HEADPHONE USE FOR PRIVACY REGULATION: THE RELATIONSHIP BETWEEN TECHNOLOGICAL ARTIFACTS, CROWDING, AND INTERACTION IN PUBLIC WORKING SPACE.

A Thesis

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ABSTRACT

This thesis describes a quasi-experimental mixed methods study that investigates headphone use as a privacy regulation mechanism within open, public workspaces. It further examined the relationship between residential crowding and desire to interact. A survey consisting of a scale on perceived residential crowding and an image-based scale on desire to interact was distributed to 200 Amazon Mechanical Turk workers. Additionally, structured interviews were conducted with 30 student participants recruited from a student commons in a large research university. Analysis of survey data supported the hypothesis that participants felt that they would be less likely to interact with the people in the images who were wearing headphones. Interview results showed that headphone use was a widely understood mechanism to manage privacy levels within an open, public workspace. The results were discussed with reference to the privacy regulation model of crowding and the implicit interaction framework for social robotic design.

BIOGRAPHICAL SKETCH

Peizhao Sun was born in Henan, China. Prior to pursuing a Master of Science degree from the department of Design and Environmental Analysis at Cornell, Peizhao earned his Bachelor's degree in Communications Studies with a minor in Graphic Design from Northeastern University in Boston. Before entering college, he had completed his high school curriculum at Nebraska Christian Schools in Central City, Nebraska.

To Mom and Dad.

And to Lester, Mary, and Raja.

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PREFACE

The first bicycle was not called “penny-farthing” until much later, when its large-wheel leading small-wheel design went out of fashion in the late 19th century. On its way to obsolescence, the design was first nicknamed “ordinary,” in contrast to the emerging, innovative designs with additional features that delivered speed, safety, and comfort. The popularity of such design was short-lived and symbolized the late Victorian Era but inspired the beginning of cycling as a modern sport. The designs of many modern technological artifacts have gone through countless iterations, mirroring the evolution of the bicycle. Our relationships to these artifacts, and the culture that guides us to interpret our usage of these artifacts, likewise transform along with each new iteration. A pair of headphones is one of such artifacts that both informs and conforms to our culture and behaviors with each generation of design and, as such, has inspired this thesis.

CHAPTER 1: INTRODUCTION

This thesis concerns the investigation of headphone use as an effective mechanism to regulate privacy in a public working space. Further, this thesis seeks to understand the impact of crowding on this relationship. To investigate the role of headphones in privacy regulation, the author showed participants photos of people with and without headphone and evaluated their approachability using a Likert-based scale. Individuals were also interviewed regarding their perceptions on this topic. Global headphone sales and usage have been consistently on the rise since portable audio technologies first became popular since the 90s (PR Newswire, 2017). Headphone use is becoming increasingly recognizable in a variety of spaces, including by workers in open-plan offices (Birnholtz, 2007), by pedestrian on the street (Richard et. al, 2012), and by video game players (Riddle, 2017). Our relationships with one another, and with our environments, are further influenced by headphone use. These relationships are likely to continue to evolve. In addition to these reasons, the increasing presence of headphone use in our daily lives inspired the current study.

Privacy regulation is important to people working in open and public spaces, who may experience shifting privacy levels due to the absence of physical barriers (Berstein & Turban, 2018). Prior studies indicated insufficient levels of privacy as a result of crowding can predict a host of adverse outcomes in many groups, such as children (Goux, 2005; Maxwell, 1996; Solari & Mare, 2012) and office workers (Evans, 2000; Laurence et al., 2013). Traditionally, workers have negotiated for priva-

cy through architectural configurations such as cubicle partitions (Sundstrom et al., 1982), opening or closing of doors (Hashim et al., 2006), and personalization (Laurence et al., 2013). However, as workplaces, particularly public spaces, have become increasingly communal and open, traditionally available architecture-based mechanisms to achieve different levels of privacy have disappeared. In order to adapt to changes in privacy levels, and levels of crowding within these public spaces, workers may employ a number of behavioral-based mechanisms in order to manage the flow of stimuli. The current thesis extends upon this line of inquiry and seeks to investigate the effectiveness of a privacy regulation mechanism, headphone use.

CHAPTER 2: LITERATURE REVIEW

The following literature review will examine the constructs relevant to the current thesis. First, it will consider social withdrawal and headphone use as regulatory mechanisms within Altman's conceptualization of privacy regulation, particularly in response to residential crowding. Headphone use will be discussed further, including the social role of audio technology. Lastly, literature regarding the spatial context of privacy regulation in open plan offices will be reviewed. This review suggests headphone use may be an effective regulation mechanism in open, public workspaces. The current study seeks to expand on this relationship by considering the impact of residential crowding on interaction and privacy regulation mechanisms.

2.1 Privacy Regulation

Altman (1976) conceptualizes privacy as a process of interpersonal boundary control. Prior definitions of privacy in literature are organized into two categories, one emphasizing seclusion and retreat from social interaction with other people, while the other capitalizes on control. Altman extends prior literature and defines privacy as "selective control of access to the self or to one's group." This definition suggests that privacy can be considered a bi-directional process where both "inputs from others to the self and outputs from the self to others" are analyzed. Its emphasis on the selective control of access further suggests a procedural conceptualization of privacy, where desired level of privacy is achieved through a dynamic interaction.

Altman suggests that analysis of privacy should concern the full spectrum of behaviors people engage in to adjust to their optimal level of privacy. Extending upon

this concept, Altman contextualized level of privacy as a position on a continuum that consistently engages in adjustment, where movements toward either too much or too little social interaction can become unsatisfactory.

Altman also compared privacy to a cell membrane to illustrate privacy's function as the barrier between self and non-self. The membrane metaphor suggests the organic and flexible nature of the interpersonal boundary control process, where desired level of privacy fluctuates in response to events in the environment and exists on a continuum. Lastly, Altman discusses privacy as a regulatory process, where gaps exist between desired and achieved level of privacy that compel people to engage in privacy regulation.

Altman's dialectic definition of privacy is crucial in formulating this study, as it clearly alludes to the ecology of regulatory behaviors people employ to achieve privacy. Successful privacy regulation should reduce the amount of inward information flow to allow "selective control of access to the self or to one's group." Measuring effectiveness of privacy regulation could be accomplished through measuring the outcome of privacy regulation, which is the change in inward information/stimuli flow.

2.2 Regulation Mechanisms in Response to Crowding

Altman (1977) discussed a variety of privacy regulation mechanisms, from verbal cues to environmental designs. Evidence was also reported by Westin (1970, as cited in Altman, 1977), who discussed nonverbal and physical regulation mechanisms, such as lowering one's voice, covering one's eyes or face. These practices again em-

phasized the aspect of control at the site of the individual who may choose to implement these behaviors in order to manage others' access to information about the individual. Further, Murphy (1964, as cited in Altman, 1977) described the use of face veils by Tuareg men as a privacy regulation mechanism, while Rapoport (1967, as cited in Altman, 1977) reports the Yagua people of Amazon withdraw from social interaction by turning their faces toward the wall, thereby signaling their unavailability to socially interact. These instances point to the variety of behavioral regulation mechanisms that different groups of people employ to control others' access to themselves, therefore achieving desired privacy level. In this view, a technological artifact, such as headphones, can also become an agent of privacy regulation, much like the face-veil used by Tuareg people.

Separately, Kubritz (2000) expanded upon Altman's view of privacy regulation and elaborated upon the categories of regulatory mechanisms. In their conceptualization, behavioral (privacy regulation) mechanisms are further separated into two groups of overt and cognitive mechanisms. While overt behaviors refer to personal space and verbal/nonverbal behaviors, cognitive mechanisms regulate privacy through stimulus screening, and through perceived user control and adaptation. They further posited that cognitive behaviors regulate privacy as "integral part of privacy regulation." Per Kubritz' expanded model, it is easy to conceptualize headphone use as a mechanism that both overtly describe a person's boundaries and affords a person control that in turn regulates privacy.

In the current context, workers in open, public, and office-like environments could engage in a host of behaviors to manage their privacy level, from social withdrawal to signaling measures, including headphone use.

2.2.1 *Withdrawal Behaviors*

Literature exists on the investigation of withdrawal behaviors as coping mechanisms in response to crowding-related stimuli-overload. In their paper, Evans et al. (2000) present extensive evidence that suggests social withdrawal as coping mechanism in response to residential crowding. Adopting a privacy model of crowding, Baum et al. (1981, as cited in Evans, 2000) showed that residential crowding in dormitory residents utilize social withdrawal to manage levels of social interaction. In their study, residents in crowded dorms reported to be "less likely to be present in the dorm and are more likely to report excessive, unwanted social interaction" (p. 335). A previously conducted study by Evans et al. (1989) indicated that those living in higher density homes coped with crowding with social withdrawal. To further investigate the underlying processes in crowded residents' use of social withdrawal as coping mechanism to residential crowding, Evans et al. (2000) conducted two research studies to understand whether social withdrawal provided relief from crowding through the blockage of social information from others. The results support the authors' hypothesis that social withdrawal may allow those withdrawing to tune out or ignore social information. These findings lend support to the hypothesis that social withdrawal is a coping mechanism for chronic crowding. They also support a privacy model of crowding, where crowding occurs when individuals are unable to regulate the amount of

stimuli. The 2000 study also pointed to a short-term relief of crowding for those engaging in social withdrawal when confronted with crowding.

