THE PENNSYLVANIA STATE UNIVERSITY
SCHREYER HONORS COLLEGE

DEPARTMENT OF PSYCHOLOGY

ARE THEY A THREAT?: THE INTERPLAY OF GAZE DIRECTION, PERCEIVED EMOTION, AND TRAIT ANXIETY IN ATTENTION ACROSS TIME

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ABSTRACT

The shared signal hypothesis, postulated by Adams & Kleck (2003, 2005), proposes that the congruence of approach/avoidance signals conveyed via eye gaze and facial expression moderates the processing of faces. This study builds on past research by hypothesizing that congruent cues (i.e. direct gaze anger/averted gaze fear) will be prioritized early in attention (i.e. 300 milliseconds); however, later attention (i.e., 1000ms) should be biased toward incongruent cues (i.e. averted gaze anger/direct gaze fear). Moreover, we predicted that levels of trait anxiety may moderate these attentional biases. We found for fear, when covarying levels of trait anxiety, there were indeed more attentional biases toward the congruent pairing (i.e., averted fear) at 300ms with a bias toward the incongruent pairing (i.e., direct fear) at 1000ms. There was no such effect for anger. The results are discussed in relation to the shared signal hypothesis and functional differences in the signal conveyed by anger and fear.

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Chapter 1

Introduction

Many years ago, the pioneer communications researchers Alfred Mehrabian and Susan Ferris (1967) determined that only 7 % of the message you are sending is sent through the words you are using, asserting the rest is comprised of 38 % vocal sounds and 55% other nonverbal communications. Although the authentic numerical percentages are debatable, and perhaps irrelevant, body language is understood to comprise the majority of all human communication. We depend on decoding the context cues provided by the nonverbal messages of the others we are interacting with in order to make sense of our social world.

In a world where how you say it means more than what you say, much can be inferred from the smallest of body parts. An attraction to the eyes is hypothesized to be innately wired into our cognition (Baron-Cohen, 1997; Driver et al., 1999). This same research has found that a particular emphasis can be found on the subtle hint of the eye's gaze direction. We can, with precise accuracy, determine the direction of another's gaze (Langton, Watt, & Bruce, 2000). Looking down in shame, forward with joy, or away with fear are salient cues we can use to interpret other's emotions and behavioral intentions.

When it comes to deciphering emotion, perceiving the other's eye gaze is an important context cue. However, eye gaze may need to be combined with the congruent emotion in order to be correctly and quickly interpreted. For example, as Adams & Kleck (2003) described, direct eye gaze could either be threatening or friendly, depending on

the context cues surrounding the gaze. Likewise, emotion, facilitated by the context cue of eye gaze, may receive a swifter and more accurate interpretation. Research prior to Adams & Kleck's study had shown eye gaze and emotion to co-occur; however, their co-occurrence neglected to highlight the specific role of eye gaze in the perceptual processing of facial emotion. In their study, Adams & Kleck (2003) demonstrated that the direction of the eye gaze does, in fact, facilitate the processing of differentiated emotions. The congruent pairings of eye gaze and emotion provided heightened emotional attention and quicker identification of the appropriate emotional state.

Despite the recent merging of research of emotional expressions and that of gaze direction in select scholars' works, the effect of eye gaze on emotional processing remains largely understudied. Much remains still hypothesized and uncertain within directional eye gaze research. This study strives to emphasize the applicability of and build upon the research on theories and ideas such as approach and avoidance and the shared signal hypothesis (Adams & Kleck, 2003, 2005). Particularly, this study focuses on congruent and incongruent eye gaze/emotion pairings as it effects speed of processing in order to underline the salience of eye gaze as a context cue in our determination of behavioral intention. Additionally, the interaction between trait anxiety and attentional processing of emotional faces will be evaluated and described.

