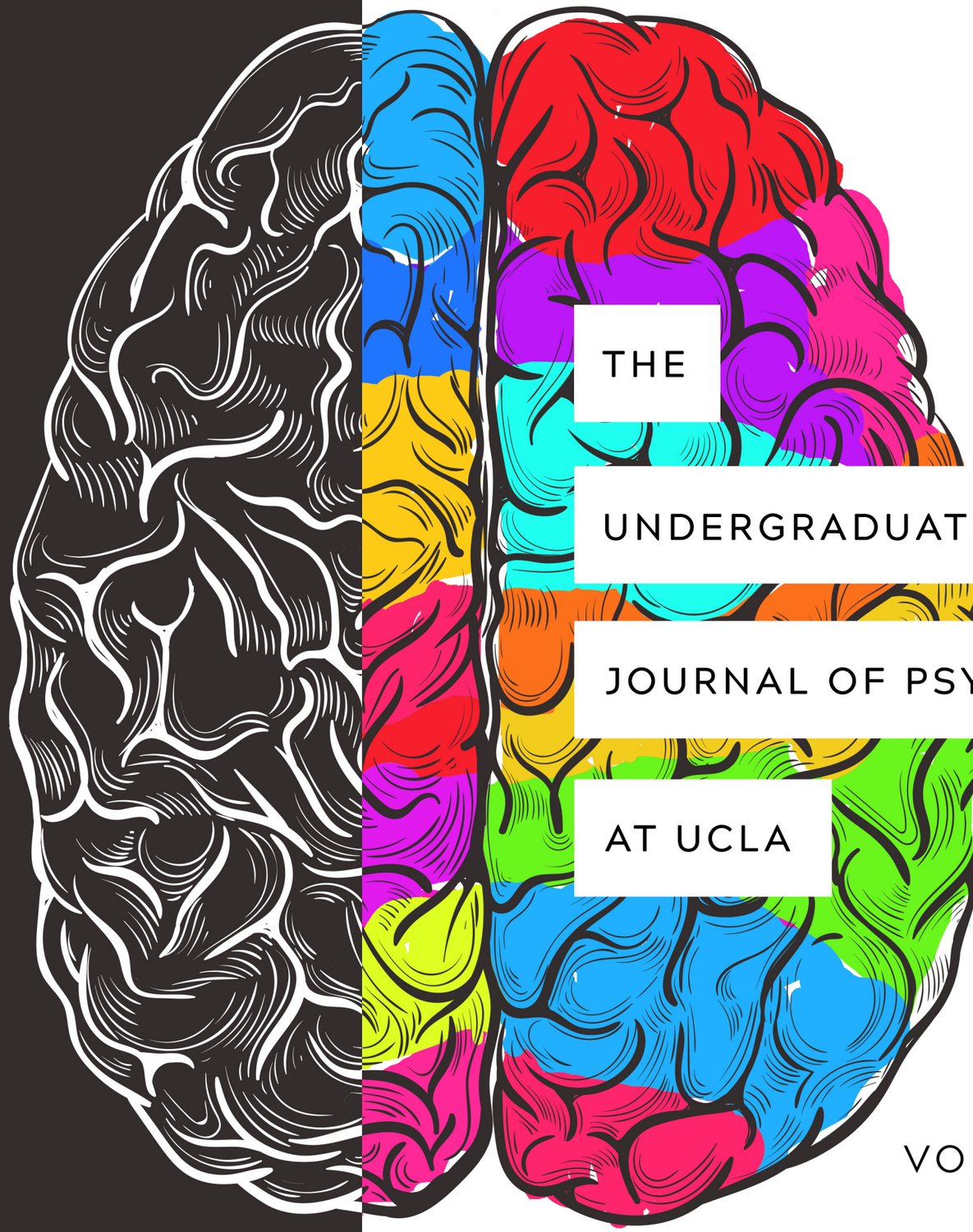

THE UNDERGRADUATE RESEARCH JOURNAL OF PSYCHOLOGY AT UCLA

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Special thanks to our founders and past members, Dr. Aaron P. Blaisdell, Krisztina Kecskei, the UCLA Department of Psychology, the UCLA Credit Union, and all of the faculty and staff that have supported us throughout the years.

NOTE FROM THE EDITORS-IN-CHIEF

It is with great pride and happiness we present the fourth edition of the Undergraduate Research Journal of Psychology at UCLA. This publication is a culmination of the yearlong efforts of the authors and our own staff, and a great deal of time and work has gone into the pages you see before you. Thank you to everyone who has contributed and pushed to make this journal what it is.

Undergraduate students have barely set forth on their academic paths, and they generally do not have access to the financial and informational resources that an established researcher does. The presence of these obstacles makes the work produced by our authors that much more incredible. I hope this opportunity can serve as a launchpad to rocket them off to new academic heights as they embark on their paths in graduate study.

With respect to beginnings and established trajectories, the Journal has now published four editions and cannot be considered 'brand new' anymore. While development is always fastest in the early years, growth will never end. To be alive is to undergo change. There is no end to science, to change, and the Journal will always strive to do more, to set further goals. Our purpose is to showcase the best undergraduate research in the world, and we will continue to do so for many years to come.

Sincerely,

Jake Gavenas and Sabrin Sidhu
Editor-in-Chief and Associate Editor-in-Chief

PREFACE

AARON P. BLAISDELL, PH.D.

Professor
University of California, Los Angeles
Department of Psychology

The Brain Research Institute
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It is my honor to write a preface for the fourth volume of The Undergraduate Research Journal of Psychology at UCLA. I remember vividly the first time I stepped foot into a research lab at a University. I was a senior in high school and my step father was taking classes at the Florida International University in Dade County, Florida. It was a geology lab and the professor was an old guy in a white lab coat. I remember picking up various rock samples collected from all around the world, and peering into stereograms showing 3-dimensional topographic landscapes. The experience shed some of the mystery of science and research. I saw that science was performed by regular people, who happened to be intensely curious, using both commonplace and highly specialized tools. It was there, in that dusty lab where I finally saw a glimmer of the world that awaited me in college the following year.

The next time I stepped into a lab was to take a private tour led by my Vertebrate Zoology professor. He was an ichthyology paleontologist, that is, he studied fossil fish. He pulled out drawer after drawer of fish fossils– most of which were embedded in rock. During my undergraduate career at SUNY Stony Brook, I got to see the inside workings of many labs from various departments, such as Anthropology, Anatomy, and Neuroscience. I had the fortunate opportunities to work with dead humans (archeological remains) and living primates in both behavioral and neuroscience labs. I marveled at the riches contained within each, but more importantly, I witnessed firsthand the human face of science. Science isn't a dry list of facts. Science is a process and shared human endeavor. I was surrounded by other undergraduate students, graduate students, postdocs, lab staff, and faculty. And I was treated as one of them, as an equal. I quickly came to be on a first name basis with even the most senior faculty, calling them "Jack" and "John" and "Brigette", instead of "Dr. Stern" and "Dr. Fleagle" and "Dr. Demes".

I don't think I realized at the time just how rare and fortunate an opportunity

PREFACE

I had stumbled into. The human face of science imprinted on me in those seminal years has stayed with me through my graduate career, postdoctoral stint, and for the past 16 years I have been a professor at UCLA.

The students who have contributed to The Undergraduate Research Journal of Psychology have also been touched by the community of science. What you have in front of you is the public fruits of their dance with research and scholarship. Hidden beneath the polished veneer of the research publication is the community of folks who nurtured the scholar's mind, helping to hone their craft and to seek answers to questions they didn't even know they had until they embarked on the journey of research. For you see, although scholarship can sometimes be a lonely journey, more often than not, it is road shared with others, with mentors, friends, and sometimes even lovers.

UCLA is a crucible of creativity, passion, and thought. We struggle to find truth and meaning. But in this struggle, we find our community, diverse and eclectic in form and function. And ultimately we find ourselves and our voice. We discover our own story as we write it. I hope each of you continues to write your story. Your Undergraduate Research is just one chapter. Take the lessons learned both in the classroom, but more importantly in the lab or clinic, and from your daily lives at UCLA, and continue to build on them. Down the road, you will have many opportunities to share your story with others and help them on their path. You see, science is more than a dry list of facts, and it is more than a process. Science is about community, and stories, and about you.

ADVICE FROM A GRAD

ALISA R. MUÑOZ

B.A. Psychology, UCLA 2016

I spent seven years earning my bachelor's degree–4 in community college and 3 at UCLA. Being a student was my norm and it was the main thing on my mind during that time. It wasn't until my last quarter at UCLA that I really started to think hard about my life outside of school. Many of you reading this may be aiming to go to grad school straight out of undergrad, or have a general idea of the type of job or industry you want to work in once you graduate. But aside from that, life after undergrad is likely a topic that stirs up a bit of anxiety or nervousness that you'd rather avoid until you can't.

It has been a full year now since I graduated. This past year was full of reflection, professional exploration, and some realizations that I wish I had come to while still a student with all the comforts, conveniences, and support systems of UCLA as my companion. Life after college can hit hard–and not just economically as you're faced with student loan debt and finding a job–it can be tough emotionally as you grapple with figuring out what your new role in this thing called life is now that you're not a full-time student. The following are three big things I wish I'd known while I was still in school.

Your GPA is not the most important thing. One of the first questions I was asked by another student when I transferred to UCLA was, "what was your transfer GPA?" UCLA, especially an impacted program like the psychology program at UCLA, can be a competitive environment and you can feel like a little fish in a big pond at times. Chances are that if you were accepted to UCLA you were a top performer at your high school and/or community college and getting good grades was always a top priority for you. In this context it can be easy to define some of your self-worth based on your GPA and feel that your whole world and future might crumble if you're anything less than perfect. It's fine to strive for that 4.0, but if that's all you have it's not good enough to distinguish you from everyone else. Having a 4.0 with little to no extracurriculars or work experience for example is less impressive than someone who earned a 3.7 while working in a research lab and also volunteering or working part-time (thus developing some practical non-classroom skills in the process). Plus, I've found that if your CV/resume has some great experience on it, people will assume you had a high GPA to go with it! I never include my GPA on my CV or resume because frankly it's not perfect, but no one has ever asked me

about it or assumed I was a bad student because it's not listed. It's important to know that outside of undergrad, employers or prospective grad programs care more about whether you can think critically and translate the lessons you've learned in school into practical knowledge. Don't get me wrong, your GPA is important because it is a reflection of the effort you put into your studies, and it is a determining factor for grad school acceptance, but at the end of the day your GPA just needs to be good enough to compliment the rest of what you have to offer.

You can intersect your interests. This piece of advice is particularly aimed at those who are unsure what they want to do career-wise. It can be easy to think of career choices as black and white, categorized as "related" or "unrelated" to your major. This kind of thinking ultimately limits your options. For example, when I first graduated one of the only job searches I did was for "psychology research assistants." Well, needless to say that the pool of full-time paid psychology research assistant jobs was extremely limited. Instead of filtering your options in this way, I recommend thinking about how your interests intersect with your major. For example, are you fascinated by neuroscience research but don't want to be the one conducting the research? Maybe you enjoy blogging or writing in your spare time; you might consider a career in science communications–a growing field that calls for people who understand research and have a knack for translating that literature for different audiences. Are you majoring in psychology but always wanted to work in the fashion industry? Believe it or not there is an emerging field called fashion psychology–you can even get a master's degree in it! I decided to combine my interest in academic research and education with my interest in publishing and editing. Now I'm working for an academic publishing company that works closely with professors to source scholarly readings, create new content, and publish textbooks.

In addition to thinking outside the box about career paths, it's important to think outside the box about who you seek advice from. Keep in mind that if you're questioning whether a career in academia is right for you, asking professors or grad students for advice on the topic will only be informative to a certain extent because, well, they are in academia (and they will likely encourage you to be in it too). Seeking out literature, educational and/or professional opportunities, and advice from people outside of your academic department (and even outside of academia) will help you feel like you're really getting a sense of your options. You might even find that exploring other paths only confirms that the one you're on has been right for you all along!

Take advantage of being a student! There are a lot of things that you can do as a student that become more difficult to do once you graduate. One of the big things that is not only expected of students but often encouraged is making

mistakes. Obviously you don't want to go around trying to make unnecessary mistakes, but you can dive into a new class, project, internship, etc. and say "I don't know what the hell I'm doing but I'm here to figure it out!" And then proceed to fail a dozen times in the process of trying and it is A-ok. After all, your main job as a student is to learn. When you're a paid employee, you can still make some mistakes but they are less tolerable because you are making them on the company's dime. Your main job is to do your job correctly and to do it well.