Findings reported by Evans et al. are important to the goal of the current thesis. Per their findings, those experiencing high levels of residential crowding would theoretically seek to withdraw from environments that overwhelm, and in turn manage their levels of social interactions. It is reasonable to expect that those who experience crowding would also likely seek to interact with others less. In the context of the current thesis, those experiencing crowding should be less likely to initiate interaction with others, especially others using headphones to signal their unavailability to interact. Headphone use further communicates the desire to disengage from social interaction outwardly (Weber, 2015).

2.2.2 *Weber and Headphones as a "Head Cocoon"*

When considered in Altman's model of privacy, headphone use adjusts levels of privacy by cutting off environmental stimuli, which controls inward information flow. Previous studies have investigated headphone use as a tool in managing personal preferences and privacy in public spaces, using ethnographic methods and considering the evolution of auditory technologies such as the Sony Walkman.

Weber (2015) examined the history of earphone use in West Germany through a social lens. The review began by emphasizing the social impact of auditory reproduction on people's behavior. They echoed prior scholars' considerations and described the technological advancement towards headphones as "one of changing spaces" instead one of "improving fidelity," because of how new listening devices, such

as the binaural headsets, crucially change how and where sound is heard. As Weber pointed out, this evolution radically changed the distinction between private and public, and therefore instigated change in social relationships. Because of the control headphones afforded its users, headphone wearers now have the capability to select audio environments.

The shift in sociality due to headphones was emphasized again by describing monaural headphones' popularity during the 50s and 60s in West Germany. Most households listened to stationary radios, which is a predominant mode of entertainment. The limited mobility associated with the stationary radio dictated that few listened using headphones. Listeners could simply enjoy radio within the bounds of their homes, without concern for privacy or possible disruption to others. The few who were able to listen through portable radio sets, a rarity at the time, did so with monaural headsets. As author described, the key feature that allowed for monaural headsets' dominance in the market was the fact that a single headphone would occupy one ear only. The other ear would remain open for ambient environment sounds and other people. This popularity of the monaural headphone suggested that listeners did not wish to entirely "turn off" the outside world, which contrast with how headphones are used today. However, this popularity was only valid among wired listeners, as society did not generally accept headphone use. Since wired listening devices were mostly outfitted for people with hearing impairments, those who wore headphones signaled to others a disability. This norm was crucial in undermining the adoption of headphones.

The prejudiced perception deterred consumers and was only dispelled through combination of later marketing and shift in norms.

Weber attributed the rise of binaural headphones, and its subsequent evolution into a highly viable mechanism for privacy regulation, to tech-enabled, media-consuming teens of the 70s. Teens favored the cheaper and more portable audio gears, which also provided them control for privacy. These binaural headsets were used to consume media without parental supervision in their own bedrooms, instead of living rooms where media used to be consumed as a communal activity. The rise of binaural headphones was further supported by the invention of the Sony Walkman, which again pushed the role of headphones and portable listening devices toward an individualistic tool that maintains privacy in public. Weber examined the commuters and travelers of the 80s and 90s and concluded that headphones had evolved into "instruments for people on the move to carve out an intimate, personal space where- and whenever needed" (pg. 358). It afforded users "individual autonomy, including the ability to choose one's network and deliberately switch between sonic privacy and public sociality with co-present others" (pg. 359).

Weber's thorough and nuanced investigation of headphones through the lens of evolving sociality provides useful insights. The review's consideration of headphones as "head cocoons" which allow user autonomy echoes the current study's intent. It clearly dictated the need to examine headphones and to review the physical environment and ecological context under which effectiveness of headphones is examined.

2.2.3 Bull and "Communication Demarcator and Enhancer"

Further, in an extensive and critical analysis of personal stereo (Sony Walkman) use, Bull (2001) examined headphone use in the management context. Bull provided a phenomenological consideration of personal portable stereo (PPS) use to illustrate the dialectic and interactive process of tech-mediated experience production. Per Bull's analysis, the invention of PPSs instigated a significant shift in norms and sociability. This is attributed to the heavily mobile nature of the device, which "permit a reorganization of public and private realms of experience, where what is traditionally conceived of as 'private' experience is brought out into the public realms in the act of individualized listening" (p. 180-181).

Bull then utilized the summaries of findings from his ethnography on individual users to highlight domains of PPS use worthy of empirical examination. A theme of management consistently emerged in Bull's interviews. A woman reported that PPS use enabled her to feel empowered when encountered with others' gaze behaviors on the street, while another user reported the "invisible shell" that the PPS provided them, which further provided social protection and boundaries. PPS also allowed users to consistently evaluate competing stimuli in the environment against their self-selected content. This evaluation often resulted in a management tactic of either engaging with the environment or retreating back into the personalized soundscape. Lastly, Bull concluded that PPS use functioned as a "form of communication demarcator and as communication enhancer" (p. 192). The findings of Birnholtz et al. (2007), in which atten-

tion mediated mutual interaction, reaffirmed Bull's theory. In the Birnholtz et al. study, office occupants used headphones to manage attention and interaction, which ultimately aided them in achieving their privacy goals. This finding directly echoes Bull's consideration that PPSs (and headphones) is a communication demarcator. Birnholtz et. al and Bull both produced evidences using qualitative methods. The current study seeks to further their findings by using quantitative methods to examine headphone use and its role as a signal for unavailability from interaction.

2.3 Spatial Context of Privacy Regulation

The current thesis seeks to examine the impact of headphone use and residential crowding on interaction within open, public workspaces, which could be considered similar to open plan offices. Examinations of Open Plan Office (OPS) have been numerous and constant, as the adoption of such designs continues. This line of inquiry often regards the interplay between various physical and social elements, and occupant performance. Privacy is a relevant construct within this literature as shift in office layout inevitably changes the architectural configuration that may have previously offered privacy regulation, such as cubicle partition and office doors.

Berstein and Turban (2018) discussed the impact of the shift from traditional office environments to OPO, through an examination of spatial boundaries. Their review detailed the history of arguments behind the removal of spatial boundaries in hope of increasing human interaction and therefore allow more effective human collaboration, a crucial reason for the widespread shift from modular to open-plan. They

also reviewed a number of subsequent empirical observations that supported the idea that proximity predicted social interaction, which facilitated social functions such as information exchange and collaboration (Berstein & Turban, 2018).

However, as authors summarized, the removal of spatial boundaries can in fact lead to adverse outcomes such as an increase in stimuli, which can lead to overload and distractions. Further, psychological privacy was also noted to be of relevance when spatial boundary is removed, as workers are left with less options to control desired level of interaction to achieve their privacy goals. The study then utilized infra-red sociometric badges that participants at two separate corporate test-sites wore, to collect empirical evidence on the effect of open-plan office on actual interaction. The badges were able to ascertain whether participants within the test-sites had interacted by determining the distance between two badges.

Privacy within an open plan office was also examined under the lens of organizational culture and employee satisfaction (Zerella et al., 2017). Employing a seven-point Likert questionnaire, researchers surveyed about 200 workers in Australia on office design, organizational culture, and job satisfaction. Data analysis suggested a mediation relationship between the constructs. Specifically, architectural configuration that provided a sufficient level of privacy positively impacted perception of organizational culture, which could predict better job satisfaction. Zerella et al. also importantly noted the effect of physical proximity on formation of culture and interaction. Researchers concluded that their findings suggest the need to ensure sufficient perception of architectural privacy, which would in turn result in positive perception of organiza-

tional culture and positive employee satisfaction. However, an OPO cannot support architectural privacy in the same manner as traditional offices and would require supplementary privacy regulation mechanisms. When organizations fail to provide privacy regulation capacity, workers engage in a host of control behaviors in response, including workspace personalization (Laurence et al., 2013) and headphone wearing (Birnholtz, 2007).

Laurence et al. (2013) examined workplace privacy, finding architectural privacy was positively linked to employees' experienced privacy. Experienced privacy was negatively correlated with emotional exhaustion, with personalization acting as a buffer, where insufficient level of personalization exacerbated the effect of low levels of privacy on emotional exhaustion. This research points to the importance of control afforded to employee in the form of personalization, which affirm the current paper's desire to investigate headphones, a form of control (Weber, 2018; Bull 2001). Birnholtz et al. (2007) investigated how workers were able to "negotiate between awareness and privacy" within an open-plan office environment. During visits to four open-plan work environments, authors conducted observations and semi-structured interviews. Using these two methods, authors were able to gather data inferring people's attitudes toward privacy and interpersonal interactions within OPS environments. Birnholtz et al. began by defining awareness as "knowledge about the activities of others" (p. 52). This definition addresses two types of behavior, much like Altman's view on privacy regulation. Awareness information is first monitored for and collected by the individual, who also at the same time engages in the display of such informa-

tion towards others in the individual's environment. Office workers interviewed reported their "shared sense that, in the open space, there were virtually no guarantees of privacy" (p. 54). At the same time, interview participants understood the expectation of interpersonal boundaries enacted by office workers through their behaviors. Further, participants reported adaptation to the limited provision of privacy within their workplace, both psychologically and behaviorally. Many participants reported conducting private matters away from their desks in order to pursue higher level of privacy. Participants also were careful of colleagues who absented themselves from public spaces and acknowledge their need for solitude.