Chapter 2

Literature Review

Eye Gaze, Emotion, and Shared Signal Hypothesis

The basic tendency to approach or avoid drives many of our social interactions. Direct gaze is associated with approach-oriented behaviors while averted gaze suggests avoidance-oriented behaviors. Likewise, positive emotions are associated with approach whilst negative emotions are linked with avoidance. Eye gaze and emotion have been found to co-occur, and, specifically, direct eye gaze has been found to co-occur with approach-oriented emotions (i.e. joy, anger) while averted eye gaze has been found to co-occur with avoidance-oriented emotions (i.e. fear and sadness) (Argyle & Cook, 1976). Adams & Kleck (2003) demonstrated the process of determining the other's intention to approach or avoid by evaluating contrasting emotional expressions of anger and fear to mirror these innate tendencies. The research found that congruent emotion-eye gaze pairings (i.e. direct gaze anger, averted gaze fear) were detected more quickly than their incongruent counterparts (i.e. averted gaze anger, direct gaze fear).

Research has replicated eye gaze's effect on the speed of processing and built upon Adams & Kleck (2003) to determine eye gaze can increase accuracy of facial memory and the perception of the intensity of the emotions (Adams & Kleck, 2005; Adams, *unpublished data*). This adaptive function suggests a highly evolved skill—the cognitive ability to quickly recognize congruent emotional expressions and discern emotion-specific context cues. According to Barron-Cohen (1995) this ability reveals our

propensity to determine the behavioral intentions of the nonverbal communications of others, which he calls “theory of mind.” He defines behavioral intentions as driven by the fundamental instinct to approach or avoid, stating they reflect “primitive mental states in that they are the basic ones that are needed in order to be able to make sense of the universal movements of all animals: approach and avoidance” (p. 33–34). The ability to discern behavioral intention from eye gaze and emotion is useful to determining whether another will approach or avoid, and, in turn, determining one’s own response.

These views are exemplified in the *shared signal hypothesis* (Adams & Kleck 2003, 2005) which states that congruent cues (e.g. direct eye gaze and anger) should facilitate the processing of emotion and behavioral intention. When the context cues (eye gaze, emotion) are congruent, the processing becomes easier than if the cues were not aligned. Thus, the signal value to either approach or avoid is shared if the cues are congruent, causing an increase in efficiency of the signal processing.

The efficiency of processing can be reflected by attention, which is a complex cognitive process by which pertinent stimuli receive priority over the numerous other potential stimuli, (Posner, 1980), allowing for more efficient processing for the stimuli with the most relevant signal value. Broadbent (1957) described attention as the gateway to downstream processing. Adams (*unpublished data)* found gaze direction to facilitate the early processing fluency of fear faces, with later downstream effects on memory. Studies such as these provide evidence for attentional weighting, which allocates perceptual advantages to the stimulus which demonstrates relevance to the individual, whether through innate biases or learned pairings (Zebrowitz, 2006; Zebrowitz, Bronstad, & Montepare, 2010).

For instance, anger could innately signify the looker's intention to approach and therefore be allotted more attention significance. Observers could also learn that anger is usually associated with a desire to approach and therefore favor it in attentional weighting. However, these signal values are only clear with direct gaze. When looking at an individual with an angry expression and averted eye gaze, the expression may seem less threatening because the target of the anger is ambiguous. Likewise, a fearful face paired with direct eye gaze may be looking at a source of threat in the environment; however, if a fearful expression has a direct eye gaze towards the onlooker, the source of the threat is ambiguous. In these cases, context cues are relevant to the signal value and processing efficiency of the stimuli.

