may indicate vulnerability to different types of crime. For example, how someone walks is unlikely to be relevant in the decision-making process used to identify victims for intimate partner violence or identity theft. Likewise, offenders that target a location rather than an individual would have little use in examining walking style. Even within the target selection literature, characteristics of a household vulnerable to burglary (Armitage, 2018; Johnson and Bowers, 2010) differ from characteristics of stores vulnerable to shoplifting (Carroll and Weaver, 2017; Lasky, Fisher, and Jacques, 2017). Given this, indicators of vulnerability are intractably linked to the type of offense, and walking style is one potential indicator of vulnerability for very specific crime types.

This is especially important to keep in mind when trying to generalize from the present work to study other forms of vulnerability. However, even with robbery offenses, there exist a variety of types that correspond to different offending strategies (Monk, Heinonen, and Eck, 2010). Given this, there is the potential that the participants in the current project may have envisioned a specific type of robbery (i.e., robbery involving confrontation) but not other types of robbery (i.e., snatch-theft robbery, blitz robbery).

This does not mean that the conclusions drawn from Study 1 and Study 2 are invalid. Walking style likely continues to be a cue offenders can use to determine a subject's vulnerability

to these different types of robbery. Rather, by recognizing that vulnerability to a crime depends on the type of offense, research may be able to develop a more accurate understanding of the individual and structural factors that contribute to crime and victimization.

Internal Validity

Measures

One of the most common threats to internal validity is that of measurement. The present work used several different questions to ask participants about their perceptions of the walkers in Study 1 and Study 2. These questions measured concepts like how easy it would be to attack or overpower the subject, and how likely it is attacking the subject would succeed, or the likelihood of being arrested. In addition, Study 2 included a measure to evaluate participant perceptions of the walker's confidence. These questions were used to try to tap into the various components of vulnerability from the perspective of an offender–such as effort and risk.

Based on the results, the current project was able to use these questions to triangulate and measure the concept of vulnerability. However, this does not mean that these measures provide the most accurate depiction of the concept of vulnerability. For example, in Study 2, perceptions of the likelihood of arrest were potentially skewed. Non-offenders tend to overestimate the likelihood of arrest (Claster, 1967; Apel, 2013). Therefore, measure evaluating perceptions of arrest risk may not be as applicable to the concept of a subject's vulnerability as originally believed.

These potential limitations provide an opportunity for future research to explore the most effective ways to measure complex concepts like vulnerability.

Between Groups versus Within Individuals

Several decisions were made in designing how to present videos of the walking styles to participants. As presented in *Chapter 4 – Methods* these decisions resulted in participants watching multiple videos. (In Study 1: 4 videos presented in point-light and the same 4 videos presented again in full-light. In Study 2: 4 videos presented in point-light and 2 of those videos presented again in full-light.) Each of these videos was treated as a unique trial. Participants were randomly assigned to a walk condition to watch in these videos. This resulted in participants seeing both the organized walk and the disorganized walk. These design decisions impacted the type of analyses used to evaluate walk effects and the conclusions that can be drawn from those results.

Using multiple trials to evaluate the impact of an intervention is a common experimental design (Shadish et al., 2002). This design allows each individual to serve as their own control. Participant A's perception of an organized walk is compared to Participant A's perception of a disorganized walk. This process occurs for every participant in the study. In addition, because the current project used multiple trials, in many cases the analyses compared Participant A's average perception of multiple organized walks to Participant A's average perception of multiple disorganized walks. Given that participants were randomly assigned to either the the organized or disorganized walk conditions across multiple trials the assumption is that the intervention is not too obvious. Otherwise, conducting multiple trials could potentially skew the results.

That potential for skewed results is the purpose of this section. Based on the results of the current study, it is not possible to say that walk effects could have a between-group effect on perceptions of vulnerability. If one randomly assigned Group A to watch an organized walk and and Group B to watch a disorganized walk, it is not possible to say if one would find walk effects when comparing those two groups.

To conclude, walk effects may only be detectable when participants can make comparisons

between the two walking styles–similar to the pattern observed in Study 1 and Study 2 when evaluating block effects. However, perception is a uniquely individual experience. A subject who appears vulnerable to one person may appear very capable to another. This variation in how individuals can perceive a subject's vulnerability may make it difficult to observe between-group differences. Future research in this area may consider alternative experimental designs to parse apart the impact of comparison and perception.