The display of such need for solitude, as authors reported, was also behavioral in nature, with participants describing such behavior as "working heads down" or "furiously in a corner". Most importantly, participants reported the use of headphones as a way to signal such unavailability to colleagues, which authors described as "blocks out unwanted sound, […] also widely understood as an indicator that the wearer wishes not to be disturbed" (p. 56). The results further support headphone use as a widely understood signaling practice, regardless of users' intentions behind headphone use.

2.4 Hypotheses

The literature reviewed above positioned the current research within both contexts of privacy regulation, and workplace environment and employee outcomes. It further expanded the scope by examining perceived residential crowding and its impact on people's desire to interact. Headphones are a viable mechanism of privacy regulation. Headphone use as privacy management is also well-understood and adopt-

ed by many. While it is difficult to disentangle people's desire to listen to music from their desire to be private, investigation of the effectiveness of headphones as regulation mechanism is still useful. Additionally, the current thesis connects an individual's level of perceived residential crowding with their privacy regulation behaviors in an open public workspace. Therefore, the current thesis will raise the following research questions: Are headphones effective privacy regulation mechanisms in work settings? Then, per literature reviewed above, does residential crowding affect people's desire to interact in an open, public workspace? Further, does residential crowding affect people's desire to interact with others using headphone as a privacy regulation mechanism? These research questions lead to the following hypotheses the current thesis seeks to address.

H1: When shown an image of an individual in an open public workspace, participants will report being less likely to socially interact if the individual is depicted wearing headphones.

H1 is presented per Altman's dialectic privacy regulation model, where people engage in privacy regulation to adjust levels of interaction in order to meet their privacy goals. H1 therefore discusses successful privacy regulation mechanisms and their outcomes from those who may engage in social interactions with headphone users.

H2: When shown an image of an individual in an open public workspace, participants who experience higher levels of perceived residential crowding will report being less likely to socially interact.

H2 reflects the second research question, raised after reviewing literature on linkage between perceived crowding and social withdrawal. This hypothesis seeks to understand whether perceived residential crowding can lead to withdrawal behavior even outside of the residential environment.

H3: *When shown an image of an individual in an open public workspace, participants who experience higher levels of perceived residential crowding will report being less likely to socially interact if the individual is depicted wearing headphones.*

H3 further discusses the questions raised above. Is headphone use more likely to impact those who experience crowding at home? In other words, are those who perceive higher levels of residential crowding more likely to pick up on headphone users' signaling of their unavailability to socially interact?

CHAPTER 3: METHOD

The current thesis used mixed methods to investigate whether headphone use serves as a viable privacy regulation mechanism in an open, public workspace, such that headphone use impacts people's desire to interact with the headphone user. Further, this research explores the impact of perceived residential crowding on desire to interact. An image-based survey will first investigate this relationship, followed by interviews.

3.1 Surveys

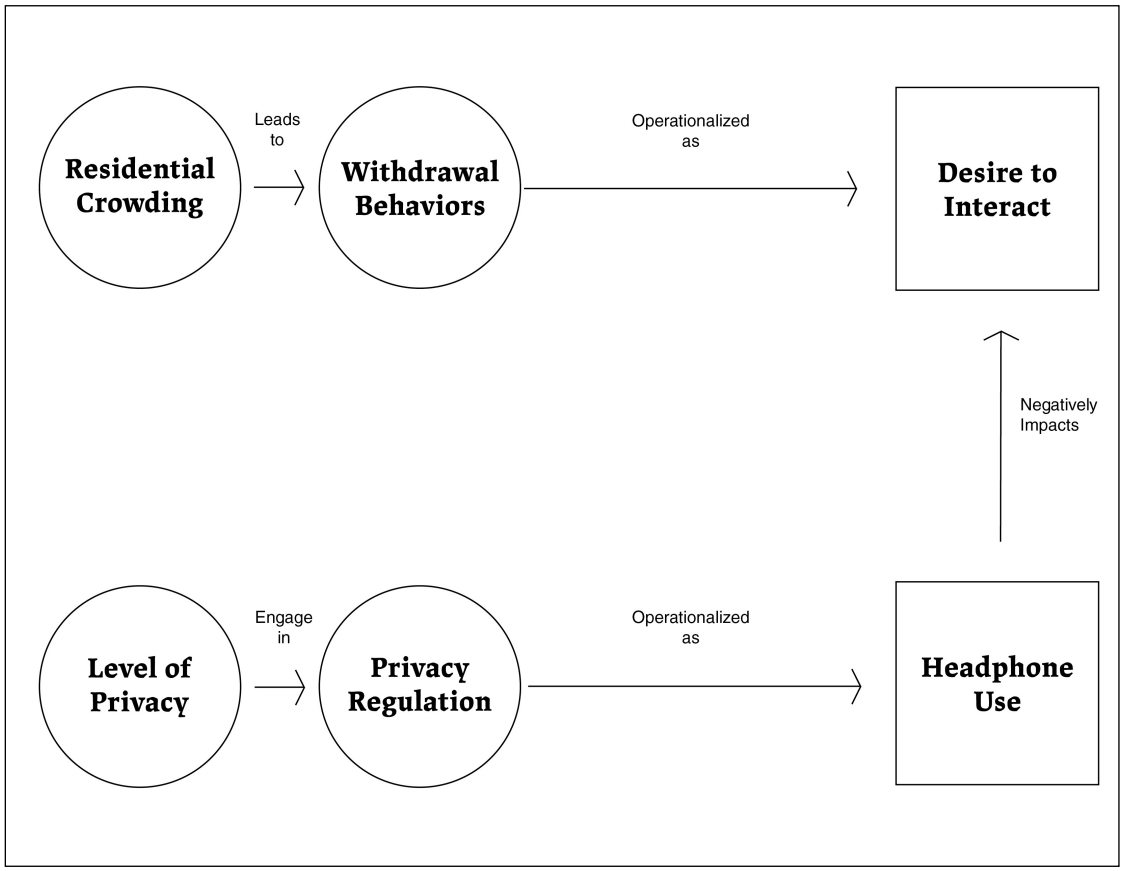
The survey had two components, an image-based survey and a survey of perceived residential crowding. The components were integrated into a single document. The survey is included in Appendix A.

3.1.1 Image-Based Survey

The independent variables of the current study are headphone use and perceived residential crowding. The dependent variable is desire to interact. Their relationships are shown in Figure 3.1. Participants will first complete a perceived residential crowding scale. Then, they will rate images of headphone users and non-headphone users in an open, public workspace based on how likely they will interact with the individual in the images on a 7-point Likert scale.

Figure 3.1

Theoretical Relationships Between Relevant Constructs to the Current Thesis



The current study employs a within group, quasi-experimental design. All participants were exposed to the two conditions of viewing images of individuals with headphones and viewing individuals with no-headphones. The order of images was randomized. Eight images of headphone users in an open-plan work environment were created: four images of a headphone-wearing person and four images of a person without headphones. In addition, four images depicted a female person while the other four show a male person. Individuals were depicted using in-ear headphones, as personal soundscape research by Haas et. al (2018) showed a high percentage of in-ears

headphone usage. The photos were additionally taken from the same vantage point to control the simulated distance between the participant and the people depicted. They were also produced at the same time, therefore controlling the amount of light within the photos. Further, the photos were taken within a short time frame and therefore avoiding large amounts of movement from people in the background. These measures were taken to control other variables that may influence the outcome of the study.

Following the density questions, participants engage with the eight images which appear in random order. Participants then rated how likely they will try to start a conversation with the persons they see in the images, on a scale from 1, very unlikely, to 7, very likely, on a slider-bar that allows decimal units.

3.1.2 Perceived Residential Crowding Instrument

Secondary research questions addressed whether residential crowding can affect people's withdrawal behavior outside of the residential environment. The survey instrument for the current thesis' experiment included a measurement of participants on their levels of perceived crowding. This 9-item, validated instrument was modified from the tool used in Rollings and Evans (2019). The instrument in the current thesis differed from the pilot study. Rather than measuring crowding only through calculating participants' household density, the current thesis uses the 9-time instrument in addition to measurements of household density.

3.1.3 Participants & Setting

Participants for the current thesis were recruited via the Amazon Mechanical Turk platform. The platform offers mediation between researchers and workers who would complete Human Intelligence Tasks (HITs) such as providing opinions about a product or answering surveys regarding political trends. Berinsky (2012) reviewed the validity of social experiments using the Amazon Mechanical Turk systematically and pointed out the benefits of a crowdsourcing platform such as MTurk regarding how the practice combats against potential hazards, such as sampling error, or over-representation of certain population sectors (e.g., college freshman psychology students). The current study requested 200 responses on MTurk, with compensation set at $0.50 per survey completion. There were no filters or selection criterion posted with the MTurk listing, therefore all workers could respond to the listing. To control for quality, null responses were excluded from the final sample. These exclusions were based on extremely short amount of response time (<30 seconds), and on null responses (same response values for all questions).