Anxiety and Attentional Bias

The discussion of the effect of emotional faces has neglected to mention the effect specific to the population's emotional affect. Thus far, we have focused on the stimulus itself rather than its effect on the individual, leaving undiscovered the interaction between emotional disposition and emotional face processing. Beck's cognitive theory of emotional disorders (Beck, 1976) laid the groundwork for the research on mood-congruent biases, presuming that the personal affect of the individual will have an impact on the attentional allocation in the individual's environment. Research has paid specific attention to the interaction between fear and positive or negative, particularly threatening, stimuli, because of its functional relevance for survival (Ackerman et al., 2006). Fox, Russo, Boyles, & Dutton (2001) demonstrate that one of the adaptive function of

attentional processing is to perceive threats in the environment and therefore attention is biased towards fear-relevant stimuli. Previous research has also found increased attention to threatening stimuli such as angry faces (see Morris, Ohman, & Dolan, 1998). Speculation as to the origins of these effects may indicate an interaction of anxiety and the processing of threatening stimuli. The increase in the general attention towards threatening stimuli may involve a mood-congruent bias, i.e. an attentional bias for those with a higher level of anxiety.

The bulk of research suggests heightened anxiety reflects heightened attentional mood processing (Fox et al., 2001). Scholars such as Beck (1976), who formed the cognitive theory of emotional disorders, would argue the bias represents the faulty cognitive processes involved in a heightened state of anxiety. It is unclear whether the attentional bias towards threatening stimuli attracts early attention or holds attention. However, Fox (1994) discovered highly anxious individuals had a more difficult time inhibiting threatening stimuli. Likewise, research has found that it was harder for participants with higher levels of anxiety to disengage from threatening stimuli, even in response to averted gaze fear, suggesting that this threatening stimuli holds attention relative to non-threatening stimuli in anxious individuals (Fox et al., 2001; Fox, Calder, Mathews, & Yiend, 2007). Thus we should expect that trait anxiety may moderate attentional biases to different pairings of eye gaze and emotion as these represent varying degrees of potential threat (i.e., direct anger and averted fear signal clear threat, averted anger and direct fear signal threat ambiguity).

Overall, this study expects early attentional biases for congruent stimuli (i.e. direct/anger and averted/fear pairings) in comparison to incongruent stimuli (i.e.

averted/anger and direct/fear pairings) because these congruent pairings should be processed more efficiently. Conversely, later attention should be biased toward incongruent pairings (i.e., averted anger, direct fear) because these produce contrasting signals that need additional cognitive resources to process.

Typically, the *dot-probe task* (MacLeod, Mathews, & Tata, 1986) has been used in studies of attentional weighting. The dot-probe task typically involves an emotional stimuli disappearing to reveal dots behind it, with the participant being asked to report something about the dots (e.g. number of dots, direction of dots). Faster processing speed in the former area of the emotional stimuli generally means greater attentional allocation to that stimulus. The dot-probe was first used with threatening words amongst an anxious population (MacLeod, Mathews, & Tata, 1986) and has since been used in research on threatening and fearful stimuli. The dot-probe task, when controlling for attentional biases over time, can determine not only where the attentional bias was, but when in time this bias occurred. This particular study will be examining the biases over 300, 500, and 1000 milliseconds, expecting the congruent stimuli to be allocated the most attention in the earlier conditions while the incongruent stimuli dominates later attention. By placing competing neutral and emotional faces, with either congruent or incongruent signals between eye gaze and emotion, the dot-probe task can determine where and when the participants' attention was drawn to the emotional faces. Thus, the task can determine when the biases towards emotional faces occurred over time as well as whether or not trait anxiety moderated these effects.

Chapter 3

Methods

Twenty-nine students (12 male and 17 female students) from the Pennsylvania State University were recruited for this study. Each student received $20 to participate in this study. The participants were tested in groups of no more than 3 at a time in individual rooms to ensure privacy.