Another thing that students can do more easily is ask for things. You can use the fact that you're a student to your advantage when asking people for advice, asking organizations for opportunities such as internships, and even asking for discounts on things like software or other products. People love to help students so let them help you. Call up that researcher or other professional you admire and tell them you'd like to meet for coffee to pick their brain because you're a student at UCLA and are considering going into the field. Email that executive at that company you want to work for that doesn't have an internship advertised and see if they can find a place for you because you are a student who is hungry for experience. Negotiate with that software company to offer you a version of their product for free because you are a student and can't afford to pay full price (I did this once and it worked!). You'd be surprised how receptive and supportive people can be.

When we're in school it can seem like life on campus is the center of the universe. We can feel like everything we do in college will dramatically impact our life forever. This perspective can create feelings of anxiety and nervousness about the future and hinder us from being creative and having fun. If there is one thing I've realized since graduating it's that college truly is a time for growth and exploration–so do just that and don't be afraid to screw up or change your mind along the way. Cheers to the class of 2017, may your post grad chapter be filled with prosperity and learning anew.

CINDY XIONG

B.S. Applied Math and B.A. Psychology, UCLA 2016

Ph.D. Candidate in Cognition at Northwestern University

I still very clearly remember sitting in my room, horrified, in Sproul Hall my last year at UCLA. It was the night before my last final in Fall Quarter. On my computer screen in front of me, was an email from a professor from a school to which I applied, scheduling a Skype call with me the next morning at 8am. I didn't know where this interview would bring me. I didn't know what was waiting for me in the mysterious realm of graduate school. I didn't even know where I would be living for the next five years after walking down the stage at my graduation ceremony.

I remember feeling stuck back then, uncertain and hesitant. Graduate school seemed like an unimaginable place, and someone always had a scary story to contribute to its inscrutability.

Now, reflecting on my first year of grad school at Northwestern as a fresh graduate from UCLA, I hope my perspective can be inspiring and helpful in clearing up a few graduate school myths.

"There is only one correct answer to 'what do you want to do after graduate school' at your interview, and that is, a career in academia." While I often received this advice before my interviews, I slowly learned that academia is definitely not a graduate student's only choice. It is true that old-fashioned faculties who only want their students to go into academia upon finishing still exist, the majority of faculties are open to other ideas. Many graduate students receive consulting and collaboration opportunities with people who work in government sectors and private industry. Some even use resources at their graduate schools to start new businesses or write for newspapers. Often, your advisors will have a conversation with you early on in your graduate school career to discuss your future aspirations. They will orient your publications and research topics to your desired outcomes.

At conferences, there are often sessions aimed at networking people from various backgrounds. It is not uncommon for a graduate student to speak with

a researcher leading a project for the U.S. Marines. Surprising opportunities often show themselves at unpredictable times. It is not unheard of to have the person sitting next to you at a Christmas departmental party to network you to your dream job. Of course, you have to work hard and be prepared when these opportunities present themselves to you.

"Grad school is lonely." You can probably search up any blog for reasons not to go to graduate school, and "loneliness" will always be one of them. Indeed, you are doing a lot of alone-work, dwelling so deep in a field investigating something so specific that no one outside your lab would understand. This, however, does not mean that you are alone. If you are a Ph.D. candidate, you will always have your cohort by your side. While in different disciplines, your cohort mates are going through very similar obstacles and reaching the same milestones as you are. Here at Northwestern, my cohort has already established a "Chili's Wednesday" tradition where we go have dinner together to wind down and relax. We share funny stories and personal highlights of the week while enjoying our $6 burger with bottomless fries, with an occasional a margarita on the side. We are all doing different lines of psychology research - clinical, health, social, cognitive, but it doesn't mean we can't complain about the annoying "results" section we had to write for that paper due next week. There are also many student organizations on campus, a good portion of which are especially oriented towards graduate students. I pretended to be an undergraduate freshman and took a Japanese class my first quarter here at Northwestern. Perks include: friendly freshman friends, free swipes into dining halls and free Japanese lessons!

Not to mention your lab mates, who are your biggest supporters throughout your graduate school life. They are your best brain power to generate ideas for research, and your best friends at conferences. You will also make conference friends all over the world when you go to conferences such as SPSP and VSS whom you meet once a year. This is great because, yeah, some people are really great in small doses.

"Grad school is a way of life...my life...and it's gloomy." I bet you have heard of this one before. Yes, yes, graduate school is very busy, very tough, and if you live in places in Chicago where spring just doesn't care to arrive, life can be very gloomy. But! While different people take different approaches towards graduate school, it is nevertheless true that you can still live your life the way you want while you are in graduate school. Vacations still exist (surprise!), and it is common practice to take winter and summer off. People save up for a down payment of a house, get married, have children and do many other things, not at all different from people who decided not to go to graduate school. If you enjoy learning and want to branch out from your discipline,

you can always take more classes while in graduate school, whether it be programming, Japanese, or learning how to use a 3D printer.

Of course, because graduate school is a long-term commitment, there is always work to be finished. I still am plagued with the feeling of guilt when I sit on my couch on a Saturday night watching YouTube videos, because I am not working on one of my seven projects. This is all normal. Work and life always need a balance. Everyone has their own way to deal with this balance, so it is very much up to you to find a style that fits you. This won't be easy, but keep in mind that graduate school is a process, not a destination.

"I'm only a graduate student, my opinions probably won't matter." While the imposter syndrome is a real phenomenon, it is absolutely not true that your opinions, as a graduate student, are of less value. Graduate school harbours a collection of people from diverse backgrounds. Everyone will have different reads on the same topic, whether it be a research question or a diversity issue. Every perspective is worth listening to. Yes, you have yet to learn many things. But so does everyone else, whether it be a professor or a fellow graduate student.

Remember, we are talking about graduate school. This is the place to voice your thoughts, to question everything and to enrich yourself through conversations. Although you are apprenticed to your advisor, it does not make your ideas less valuable. Even professors change interests from time to time. This means they may be just starting to learn about a field that you are already familiar with.

Lastly, I just want to say, enjoy graduate school! You are only a graduate student for so long. This is the time to focus on research, to find yourself, and to determine your interests. There are many opportunities and possibilities ahead. This is the time to be inspired and hopeful.

RESEARCH

Carter Bedford
University of California, Los Angeles

Carter Bedford is a recent graduate from the department of psychology at UCLA. During her time in California, Carter helped in various labs on campus and contributed to several research projects before beginning her own studies on gender and emotion. Her other research interests include trauma, coping, and psychophysiology. Carter hopes to obtain a Ph.D. in Clinical Psychology, publish more of her work, and perhaps teach a new generation of psychology students how to conduct groundbreaking research of their own.

Was there a particular experience that sparked your research interests?

As someone who identifies as a woman, I often feel the societal pressure to suppress emotions deemed situationally-inappropriate. I was curious about whether my own experiences translate into research findings, and how men's emotional expressions are either different or similar to my own.

Who has been an influential person in your life?

My grandmother, she is a true symbol of human resiliency and empowerment. She constantly inspires me to persevere even when life gets tough.

When and where are you the most productive?

I am most productive after sleeping, either early in the morning or after a nice long nap. I tend to do my best work when sitting cross-legged on the ground.

Where do you see yourself in 10 years?

Finished with graduate school, splitting my time between trauma research and trauma therapy. Hopefully some social justice and trauma survivor advocacy as well!

The Role of Gender in Emotional Expression: A Multidimensional Approach

Carter E. Bedford, Yilan Wang, Michael Sun, and Anna S. Lau
University of California, Los Angeles

Emotional phenomena are moderated by biological and societal norms. These norms in turn influence gender roles, with each gender expected to adhere to specific rules about emotional expression. In order to examine the effects of gender on emotional expression, participants were filmed while completing an emotional picture viewing task and self-report measures. Videos of participants' behavioral reactions to the task were coded for several categories of emotional expression. Analyses revealed that women rated negative stimuli as eliciting emotions of a lower valence than did men. In addition, women were more intense in their emotional displays and exhibited greater facial reactivity than did men, particularly when feeling anger, sadness, fear, and disgust. This data provides support for the social cognitive theory of gender development, which states that individuals of a particular gender are more likely to exhibit normative behavior in response to stimuli; thus, women are more likely to display communal and vulnerable emotions while men are more likely to display agentic and dominant emotions.

Gender, defined as the set of characteristics differentiating masculinity and femininity, is often used to categorize individuals within a species. The belief that "gender" is synonymous with "difference" was developed by conventional theorists, who emphasized the distinctions between men, women, transgender, and non-binary individuals. In more recent decades, psychologists have come to define gender not as a means by which to differentiate individuals, but as a unique system of human relations moderated by other social hierarchies (Stewart & McDermott, 2004). Gender researchers in the field of psychology tend to agree that differences do exist between the genders, but these differences vary in their importance and magnitude (Helgeson, 2015). Given its potential to moderate a variety of psychological states, gender thus provides a useful tool in studying how emotions are expressed.

It is uncertain whether emotions are innate and biologically motivated or societally constructed (Scherer & Ekman, 2014). Emotions vary according to the individual and the context, with different cultures reinforcing the expression of certain emotions while punishing the expression of others (Butler, Lee, & Gross, 2007). The social cognitive theory of gender development attempts to explain how children learn these societal rules about emotional expression. According to this theory, a great deal of learning about gender norms occurs through modeling, whereby exemplars convey the rules and structures underlying a particular activity for observers to replicate (Bussey & Bandura, 1999). Because humans are easily aroused by the emotional expressions of others, stimuli

eliciting such a response from a model are likely to be remembered by observers. Observers may then use this association as a guide for their own emotional behavior in the future (Bussey & Bandura, 1999). Modeling and learning are the primary mechanisms by which social rules and values are transmitted and behavior is shaped to reflect external expectations. These expectations and norms vary by gender: women are expected to express emotions that display their communal qualities (i.e. happiness, love, sadness) more frequently and intensely than men. Conversely, men are expected to express emotions that display their agentic qualities (i.e. anger, pride) more frequently and intensely than women (Chentsova-Dutton & Tsai, 2007; Grossman & Wood, 1993; Hess, Adams, & Kleck, 2004).

These gender-specific emotional displays may arise due to differences in the ways that men and women conceptualize relationships. Across different cultures, women are more likely to value relationships for their communal qualities, including emotional closeness and intimacy. Conversely, men are more likely to value relationships for their instrumental qualities, including task efficiency and productivity (Burleson, 2003). In order to facilitate the kinds of relationships that they desire, women are more likely to express the vulnerable emotions that foster intimacy and men are more likely to express the dominant emotions that foster productivity (Carli, 2001). According to social cognitive theory, young children observe and learn from these behaviors, and subsequently express or suppress their emotions in accordance with their own gender roles (Bussey & Bandura, 1999).

A great deal of evidence supports the social cognitive theory and its applications to the gender-emotion relationship. Cognitive efforts at self-regulation have been shown to impact how emotions are expressed, and these self-regulatory strategies are shaped and modified in response to societal pressures and norms (Butler et al., 2007; Bandura, 1991). In addition, measures of emotion thought to be vulnerable to social learning and voluntary control reveal some of the greatest statistical differences between men and women (Bradley, Codispoti, Sabatinelli & Lang, 2001). Several studies using self-report measures found that women reported being more emotionally intense (i.e. responding with larger emotional displays) and emotionally responsive than men (Chentsova-Dutton & Tsai, 2007; Fischer, 1993; Grossman & Wood, 1993). Along with being more intense and responsive in their emotions, on some direct self-report measures women rated themselves as being generally more emotional than men. These differences were less reliable when using indirect self-report measures, such as tests of memory for emotional events (LaFrance & Banaji, 1992). It is possible that the greater self-reports of emotion from women were a result of social pressures and gender-specific rules about emotional display. Such claims are supported by studies which found that women were more likely than men to report being expressive in public settings, but the two genders were equally likely to report being expressive in private (Sells & Martin, 2001).