3.1.4 Procedure

The perceived crowding measure and the image evaluation task comprised the survey. The survey was created on the Qualtrics survey platform. The survey link was copied to Amazon Mechanical Turk's platform and distributed to workers who responded to the request. After accessing the survey through MTurk, respondents provided consent to the study. Then, participants responded to the perceived crowding measure and the image evaluation task. After completing the survey, participants were

directed to a page with their unique participation code, which is necessary to receive compensation on the MTurk platform. A pilot study was conducted in October of 2019, followed by a final study in spring 2020.

3.1.5 Data Analysis

The author requested 200 responses from the MTurk platform. The scores from the perceived crowding scale and the desire to interact image-scale were summed for each participant. Items 1, 2, and 6 of the perceived crowding scale were reverse-coded, so that higher final scores reflect high levels of perceived residential crowding. High scores on the desire to interact scale also indicate a higher level of desire to socially interact with images on the survey. Further, the summed scores for the images depicting individual with headphones and for the images depicting individuals without headphones were grouped separately.

IBM SPSS Statistics for Mac (IBM Corp., Version 24) was used for statistical analyses. Data collected from the survey instrument were analyzed using paired samples *t*-tests to compare the effectiveness of headphone use in regulating privacy. Correlations between perceived residential crowding and image evaluations were investigated using simple linear regression.

For H1: Paired-sample *t* tests were conducted to investigate whether statistically significant differences existed between how people scored when presented with an image of an individual with headphones and without headphones. Further, a comparative boxplot (Figure 4.1) for these variables was created.

For H2 and H3: A scatterplot was used to explore the correlation between levels of perceived residential crowding and desire to socially interact, measured by the image-based scale. Regression analysis was conducted to investigate the relationship between scores on the perceived crowding scale and scores on images depicting individuals wearing headphones.

3.2 Structured Interviews

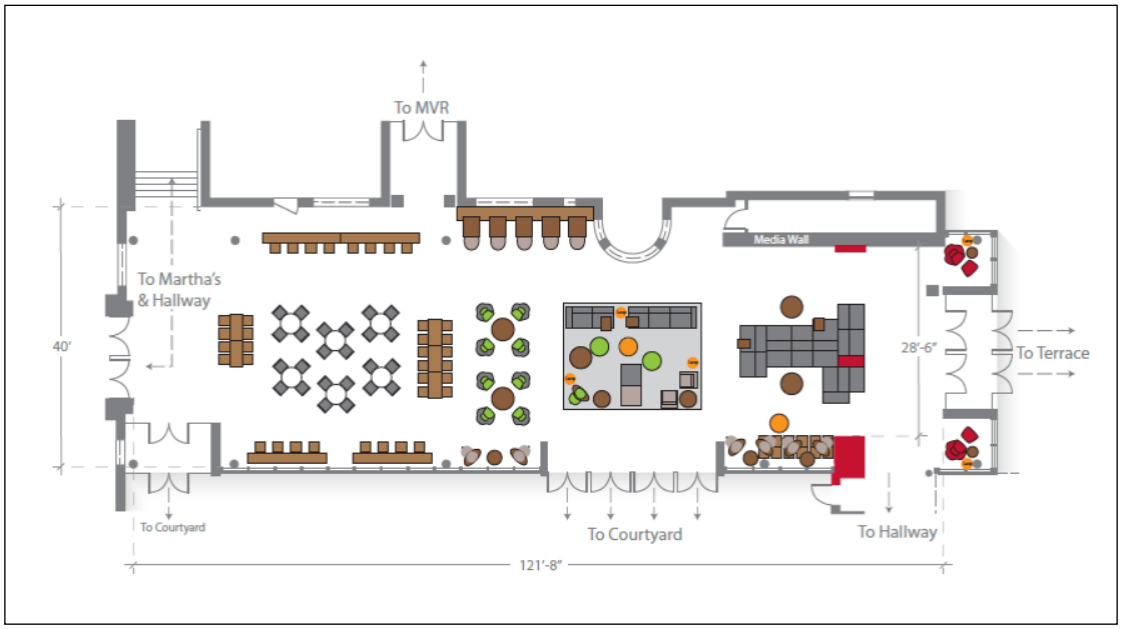
The current thesis included structured interviews as a way to garner further insight from those who work in an open public space. The interview included five questions. These questions regarded participants' privacy regulation mechanisms in an open public space, as well as their headphone usage.

3.2.1 Participants & Setting

The current thesis recruited a convenience sample of 30 participants from an indoor commons on a large research university in upstate New York (referred to as the Commons in this thesis). The Commons environment can be classified as an open public workspace (see Figure 3.2.). These participants were students at the large research university. The participants were occupants within the Commons where interviews were conducted. The author approached participants for their consent to being interviewed, with the option to receive a compensation of $0.50.

Figure 3.2

The Commons



3.2.2 *Procedure*

The author approached students occupying the student Commons on a Wednesday from 12 pm to 4 pm, then again the following day from 11 am to 3 pm. Upon approaching the students, the author explained the purpose of the interview and the compensation they may receive, then requested their signatures for both consent to be interviewed and consent to be tape-recorded. The author then began interviewing recruited participants with five questions created for the structured interview data collection. Those questions were:

1. How do you manage being in a public working space?
2. How do you manage unwanted interaction?
3. Do you use headphones, and why?

4. What does seeing other people who wear headphones make you think?

5. What do you think you are communicating to others when you wear headphones?

These interviews were on average two minutes. After finishing the interview, author thanked the participant for their time and ended the recording. The interviews were then transcribed and recorded for analysis. Transcription was done by the author.

3.2.3 *Analytical Approach*

Transcribed interview data was analyzed using Naturalistic Inquiry (Lincoln & Guba, 1985) Naturalistic Inquiry is a research paradigm proposed by Lincoln and Guba, which "focus on the *social constructions* of research participants." (Lincoln, 2007: 1). This focus sets Naturalistic Inquiry apart from traditional inquiry paradigms, set in laboratories where the researcher manipulates the experience and is operating under a priori theoretical guidance (Lincoln & Guba, 1985). Illustrating the need to inquire within a natural setting, they stated that "realities are wholes that cannot be understood in isolation from their contexts" (p. 39), affirming the current thesis' investigation of headphone use within the open common space. Multiple studies have used this method to inquire within contexts such as E-learning (Agostinho, 2005), ICU and family relations (Williams, 2005), swap meets (Belk et. al, 1988), and expiration experiences (Bikos et. al, 2007). In a recent example, Shepley, Peditto, Sachs, and Mehrabyan (2020) utilized Naturalistic Inquiry in their investigation of whether design goals were met during the construction of an on-campus healthy facility. They first conducted semi-structured interviews with 12 participants, after which the interviews

were transcribed. This method first organizes interview transcriptions into different concepts, which are then recorded on cards. The cards with recorded concepts are then categorized using themes that may emerge.

For the current thesis, the author conducted the card sort process twice. Per the methodology described by Galloway et al. (2019), author wrote down concepts on the front of the card, with corresponding, verbatim quotes from interviewees on the back of the card. Then, these cards were organized into themes. For example, in the current study, “looking away to signal busy” and “wearing headphones tell people to back off” were both placed under the “signaling” theme. The author enlisted a second individual the second time. The author completed the process once first, then asked the second reviewer to shuffle the cards. The cards were then rearranged by that individual. The themes created during these two sessions were compared and synthesized to create the final list of themes.