Stimuli

Forty-eight faces balanced for gender were produced using FaceGen software and presented in each treatment condition, 2 (emotion: anger or fear) by 2 (gaze: direct or averted), by 3 (300, 500, or 1000 milliseconds) (see Figure 1). Each face was saved in a grayscale color format and uniformly cropped so that no obvious extraneous characteristics (e.g., hair) were present. Faces were sized to ovals approximately 1.75 x 2.5 inches. Faces were presented on a 17 inch monitor. Participants sat approximately 24 inches from the monitor, subtending a visual angle of 4 x 6 degrees. Each face was shown displaying anger and fear, twice with direct gaze and twice with averted (once left and once right). Presentations and responses were executed and recorded with Open Sesame 0.27 (Mathôt, Schreij, & Theeuwes, 2012). The survey used was the State Trait Anxiety Inventory (Spielberger, 1983).

Procedures

A dot-probe paradigm was used for this study. Participants were told that they would be completing a task in which they were to identify the number of dots on the screen. They were asked to respond to each trial as quickly and accurately as possible. Each trial started with the display of a fixation point for 750 ms. Following this, two faces (one expressive, one neutral) were presented to the left and right of the fixation point for either 300, 500, or 1000 ms (see Figure 2). Both faces were matched for eye gaze, either displaying direct or averted such that both the left and right face were looking the same way (left or right). Therefore, 50% of trials showed a direct gaze whereas 25% showed a right-averted gaze and 25% showed a left-averted gaze. Likewise, the 300, 500, and 1000 ms conditions were each presented 33.33% of the time. The center of each image deviated from fixation by a visual angle of 4 degrees. The location of displays (right or left) for emotional versus neutral faces were fully randomized within participant.

After the faces disappeared, dots appeared in the former location of one of the two faces. The dots were 36 x 36 pixels (2 degrees) and either one dot or two dots aligned horizontally were presented and remained on the screen until the participant made a response, or 2000 ms, after which the next trial immediately ensued. Participants responded to one dot by pressing the keyboard's left arrow and two dots by pressing the right arrow. There were a total of 768 trials. After the trials, the participants were asked to fill out the State Trait Anxiety Inventory on the same computer.

Chapter 4

Results

One participant was dropped for low accuracy (3 standard deviations below the mean) and four participants were dropped for technical issues. Additionally, one participant was dropped for not completing the STAI. Overall, less than 1% of all trials were dropped for being too fast (less than 100ms) or slow (more than 1000ms). For each category of eye gaze by expression, our variables were created by creating bias scores by subtracting the reaction time to the emotional face from the reaction time to the neutral face. Therefore, positive values reflect attentional weighting towards the expressive face while negative values reflect bias towards the neutral face.

Our main hypothesis was tested using a 2 (angry vs. fearful expression) x 2 (direct vs. averted gaze) x 3 (300, 500, or 1000 ms) within-subjects repeated measures analysis of variance. There was no significant main effect for emotion, gaze, or length of stimulus presentation, or any interactions.

When the covariate of trait anxiety was added, results showed interesting effects. A main effect of emotion was borderline significant, $F(1, 22) = 3.823$, $p = 0.063$, $\eta_p^2 = 0.148$, although no main effects for length of stimulus presentation or gaze were found. The two-way interaction of emotion and trait anxiety ($F(1, 22) = 4.126$, $p = 0.054$, $\eta_p^2 = 0.158$) and the three-way interaction of gaze, length of stimulus presentation, and trait anxiety ($F(2, 44) = 2.651$, $p = 0.082$, $\eta_p^2 = 0.108$) were borderline significant, although no interactions found significant effects. However, some unpublished data in our lab has

found stronger interaction effects for fear but not anger, thus we had reason to examine these emotions separately.

There were no main effects or interactions within anger. For fear, no main effects or two-way interactions emerged; however, a significant three-way interaction appeared between gaze, length of stimulus presentation, and trait anxiety ($F(2, 44) = 4.475$, $p = 0.017$, $\eta_p^2 = 0.169$).