Policy Implications

The two experimental studies conducted in this project represent some of the first experimental work in this area. The current project used two relatively small samples, and is subject to a variety of limitations. Therefore, while readers may consider it prudent to consider policy implications, I want to emphasize the necessity of additional research in this area. It would be remiss of me, however, to not translate the results into actionable recommendations. In doing so, I outline directions for future research to explore and provide policy suggestions that could be supported with further evidence.

There are three general directions in which policy may seek to move. These intervention points include: (1) changing the subject, or the subject's walk, (2) changing contextual factors impacting perception, and (3) changing the observer's behavior. This third option is outside the scope of the current project and will not be discussed further. The remaining two, are explored in further detail below. Please note that while there is some cascading and overlap between these three directions for policy implications (i.e., changing a subject's walk may change how they are perceived, which then may change an observer's decision-making), they are discussed independent of one another as each option can be manipulated without addressing the others.

First, the current project provided evidence of walk effects. The understanding that an in-

dividual's walking style can impact perceptions of them has clear policy implications. The association between walking-style and perceptions of target attractiveness is one of the factors of a variety of self-defense programs try to address (Kardian, 2017). These programs have been implemented in a variety of universities and communities (Defend University, 2022; R.A.D., 2022) and teach some basic self-defense techniques. Often, these walk-safe programs focus on how to avoid victimization target women and feminine-presenting individuals (Partington, 2016; Defend University, 2022).

Based on the results of the current work, these programs may provide an avenue to changing how one walks and thus, how they are perceived. However, the efficacy of walk-safe programs in achieving changes in walking style or in changes of perceptions is unclear.

Policy-makers looking to explore the efficacy of changing how individuals present themselves through their walking style have a variety of avenues for future research. Future research may consider conducting program evaluations of specific walk-safe programs and their alternatives. For example, traditional self-defense courses may impact how one carries themselves (Johnston et al., 2004). Likewise, consistent non-specific physical activity may impact an individual's overall health, mobility, and energy levels enough to impact how they walk. If these differences are more substantial or similar to the impact of walk-safe programs, alternative methods to changing walking style may be more beneficial. Given this, researchers may need to evaluate the impact of traditional exercise on walking style and perceptions of a walker.

I want to note that none of these considerations are a direct critique of programs designed to change how an individual carries themselves. Walking-programs may have inherent value in making their participants feel more confident and safer–but this does not mean they are effective in producing the desired changes in offender perceptions. Future research exploring the efficacy of changing how an individual walks should consider the potential that the primary usefulness of walking-programs is to draw individual's attention to how they are car-

rying and presenting themselves. This increased mindfulness and attention in walking style may prove to be what most impacts any observed changes in walks and the corresponding perceptions.

Given that the effects of walk-programs may be due to the additional attention paid to how someone walks, research may also need to consider broader contexts that can impact how an individual carries themselves. This brings us to the second potential avenue for policy makers and researchers to explore and evaluate: changing the contextual factors potentially impacting perceptions. Pickett (2018) provided an example of this concept put into practice. By using pseudo-certainty messaging, Pickett (2018) demonstrated perceptions of the likelihood of experiencing sanctions can be manipulated. Note that this intervention that wasn't trying to change individuals–only their perception of the environment and broader context in which they were operating.

In relation to the present work, future research may look at the impact of day-to-day mental well-being on how individuals walk. As discussed previously, walks act as a form of nonverbal communication. While providing concrete techniques to change how someone walks can be valuable, research should consider the purpose that nonverbal communication serves. Because many nonverbal cues and communication are often intuitive and unintentional, asking an individual to intentionally attend to and change how they carry themselves may have limited benefits. If the techniques supplied by walk-safe programs are unsustainable or unobservable in certain situations, that may point to the need to consider the broader contexts individuals exist within and how those contexts impact the individuals. In addition, if higher levels of mental well-being substantially impact how individuals carry and present themselves, and how they are perceived, that may indicate a need to address well-being and the contextual factors that influence that.

The current work provided preliminary evidence that being able to compare between different contexts (Block A and Block B) corresponds to differences in perceptions of the individuals

within them. While additional research is needed to confirm that the design of an environment can directly impact how vulnerable individuals within it are perceived, this provides a variety of avenues for policy makers and researchers to explore. For example, future research may be able to provide evidence that an effective way to reduce victimization is to invest in communities to ensure they appear and have the presence of capable guardianship through informal social controls and the ownership of those spaces.