CHAPTER 4: RESULTS

4.1. Survey Results

4.1.1. Participants and Criteria

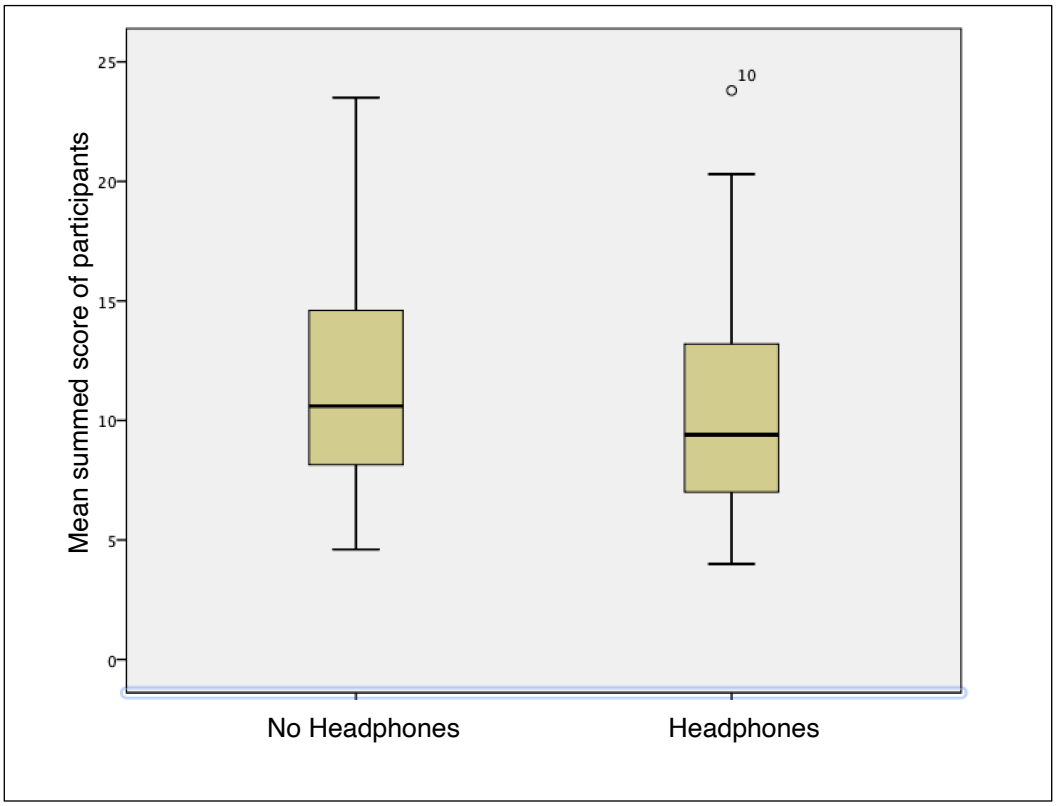
200 participants completed the survey. The initial dataset was then screened based on the following exclusion criteria. The survey platform, Qualtrics, reports participant response progress in percentage. Some responses were therefore excluded based on progress lower than 100, indicating incomplete response. Other responses with missing values were also excluded. After careful examination, some responses were deemed null, as all items were scored the same. These exclusion decisions were made with consideration to the amount of time the participant had spent on the survey. The final dataset included 83 participants, 31 females (37.3%) and 52 males (62.7%). Participants' ages ranged from 26 to 73, averaging 39 years.

4.1.2 Headphones as a Privacy Regulation Mechanism

Results from data analysis indicate a statistically significant difference between participants' scoring of desire to interact with images depicting individuals with and without headphones, $t(82) = 4.36$, $p < 0.001$. On average, participants scored 1.3169 points higher on images without headphones than on images with headphones (M=1.3169) (see Figure 4.1). This result rejects the null hypothesis, indicating that evidence collected supports H1 at 95% significance level. In other words, when shown an image of an individual in an open public workspace, participants reported being less likely to socially interact if the individual is depicted wearing headphones, suggesting that headphones deterred interaction.

Figure 4.1

Participants' Scores on Image-Based, Desire to Interact Scale



4.1.3. Crowding as an Influence on Desire to Interact

Simple linear regression was calculated for variables perceived crowding and interaction. The results are depicted in Table 4.1 and Figure 4.2. Results show R = 0.015, indicating a very low degree of correlation between the two variables. Nearly 0% of the total variation in "interaction" could be explained by "perceived crowding" (R^2 = 0.000). Further, coefficients for the regression indicate a non-significant, inverse relationship between perceived crowding and interaction variables (b = -0.014, p = 0.892). These results do not suggest a relationship between perceived

crowding and desire to interact, contrary to H2. Because these results were not significant, moderation analysis was not performed to investigate H3.

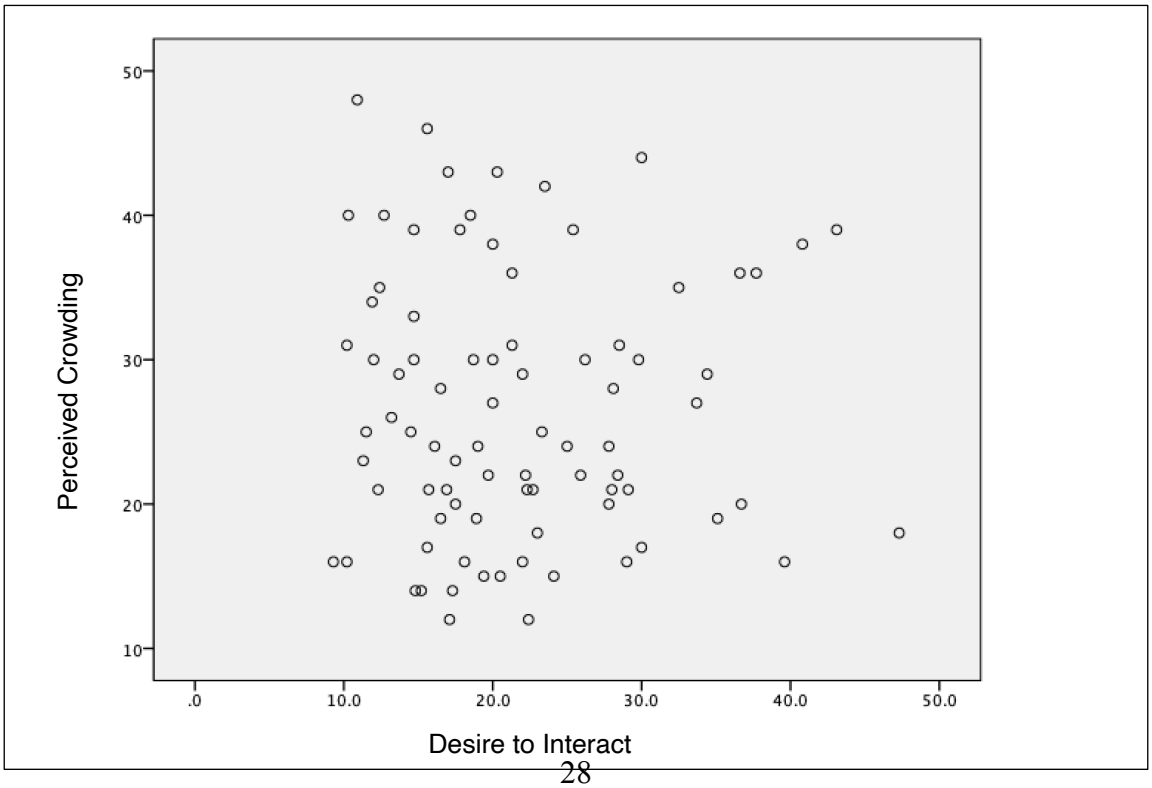
Table 4.1

Linear Regression Analysis of Perceived Crowding and Desire to Interact

Variables	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
(constant)	22.145	2.872		7.712	0.000
Perceived Crowding	-0.014	0.102	-0.015	-0.137	0.892

Figure 4.2

Scatterplot of the Relationship Between Perceived Crowding and Desire to Interact



4.2. Structured Interview: Privacy Regulation Mechanisms

Participants all reported needing some forms of regulation when working in the Commons in which they were interviewed. Three categories of regulation mechanisms were reported by the interview participants: headphone use, behavioral mechanisms, and spatial mechanisms. While most participants choose headphones as a way to achieve their desired level of interaction with others and their environment, some also employed other techniques to manage being in the Commons. Participant quotes below are referred to using number assigned to them based on the order in which they were interviewed.

4.2.1. Headphone Use

Many participants reported noise level as a factor that prevents them from being private ("I'm often distracted because of the noise here" p25), which led them to use headphones as a control mechanism. When asked about what they use headphones for in an open working space like the Commons, some participants reported listening to white noise, while others played music to "tune it out" (p9, p11, p21). One participant explicitly stated: "I don't use headphones besides noise blocking and music" (p4).

Headphone use was also reported as a mechanism that deters interaction, in addition to controlling the amount of noise that enters. One participant reported "I know some people use them to prevent interactions with others I just use it to listen to music if there's really a great amount of noise just lower it a little bit." (p26). Additionally, a participant described headphone use as "creating a bubble for me" (p2), or

"a barrier between you and people encouraging them not to come up to you cause it separates you in a way" (p19).

When asked about their perceptions of headphone use in an open public workspace, participants reported similar sentiments on it being a signaling practice. Besides listening to music or using white noise as noise blocking, many participants responded that they used headphones to cue or signal to others and agreed on the meaning it communicates. One interviewee described headphone use as "sort of like a cue or a signal that like I want to do very individual thing right now" (p29). This sentiment was elaborated upon, as one participant described it as "…don't intrude. They kinda give off this sorta vibes like… Like don't approach me. So I know a lot of times… [if] people want to be left alone or if they are studying they will put in their headphones cause that's kind of a cue to stay far away" (p25). Participants also expressed that they find headphone use to be an effective way to signal to others, that they are "…not approached that much when I have headphones in" (p13). Conversely, one participant described that absence of headphone use may communicate that "I'm willing to talk to other people" (p28), which again affirms headphone use as a signaling practice.

The author further asked participants what they thought others who wear headphones communicated to them, in order to understand how people interpreted signaling through headphone use. An interviewee treats headphones use as a "do not disturb" sign, stating "if someone is wearing headphones it's just kinda a sign that you shouldn't disturb them. I know like on the train in the city people like won't even listen to music but its just like don't talk to me" (p14). Most participants agree on inter-

preting headphone use as a behavioral "do-not-disturb," with one interviewee stating, "I would assume that they are busy and don't want to be interrupted and I probably would not go up to them" (p30). Another participant pointed out the additional layer of spatial context that determines how headphone use is interpreted by stating "they want to focus on their work and they don't want to talk to people especially if they are in public spaces and they are using their laptops" (p20). The nuance of spatial context was reiterated by one participant, who reported that "if I am walking around... like these ones I have are pretty small so like sometimes people don't really notice them. So I feel like its not as a clear signal like stop" (p29).