Gleaning from the effects of fear, we separated the results by length of stimulus presentation, including the covariate of trait anxiety, in order to view the direction of the results. As expected, there was a larger bias toward averted relative to direct fear at 300ms, $F(1,22) = 5.021$, $p = 0.035$, $\eta_p^2 = 0.186$ (see Figure 3). There was no significant difference at 500ms ($p = .612$). At 1000ms, however, direct fear showed a marginally larger bias than averted fear, $F(1, 22)=2.954$, $p = .100$, $\eta_p^2 = 0.118$, in line with our original hypotheses (see Figure 4).

Chapter 5

Discussion

For only fearful faces, attention to congruent or incongruent faces changed between early (i.e., 300ms) and late (i.e., 1000ms) attention. In accordance with our hypothesis, the congruent pairing (averted/fear) attracted more attentional bias during the 300ms stimulus duration whereas the effect flipped during the 1000ms trial, during which the incongruent pairing (direct/fear) dominated the attention. There were no significant effects for anger. These results support our first hypothesis on shared signals, but only within fearful faces. Additionally, these effects only appear when covarying out the level of trait anxiety, thus suggesting that anxiety has an important role in the processing of eye gaze and emotion, as has been found in previous attention-related research (i.e., Fox et al., 2007).

However, the results for anger reflect our second predictions. Fox et al. (2007) found that when those with anxiety were shown fearful and angry faces with either direct or averted eye gaze, they had difficulty disengaging from the angry faces, causing the angry faces with either eye gaze to hold their attention longer. Additionally, the researchers found that highly anxious participants showed attentional weighting towards the eye gaze of fearful faces relative to all other faces. Both significant effects in fearful faces and trouble disengaging from angry faces amongst those with anxiety are replicated in our study. Thus, the lack of effect between lengths of stimulus presentation may be attributed to the tendency of threatening stimulus to hold attention longer than neutral or

fearful stimuli. Additionally, Pinkham, Griffin, Baron, Sasson, & Gur (2010) found that angry faces were more efficiently and quickly detected in a crowd of faces than other emotional faces, providing evidence suggesting anger is processed pre-attentively, hence may not interact with eye gaze to influence attention.

Overall, the interaction of direction of eye gaze, emotional disposition, and trait anxiety is highly complex and requires further research in order to accurately determine the relationship between the variables. Further research should focus on the effect of eye gaze direction and emotion on disengaging from threatening stimuli. Also, further research should examine the role that attentional biases may play in downstream cognitive effects (i.e., memory). More research is needed in order to accurately determine the global effect of eye gaze, emotion, and trait anxiety in attentional weighting across time.

Chapter 6

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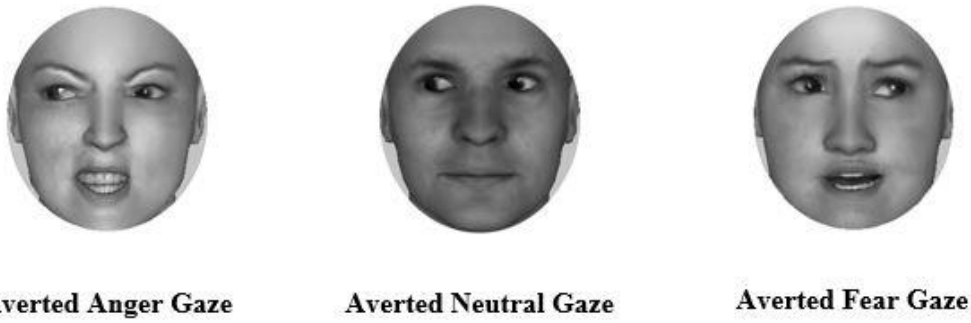
Appendix A