Beyond self-report measures, facial expressivity itself can be influenced by social learning and voluntary control. Studies examining facial reactivity have supported the social cognitive theory and the results have found differences in the ways men and women react using facial movement. Women were consistently found to be more facially expressive than men and rated themselves higher than men on measures of nonverbal expressivity (LaFrance & Banaji, 1992). Studies directly examining facial expressivity found that women were more likely than men to outwardly display several different emotions including sadness, fear, and love (Bradley et al., 2001; Chentsova-Dutton & Tsai, 2007; Fischer, 1993; Grossman & Wood, 1993). While results were mixed for expressions of anger and happiness (Grossman & Wood, 1993; Hess, Adams, & Kleck, 2004), displaying a smile was more common for women (LaFrance, Hecht, & Paluck, 2003). Such variation in expression may be a result of gender-specific rules about emotional display, namely, that men and women displayed the emotions deemed societally appropriate for the given context.

Unlike measures of facial expressivity and subjective judgments, measures of physiology are less likely to vary according to gender norms. According to social cognitive theory, biology influences emotional expression, but cannot provide a full explanation for the variation between the genders. Indeed, the results from studies of physiological gender differences have been mixed, and the results vary according to which particular physiological measure was used. Several studies examining gender differences in blood pressure found that men were more physiologically reactive to stimuli and exhibited greater systolic blood pressure changes than women (Kubzansky & Kawachi, 2000; Lawler, Kline, Adlin, Wilcox, Craig, Krishnamoorthy, & Piferi, 1995); but other studies found no difference (Neumann & Waldstein, 2001; Sarlo, Palomba, Buodo, Minghetti, & Stegagno, 2005). Several studies examining gender differences in skin conductance found that men were more likely than women to show changes in skin conductance when emotionally aroused (Lang et al., 1997), but other studies found that this effect may be moderated by the nature of the stimulus. Men were shown to be more reactive in response to stimuli intended to anger or scare, and women were shown to be more reactive in response to stimuli intended to sadden or disgust (Kring & Gordon, 1998). For the studies that did find a difference, men conveyed their emotional state physiologically while displaying less facial reactivity. Conversely, women displayed their emotional state with facial reactivity while conveying less physiologically. These findings raise an important question about the relationship between external display and internal reactivity (LaFrance & Banaji, 1992).

The present study is one of few to take a three-pronged, multidimensional approach to researching the gender-emotion relationship (for others, see Bradley, Codispoti, Sabatinelli, & Lang, 2001 and Chentsova-Dutton & Tsai, 2007). While previous studies have examined self-report, behavioral, and physiological measures separately, few have examined all of these dimensions within the same sample. In addition, few studies have taken an observational coding approach to examining emotional displays, and this study is the first to use the Emotional Expressive Behavior coding system (Gross, 1996) to study gendered emotional displays. This procedure provides an alternative to analysis of facial electromyography, as facial muscle movement does not necessarily provide observers with the socially recognized expressions used in everyday life (Kring & Sloan, 2007). By testing a diverse population with a battery of measures, including a behavioral coding measure, the present study provides insight as to how gender moderates the various responses that result in an emotional display.

Hypothesis

Past research on the gender-emotion relationship has suggested differences in the ways that men and women express emotion, and has suggested that these differences are largely due to societal norms. Our study was conducted to critically evaluate this pattern with regards to results from self-report, behavioral, and physiological measures. We were particularly interested in differences between men and women in emotional valence ratings, emotional expression, and physiological reactivity. In order to examine these differences, behavioral responses to an emotional image viewing task were video recorded and coded. Valence ratings were collected in a self-report task which measured emotional state. Physiological measures were taken throughout.

Our experiment was conducted in order to evaluate several hypotheses. First, we predicted

that women would self-report a lower, more negative valence rating in response to aversive images than would men. Additionally, we predicted that women would self-report a higher, more positive valence rating in response to pleasant images than would men. Second, we predicted that women would display more sadness and fear and display more intense emotional expressions than men, and we predicted that men would display more anger than women. Third, we predicted that men would show greater physiological reactivity than women in measures of average systolic and diastolic blood pressure.

Method

Participants

Three-hundred and four participants were recruited at the University of California, Los Angeles. Participants were invited to complete internet-delivered questionnaires via SurveyMonkey (www.surveymonkey.com), where they answered demographic questions as well as questions about their mental health history and emotion regulation strategies. Participants were of varying ethnic and cultural backgrounds and proficient in English. Subjects received credit towards various psychology courses for their time in the study. The study was approved by the university's institutional review board and all participants provided written informed consent prior to enrollment. Due to errors made by the equipment or experimenters, certain data was unobtainable for some participants. Final N values were 151 male and 154 female subjects.

Materials and Apparatus

The emotional picture viewing task was developed using images selected from the International Affective Picture System (IAPS; Lang, Bradley & Cuthbert, 1997). The IAPS is a database of affective images designed to provide a "standardized set" of stimuli for the study of human emotion. IAPS images have been proven to be effective in eliciting a range of emotional responses (Lang & Bradley, 2007). Images in this study were chosen to represent three different valences of emotion: pleasant, unpleasant, and neutral. In the initial design a total of 60 images were presented, with each subject viewing 25 pleasant, 25 unpleasant, and 10 neutral pictures. Subsequent revisions shortened the duration of the experiment to a total of 30 images, with each subject viewing 10 pleasant, 10 unpleasant, and 10 neutral pictures. For the pleasant and unpleasant valences, images were selected from each of 10 thematic categories (positive: erotic, food, adventure, nature, and families; negative: human attack, animal attack, mutilation, loss and contamination). Picture presentations were pseudo-randomized such that each subject viewed one of three pre-set orders which were counterbalanced between participants. Within each pre-set order, pictures were organized into five blocks. In the initial lab design each block contained five pleasant, five unpleasant, and two neutral images. Following changes to the experimental procedure, a new set of three pseudo-randomized orders were created, with each block containing two pleasant, two unpleasant, and two neutral images. In the revised design the two pleasant and unpleasant pictures were selected from each of the 10 thematic categories, and the neutral images were left unchanged. No more than two pictures with the same valence values were presented consecutively. Images were digitized and presented on a 20-inch (50.80 cm) monitor situated approximately 18 inches away from the participant. An HP Omni 120 computer controlled picture presentation using Inquisit software.

Immediately after each picture presentation, participants rated their emotional response to the picture using a computerized version of the Self-Assessment Manikin (SAM; Bradley & Lang, 1994). The SAM is often used in conjunction with the IAPS database and consists of a non-verbal pictorial assessment of the participant's affective reaction to an emotional stimulus. The SAM ratings have been found to exhibit cross-cultural consistency and high validity (Lang & Bradley, 2007). The computerized SAM in this study used a 20-point scale to illustrate each of three affective dimensions: valence (i.e. pleasantness or unpleasantness), arousal, and dominance. In each case, higher scores represented more positive feelings, higher arousal, and a greater sense of control in response to the image. Figure 1 illustrates the SAM figure used to measure valence.

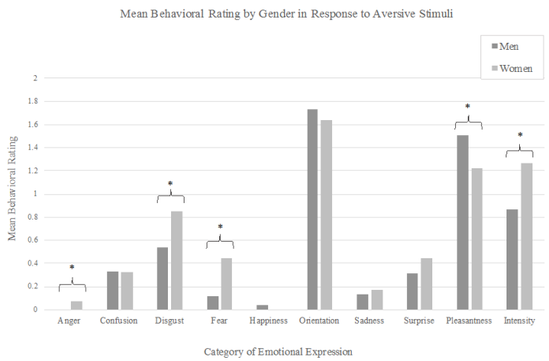

Figure 1. SAM figure used to measure valence.

Various physiological data were recorded throughout the laboratory session in order to provide additional measures examining the subject's emotional response. Prior to beginning the experiment, an inflatable blood pressure cuff was placed on the participant's non-dominant arm above the elbow and attached to a GE vital signs monitor (Carescape Dinamap Model V100). Systolic and diastolic blood pressure, mean arterial pressure, and pulse rate were assessed automatically every minute.

The duration of the laboratory session was filmed using a small webcam placed atop the HP Omni 120 computer. Participants were aware of the camera's presence and continuous video captured each subject's expression in response to the emotional picture viewing task. The full video was then edited to contain each participant's reaction to their highest self-reported positive and negative image. Each clip was shortened to 12 seconds in length and edited to include 6 seconds of the subject's baseline state and 6 seconds following picture presentation. A coding team was responsible for measuring each participant's behavioral response to the emotional picture viewing task, as seen in the edited video clip.

Coding Procedure and Inter-Rater Reliability

Coder ratings were given according to the Emotional Expressive Behavior coding system (EEB; Gross, 1996). Participants' reactions following picture presentation were scored for 18 different categories of emotional expression, with lower ratings indicating that the emotion was displayed to a lesser extent or that movements were more contained. Videos of each participant were coded for expressions of anger, confusion, disgust, fear, happiness, orientation (i.e. interest), sadness, and surprise; for indications of pleasantness or unpleasantness; for perceived intensity of the displayed emotion; and for movement of the body and facial features. Categorical yes and no ratings were given for smiling, yawning, and obscuring one's vision with hands or by looking away from the image. Number of eye blinks were counted for each participant during the six seconds following stimulus presentation.

Following thorough training to achieve consistency, each of the four coders independently scored between 100 and 150 individual video clips. In order to test reliability, each coder then scored ten video clips from each of the three other coders. This procedure resulted in 120 "double-coded" video clips, which were then tested for reliability between coders. For our nominal values, analyses of Cohen's Kappa were used. These ratings revealed a good level of agreement between coders for expressions of happiness (K = 0.746, p < 0.001), ratings of pleasantness (K = 0.639, p < 0.001) and instances of smiling (K = 0.875, p < 0.001). Additionally, these ratings revealed a moderate level of agreement between coders for expressions of

sadness (K = 0.538, p < 0.001), ratings of intensity (K = 0.412, p < 0.001), ratings of facial movement (K = 0.560, p < 0.001), ratings of body movement (K = 0.523, p < 0.001), and instances of obscuring vision (K = 0.568, p < 0.001). For numerical counts of eye blinks, analyses of Intraclass Correlation Coefficients (ICC) were used. These ratings revealed a significant correlation between coders for counts of eye blinks (ICC = 0.981, p < 0.001).

Experimental Procedure

The study was conducted in one session lasting two hours. Upon entering the lab, participants provided informed consent and were given a brief overview of the study. Each subject then participated in five tasks: an implicit association task, an emotional picture viewing task, a video emotion recognition task, a "reading the mind in the eyes" task, and an attentional dot-probe task. The task order was controlled for by a 5×5 between-subjects, Latin Square augmented design. Every task preceded the picture viewing task at least once, as emotions elicited by the picture viewing task had the potential to affect results on succeeding tasks. For the purposes of the current analysis, details will be provided for the emotional picture viewing task only.

Before beginning the first task, subjects were fitted with an inflatable blood pressure cuff and skin conductance electrodes. The experimenter then began the physiological measurement and video recordings. Participants proceeded through the experiment as directed by the Latin square, pausing between tasks to allow the experimenter to save data for each portion of the session. Once the emotional picture viewing task began, each participant was presented with a neutral, pleasant, or unpleasant image for 6 seconds before being prompted to rate their reaction using the Self-Assessment Manikin. A short pause followed each SAM measure before the next image was presented on the screen. After all of the images were presented, skin conductance data was saved before moving on to the next task. At the end of the laboratory session, experimenters saved physiological data and video recordings. Participants were then debriefed and the experiment concluded.

Results

Self-report measures of emotional state, as given in response to the SAM prompts, were examined using independent-samples t-tests. For the purposes of the current analysis, details will be provided for the results of the SAM valence prompt only. The greatest statistical difference between the genders for unpleasant imagery occurred in response to an image of a dead animal, with women (M = 7.92, SD = 4.51) rating their emotional state as significantly lower in valence than men (M = 9.70, SD = 4.12), $t(303)$ = 3.605, p < 0.001. The second greatest statistical difference for aversive imagery occurred in response to an image of an injury, with women (M = 4.33, SD = 3.10) rating their emotional state as significantly lower in terms of valence than men (M = 7.60, SD = 1.67), $t(24)$ = 3.236, p = 0.020. Figure 2 illustrates the statistical difference between the two genders in response to unpleasant stimuli.