Research in related areas such as target selection has found evidence suggesting that some homes are considered more attractive targets than others. One of the factors impacting these perceptions includes whether a home is located in a cul-de-sac (Armitage, 2018; Johnson and Bowers, 2010; Armitage, 2006). This factor impacts ease of access and escape and provides additional evidence that the design of a location can change perceptions of the vulnerability of a target to a particular event.

Finally, although I will not speak to how to change the behavior or decision-making of an observer directly, I do wish to point out the potential to change the contexts in which an individual makes decisions. The current project found clear evidence indicating that a female walker is perceived as easier to overpower or attack than a male walker. This means that this understanding of vulnerability can be found in offending and non-offending samples. Wright and Decker (1997) stated the one of the primary factors contributing to an offender's selection of a victim involved the recognition and willingness to exploit an individual's vulnerabilities–whatever they may be. Given that the current project focuses on the concept of vulnerability, it seems prudent to emphasize that factor certainly is the most important: the willingness to exploit a vulnerability. This finding, indicating that nearly everyone (offenders and non-offenders) understand that women are easier to overpower than men, means that the primary difference between these individuals is the willingness to exploit that vulnerability. The current paper cannot speak to how to effectively change an offender's behavior. However, it can recommend future researchers consider the factors that

incentivize a willingness to exploit a person's vulnerability–both at an individual-level and at a contextual-level.

Finally, I want to caution against the conclusion that the solution to victimization is the responsibility of the vulnerable individual. While target hardening strategies can be effective in reducing criminal activity, they should not be treated as the primary or sole solution to victimization. This recommendation is not to say that individual-based prevention efforts are wholly unuseful or bad. Walking programs may help people feel more confident and comfortable in their environment–which is an intrinsically valuable experience in and of itself. Rather, the goal of this cautioning is to fully articulate that it is an offender's willingness to exploit someone's vulnerability that is the problem behavior–not the way a person is carrying themselves.

I recommend policy makers make intentional decisions regarding who's shoulders they place the primary burden of preventing a victimization experience and understand that these decisions have far-reaching implications. When policy makers place the burden of ownership of the likelihood of a victimization experience on the shoulders of potential victims, police officers, community members, and offenders now also have the platform and position to believe the same thing and expect a victim to have done better.

Despite my hesitation regarding policy implications, the current work remains valuable and meaningful. This work demonstrated the validity of walking styles in two independent experimental designs, laying the foundation for future work to expand upon. It is not possible to effectively change something until it, and its mechanisms, are truly understood. Given this, I would recommend policy makers look for additional avenues to address crime and victimization while research continues to explore the relationship between walking style, environmental contexts, and perception.

Conclusion

The current project explored the relationship between walking style and perceptions. I found that walks have a direct impact on the perception of subjects. These perceptions can be influenced by a variety of other factors. The type of video (point-light or full-light) can impact participant perceptions and responses. When visible, a subject's sex impacts an observer's perceptions of their vulnerability. Even the environment a subject is presented within may influence how observers perceive them. These results firmly establish the study of perception within the the victim selection and vulnerability literature.

This research showed the importance of considering nonverbal communication in the study of victim selection. The use of point-light displays and biological motion allowed the project to isolate subject movement. Clearly, this technology can be applied and used to study areas of crime and criminology in new ways. However, the presence of light effects demonstrates the need for researchers to make intentional research design decisions–as point-light and full-light videos are not perceived the same way. Despite this, point-light technology provides researchers a variety of ways to test many different theories and should be considered a potential methodological tool.

Perception research has substantial implications on potential intervention points to offender decision-making. Walks can be used as a cue to determine how easy it may be to overpower or attack someone. That does not mean those perceptions are correct, and it does not mean individuals should have to change how they walk. Rather, the current research explored one signal offenders use to identify people to exploit. There are many more factors to explore and may more questions to ask as research continues to explore how people perceive vulnerability.