4.2.2. Behavioral Mechanisms

Some participants reported aversion to using headphones as a way to deter interaction, while some stated their use of behavioral cues to manage interaction. A commonly reported behavior was to avert eye contact after the participant sensed potential interactant such as an acquaintance. One participant reported that "mostly like I just don't like to make eye contact when it's unnecessary cause sometimes people start a conversation and …." (p2).

In addition to averting eye contact, participants also discussed appearing occupied by tasks as a way to manage unwanted interaction within the Commons. This was illuminated by the following comment: "I try to like avert eye contact and pretend I'm looking really really busy usually when I am working in the common space. It's because I am really busy so like sometimes I naturally avoid eye contact anyhow." Displaying their attention towards their task was echoed by other interviewees as a viable

way to manage interaction. One interviewee explained that others understand her unavailability to interact “if it’s clear that I'm like focused on like my computer or what’s in front of me or even on my phone” (p29).

4.2.3. Spatial Mechanisms

Lastly, interviewees reported spatial mechanisms they employ to adjust their level of privacy. Participants discussed finding a section within the Commons they consider quieter (p19, 26, 27) to avoid noise and interaction. An interviewee mentioned how particular seats and their spatial characteristics allowed her management of unexpected interactions and her visibility to others. When author approached her, she sat in a section with only a big reclining chair that faced away from the rest of the Commons. She explained that “… the reason why I’m sitting here is because normally I like to have my own space. I don’t like people looking at my screen...” (P28). These examples illustrate how participants employ spatial characteristics of the Commons to negotiate privacy, in addition to headphone use.

CHAPTER 5: DISCUSSION

5.1 Survey

5.1.1 Headphones as a Privacy Regulation Mechanism

In Altman's model of privacy, people engage with a variety of mechanisms to control the amount of information from the outside world and from themselves in order to achieve an optimal level of privacy. To further investigate Altman's theories, the current thesis sought to examine headphone use as one of the tools people may employ to regulate privacy within the specific spatial context of an open, public workspace. The investigation used a survey to examine headphone use independent of observed users' intention for wearing headphones. Instead, the image-based survey scale sought to investigate whether study participants reacted differently towards images showing headphone use regarding approachability, compared to images that do not. The data was intended to explain whether headphone use, independent of what the user intended to communicate by their use, affected others' desire to interact with the user.

Within Altman's model of privacy, regulation should be considered effective if information flow inward is reduced, such as when instances of social interactions with others in the environment decrease. Data collected suggested a significant, albeit minor difference in participants' desire to interact with individuals depicted with and without headphones. This evidence supported the first hypothesis, which stated "when shown an image of an individual in an open public workspace, participants will report being less likely to socially interact if the individual is depicted wearing headphones." This supports the researcher's proposition that headphones could be considered priva-

cy regulation mechanisms. Regardless of user intention, data analysis suggests that headphone use could somewhat deter others from initiating interaction, therefore allowing the user to achieve their privacy goal.

Headphone use, as a privacy regulation mechanism, is similar to other behavioral mechanisms, like the use of personalization to mitigate high levels of invasion of privacy (Laurence et. al, 2013). The 2013 study found that office workers engaged in personalization behaviors which moderated low levels of experienced privacy as a result of architectural configuration. Considering Weber's discussion on the impact of headphones, it is easy to see how headphones use may allow users to create a head cocoon that cuts off outside stimuli whenever the user chooses, thereby achieving the user's desired level of privacy.

Headphone use could also be considered as a withdrawal behavior within Altman's model of privacy. Evans (2000) produced results that indicated how social withdrawal can be an effective coping mechanism for crowding, because it allows those withdrawing to tune out or ignore social information. The social bubble headphone use creates allow users to retreat from the environment while being in the environment simultaneously. The retreat afforded to users therefore allow users to achieve optimal level of privacy through tuning out or ignoring social information as well.

This finding is in agreement with Birnholtz (2007), where interview data with open office workers showed that headphone use was employed often to regulate privacy. As people are less inclined to interact with those who wear headphones, they serve to regulate behaviors.

5.1.2 Crowding as an Influence on Desire to Interact

A secondary research question raised in the current thesis was whether perceived residential crowding influenced desire to interact in an open public workspace. The literature reviewed suggested that individuals who experience higher levels of residential crowding may engage in withdrawal to mitigate their crowding experience (Evans, 2000). Therefore, the current thesis hypothesized that, when shown an image of an individual in an open public workspace, participants who experience higher levels of perceived residential crowding will report being less likely to socially interact. Further, it was hypothesized that when shown an image of an individual wearing headphones in an open public workspace, participants who experience higher levels of perceived residential crowding will report being less likely to socially interact. However, the data analysis did not find a relationship between how participants scored on the perceived crowding scale and the image-based desire to interact scale. The lack of correlation in this study is likely the result of the size of the study population and confounding variables such as the length of stay in a particular residential setting or the relationship between dwelling unit members.

Additionally, the finding could be due to the image-based scale not accurately capturing an individual's withdrawal behavior as it only involved one question regarding a snapshot of a two-dimensional image. Evans (2000) measured individuals' withdrawal behaviors as the amount of social information recalled, per the theory's proposition that people may withdraw by tuning out social information. Prior studies in real settings showed that those experiencing crowding engage in many behavioral mecha-

nisms to withdraw. The image-based scale only asks participants to score how likely they would initiate an interaction with individual depicted in an open public workspace, therefore limiting nuances. Further, the participants recruited from MTurk's platform may not find the context relatable as they may not have worked in an open environment themselves. Lastly, the fact that participants were asked to score images of strangers may have deterred them from wanting to interact, independent of their level of experienced crowding.

5.1.3 Perceived Residential Crowding and Trait

The current thesis measured survey participants' perceived residential crowding. The measurement subjectively reflected the state of crowding within the participant's home. However, participants' innate traits were not discussed within the thesis. Since personality traits may very well affect individual's desire to interact, subjective measurement of participants' perceived crowding may not accurately reflect how participants may choose to approach individuals in the images. Though theory dictates those who experience crowding may seek to withdraw from social engagement, perhaps individual trait differences may still lead to different behaviors.

5.2 Structured Interviews

5.2.1 Headphone Use, Privacy Regulation, and Social Interaction

Interview transcripts revealed attitudes and behavioral norms of students working in the Commons, which resembles an open public workspace. These results were consistent with prior findings by Bull (2001), Weber (2010), and Birnholtz (2007). Students reported headphone use as a widely understood signal for deterring social

interaction and achieving privacy. Many students reported that they specifically use headphones to tune out the environment, as the Commons could sometimes become a place for social gatherings. Students also agreed that headphone use communicates unavailability for social interaction with others in the environment. Findings from Birnholtz (2007) may illuminate the current result. Birnholtz sought to examine the role mutually displayed attention played in both collaboration and privacy regulation within the open plan office. Workers withdrew their attention through a variety of behaviors including wearing headphones in order to maintain boundary and adjust privacy, since traditionally available architectural adjustments for privacy were absent. Interviews showed that students likewise intentionally signaled to others their unavailability specifically by putting on headphones.

5.2.2 Signaling and Social Robotics

Interview results show that students readily understood headphone use as a signal and frequently employ it themselves within the context of open public workspace, when they need to manage privacy. This establishes headphone use as a behavioral "do not disturb" sign, which could have implication for interaction design for robotic agents. According to the Implicit Interaction framework establish by Ju (2008), non-verbal behaviors humans use to communicate social meanings can be studied to inform the design of social robotic agents. Examples included examining the interaction sequence between a door person who would open the door and an individual approaching the door. The examination led to designs that could implicitly communicate to human counterparts a robotic agent's intention to open the door for them, therefore

achieving more efficient interactions. Similarly, it's easy to imagine contexts where future social robots include capacity to recognize human headphone use as a signal for unavailability. Perhaps there would be robotic agents within open public workspaces that could recognize signaling via headphone use, such as autonomous cleaners that limit their noise level by generating paths that avoid headphone users.

5.2.3 Headphone Design

Regarding headphone technology, the interview results illustrated the role the design of these technological artifacts could play in social interaction. As discussed above, headphone use and its symbolic meaning seemed to deter people from interaction. This fact highlights social functions of technological artifacts, headphones in particular, which layer on top of their originally intended functions. Weber (2010) described how prior models of headsets featuring only one earbud intended to allow the user to still engage in social interaction while enjoying music. Current trends of headphones designs tend to focus on noise cancelling. These designs reflect the social role they may play in users' social environment. Interview results again reflect how headphones socially function for student users. Results seem to suggest future headsets to better support privacy regulation. Interview participants discussed visibility as a factor in how effective wearing headphones may stop strangers from approaching. Therefore, future headsets could become even more visible. Separately, since headphone use could be readily understood as a signal to deter interaction, it would be interesting to investigate whether accessories that resemble headphones that do not play music would accomplish the same. This could lead to designs of products that may look like

headphones only to communicate the same social meaning, without requiring audio technology.