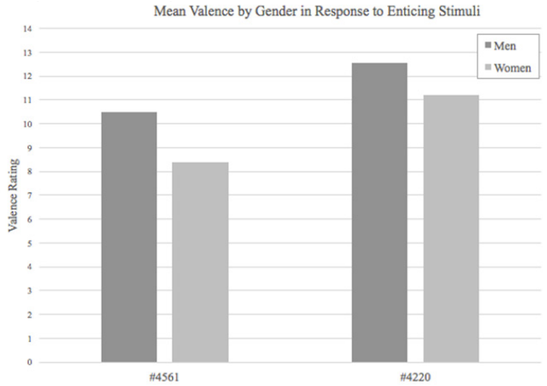

Figure 2. Illustration of mean valence rating by gender in response to IAPS images #4561 and #4220, both pleasant images.

The greatest statistical difference between the genders for pleasant imagery occurred in response to an image of an erotic female, with men (M = 10.49, SD = 4.80) rating their emotional state as significantly higher in terms of valence than women (M = 8.40, SD = 4.29), $t(303)$ = 4.02, p < 0.001. The second greatest statistical difference for pleasant imagery also occurred in response to an image of an erotic female, with men (M = 12.54, SD = 3.68) rating their emotional state as significantly higher in terms of valence than women (M = 11.19, SD = 4.41), $t(303)$ = 2.903, p = 0.004. Figure 3 illustrates the statistical difference between the genders in response to pleasant stimuli.

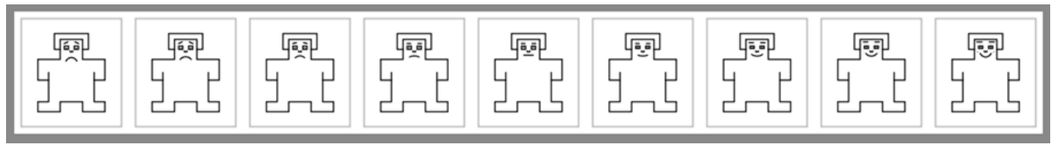

Figure 3. Illustration of mean valence rating by gender in response to IAPS images #9181 and #9421, both unpleasant images.

Behavioral measures of emotional state, as rated by coders on nominal scales, were analyzed using Mann-Whitney U tests for nonparametric data. These analyses revealed several differences in emotional behavior between women and men. Upon viewing negative images of various thematic content, women were significantly more likely than men to display anger (U = 8568.00, p = 0.012), disgust (U = 7515.50, p = 0.010) and fear (U = 7515.50, p < 0.001). Women were also more likely than men to indicate unpleasantness (U = 7126.50, p = 0.001) and to exhibit more intense emotional displays (U = 7247.50, p = 0.004). In addition, women were more likely than men to display facial movement (U = 7597.00, p = 0.021). No significant gender differences were found for displays of confusion, happiness, orientation, sadness or surprise (U = 8371.50 - 8918.00, p = 0.163 - 0.871). In addition, no significant gender differences were found for body movement or face touching (U = 8223.50 - 8495.00, p = 0.055 - 0.419). No significant gender differences were found for responses to the positive images (U = 8601.50 - 9039.50, p = 0.064 - 0.979). Figure 4 illustrates the differences in behavioral ratings between the genders in response to aversive stimuli.

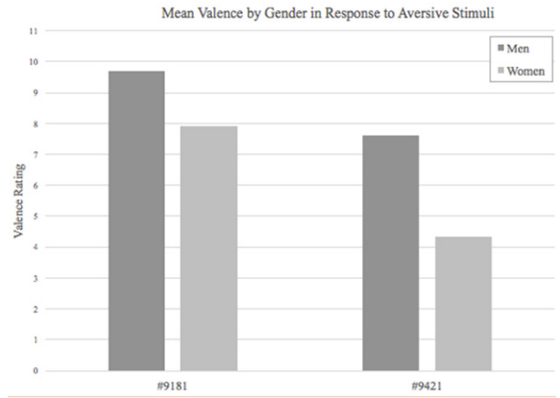

Figure 4. Illustration of mean behavioral rating by gender in response to aversive stimuli.

Physiological measures of emotional state, including systolic blood pressure, diastolic blood pressure, mean arterial pressure, and pulse rate were analyzed using independent-samples t-tests. No significant gender differences were found for any of these measures (t = -0.101 - 1.892, p = 0.060 - 0.919).

Discussion

The results of this study are largely in accordance with the findings from other studies of a similar nature. In response to self-report measures, women were more likely than men to rate aversive images as eliciting negative emotions. In particular, women were much more likely than men to rate images of injury and death as being highly unpleasant. These findings replicate those found in earlier studies, in which women rated negative images as being of a lower valence than men (Bradley et al., 2001; Grossman & Wood, 1993; Hess, Blairy, & Kleck, 2000). These results provide support for social cognitive theory in that women

are more likely to express "vulnerable" emotions such as fear (Bradley et al., 2001; LaFrance & Banaji, 1992), particularly in response to aversive images of death and pain. Likewise, the tendency for men to rate erotic imagery as significantly more positive in valence has also been seen in other studies. Erotica is consistently found to be more arousing for men than for women (Bradley et al., 2001).

The present study is one of few to use a video coding system to analyze behavioral responses to emotional stimuli. Nevertheless, the results of this study are consistent with those found in experiments of a similar design, such as Bradley, Codispoti, Sabatinelli, & Lang (2001) and Chentsova-Dutton & Tsai (2007). As hypothesized, women were more likely than males to express sadness and fear. Women were also more intense in their emotional displays and more facially reactive (LaFrance & Banaji, 1992). These trends are also seen in self-report and evaluative judgments of emotion, reinforcing the notion that women are more likely to report and express communal emotions. Rather interestingly, the unexpected finding that women are more expressive in displays of anger has also been found in other studies (Chentsova-Dutton & Tsai, 2007), despite the fact that this finding goes against the popular notion of men being more expressive in their displays of anger. It is possible that in the absence of an audience, the relatively private laboratory setting allowed women to express an emotion that is commonly regarded as gender-inappropriate (Hess, Adams, & Kleck, 2004). Conversely, men's non-reactivity in a laboratory setting could stem from a desire to minimize expressiveness, especially in a social context. It has been shown that men, particularly when being watched or filmed, are more likely to express emotions in accordance with perceived stereotypes of masculinity. This process is known as "positional identification" (Brody, 2000). It is possible that in the societal context of this study and with the awareness that they were being filmed, men were less likely to provide visible behavioral responses to the stimuli.

The failure to find significant physiological differences between the genders was not unexpected, as the literature examining physiological gender differences has been quite mixed. The present study therefore supports claims from other researchers that gender-specific patterns of physiological responding are either nonexistent or inconsistent, depending on the particular measures used. These results also provide support for a social cognitive view, insofar as the majority of variance in the data is not sufficiently explained by biological or physiological differences between men and women. The differences found in this study are better explained by the specific rules and norms that define how individuals of each gender should respond to positive and negative stimuli. For women, displays of vulnerability are commonly accepted, for men, they are not (Bradley et al., 2001). Why these norms exist, and the mechanisms by which they contribute to emotional responding, remain to be fully understood.

The findings of the present study expand on previous research studying the gender-emotion relationship. In addition, the results provide new data in the form of observational codes for emotional behavior, as the present study is the first to use the Emotional Expressive Behavior coding system to examine the gender-emotion relationship (Gross, 1996; for an alternative coding system, see Ekman & Rosenberg, 1997). These results provide new information about how men and women differ in their emotional displays, with important implications for the social and clinical functions that emotions serve. In a social context, the finding that men are more likely than women to respond to erotic imagery with greater attention and positivity may play a role in how advertisements are designed to target men. In a similar manner, the finding that women are likely to respond to violent imagery with greater distaste informs content writers and producers that negative imagery is not as effective in capturing women's attention. In a clinical context, the finding that women are more likely to respond to aversive imagery with larger displays of anger, fear, and disgust, provides future researchers with opportunities to study how these kinds of traumatic stimuli function as precursors for mental illness in women.

Limitations

One of the greatest challenges for emotion researchers is the use of psychophysiological measures, given a lack of biological indicators of emotion. It is possible that the particular physiological measures used in the present study are not the most effective measures of emotional reactivity. Blood pressure and pulse rate, while important indicators of certain physiological states, are only a few of many measures examining bodily reactions to emotional stimuli. Different physiological measures, including EEG and fMRI, may be more appropriate for studying the processes that contribute to emotional displays.

In a similar manner, behavioral and self-report measures are prone to manipulation. These measures are under the voluntary control of the subjects, who may well be responding in order to fulfill expectations. Laboratory settings and the knowledge that one is being filmed may play a role in how subjects respond to stimuli, and may exacerbate or reduce gender-normative displays of emotion. While difficult, field studies may provide insight into how emotions are elicited and managed in natural settings, and whether these contexts lead to different displays for each gender. In either context, an observational coding approach lacks the objectivity of facial electromyography. The coding system used in the present study did not facilitate more than moderate-level agreement between coders for several categories of emotional expression. For this reason, future research may choose to include both observational coding and facial electromyography in studying behavioral responses to emotional stimuli.

In addition, the present study examined gender as a categorization of individuals into two distinct groups based on biological sex, (i.e. "men" and "women"). For this reason, the findings of this study may not be as applicable to individuals with other identities. Future research may choose to focus on the relationship between emotion and overt expressions of masculinity and femininity, rather than gender per se. It is also important to acknowledge that gender is only one moderator of emotional expression, and other factors such as age and personality may play a role in how individuals respond to emotional stimuli.

Conclusion

In conclusion, the present study found several differences in emotional displays between men and women. In response to aversive stimuli, particularly images of death and injury, women rated their emotional valence as more negative than did men, and were more likely to exhibit expressions of anger, disgust, and fear. Women were also more likely than men to respond to aversive stimuli with facial movement and were more intense in their emotional displays. Conversely, in response to pleasant, erotic stimuli, men rated their emotional valence as more positive than did women. No significant gender differences were found for any of the physiological measures. These findings confirm previous results regarding self-report measures of emotional state, and provide new behavioral data regarding how men and women differ in their emotional displays. The results of the present study provide a foundation for further research on gender and emotion research, particularly the social and clinical functions that emotions serve.

References

Bradley, M. M., & Lang, P. J. (1994). Measuring emotion: The self-assessment manikin and the semantic differential. *Journal of Behavioral Therapy and Experimental Psychiatry*, 25, 49-59.

Bradley, M. M., Codispoti, M., Sabatinelli, D., & Lang, P. J. (2001). Emotion and motivation II: sex differences in picture processing. *Emotion, 1*(3), 300.

Brody, L. R. (2000). The socialization of gender differences in emotional expression: Display rules, infant temperament, and differentiation. *Gender and Emotion: Social Psychological Perspectives*, 24-47.

Burleson, B. R. (2003). The experience and effects of emotional support: What the study of cultural and gender differences can tell us about close relationships, emotion, and interpersonal communication. *Personal Relationships*, *10*(1), 1-23.

Bussey, K., & Bandura, A. (1999). Social cognitive theory of gender development and differentiation. *Psychological Review, 106*(4), 676.

Butler, E. A., Lee, T. L., & Gross, J. J. (2007). Emotion regulation and culture: are the social consequences of emotion suppression culture-specific? *Emotion, 7*(1), 30.

Carli, L. L. (2001). Gender and social influence. *Journal of Social Issues, 57*(4), 725-741.

Chentsova-Dutton, Y. E., & Tsai, J. L. (2007). Gender differences in emotional response among European Americans and Hmong Americans. *Cognition and Emotion, 21*(1), 162-181.

Ekman, P., & Rosenberg, E. L. (1997). *What the face reveals: Basic and applied studies of spontaneous expression using the Facial Action Coding System (FACS).* Oxford University Press, USA.

Fischer, A. H. (1993). Sex differences in emotionality: Fact or stereotype?. *Feminism & Psychology, 3*(3), 303-318.

Gross, James J. (1996). Emotional Expressive Behavior (EEB) Coding System.

Grossman, M., & Wood, W. (1993). Sex differences in intensity of emotional experience: a social role interpretation. *Journal of Personality and Social Psychology, 65*(5), 1010.

Helgeson, V. (2015). *Psychology of gender.* Psychology Press.

Hess, U., Adams, R. B. Jr., & Kleck, R. E. (2004). Facial appearance, gender, and emotion expression. *Emotion, 4*(4), 378.