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Appendix

Table 6.1: Comparing Perceptions of Organized and Disorganized Walks – Study 1

	Organized			***Disorganized***				
	$\overline{X}$	*SE*	(*95% Conf.*)	$\overline{X}$	*SE*	(*95% Conf.*)	*t-stat*	*N*
Point-light								
Ease	0.16	0.14	(-0.11, 0.43)	0.51	0.16	(0.19, 0.84)	2.55*	70
Risk	0.51	0.02	(0.47, 0.54)	0.54	0.02	(0.50, 0.58)	2.22*	69
Full-light								
Ease	1.17	0.16	(0.84, 1.50)	1.60	0.14	(1.32, 1.89)	3.00**	69
Risk	0.65	0.02	(0.61, 0.70)	0.69	0.02	(0.65, 0.73)	1.52	69

Notes: *p<0.05, **p<0.01, ***p<0.001. Analyses used paired t-tests. Point-light results correspond to Figure 5.2. Full-light results correspond to Figure 5.3.

Table 6.2: Comparing Perceptions of Organized and Disorganized Walks – Study 2

	Organized			***Disorganized***				
	$\overline{X}$	*SE*	*(95% Conf.)*	$\overline{X}$	*SE*	*(95% Conf.)*	*t-stat*	*N*
Point-light								
Ease	-0.76	0.10	(-0.96, -0.56)	-0.27	0.11	(-0.49, -0.05)	4.55***	86
Risk	1.06	0.11	(0.84, 1.28)	0.76	0.11	(0.53, 0.98)	3.75***	86
Confidence	1.11	0.08	(0.95, 1.27)	0.01	0.11	(-0.21, 0.22)	8.53***	86
Full-light								
Ease	-0.14	0.20	(-0.55, 0.27)	0.42	0.21	(-0.01, 0.85)	1.93	43
Risk	0.77	0.18	(0.41, 1.13)	0.74	0.21	(0.33, 1.16)	0.15	43
Confidence	1.07	0.13	(0.81, 1.33)	-0.88	0.17	(-1.23, -0.54)	9.41***	43

Notes: *$p<0.05$, **$p<0.01$, ***$p<0.001$. Analyses used paired t-tests. Point-light results correspond to Figure 5.4. Full-light results correspond to Figure 5.5.

Table 6.3: Comparing Perceptions of Point- and Full-light Videos – Study 1

	Point-light			***Full-light***				
	$\overline{X}$	*SE*	(*95% Conf.*)	$\overline{X}$	*SE*	(*95% Conf.*)	*t-stat*	*N*
Ease								
Organized	0.30	0.14	(0.01, 0.58)	1.23	0.16	(0.92, 1.54)	4.81***	74
Disorganized	0.46	0.16	(0.14, 0.78)	1.55	0.14	(1.27, 1.82)	5.89***	75
Risk								
Organized	0.52	0.02	(0.48, 0.56)	0.66	0.02	(0.62, 0.70)	5.36***	74
Disorganized	0.53	0.02	(0.49, 0.57)	0.68	0.02	(0.64, 0.72)	5.91***	75

Notes: *p<0.05, **p<0.01, ***p<0.001. Analyses used paired t-tests. Ease results correspond to Figure 5.6. Risk results correspond to Figure 5.7.

Table 6.4: Comparing Perceptions of Point- and Full-light Videos – Study 2

	Point-light			***Full-light***				
	$\overline{X}$	*SE*	(*95% Conf.*)	$\overline{X}$	*SE*	(*95% Conf.*)	*t-stat*	*N*
Ease								
Organized	-0.78	0.12	(-1.02, -0.55)	-0.20	0.16	(-0.52, 0.12)	4.16***	60
Disorganized	-0.34	0.13	(-0.60, -0.07)	0.35	0.18	(0.00, 0.71)	4.21***	58
Risk								
Organized	1.12	0.12	(0.87, 1.36)	0.81	0.14	(0.52, 1.10)	2.86**	60
Disorganized	0.89	0.12	(0.64, 1.13)	0.84	0.16	(0.51, 1.17)	0.42	58
Confidence								
Organized	1.18	0.08	(1.01, 1.35)	0.99	0.12	(0.75, 1.23)	1.77	60
Disorganized	0.09	0.13	(-0.17, 0.34)	-0.81	0.14	(-1.09, -0.53)	4.97***	58

Notes: *$p<0.05$, **$p<0.01$, ***$p<0.001$. Analyses used paired t-tests. Ease results correspond to Figure 5.8. Risk results correspond to Figure 5.9. Confidence results correspond to Figure 5.10.