5.3 Relationship of Interviews and Surveys

Predecessor studies have conducted multi-methodological studies using interviews and surveys to explore the impact of the physical environment. Sachs et al. (2019) evaluated a mockup of a mental and behavioral health inpatient room. Researchers used an analytical method that first extracted themes from interview transcripts, which were then congregated into categories. This was illuminated by interview data, where specific quotes from patients and staff painted a comprehensive picture that explain the difference in their scoring on the survey instrument. (Sachs et al, 2019). Similarly, in my study, survey results indicated that people were less likely to interact with headphone users when compared to non-headphone users. Interview results illuminated this survey finding, as student participants reported that headphone use as a signal to deter social interaction is widely understood in an open public workspace. Interview data and surveys together answer the research question that headphones are indeed effective privacy regulation mechanisms.

CHAPTER 6: CONCLUSION

6.1 Summary

This thesis describes a quasi-experimental mixed methods study that investigates headphone use as a privacy regulation mechanism within open, public workspaces. It further examined the relationship between residential crowding and desire to interact. A survey consisting of a scale on perceived residential crowding and an image-based scale on desire to interact was distributed to 200 Amazon Mechanical Turk workers. Additionally, structured interviews were conducted with 30 student participants recruited from a student commons in a large research university. Analysis of quantitative data collected from survey supported the hypothesis that participants felt that they would be less likely to interact with the people in the images who were wearing headphones. Interview results further showed that headphone use was a widely understood mechanism to manage privacy levels within an open, public workspace. The results were discussed with reference to the privacy regulation model of crowding, as well as the implicit interaction framework for social robotic design.

6.2 Limitations of Study

6.2.1 Participants

The current study is situated within the spatial context of open, public workspaces. However, the current study recruited survey participants from Amazon Mechanical Turk platform, a "crowdsourcing marketplace" that provides "a global, on-demand, 24x7 workforce" (Amazon Mechanical Turk, 04/2020). While the platform provided the study with a diverse sample, the participants recruited may not be famil-

iar with an open, public workspace. This could lead them to produce inaccurate results. Further, due to the nature of the platform, controlling for quality of data was difficult. A number of participants did not complete the survey, while others submitted the same scoring across all questions. After applying the exclusion criteria, the initial pool of 200 data entries was reduced to 83. The limited number of data points could lead to statistical analyses that may not have accurately represented a broad range of participants. Similarly, interview participants were recruited from occupants of the student commons, who were almost entirely students. The limited demographic make-up of the interview participants could also lead to a uni-dimensional interpretation of headphone use and its social functions.

6.2.2 Desire to Interact Scale

The current thesis utilized an image-based scale created from a previous pilot study. The scale asks a single question regarding how likely participants will initiate interaction with individuals depicted in the images. Although the scale was validated in the pilot study, the limited scope of the scale might undermine the potential validity of the investigation. The construct, desire to interact, could be operationalized in a variety of ways, beyond how likely an individual would want to interact with a simulated stranger within a photo. Therefore, the scale could be inaccurately capturing participant's desire to interact.

6.2.3 Interviews

Though the current thesis examined the relationship between residential crowding and desire to interact with regards to headphone use, the structured interviews conducted did not ask questions regarding participants' residential crowding levels. Student participants likely resided within dorms, which could increase their levels of residential crowding and influence their headphone use, as well as their interaction tendencies within the Commons. On the other hand, the fact that participants chose to work within an open space that may invite interaction could point to their low levels of crowding. Further investigation is needed.

6.3 Recommendations for Future Research

6.3.1 Desire to Interact Scale

Future studies could benefit from a review of other tools that investigate desire to interact. Benner and Marlow (1991) investigated how a workshop on childhood cancer might affect school age children using the *Cancer Knowledge Questionnaire* (CKQ). Six Likert items addressing interaction specifically addressed interaction among school children as a result of cancer knowledge workshop. In another study, Lee and Dubinsky (2011) reported on the construction of a scale measuring consumers' desire to interact with a salesperson during e-shopping (online shopping). Researchers interviewed 16 undergraduate and graduate students on a university campus. These interviews produced a trove of statements regarding participants' attitudes on interaction between them and salespeople. These statements informed the construction

of their scales. The process of scale construction described in the two studies above should also inform future construction of scale on desire to interact.

6.3.2 Spatial Context and Headphone Use

The initial inspiration for the current thesis came from a similar study conducted within an open-plan office that examined the role of mutual attention display plays in interaction (Birnholtz, 2007). However, it could be interesting to investigate other spatial context of headphone use, such as homes or traditional offices.

6.3.3 Additional Measures

Future studies could benefit from including additional measures that examine participants' perception of crowding level within the images. This may lead to more nuanced data analysis that may result in productive results supporting the negative impact of crowding on desire to interact. Future studies should also include measures that examine participants' attitudes regarding headphones' role in elevating one's level of privacy. The construct of control could further be introduced. Additional measure could examine whether participants felt more in control through using headphones.

6.4 Closing

This thesis showed that headphone use might restrict individuals from interacting with those wearing the headphones, regardless of whether the user intended to communicate the need for privacy. This evidence allows us to reflect on our relationships with the technology we use, as well as with our physical and social environment. How we choose to engage with the world can greatly impact social outcomes. This thesis opens a discussion regarding social implications of technology use.

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Appendix A

Consent Form

Consent Form
Investigation of Privacy Regulation Behaviors in Public workspaces
Investigators:
Joey Sun (ps935@cornell.edu)

You are being asked to take part in a research study on people's behaviors and attitudes in public work spaces. Please read this form carefully and ask any questions you may have before agreeing to take part in the study.

What the study is about: The purpose of this study is to understand behaviors and attitudes people have regarding working in public work spaces.

What we will ask you to do: If you agree to be in this study, we will conduct an interview with you. You will be asked some questions about your experience with public workspaces. Others will be about reasons why you make certain decisions about working in a public workspace.
Risks and benefits: I do not anticipate any risks to you participating in this study other than those encountered in day-to-day life. There are no benefits to you.
Compensation: You may earn 0.5 US dollar for participation.
Your answers will be confidential. The records of this study will be kept private. In any sort of report we make public we will not include any information that will make it possible to identify you. Research records will be kept in a locked file; only the researchers will have access to the records.
Taking part is voluntary: Taking part in this study is completely voluntary. You may skip any questions that you do not want to answer. If you decide not to take part or to skip some of the questions, it will not affect your current or future relationship with Cornell University. If you decide to take part, you are free to withdraw at any time.
If you have questions: The researchers conducting this study are Joey Sun and Dr. Mardelle Shepley. Please ask any questions you have now. If you have questions later, you may contact Joey Sun at ps935@cornell.edu, or at 617.922.4955. You may also

contact Dr. Mardelle Shepley at mshepley@cornell.edu. If you have any questions or concerns regarding your rights as a subject in this study, you may contact the Institutional Review Board (IRB) at 607-255-5138 or access their website at http://www.irb.cornell.edu. You may also report your concerns or complaints anonymously through Ethicspoint (www.hotline.cornell.edu) or by calling toll free at 1-866-293-3077. Ethicspoint is an independent organization that serves as a liaison between the University and the person bringing the complaint so that anonymity can be ensured.

This consent form will be kept by the researcher for at least three years beyond the end of the study.

Statement of Consent: I have read the above information, and have received answers to any questions I asked. I consent to take part in the study.

Initials

Date

Crowding

What is your gender?

- M
- F

What is your age?

How many people are there in your home?

How many rooms are in your home?

How often do you have a place to go to be by yourself if you want to be?

1 2 3 5 6 7

How often do people let you be by yourself when you want to be alone?

1 2 3 5 6 7

How often do people get in your way at home?

1 2 3 5 6 7

How often do you feel crowded at home?

0 1 2 4 5 6 7

How often do you feel crowded at home?

1 2 3 5 6 7

How often do you feel squished or cramped at home?

1 2 3 5 6 7

If you want to read or do work, can you do that without someone bothering you?

1 2 3 5 6 7

Are there too many people in your house?

1 2 3 5 6 7

Is your house too small?