Figures

Figure 1. Examples of Emotional and Neutral Stimuli for Direct and Averted Gaze



Averted Anger Gaze **Averted Neutral Gaze** **Averted Fear Gaze**

Direct Anger Gaze **Direct Neutral Gaze** **Direct Fear Gaze**

Figure **1**: Examples of Stimuli

Figure 2. Dot Probe Paradigm

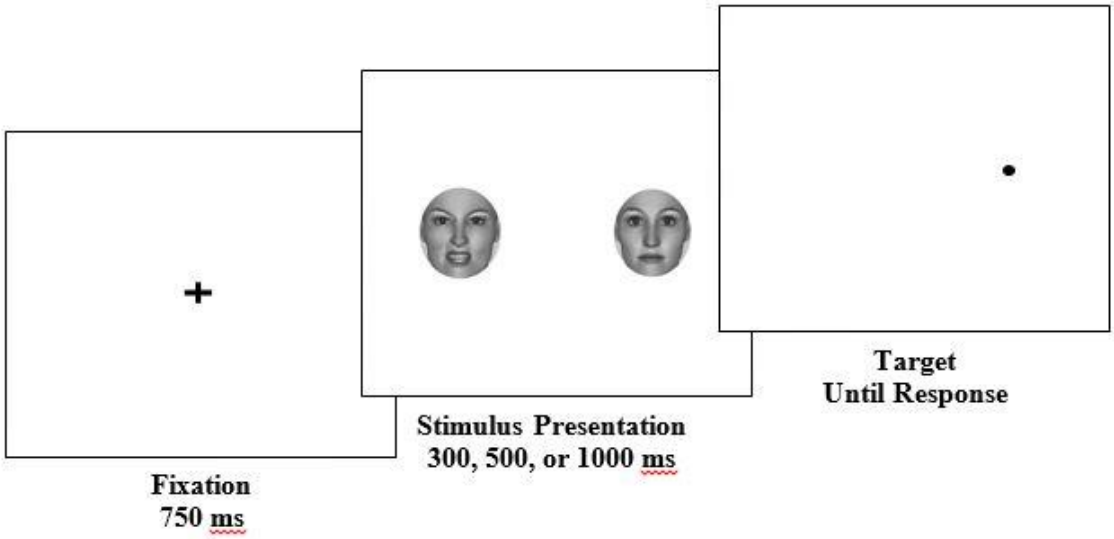


Figure **2**: Dot Probe Paradigm

Figure 3. Estimated Marginal Means of Fear Effect with Covariate of Trait Anxiety at 300 Milliseconds