Table 6.5: Comparing Perceptions of Block A and Block B – Study 1

	Block A			***Block B***				
	$\overline{X}$	*SE*	(*95% Conf.*)	$\overline{X}$	*SE*	(*95% Conf.*)	*t-stat*	*N*
Ease								
Point-light								
Organized	0.79	0.22	(0.34, 1.24)	0.46	0.23	(0.00, 0.93)	2.09*	41
Disorganized	0.54	0.21	(0.12, 0.96)	0.32	0.22	(-0.11, 0.75)	1.47	50
Full-light								
Organized	1.01	0.24	(0.52, 1.51)	1.45	0.24	(0.97, 1.93)	2.42*	39
Disorganized	1.24	0.20	(0.85, 1.63)	1.72	0.18	(1.36, 2.08)	2.78**	50
Risk								
Point-light								
Organized	0.57	0.03	(0.51, 0.63)	0.54	0.03	(0.48, 0.60)	1.50	41
Disorganized	0.53	0.03	(0.48, 0.58)	0.51	0.03	(0.46, 0.57)	0.68	50
Full-light								
Organized	0.64	0.03	(0.57, 0.71)	0.71	0.03	(0.64, 0.78)	2.76**	39
Disorganized	0.63	0.03	(0.58, 0.68)	0.71	0.03	(0.65, 0.76)	3.24**	50

Notes: *p<0.05, **p<0.01, ***p<0.001. Analyses used paired t-tests. Ease results correspond to Figure 5.11. Risk results correspond to Figure 5.12.

Table 6.6: Comparing Perceptions of Block A and Block B – Study 2

	Block A			***Block B***				
	$\overline{X}$	*SE*	*(95% Conf.)*	$\overline{X}$	*SE*	*(95% Conf.)*	*t-stat*	*N*
Ease								
Point-light								
Organized	-0.92	0.14	(-1.19, -0.64)	-0.67	0.16	(-1.00, -0.34)	1.17	75
Disorganized	-0.38	0.15	(-0.69, -0.08)	-0.28	0.18	(-0.66, 0.09)	0.43	75
Full-light								
Organized	-0.28	0.19	(-0.68, 0.11)	-0.07	0.28	(-0.64, 0.51)	0.66	60
Disorganized	0.20	0.25	(-0.31, 0.71)	0.52	0.25	(0.00, 1.04)	0.90	58
Risk								
Point-light								
Organized	1.18	0.15	(0.88, 1.49)	1.09	0.15	(0.80, 1.39)	0.43	75
Disorganized	0.84	0.16	(0.52, 1.16)	0.86	0.15	(0.55, 1.16)	0.10	75
Full-light								
Organized	0.89	0.18	(0.54, 1.25)	0.67	0.25	(0.15, 1.19)	0.73	60
Disorganized	0.82	0.23	(0.36, 1.28)	0.86	0.24	(0.36, 1.36)	0.12	58
Confidence								
Point-light								
Organized	1.23	0.09	(1.05, 1.42)	1.00	0.14	(0.71, 1.29)	1.45	75
Disorganized	-0.10	0.14	(-0.38, 0.18)	0.20	0.18	(-0.15, 0.56)	1.39	75
Full-light								
Organized	1.04	0.11	(0.82, 1.26)	0.91	0.26	(0.38, 1.45)	0.52	60
Disorganized	-0.83	0.20	(-1.24, -0.43)	-0.79	0.19	(-1.19, -0.39)	0.17	58

Notes: $^{*}p<0.05$, $^{**}p<0.01$, $^{***}p<0.001$. Analyses used unpaired t-tests. Ease results correspond to Figure 5.13. Risk results correspond to Figure 5.14. Confidence results correspond to Figure 5.15.