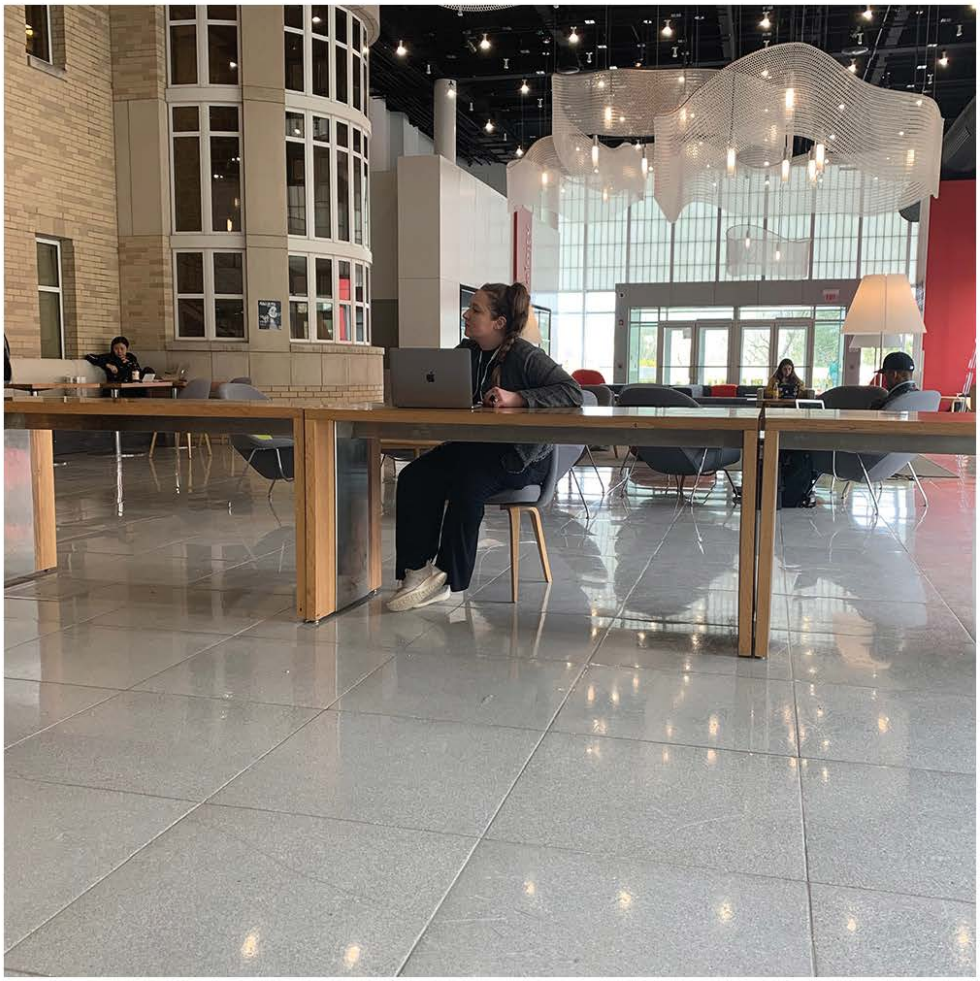
1 2 3 5 6 7

Do you wish your house had more rooms?

1 2 3 5 6 7

Block 4

On a scale from 1 (very unlikely) to 7 (very likley), please rate how likely you will try to start a conversation with the persons you see in the images.



1 2 3 4 5 6 7

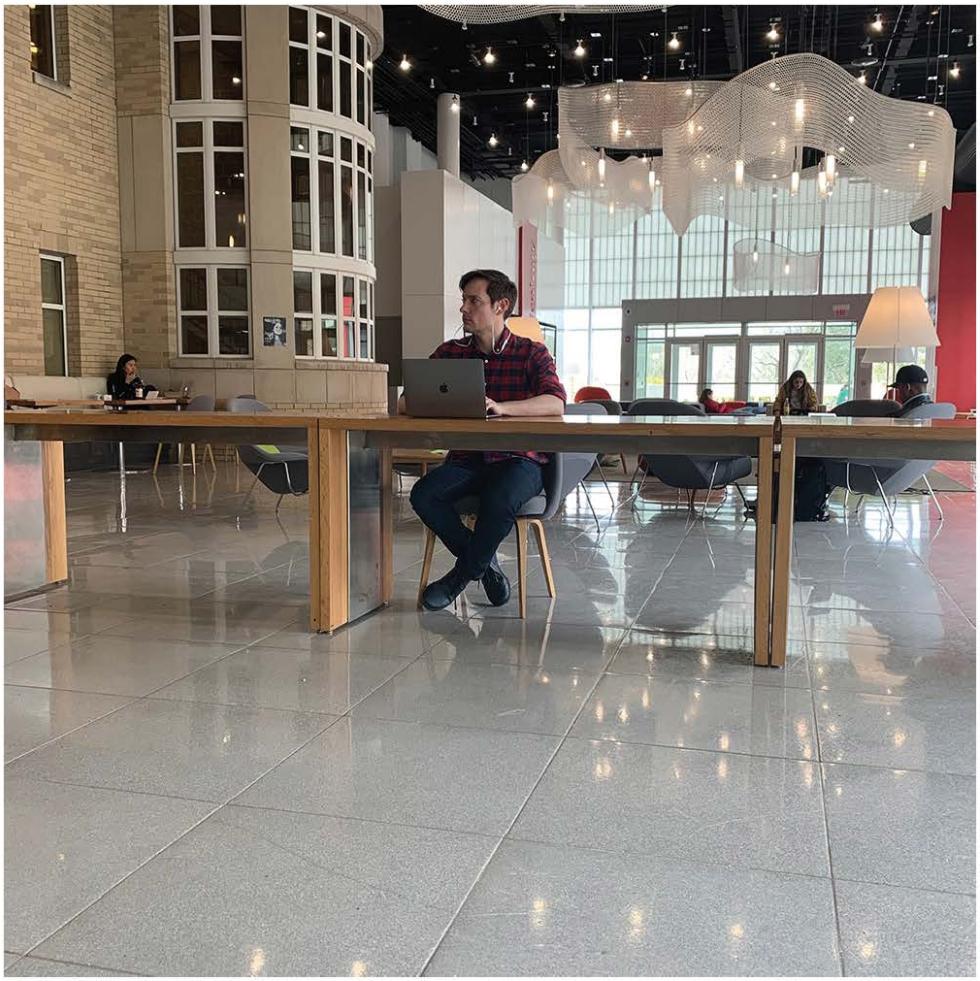
1 2 3 4 5 6 7

1 2 3 4 5 6 7

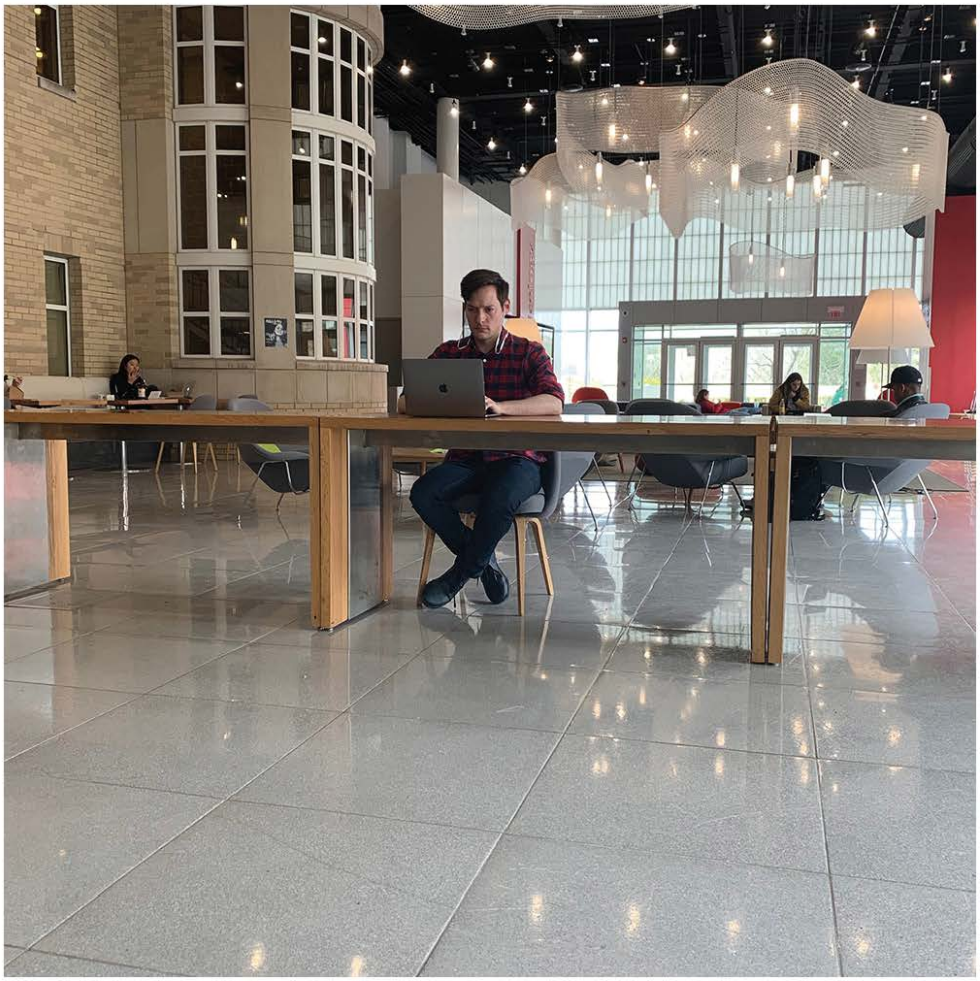
1 2 3 4 5 6 7

1 2 3 4 5 6 7

1 2 3 4 5 6 7



1 2 3 4 5 6 7



1 2 3 4 5 6 7

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