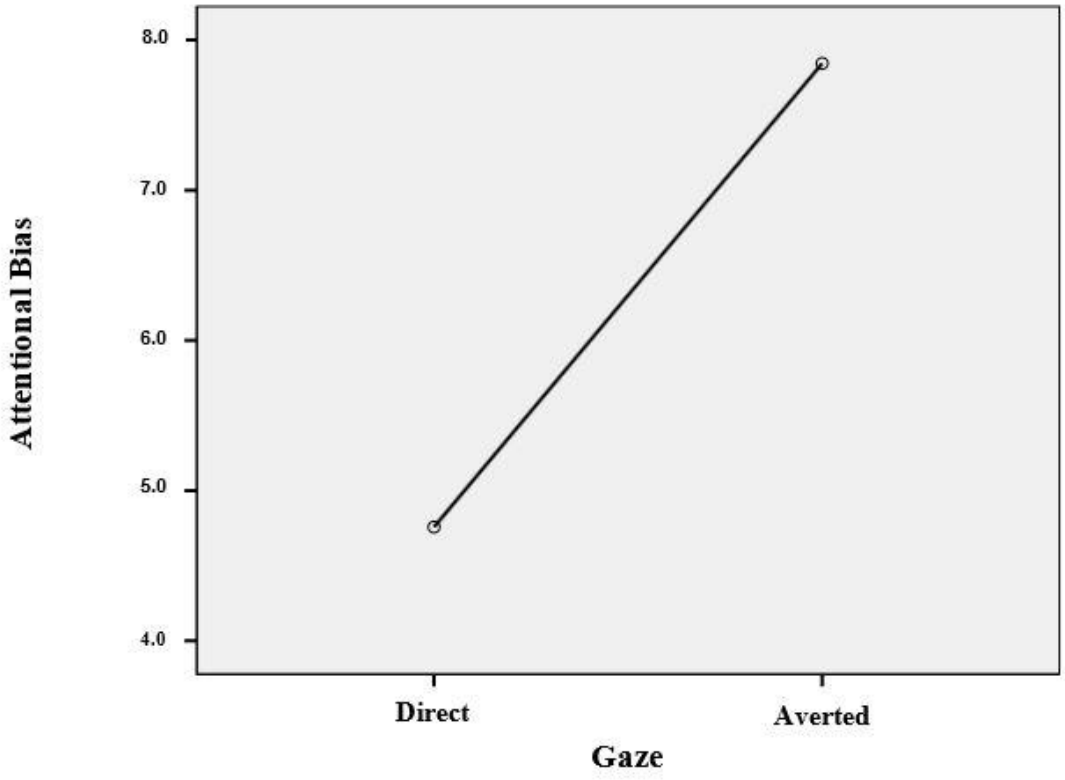


Figure **3**: Estimated Marginal Means, 300ms

Figure 4. Estimated Marginal Means of Fear Effect with Covariate of Trait Anxiety at 1000 Milliseconds

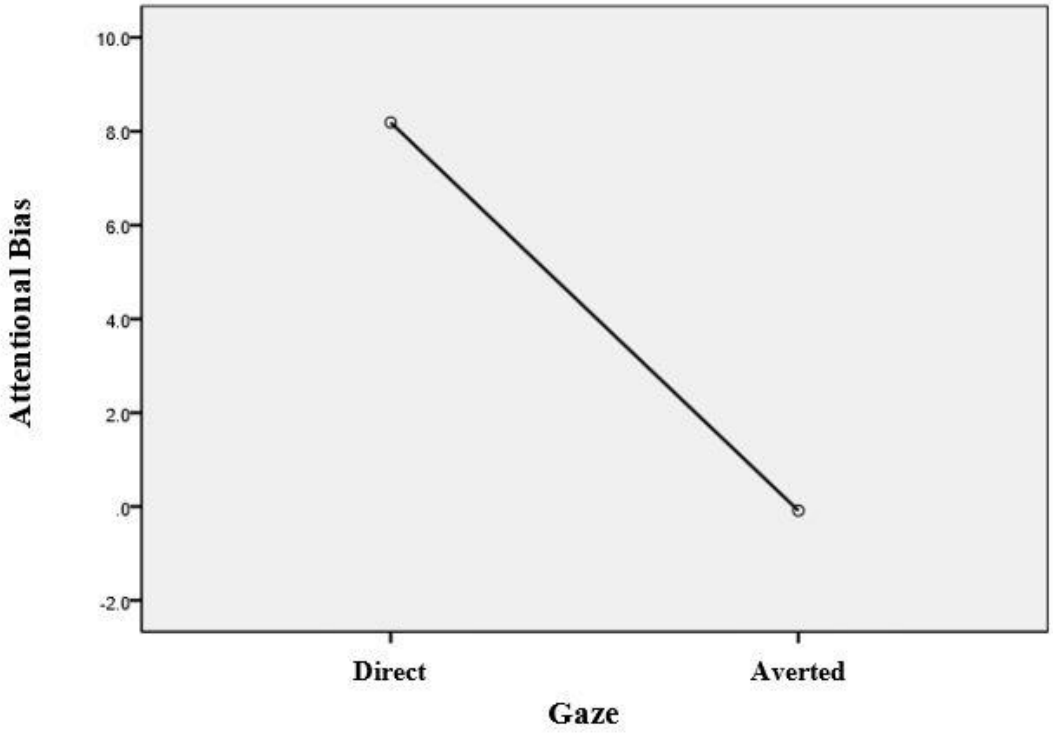


Figure **4**: Estimated Marginal Means, 1000ms

ACADEMIC VITA

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Education

The Pennsylvania State University, University Park
Schreyer Honors College
Bachelor of Arts in Psychology and Sociology
Certificate of Law, Crime, and Society
Excellence in Communication Certificate Graduation Date August 2013