Hess, U., Blairy, S., & Kleck, R. E. (2000). The influence of facial emotion displays, gender, and ethnicity on judgments of dominance and affiliation. *Journal of Nonverbal behavior, 24*(4), 265-283.

Kring, A. M., & Gordon, A. H. (1998). Sex differences in emotion: expression, experience, and physiology. *Journal of Personality and Social Psychology, 74*(3), 686.

Kring, A. M., & Sloan, D. M. (2007). The Facial Expression Coding System (FACES): development, validation, and utility. *Psychological Assessment, 19*(2), 210.

Kubzansky, L. D., & Kawachi, I. (2000). Going to the heart of the matter: do negative emotions cause coronary heart disease?. *Journal of Psychosomatic Research,* 48(4), 323-337.

LaFrance, M., & Banaji, M. (1992). Toward a reconsideration of the gender-emotion relationship. *Emotion and Social Behavior, 14*, 178-201.

LaFrance, M., Hecht, M. A., & Paluck, E. L. (2003). The contingent smile: a meta-analysis of sex differences in smiling. *Psychological bulletin, 129*(2), 305.

Lang, P., & Bradley, M. M. (2007). The International Affective Picture System (IAPS) in the study of emotion and attention. *Handbook of Emotion Elicitation and Assessment, 29.*

Lang, P. J., Bradley, M. M., & Cuthbert, B. N. (1997). International affective picture system (IAPS): Technical manual and affective ratings. *NIMH Center for the Study of Emotion and Attention,* 39-58.

Lawler, K. A., Wilcox, Z. C., & Anderson, S. F. (1995). Gender differences in patterns of dynamic cardiovascular regulation. *Psychosomatic Medicine, 57*(4), 357-365.

Neumann, S. A., & Waldstein, S. R. (2001). Similar patterns of cardiovascular response during emotional activation as a function of affective valence and arousal and gender. *Journal of Psychosomatic Research, 50*(5), 245-253.

Sarlo, M., Palomba, D., Buodo, G., Minghetti, R., & Stegagno, L. (2005). Blood pressure changes highlight gender differences in emotional reactivity to arousing pictures. *Biological Psychology, 70*(3), 188-196.

Scherer, K. R., & Ekman, P. (2014). *Approaches to emotion.* Psychology Press.

Sells, D. J., & Martin, R. B. (2001). Gender and Modality Differences in Experiencing and Emotional Expression. *Canadian Journal of Counselling, 35*(2), 176-88.

Stewart, A. J., & McDermott, C. (2004). Gender in Psychology. *Annu. Rev. Psychol.*, 55, 519-544.

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Michael Berry is a senior at Yale University, where he is pursuing a B.S. in Psychology, with a track in Neuroscience. At Yale, he is a research assistant for Professor Jutta Joormann, whose lab studies the cognitive and affective underpinnings of mood and anxiety disorders, particularly major depression. He is also an Editor-and-Chief for Yale's Undergraduate Review of Research in Psychology and active in mental health advocacy on campus. He hopes to eventually pursue a Ph.D. in Clinical psychology and go into practice.

Was there a particular experience that sparked your research interests?

No single experience has sparked my research interests, but I have been very interested in topics pertaining to clinical psychology, particularly clinical neuroscience, since my freshman year in college. In particular, a class that I took during my sophomore year at Yale called "Animal Models for Clinical Disorders" sparked my interest on a variety of topics related to the relationship between brain function and behavioral manifestations of psychopathology. Since then, I have been working as a research assistant for a lab at Yale that studies anxiety and depression, and next year I will be working full-time for a lab that does neuroimaging work with chronic pain and fibromyalgia.

Who has been an influential person in your life?

I've been quite strongly influenced by a professor at Yale, Dr. Marvin Chun, who was my academic advisor during my freshman and sophomore years and really encouraged me to pursue research as an undergraduate, even though he studies a topic totally different from what I am primarily interested in. He definitely made a big difference during my early undergraduate experience in terms of boosting my self-confidence and keeping me informed about various research opportunities on and off campus.

When and where are you the most productive?

I am probably the most productive in coffee shops–it's partly the coffee, partly the atmosphere! I also may be slightly unusual in that I like to get started on things early, and actually find it somewhat harder to be productive when a deadline is quickly approaching. That feeling of having a lot of time to get things done and not feeling rushed or stressed about my assignments helps me to maintain clear concentration.

Where do you see yourself in 10 years?

I'm hoping that in ten years, I'll have a graduate degree–preferably a Ph.D.–in either clinical psychology or in a neuroscience program with a focus on mental disorders. I will be taking two years off first to work at Massachusetts General Hospital starting this summer, so in ten years I should hopefully be about 2 years out of graduate school, either having entered an academic position and/or having gone into clinical practice.

Can Computer Training Improve Long-Term Outcomes in Substance Use Disorders?: An Assessment of Current Evidence and Directions for Future Inquiry

Michael Berry
Yale University

Substance use disorders are frequently characterized by widespread deficits to cognition and executive function, particularly memory, self-regulatory ability and verbal reasoning. These deficits are believed to contribute to the severity of substance abuse disorders themselves, and excessive use and cognitive impairment may mutually reinforce each other in maintaining the abuser's psychological and physiological dependence on their substances of choice. It has been suggested that computerized cognitive rehabilitation (CCR), which attempts to remediate the deficits characteristic of the substance abuse disorders through the completion of various challenging cognitive training exercises, might be a useful treatment approach for this clinical population. This review surveys a wide range of techniques and findings in the cognitive rehabilitation and substance abuse literature, and assesses these findings in light of their theoretical and methodological limitations. An in-depth, critical discussion of these shortcomings is provided, and ways in which future studies can work to clarify the efficacy of cognitive rehabilitation for substance abuse are presented in the concluding section of the review.

Neuropsychological impairment is a consistent and well-documented feature of the substance use disorders (Bowden, Crews, Bates, Fals-Stewart & Ambrose, 2001; Bates, Bowden & Barry, 2002), despite its absence from the clinical definition offered by the *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition*. Impoverished self-regulatory ability, which may involve a progressive loss of control over drug use and behaviors that directly contribute to drug use over time (Bowden et al., 2001) has emerged as a popular explanation for how impulsive and compulsive drug use behaviors are able to emerge, persist and recur many times over the lifespan of individuals who qualify for a substance use disorder diagnosis. Deficits to cognitive and executive functioning can be viewed either as preceding substance abuse, in which case they represent a risk factor for the disorder's onset, or as resulting from chronic use itself, in which case they may contribute to escalating severity of the condition over time. While it is inherently difficult to establish causal links between levels of cognitive impairment and propensity to abuse substances (or vice versa), as many as 37% of addicts may exhibit memory deficiencies by the time they begin treatment, with 21% exhibiting significant impairment to abstract and verbal reasoning (Schrimsher, Parker & Burke, 2007). Additionally, several studies have indicated that patients who enter treatment with significantly impaired cognition are more likely to drop out from treatment and less likely to remain abstinent following treatment discharge (Aharonovich, 2006; Fals-Stewart & Shafer, 1992).

Substance-abusers most frequently exhibit impairment in the domains of executive functioning, verbal ability, processing speed and memory (Fals-Stewart & Bates, 2003). Family studies on alcohol and drug abuse have revealed that individuals exhibiting neuropsychological impairment, even children, are more likely to eventually engage in risky drug use behaviors (Schaffer, Parsons & Errico, 1998; Poon, Ellis, Fitzgerald & Zucker, 2000). Thus, diminished cognitive functioning may be either a cause or a consequence of drug abuse, with cognitive impairment resulting from substance use serving to facilitate future risky drug use behaviors. Substance use disorders have also been directly linked to physiological abnormalities in the brain regions known to be associated with higher cognitive functions have been directly linked to substance use disorders, including shrinkage of prefrontal cortical tissue (Sullivan & Pfefferbaum, 2005) and reduced rates of resting metabolic activity in left parietal and right frontal cortex (Volkow et al., 1994). Because prefrontal areas of the brain in particular have been heavily implicated in self-regulatory ability and decision-making (Kane & Engle, 2002), it is not surprising that individuals who exhibit reduced prefrontal cortical integrity appear to have difficulty regulating their drug use behavior. Overall, the well-demonstrated link between neuropsychological impairment and proclivity to engage in risky or addictive drug use behaviors highlights the importance of intact cognitive and executive abilities in the chronic substance abuser's path to recovery.

It is no mystery, then, why cognition itself has come under scrutiny in the substance-abuse literature as a potential target for treatment. Programs designed to strengthen cognition through the completion of repetitive, challenging game-like computer tasks, referred to colloquially as "brain training," or more formally, computerized cognitive remediation (CCR), have received some attention in the substance use disorder literature for their potential to remediate self-regulation difficulties in substance abusers and thus improve clinical outcomes (Rabipour, 2012). Given this potential, it is somewhat surprising that the literature on computerized cognitive remediation for substance use disorders remains relatively sparse compared to work done using similar programs for schizophrenia and neurodegenerative disease. Nonetheless, research focusing on CCR as a potential substance abuse intervention has gradually gained momentum over the past ten to twenty years. Optimism about its efficacy has grown in light of some promising findings suggesting that the disorder's characteristic neuropsychological impairment can be attenuated through the use of brief cognitive training regimens, usually carried out on a computer and requiring that participants complete a series of repetitive, cognitively demanding exercises (Vocci, 2008). Different training exercises typically target distinct "modules" of cognition (e.g. working memory, spatial reasoning, shifting of attention) and either increase or decrease in difficulty level between testing sessions, dependent on the subject's prior performance.

As it currently stands, experimental data on the efficacy of these intervention programs leaves more questions unanswered than it has been able to successfully resolve. Computerized cognitive rehabilitation programs do seem to be effective, primarily in the short term, for increasing performance on batteries of commonly-used cognitive tests, but concerns about the ecological validity of such findings and their transferability to other cognitive domains remain for the most part inadequately addressed. Most of the documented improvements are

not limited to substance abusers, nor are they limited exclusively to cognitively impaired individuals, and data on long-term clinical efficacy for individuals who do have a substance use disorder is generally sparse and not always reliable (Rabipour & Raz, 2012). Insufficient and sometimes inadequate cognitive assessment measures coupled with a striking lack of neurological data to support behavioral findings casts further doubt on the real-world efficacy of these interventions. In short, the degree to which the training programs implemented so far in the literature actually help substance abusers in the long-term remains uncertain on account of both various methodological shortcomings and a general paucity of relevant experimental data.

The following review survey the experimental designs, task characteristics and key findings that have so far been presented in the cognitive rehabilitation and substance abuse literature. A critique of these results will then be presented, with a particular emphasis placed on possible directions for future inquiry. Throughout, it is essential to keep in mind that the current body of literature pertaining to cognitive rehabilitation for substance use disorders is very small, and therefore all conclusions drawn from the work that has been performed so far must be considered tentative and in need of significant clarification.

Method

General Principles

The majority of the experimental work conducted to assess the impact of computerized cognitive rehabilitation on substance abuse follows the same basic experimental layout. Individuals diagnosed with a substance use disorders who display neuropsychological impairment and healthy controls are randomly assigned to one of either two or three treatment groups: computerized cognitive training, no training, and in some cases, "control training" designed to provide participants with a semblance of being trained without directly modifying their cognitive abilities. Training is carried out over variable but generally relatively brief time intervals ranging from two weeks (Yohman, Schaeffer & Parsons, 1988) to six months (Fals-Stewart & Lam, 2010), and most frequently takes place at a residential, inpatient treatment facility. Training sessions are typically about an hour long and meet several times per week for each participant. Participants are instructed to complete to the best of their abilities a series of cognitively demanding tasks, each tailored to strengthen different "modules" of cognition (Fals-Stewart & Lucente, 1994).