Table 6.7: Comparing Perceptions of the Male and Female Walkers – Study 1

	Male Walker			***Female Walker***				
	$\overline{X}$	*SE*	(*95% Conf.*)	$\overline{X}$	*SE*	(*95% Conf.*)	*t-stat*	*N*
Ease								
Point-light								
Organized	0.05	0.23	(-0.42, 0.52)	0.65	0.23	(0.19, 1.12)	2.70*	39
Disorganized	0.12	0.24	(-0.36, 0.61)	0.41	0.21	(-0.02, 0.84)	1.34	49
Full-light								
Organized	0.69	0.25	(0.19, 1.20)	1.83	0.22	(1.38, 2.28)	5.87***	39
Disorganized	1.03	0.22	(0.58, 1.48)	1.88	0.15	(1.58, 2.17)	4.49***	48
Risk								
Point-light								
Organized	0.50	0.03	(0.43, 0.56)	0.57	0.03	(0.51, 0.63)	2.60*	39
Disorganized	0.50	0.03	(0.44, 0.46)	0.53	0.03	(0.48, 0.59)	0.98	49
Full-light								
Organized	0.60	0.04	(0.53, 0.67)	0.74	0.03	(0.67, 0.81)	4.53***	39
Disorganized	0.61	0.03	(0.55, 0.67)	0.73	0.02	(0.68, 0.78)	4.45***	48

Notes: * $p<0.05$, ** $p<0.01$, ***$p<0.001$. Analyses used paired t-tests. Ease results correspond to Figure 5.16. Risk results correspond to Figure 5.17.

Table 6.8: Comparing Perceptions of the Male and Female Walkers – Study 2

	Male			***Female***				
	$\overline{X}$	*SE*	*(95% Conf.)*	$\overline{X}$	*SE*	*(95% Conf.)*	*t-stat*	*N*
Ease								
Point-light								
Organized	-0.8	0.12	(-1.04, -0.56)	-0.78	0.12	(-1.02, -0.53)	0.18	80
Disorganized	-0.47	0.13	(-0.73, -0.22)	-0.23	0.14	(-0.51, 0.05)	1.55	78
Full-light								
Organized	-0.85	0.18	(-1.21, -0.48)	0.39	0.20	(-0.02, 0.81)	4.53***	77
Disorganized	-0.47	0.22	(-0.91, -0.03)	1.06	0.20	(0.65, 1.46)	5.20***	72
Risk								
Point-light								
Organized	1.03	0.11	(0.80, 1.25)	1.18	0.12	(0.94, 1.41)	1.75	80
Disorganized	0.76	0.14	(0.48, 1.03)	0.91	0.13	(0.66, 1.16)	0.99	78
Full-light								
Organized	0.95	0.16	(0.62, 1.28)	0.71	0.20	(0.31, 1.11)	0.93	77
Disorganized	1.14	0.18	(0.78, 1.50)	0.61	0.24	(0.13, 1.09)	1.78	72
Confidence								
Point-light								
Organized	1.19	0.10	(0.99, 1.38)	1.08	0.11	(0.85, 1.30)	0.85	80
Disorganized	0.10	0.14	(-0.18, 0.39)	-0.06	0.15	(-0.35, 0.23)	0.84	78
Full-light								
Organized	0.97	0.17	(0.64, 1.31)	0.92	0.17	(0.58, 1.26)	0.23	77
Disorganized	-0.55	0.18	(-0.91, -0.20)	-1.03	0.17	(-1.38, -0.68)	1.92	72

Notes: *$p<0.05$, **$p<0.01$, ***$p<0.001$. Point-light analyses used paired t-tests. Full-light analyses used unpaired t-tests. Ease results correspond to Figure 5.18. Risk results correspond to Figure 5.19. Confidence results correspond to Figure 5.20.

Table 6.9: Checking Instrumentals Effect of Video-Type Order in Study 1

	Participant first watched:							
	Point-light			***Full-light***				
	$\overline{X}$	*SE*	(*95% Conf.*)	$\overline{X}$	*SE*	(*95% Conf.*)	*t-stat*	*N*
Point-light								
Organized	0.36	0.18	(0.00, 0.72)	0.23	0.23	(-0.25, 0.71)	0.44	77
Disorganized	0.50	0.22	(0.07, 0.94)	0.29	0.23	(-0.18, 0.75)	0.67	78
Full-light								
Organized	1.16	0.21	(0.73, 1.59)	1.33	0.23	(0.86, 1.81)	0.55	74
Disorganized	1.52	0.18	(1.16, 1.89)	1.58	0.22	(1.13, 2.02)	0.20	75

Notes: *p<0.05, **p<0.01, ***p<0.001. Analyses used unpaired t-tests.