Experience

Social Vision and Interpersonal Perception Lab January 2011 – Present
Research Assistant

- Learned how to conduct research and use specialized software
- Conducted literature searches and other forms of preliminary research
- Tested subjects for and presented on the findings of current experiments
- Devised and completed an undergraduate thesis on eye gaze, emotion, and trait anxiety as it affects attention over time

Schreyer Honors College August 2011 – May 2013
Work Study Position

- Assisted with the faculty member's events and research projects, especially for website and career development
- Greeted visitors, answered phones, and fulfilled various office needs

NSF Crime REU Program June 2012 – August 2012
Research Assistant

- Formulated, planned, and executed a research project at the University of Alabama at Birmingham involving the interviewing of former methamphetamine addicts from a nearby rehabilitation facility and the development and administration of a facility-wide survey

- Created interview guides and conducted semi-structured interviews
- Presented on and wrote a scholarly paper of the research findings

Sociology Department August 2011 – December 2011
Teaching Assistant

- Attended class, gave input, and suggested questions for upcoming quizzes.
- Graded student's written responses and quizzes.

International Center for the Study of Terrorism May 2011 – August 2011
Undergraduate Intern

- Read and reported on terrorism-related scholarly articles particularly related to the IRA (Irish Republican Army)
- Coded vital information into Excel spreadsheets to be reviewed and analyzed

Presentations

Copes, H., Kerley, K.R., Deitzer, J., & Leban, L. (2013). "'It's Not Who I Am': Exploring the Identities, Boundaries, and Accounts of Women Methamphetamine Users." Southern Sociological Society Annual Meeting, Atlanta, GA.

Copes, H., Kerley, K.R., Deitzer, J., & Leban, L. (2012). "Understanding the Identities, Boundaries, and Accounts of Women Methamphetamine Users." Southern Criminal Justice Association Annual Meeting, Atlantic Beach, FL.

Awards and Honors

Marine Corps Scholarship Foundation Scholarship Recipient
Penn State University College of the Liberal Arts Scholarship Recipient
Paterno Liberal Arts Undergraduate Fellow, Schreyer Honors College
Penn State University College of the Liberal Arts Travel Grant 2012

Skills

Microsoft Office Software experience, including PowerPoint and Excel
IBM SPSS Software experience
Minitab Software experience
Psychomorph and E-prime experience

Activities

Penn State Dance Marathon (THON) 2009 – 2013

- Largest student-run philanthropy in the world

- A year-long fundraising effort culminating in a 46-hour no-sitting, no-sleeping marathon
- Raised over $88 million for the Four Diamonds Fund, which works through Hershey Medical Center to fund the complete treatment of pediatric cancer patients and to find a cure for pediatric cancer

Morale Committee Member, 2011 – 2013

- Provided physical and emotional support for the 46-hour marathon dancers during THON weekend
- Encouraged involvement and energy year-long during fundraisers and events

Security Leader, 2010 – 2011

- Served as the secondary leader of a Rules & Regulations Committee
- Learned and enforced rules and committee schedule for THON weekend and the Family Carnival event

Rules & Regulations Committee Member, 2009 – 2011

- Learned and enforced the rules of the Bryce Jordan Center and Penn State Dance Marathon (THON)

Schreyer Honors College's London Study Tour 2012

- Spring semester theater class and spring break study abroad experience on through Schreyer Honors College
- Traveled to London, Greenwich, and Bath to see many performances
- Wrote journals and a term paper on a cultural issue of diversity as seen through theater and musical performances

Penn State Women's Chorale 2010 – 2011; 2012 – 2013

- Section of Penn State Choirs comprised of all women voices
- Participates in various concerts and performances during the school year