Training: Remediating Cognition Globally to Improve Clinical Outcome

The majority of studies in the CCR literature for substance abuse have chosen to focus on not just one, but numerous domains of cognition during remediation training. One fairly prototypical but unusually extensive training regimen implemented by Fals-Stewart & Lucente (1994) aimed to remediate thirteen cognitive "modules" in a sample of rehabilitated substance use disorder patients exhibiting neuropsychological impairment and healthy control subjects. Each module was designed to target a different general domain of cognitive ability (e.g. working memory, verbal reasoning, rule-shifting), with a particular emphasis on cognitive abilities that have been empirically demonstrated to be impaired in substance use disorders and which may impede successful treatment. In one exercise designed to strengthen perceptual-motor skills, participants in this study were required to move a mouse cursor to manipulate an onscreen "paddle-ball" and in doing so maintain the orientation of a horizontal line so as to exactly match an orientation specified by the computer. In an exercise intended to enhance working memory and attention, participants were briefly presented with a series of numbers on the top half of the computer screen, then asked to reproduce this sequence in the bottom half of the screen from memory, with the occurrence of three consecutive errors ending any given trial. Also included in this training battery were exercises designed to enhance abstract reasoning through solving logic problems and others designed to increase processing speed by requiring participants to press keys corresponding to onscreen stimuli as quickly as possible. For all of these training modules, task difficulty was calibrated between sessions to match the current performance level of each participant.

Most research groups who decide to include multiple domains of cognition in their CCR programs obtained training exercises directly from commercial cognitive remediation packages, including the Psychological Software Service's *CogRehab* program (Fals-Stewart & Grohman, 2003; Bickel, Yi, Landes, Hill & Baxter, 2011; Fals-Stewart & Lam, 2010). This package is designed to improve visual and auditory reaction time, attentional ability, problem-solving skills, visuospatial memory and visuo-constructional ability (Fals-Stewart & Lam, 2010). Another such package is *NeurXercise*, which aims to strengthen visual working memory, visuomotor coordination and spatial skills (Peterson, Patterson, Pillman & Battista, 2002), and *CogPack*, which targets mainly attention and working memory (Rupp et al., 2012). These commercial packages were explicitly designed for populations suffering from neurodegenerative disease (Rabipour, 2012), but also suit the purposes of computerized cognitive remediation for substance use disorders.

Training: Remediating Only Treatment-Specific Domains of Cognition

Some CCR paradigms have employed treatment-specific forms of remediation that directly target behavioral and attentional biases associated with substance abuse. Schoenmakers et al., (2010) had a sample of alcohol use disorder patients and healthy controls complete a form of alcohol-bias modification training (ABM) that reinforced the disengagement of attention away from alcohol-related cues. Under this paradigm, participants had to correctly indicate the spatial orientation of an arrow-shaped response target. For the purposes of training, these response targets were always adjacent to non-alcohol cues and never alcohol cues, forcing participants to practice disengaging their attention away from alcohol-related content. Eberl and colleagues (2013) took a more behavioral approach, implementing a form of avoidance training for patients with alcohol use disorders that rewarded using a joystick to "push away" pictures of alcoholic beverages and "pull" towards oneself images of soft drinks that contained no alcohol-related. This avoidance exercise was intended to reinforce and strengthen each alcohol-abusing individual's ability to behaviorally "reject" alcohol and develop an automatic tendency to avoid the substance (Eberl et al., 2013). Another study specifically examined the effects of working memory training on delay discounting in stimulant addicts, a population that frequently exhibits poor ability to delay gratification in tasks where they are given the choice between a small, immediate reward and a larger one that they must wait to receive (Bickel et al., 2011). Thus, several studies to date in the CCR literature for substance abuse have focused on a more limited set of cognitive skills specific to successful treatment outcome (e.g. learning to modulate one's response to alcohol), in contrast to studies that have focused on more generally strengthening a wide range of cognitive abilities (e.g. Fals-Stewart & Lucente, 1994).

Assessments of Cognitive Change following CCR

At both the onset and conclusion of CCR training, participants usually complete batteries of standard neuropsychological tasks to assess both general and domain-specific changes to their cognitive abilities over the course of training. Some tasks are intended to probe working memory capacity, including the n-back, letter-number sequencing and digit-span tasks (Rupp et al., 2012; Fals-Stewart & Lam, 2010; Bickel et al., 2011), others to assess executive function and response inhibition ability, including the Go/No Go and Color-Stroop tasks (Bickel et al.,

2011; Rupp et al., 2012; Peterson et al., 2002), and several others to analyze visual-attentional abilities, for which relevant measures include the Trail-Making and Block Design components of the Wechsler Adult Intelligence Scale (Peterson et al., 2002; Bickel et al., 2011; Fals-Stewart & Lucente, 1994). Notably, Schoenmakers et al., 2010 and Eberl et al., 2013 chose not to employ batteries of standard cognitive tasks and instead assessed attentional and behavioral biases using modified versions of their original training tasks.

Assessments of Clinical Outcome following CCR

Clinical outcome following CCR is typically assessed either immediately after treatment is complete or several months following its conclusion. End-of-treatment measures frequently include self-reported craving levels and staff ratings of each individual's engagement with treatment (Fals-Stewart & Lucente, 1994; Rupp et al., 2012). Longitudinal outcome measures have assessed probability of relapse over a 12-month period (Schoenmakers et al., 2010), probability of experiencing any lapse greater than three days in duration (Eberl et al., 2013), self-reported percentage of days abstinent over the course of a year (Grohman & Fals-Stewart, 2003; Fals-Stewart & Lam, 2010), indicators of addiction severity as determined by an in-person diagnostic assessment (Fals-Stewart & Lam, 2010) and overall level of psychological wellbeing (Rupp et al., 2012). Somewhat surprisingly, a number of studies did not measure either short-term or long-term clinical or psychological outcome following the completion of training, limiting outcome measures entirely to cognitive performance (Godfrey & Knight, 1985; Yohman et al., 1988; Hannon et al., 1989; Bickel et al., 2011; Peterson et al., 2002).

Experimental Control Procedures

It is worth reiterating that only certain studies included in this review incorporated a control training condition to account for the effects of self-perceived group assignment on participant expectation. Furthermore, the conceptual basis of such control trainings, when they are even implemented, has been inconsistent between research groups (Rabipour & Raz, 2012). Schoenmakers et al., (2010) had their control training group practice a distinct "categorization game" requiring individuals to sort cues according to whether they were alcohol-related or not, while Bickel et al., 2011 had their control training group complete the exact same working memory trainings that the as the experimental training group, but merely modified so that all of the correct answers were revealed at the start of each task, ensuring that participants did not actually "exercise" their working memory ability. Other control training programs have had participants listen passively to an audiobook (Peterson et al., 2002), take a public speaking course (Godfrey & Knight, 1985) and complete an interactive typing program in which participants are instructed to replicate onscreen passages, receiving feedback based on response time and accuracy (Fals-Stewart & Lucente, 1994; Fals-Stewart & Lam, 2010). Other studies have not included any form of active control training condition, solely assigning participants to either a training or no-training group (Yohman et al., 1988; Hannon et al., 1989; Rupp et al., 2012; Eberl et al., 2013).

Results

Cognitive Improvement following CCR

The majority CCR studies for substance abuse have reported significant effects of cognitive training on several neuropsychological measures, excluding three cases of null findings (Godfrey & Knight, 1985; Hannon et al., 1989; Peterson et al., 2002). Fals-Stewart & Lucente, 1994 reported training-specific improvements on three components of the WAIS (Vocabulary, Digit-Symbol, Block Design) and multiple measures of attention over the first five months of a six-month training period. These researchers also reported an increased *rate* of performance improvement specific to their cognitive training group over the first two months of intervention, even after controlling for variation in depression and anxiety symptoms (Fals-Stewart & Lucente, 1994). Bickel et al., (2011) reported a significant decrease to levels of delay discounting in their working memory training group compared to control participants, and found that working memory performance on the letter-number sequencing task correlated negatively with rate of discounting. However, no significant group differences were evident on end-of-training assessments for risk-seeking behavior (Balloon Analogue Risk Task), executive dysfunction (Frontal Systems Behavioral Scale), verbal learning, or response inhibition (Go/No Go task). Schoenmakers et al., 2010 reported reduced alcohol bias specific to ABM training, measured using a modified version of their task in which response targets could appear next to either alcohol or non-alcohol cues (with speed of disengagement from alcohol cues as the dependent measure), and Eberl et al., 2013 similarly reported increased alcohol avoidance behavior specific to their avoidance-training program. Rupp et al., 2012 noted increased performance on measures of working memory, visual-constructional ability, attentional capacity and overall alertness in their cognitive training group compared to a no-treatment group, but reported no group differences for response inhibition scores on the Color-Stroop task.

Clinical Outcome

Among those studies that assessed clinical outcome, most have reported weak to moderately positive findings supporting an effect of cognitive training on substance abuse severity. Fals-Stewart & Lucente, 1994 found that clinical participants in their experimental training group were rated as more positively participatory in treatment by medical staff than other participants, despite the fact that medical staff had no knowledge of whether or not patients had received training or not. The authors of this study noted that positive treatment participation is a metric correlated positively with long-term treatment outcome–however, neuropsychological performance was not a strong predictor of staff rating, somewhat weakening the assertion that training was causally implicated in improved treatment participation. Other studies have found that training delayed clinically confirmed incidences of relapse, but did not reduce its overall probability of occurrence (Schoenmakers et al., 2010), increased percentage of days abstinent over the six months following training (Fals-Stewart & Lam, 2010; Grohman & Fals-Stewart, 2003), decreased self-reported psychological distress (Rupp et al., 2012), and reduced overall probability of self-reported relapse (Ebertl et al., 2013).

Interpretation

It is difficult to make any holistic assertions about the data collected thus far from cognitive rehabilitation-substance abuse paradigms, given its somewhat heterogeneous nature. While most researchers have found evidence for some form of neuropsychological improvement resulting from training, the precise domains of improvement vary from study to study despite the fact that the cognitive training programs used mostly target the same few domains of cognition (e.g., working memory, visuospatial ability, attention, response inhibition). The most promising findings are arguably those of Fals-Stewart & Lam, 2010, the sole study included in this review that not only found correlations between cognitive training, task performance and long-term clinical outcome, but also assessed addiction severity beyond mailed-in self-report data.

Given the general paucity of methodologically sound long-term clinical outcome data, it is clear that much more research, particularly that which reliably assesses individual progress post-training, will be required before any bold claims about the efficacy of cognitive training can be made with a clear conscience. Nonetheless, it would be unwise to entirely discount the array

of potentially encouraging findings outlined in the published results of these research teams, particularly those that relate to decreased levels of craving, substance-use frequency and probability of relapse.

Discussion

Limitations and Future Directions

Thus far, this review has surveyed the premise, rationale and general methodology pertaining to cognitive rehabilitation for substance abuse disorders. This section provides an overview and theoretical discussion of several limitations that are important to consider in interpreting the work that has been presented up to this point.

Paucity of Clinical Outcome Data

First and foremost, a relative lack of data concerning long-term clinical outcome, particularly non-self-reported information about diagnostic status, makes the true ability for cognitive training programs to reduce substance abuse severity hard to substantiate. The link between improved performance on neuropsychological assessments and real-world clinical effects is only weakly upheld by work in the field as it currently stands, a problem that is only further aggravated by lack of evidence supporting long-lasting alterations to brain activity associated with cognitive training. Only one study cited in this review (Fals-Stewart & Lam, 2010) assessed more than one domain of clinical outcome without solely relying on self-report. Because self-report data is likely to be unreliable, particularly in substance-abusing populations, it is imperative that future studies on CCR for substance use make a more concerted effort to have as many participants as possible assessed by a trained clinician in the months to years following training.

Theoretical Concerns Pertaining to CCR Training Regimens

Cognitive training studies effectively operate under the assumption that the neural circuits underlying human capacities for working memory, response inhibition and self-regulatory ability can be "exercised" (Rupp et al., 2012; Rabipour, 2012) as if they were muscles, through repeated performance of certain types of cognitively demanding tasks. Further, it is sometimes assumed that once neural circuits responsible for higher-order cognitive functions have grown accustomed to completing certain kinds of cognitive tasks, the speed and accuracy with which they do so will increase (Smith et al., 2009; Rabipour, 2012). This assumption is, of course, not an unreasonable one. Primary and secondary education often relies on this principle of task repetition, particularly in the field mathematics. The well-known capacity for neural networks to undergo plastic, experience-dependent changes to connectivity suggests that task repetition could feasibly have long-lasting effects on the structure and function of the brain's cognitive systems (Smith et al., 2009).