Table 6.10: Testing the Impact of Control Variables on Perceptions – Study 1

	Point-light				**Full-light**			
	Organized		Disorganized		Organized		Disorganized	
	$\hat{\beta}$	*SE*	$\hat{\beta}$	*SE*	$\hat{\beta}$	*SE*	$\hat{\beta}$	*SE*
Ease to Attack								
Delinquency	0.43	0.62	-1.15	0.70	-0.78	0.70	-0.72	0.61
Height	-0.01	0.02	-0.03	0.02	-0.02	0.02	0.00	0.02
Weight	-0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00
Age	0.01	0.02	0.00	0.02	-0.01	0.02	-0.01	0.02
Sex (1=male)	0.59	0.43	0.31	0.49	-0.22	0.48	-0.17	0.43
Race (1=white)	0.65	0.33	0.07	0.37	0.42	0.37	-0.26	0.32
Likelihood of Success								
Delinquency	3.55	8.52	-10.94	8.65	-0.63	9.86	-11.66	8.84
Height	0.05	0.24	-0.32	0.24	-0.35	0.27	-0.03	0.25
Weight	-0.13*	0.06	-0.02	0.06	0.03	0.07	0.06	0.06
Age	0.06	0.31	0.04	0.29	-0.42	0.35	-0.23	0.29
Sex (1=male)	6.85	5.87	4.12	6.04	0.75	6.79	-1.78	6.18
Race (1=white)	5.72	4.49	-1.77	4.52	5.70	5.19	-2.47	4.62

Notes: *p<0.05, **p<0.01, ***p<0.001

Table 6.11: Testing the Impact of Control Variables on Perceptions – Study 2

	Point-light				**Full-light**			
	Organized		Disorganized		Organized		Disorganized	
	$\hat{\beta}$	*SE*	$\hat{\beta}$	*SE*	$\hat{\beta}$	*SE*	$\hat{\beta}$	*SE*
Ease to Overpower								
Delinquency	0.36	0.27	-0.02	0.29	0.34	0.41	0.91*	0.41
Low Self-control	0.15	0.13	0.29	0.15	0.31	0.24	0.40	0.23
Intuition	0.04	0.10	-0.06	0.11	-0.04	0.16	0.05	0.16
Height	0.01	0.01	-0.03	0.02	0.00	0.03	-0.06*	0.03
Weight	0.00	0.00	0.00	0.00	-0.01	0.00	0.00	0.00
Age	0.00	0.01	-0.02	0.01	0.02	0.02	-0.01	0.02
Sex (1=male)	0.23	0.30	0.45	0.33	0.23	0.50	0.90	0.07
Race (1=white)	-0.22	0.31	-0.09	0.34	0.30	0.51	-0.93	0.58
Likelihood of Arrest								
Delinquency	-0.49	0.27	-0.48	0.29	-0.76*	0.36	-1.13**	0.37
Low Self-control	-0.10	0.14	-0.01	0.15	-0.17	0.21	-0.18	0.21
Intuition	-0.13	0.10	0.02	0.11	-0.07	0.14	-0.14	0.15
Height	0.01	0.02	0.02	0.02	0.01	0.02	0.06*	0.02
Weight	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Age	-0.01	0.01	0.00	0.01	0.01	0.02	0.00	0.02
Sex (1=male)	-0.08	0.30	-0.23	0.33	-0.11	0.44	-0.90*	0.44
Race (1=white)	-0.10	0.31	-0.17	0.34	-0.12	0.44	0.47	0.53
Walker Confidence								
Delinquency	0.18	0.20	-0.21	0.29	-0.06	0.30	-0.58	0.33
Low Self-control	-0.37**	0.10	0.05	0.14	-0.24	0.17	0.14	0.18
Intuition	-0.04	0.08	0.13	0.11	-0.15	0.11	-0.08	0.13
Height	0.00	0.01	-0.01	0.02	0.02	0.02	0.02	0.02
Weight	0.00	0.00	-0.01*	0.00	0.01	0.00	0.01	0.00
Age	-0.01	0.01	0.03*	0.01	0.00	0.01	0.01	0.02
Sex (1=male)	-0.01	0.23	0.39	0.32	-0.24	0.36	-0.20	0.39
Race (1=white)	-0.09	0.23	-0.24	0.33	-0.41	0.36	0.44	0.47

Notes: *p<0.05, **p<0.01, ***p<0.001