Yet, there is a clear distinction between performance improvements on a single task and performance improvements on a whole host of operations that all fall under a broad cognitive domain such as working memory. While most researchers have been careful not to test neuropsychological function using the same exact tasks as those used during training exercises, it is nonetheless difficult to rule out the confounding influence of task-specific improvement. For example, the working memory training tasks provided by programs like PSS CogRehab typically require participants to recall previously-presented series of digits or letters (Fals-Stewart & Lucente, 1994). Working memory assessments, including n-back and letter-number sequencing paradigms, similarly tend to require short-term maintenance of digits, letters and their spatial locations in memory, only this time using performance as a metric for how much the participant has improved rather than as a training exercise (Bickel et al., 2011). Effectively, however, this information only conveys that an individual has improved their ability to regurgitate sequences of letters and numbers–not that their biological capacity for working memory actually grew.

Thus, the possibility that participants are simply developing task-specific strategies to improve their performance during cognitive training programs cannot be readily ruled out. Indeed, learning how to memorize a simple series of letters or numbers, becoming proficient at inhibiting a key press under certain controlled experimental conditions or figuring out the best techniques for solving a particular kind of tricky logic problem will be of no use to the addict in after training ends. It will thus be particularly important for future CCR studies on substance abuse to perform longitudinal assessments of how well training effects actually carry over into behavioral domains that directly relate to substance use.

Theoretical Concerns Pertaining to Cognitive Assessment

The use of single assessments to summarize performance within an entire domain of cognition only aggravates concerns about the transferability of cognitive training. Indeed, to what extent can one-time performance on a single test inform us about the strength of neural connectivity in regions of the brain responsible for self-regulation? Studies in which cognitive change was solely measured using a lightly modified version of training tasks (e.g. Schoenmakers et al., 2010, Eberl et al., 2013) were particularly susceptible to this confound. (*Please consider rewriting "worst offenders," in a nicer way!)* It is difficult to assert that increases to task performance found in these studies were applicable outside of the laboratory setting at all, given how similar the training and assessment tasks were. Indeed, subjects could have easily learned task-specific strategies to improve their performance without these strategies necessarily being applicable to real-world scenarios.

In some cases, assessment tasks are sufficiently distinct from training tasks to alleviate any concerns about strategy-use effects. For example, Bickel and colleagues demonstrated that working memory training was sufficient to reduce levels of delay discounting in stimulant abusers, a causal effect that cannot be plausibly attributed to strategy development. This study may have therefore documented real transfer effects between a mostly treatment-irrelevant cognitive domain (working memory) and a treatment-relevant domain (delay discounting). Unfortunately, due to lack of post-treatment clinical outcome data, it is not possible to ascertain whether the reduced delay discounting observed in this clinical sample was itself transferable to genuine, enduring behavior modifications that aided patients in their everyday struggles with substance abuse after the study terminated. In order to address these ongoing doubts about the transferability and ecological validity of cognitive training programs, future work should ideally both examine changes to brain activity over the course of cognitive training and make a more substantial effort to assess the long-term clinical effects of these programs.

The Influences of Participant Motivation and Expectation

Another major influence that must be disentangled from the real cognitive effects of these training programs is that of participation motivation and expectation. Participants assigned to cognitive training groups may be well aware of the fact that they are "expected" to improve between the pre- and post-training assessment periods, and make greater efforts to perform well on these tests than participants assigned to no-training or control training groups. While experimenters presumably ensure that participants are randomly assigned to conditions and keep each participant's group assignment confidential, for many of these studies, it is hard to imagine that participants were truly oblivious to whether or not they were expected to substantially improve. As has already

been mentioned, several cognitive rehabilitation studies omitted control training groups entirely–participants in the no-training group may have been cognizant of the fact that they were not expected to show significant improvement over the course of the study and may not have felt personally invested in their end-of-study performance.

This methodological confound, known as the Hawthorne effect (Shipstead, Redick & Engle, 2012), challenges the interpretability of both the experiments that lacked control training groups and even some of those that did include them. Indeed, designing a sound control training task that is relatively immune to the Hawthorne effect but still does not risk mimicking the effects of the experimental training is no simple matter, and the tasks described thus far in the literature leave considerable room for improvement.

The computerized typing tutorial employed by both Fals-Stewart & Lucente, 1994 and Fals-Stewart & Lam, 2010 was well-chosen in that it gave participants a strong impression that they were being trained in some way, but the lack of congruence between the content of these tasks (learning to type more quickly) and the content of the pre- and post-training task batteries (cognitive skills) could very well have lead participants in the control training group to feel less confident about their assessment task performance.

Bickel and colleagues (2013) took a completely inverted approach from that used by Fals-Stewart by having their control training participants perform the exact same tasks as the experimental training group, but with all of the correct answers revealed beforehand. In this case, participants likely felt comfortable and familiar with the material presented in the post-training assessments, but were also quite likely aware that they had not really been "trained" in any way, given that they were never required to solve any problems themselves. This could have caused participants to put less effort into post-training assessments, owing to an intuition that they were not personally expected to perform well.

The Hawthorne effect may also be applicable to long-term clinical efficacy data, given that the same participants who believe themselves to be properly trained for the assessments they receive may also experience improved self-efficacy on account of this perceived group assignment. Several of the studies that measured long-term substance-abuse outcome relied entirely on mailed-in self-reports, which further raises the possibility that only participants experiencing positive post-training outcomes were sufficiently motivated to fill out and mail back these self-report forms.

All in all, while some efforts have been made to rule out motivational and expectation-related confounds in these experiments, the inherent difficulty of designing sound control training tasks limits the interpretability of many cognitive and clinical findings. While the inclusion of manipulation checks to control for these confounds would be well-advised, the acquisition of neuroimaging data to verify the existence of tangible training effects would perhaps be even more useful.

Magnitude of Effects Induced by CCR

A final challenge that faces findings in both the cognitive and clinical domains of these CCR studies is that statistically significant results do not always indicate that the intervention produced large improvements to cognitive functioning. While a thorough description of how findings quantitatively differ within and between studies is outside the scope of this review, it is well-established that researchers conducting examinations of treatment efficacy have a general tendency to overemphasize the statistical significance of group differences in their results without acknowledging the actual size of this difference, which is frequently less impressive than authors portray it to be (Rabipour & Raz, 2012).

Several of the studies discussed in this review have reported quite modest effect sizes, leading authors to perhaps overemphasize training-induced changes to neuropsychological performance and/or clinical outcome on the grounds that the effects were statistically significant. Eberl and colleagues (2013) reported a significant difference in proportion of "successful outcomes" (lapse-free period) between their training and control groups at follow-up, but the actual between-group difference was only a matter of eight percentage points, with the non-trained group exhibiting a 43% chance of successful outcome compared to 51% for the control group. While this difference was indeed statistically significant, its admittedly modest size does not do much to advance the argument that this study's training program could serve as a stand-alone treatment method. Closer analysis of other researchers' outcome data yields similar conclusions, with actual differences between the efficacy of experimental and control training programs often being somewhat overstated in the body of the article relative to how they appear in the actual data (e.g. Fals-Stewart & Lam, 2010). It is furthermore not entirely implausible to imagine that motivation, expectation and strategy-related confounds could be mostly or solely responsible for some of these relatively small differences.

Conclusion

Computerized cognitive rehabilitation as an intervention for substance abuse disorders is still in its early stages, but encouraging findings across multiple domains of cognition and clinical categories reaffirm its potential as a means of remediating cognitive deficits observed in substance abuse disorders. However, a variety of methodological and theoretical concerns associated with the experimental studies performed thus far warrant a more cautious approach to how such findings are interpreted. In particular, the general paucity of data demonstrating clinical improvements that persist for more than a year following training represents a major obstacle in terms of demonstrating that CCR is actually effective for treating substance use disorders.

Future experimental studies have the opportunity to address these gaps in our understanding of cognitive rehabilitation for substance abuse disorders. Such studies should aim primarily to track clinical outcomes longitudinally in a more consistent manner than has been demonstrated in the existing literature, but should also aim to diversify upon the training programs offered. Some evidence suggests that in particular, skills-based training that focuses on roleplays and hypothetical scenarios may be highly effective for improving clinical outcome in substance abusing populations (Botvin et al., 1995). These training programs are designed to instruct individuals on how to effectively grapple with scenarios in which they are tempted to use drugs, and appear particularly applicable to racial minority and low-income populations, who often are less responsive to "traditional" forms of intervention such as psychoeducation (Botvin et al., 1995). Implementing skills-based training paradigms into computerized cognitive rehabilitation might represent a more ecologically valid means by which to enhance self-regulatory ability and improve clinical outcome in substance-abusing patients. As CCR continues to expand in its scope and application, perhaps by taking inspiration from other areas of substance-use intervention such as life skills training paradigms, it may eventually serve as a widespread, inexpensive and accessible means of intervention for the substance use disorders.

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References

Aharonovich, E., Hasin, D. S., Brooks, A. C., Liu, X., Bisaga, A., & Nunes, E. V. (2006). Cognitive deficits predict low treatment retention in cocaine dependent patients. *Drug and alcohol dependence, 81*(3), 313-322. doi: 10.1016/j.drugalcdep.2005.08.003

American Psychiatric Association. (2013). *Diagnostic and Statistical Manual of Mental Disorders: DSM-5*.

Bates, M. E., Bowden, S. C., & Barry, D. (2002). Neurocognitive impairment associated with alcohol use disorders: implications for treatment. *Experimental and clinical psychopharmacology, 10*(3), 193-212. doi: 10.1037/1064-1297.10.3.193.

Bickel, W. K., Yi, R., Landes, R. D., Hill, P. F., & Baxter, C. (2011). Remember the future: working memory training decreases delay discounting among stimulant addicts. *Biological psychiatry, 69*(3), 260-265. doi: 10.1016/j.biopsych.2010.08.017

Botvin, G. J., Schinke, S. P., Epstein, J. A., Diaz, T., & Botvin, E. M. (1995). Effectiveness of culturally focused and generic skills training approaches to alcohol and drug abuse prevention among minority adolescents: two-year follow-up results. *Psychology of Addictive Behaviors, 9*(3), 183-194. doi: 10.1037/0893-164X.9.3.183

Bowden, S. C., Crews, F. T., Bates, M. E., Fals-Stewart, W., & Ambrose, M. L. (2001). Neurotoxicity and Neurocognitive Impairments with Alcohol and Drug-Use Disorders: Potential Roles in Addiction and Recovery. *Alcoholism: Clinical and Experimental Research, 25*(2), 317-321. doi: 10.1111/j.1530-0277.2001.tb02215.x.

Eberl, C., Wiers, R. W., Pawelczack, S., Rinck, M., Becker, E. S., & Lindenmeyer, J. (2013). Approach bias modification in alcohol dependence: do clinical effects replicate and for whom does it work best? *Developmental cognitive neuroscience, 4*, 38-51. doi: 10.1016/j.dcn.2012.11.002. doi:

Godfrey, H. P., & Knight, R. G. (1985). Cognitive rehabilitation of memory functioning in amnesiac alcoholics. *Journal of consulting and clinical psychology, 53*(4), 555-557. doi: 10.1037/0022-006X.53.4.555.

Grohman, K., & Fals-Stewart, W. (2003). Computer-Assisted Cognitive Rehabilitation with Substance-Abusing Patients: Effects on Treatment Response. *Journal of Cognitive Rehabilitation, 21*(4), 10-17. doi: 10.1111/j.1530-0277.2001.tb02215.x.

Fals-Stewart, W., & Schafer, J. (1992). The relationship between length of stay in drug-free therapeutic communities and neurocognitive functioning. *Journal of clinical psychology, 48*(4), 539-543. doi: 10.1002/1097-4679(199207)48:4<539::AID-JCLP2270480416>3.0.CO;2-I.

Fals-Stewart, W., & Lucente, S. (1994). The effect of cognitive rehabilitation on the neuropsychological status of patients in drug abuse treatment who display neurocognitive impairment. *Rehabilitation Psychology, 39*(2), 75-94. doi: 10.1037/h0080316.

Fals-Stewart, W., & Bates, M. E. (2003). The neuropsychological test performance of drug-abusing patients: an examination of latent cognitive abilities and associated risk factors. *Experimental and clinical psychopharmacology, 11*(1), 34-45. doi: 10.1037/1064-1297.11.1.34

Fals-Stewart, W., & Lam, W. K. (2010). Computer-assisted cognitive rehabilitation for the treatment of patients with substance use disorders: A randomized clinical trial. *Experimental and Clinical Psychopharmacology, 18*(1), 87-98. doi: 10.1037/a0018058.

Hannon, R., Dorothy, E., Cano, T. C., Moreira, K., Nasuta, R., & Staub, G. V. (1989). Memory retraining with adult male alcoholics. *Archives of clinical neuropsychology, 4*(3), 227-232. doi: 10.1016/0887-6177(89)90015-2.

Kane, M. J., & Engle, R. W. (2002). The role of prefrontal cortex in working-memory capacity, executive attention, and general fluid intelligence: An individual-differences perspective. *Psychonomic bulletin & review, 9*(4), 637-671. doi: 10.3758/BF03196323.

Peterson, M. A., Patterson, B., Pillman, B. M., & Battista, M. A. (2002). Cognitive recovery following alcohol detoxification: A computerised remediation study. *Neuropsychological rehabilitation, 12*(1), 63-74. doi: 10.1080/09602010143000167.

Poon, E., Ellis, D. A., Fitzgerald, H. E., & Zucker, R. A. (2000). Intellectual, cognitive, and academic performance among sons of alcoholics during the early school years: Differences related to subtypes of familial alcoholism. *Alcoholism: Clinical and Experimental Research, 24*(7), 1020-1027. doi: 10.1111/j.1530-0277.2000.tb04645.x.

Rabipour, S., & Raz, A. (2012). Training the brain: Fact and fad in cognitive and behavioral remediation. *Brain and cognition, 79*(2), 159-179. doi: 10.1016/j.bandc.2012.02.006.

Rupp, C. I., Kemmler, G., Kurz, M., Hinterhuber, H., & Wolfgang Fleischhacker, W. (2012). Cognitive remediation therapy during treatment for alcohol dependence. *Journal of studies on alcohol and drugs, 73*(4), 625-634. doi: 10.1016/j.2012.07.006.

Schaeffer, K. W., Parsons, O. A., & Errico, A. L. (1988). Abstracting deficits and childhood conduct disorder as a function of familial alcoholism. *Alcoholism: Clinical and Experimental Research, 12*(5), 617-618. doi: 10.1111/j.1530-0277.1988.tb00251.x.

Schoenmakers, T. M., de Bruin, M., Lux, I. F., Goertz, A. G., Van Kerkhof, D. H., & Wiers, R. W. (2010). Clinical effectiveness of attentional bias modification training in abstinent alcoholic patients. Drug and alcohol dependence, 109(1), 30-36. doi: 10.1016/j.drugalcdep.2009.11.022.

Schrimsher, G. W., Parker, J. D., & Burke, R. S. (2007). Relation between cognitive testing performance and pattern of substance use in males at treatment entry. *The Clinical Neuropsychologist, 21*(3), 498-510. doi: 10.1080/13803390600674441.

Shipstead, Z., Redick, T. S., & Engle, R. W. (2012). Is working memory training effective? *Psychological bulletin, 138*(4), 628-654. doi: 10.1037/a0027473.

Smith, G. E., Housen, P., Yaffe, K., Ruff, R., Kennison, R. F., Mahncke, H. W., & Zelinski, E. M. (2009). A cognitive training program based on principles of brain plasticity: results from the Improvement in Memory with Plasticity-based Adaptive Cognitive Training (IMPACT) Study. *Journal of the American Geriatrics Society, 57*(4), 594-603. doi: 10.1111/j.1532-5415.2008.02167.x.

Sullivan, E. V., & Pfefferbaum, A. (2005). Neurocircuitry in alcoholism: a substrate of disruption and repair. *Psychopharmacology, 180*(4), 583-594. doi: 10.1007/s00213-005-2267-6.

Vocci, F. J. (2008). Cognitive remediation in the treatment of stimulant abuse disorders: a research agenda. *Experimental and Clinical Psychopharmacology, 16*(6), 484-497. doi: 10.1037/a0014101.

Volkow, N. D., Hitzemann, R., Wang, G. J., Fowler, J. S., Burr, G., Pascani, K., ... & Wolf, A. P. (1992). Decreased brain metabolism in neurologically intact healthy alcoholics. *Am J Psychiatry, 149*(8), 1016-1022. doi: 10.1002/syn.890110303.

Yohman, J. R., Schaeffer, K. W., & Parsons, O. A. (1988). Cognitive training in alcoholic men. *Journal of consulting and clinical psychology, 56*(1), 67. doi: 10.1037/0022-006X.56.1.67.

Justin Edwards
Williams College

Justin Edwards is a psychology major at Williams College and produced this research article while studying abroad at University College London. In addition to cognitive psychology, Justin enjoys working in schools and broadcasting sporting events for Williams College.

Was there a particular experience that sparked your research interests?

My research interest in human-computer interaction was informed by a class I took on the topic during my fall semester at University College London. I had no prior experience in human-computer interaction before that class, but it uniquely combined my academic interests and excited me as an emerging field. The human-computer interaction faculty at UCL were very gracious in accepting my request to do research in their lab the following semester and helping me explore that new passion.

Who has been an influential person in your life?

One very influential person in my life has been my grandfather. He didn't have the privilege of much formal education, but he has nevertheless devoted himself to being a lifelong learner. He holds multiple patents for welding tools, was an early computer hobbyist, and has more self-taught skills than I can list. His devotion to constant self-improvement and exploration of new ideas is something I have always tried to model myself on.

When and where are you the most productive?

I am most productive late at night alone in my bedroom listening to music. I have the habit of losing concentration when I feel like I have no time pressure, but if I am fighting the clock for a deadline or even for the ability to go to sleep, I find myself able to focus deeply and output high-quality work very quickly.

Where do you see yourself in 10 years?

In 10 years, I hope to be a human-computer interaction researcher within the tech industry. Unlike many academic fields, a large quantity of published research in human-computer interaction originates in the consumer industry from tech companies working to realize new technologies and methodologies. I would relish the opportunity to be in this situation, so I could work on real products that computer-users would own while also contributing to the scientific growth of my field.

A New Index to Measure Media Multitasking

Justin Edwards
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Media multitasking is the increasingly ubiquitous phenomenon in which people concurrently consume content across multiple media platforms, including but not limited to smartphones, computers, and print media. For this reason, media multitasking has become a popular area of study for human-computer interaction researchers and technology developers alike. The behavior has thus far been assessed through a long, time-consuming questionnaire, making research on the behavior especially arduous for both researchers and participants, likely deterring study in the area to some degree. A new questionnaire was administered online including the traditionally used Media Multitasking Index as well as a new, shorter Abbreviated Media Multitasking Index. Scores on the abbreviated index correlated highly with those from the original index, indicating the abbreviated index is sufficient in measuring the same construct. The new, shorter questionnaire for measuring people's media multitasking tendency can be more efficiently administered and thus allow for easier study and greater understanding of multitasking behaviors.

Media multitasking, the concurrent use of multiple technologies in order to simultaneously access multiple sources of media content, has become a fixture of everyday life both at work and in consuming entertainment. Multitasking has long been a focus of cognitive psychology, with cognitivists of the 1970s viewing dual-task behavior as a paradigmatic way in which the human brain was similar to machines like computers (McLeod, 1977). It was not until the 2000s that research began in earnest on dual-task behavior wherein both tasks involved media consumption across different media. As the number of devices available to consumers has grown and the amount of sources online content has followed suit, opportunities for media multitasking have increased as well, making media multitasking a topic of fascination for technology developers, consumers and researchers alike. This behavior is not predicated upon modern technology as even behavior like reading a newspaper while listening to the radio would qualify as media multitasking. Nonetheless, this behavior had largely not been studied until the end of the last decade, coinciding with the rise in popularity of the smartphone which led to dramatically increased opportunity for media multitasking.

In recent human-computer interaction literature, categorizing the extent to which people are media multitaskers has been done using a questionnaire called the Media Multitasking Index (MMI) (Ophir, Nass, & Wagner, 2009). That questionnaire was created ad-hoc to categorize heavy and light media multitasking in order to assess their differences in cognitive control. Following the publication of Ophir et al., media multitasking behavior as a trait has been studied broadly across research areas, using that same

ad-hoc questionnaire, including studies on the relationships between media multitasking and grey-matter density (Loh & Kanai, 2014) as well as the impact of media multitasking on social well-being (Pea, et. al., 2012). Other media multitasking research has been focused on other behaviors of chronic multitaskers including academic performance (Junco & Cotton, 2010) and essay-writing abilities (Lottridge et. al., 2015). Studies such as these have lead to the MMI becoming a widely used and cited instrument in human-computer interaction and psychology literature across many areas of focus.

Though the present index has been used widely to study a construct that many researchers are currently investigating, administering it is not time-efficient. The MMI as published contains 144 fields in which participants must assess their media multitasking behaviors, causing it to be extremely time-consuming for participants and making it an unattractive survey for researchers to include in batteries of multiple surveys. Most of the questions contained in the MMI are related to specific multitasking situations, asking subjects how frequently they use various forms of media concurrently with a given medium. The specificity sought by the MMI has largely not been used by its practitioners as most researchers have been more interested in determining the extent to which a person multitasks rather than determining the specific situations in which one does so. In fact, the MMI only uses these specific situational questions in order to produce a single score representing a participant's media multitasking behavioral tendency and the most influential studies to use the MMI have only been interested in that single score rather than its constituent situational questions (Sanbonmatsu, Strayer, Medeiros-Ward, & Watson, 2013; Pea, et. al., 2012). Even in its original publication, the MMI was used only to differentiate between heavy and light multitaskers, with no consideration of multitasking contexts or even of MMI scores of individuals in those groups (Ophir et al., 2009). I believed that a new MMI could be developed with fewer, more general questions that would take participants less time to complete and categorize people's media multitasking behavior in the same way as the original MMI. This shorter questionnaire would be useful to researchers as it would make the MMI easier to administer and allow for the inclusions of the MMI in a greater body of research where multitasking isn't necessarily the primary topic of interest.

The MMI, as originally published, contains a section of 12 items that ask about the total number of hours per week the subject spends using each of 12 forms of media, then a section with 12 matrices of 11 items each that ask about the relative frequency with which the participant uses each medium concurrently with each other medium (Ophir et al., 2009). By collapsing each matrix into a single question, I believed that the same underlying construct could be measured without the need to ask about each media pairing individually. I created this Abbreviated Media Multitasking Index (AMMI), to measure participants' multitasking tendencies while using the same scale as the MMI. To test this, I administered both the AMMI and the MMI to participants and assessed the between-methods reliability of their scores. If the AMMI and MMI are consistent in their measurements across subjects, the AMMI and MMI are measuring the same construct. Following the work by Ophir et al., (2009), this would indicate that the construct both indices measure is the "level of media multitasking the participant is engaged in during a typical media-consumption hour." The MMI *is* an ad hoc index to differentiate between heavy and light media multitaskers created without empirical basis for its questions. It has nevertheless been widely cited for this purpose with as-yet minimal focus on the justification for its method for measuring the target construct. The AMMI does not purport to surpass the MMI in this way but merely seeks to incrementally improve on the index as it exists by increasing efficiency.

Method

Participants

Thirty-two participants took part in the study. 27 were female and five were male. The mean age was 20.3 years (SD = 2 years, range = 18-31 years). All participants were drawn from the same university subject pool and were given course credit for approximately 30 minutes of their time. The process of participation was automated; the experimenters' only role was to approve course credit. The study was made accessible online for a two-week period and the demographics of the sample were not influenced by the experimenters.

Materials

Multitasking Preference Inventory. The Multitasking Preference Inventory (MPI) is a 14 item questionnaire in which participants are asked to rate their agreement with statements about preferences toward different multitasking behaviors on a 5 point Likert-type scale. This questionnaire contained seven statements of preference toward multitasking and seven statements of preference against multitasking in a pseudo-randomized order. The anti-multitasking items were reverse scored and responses were averaged for each participant. This inventory was included to exclude the possibility that the AMMI was merely a measure of attitude toward media multitasking. Since the AMMI used fewer and more general questions than the MMI, it may have encouraged participants to report what they would prefer their media multitasking to be like rather than reporting their actual behavior.

Media Multitasking Index. The modified version of the original MMI questionnaire included questions about 13 forms of media including 11 media from the original: print media, television, computer-based video, music, non-music audio, video games, voice calls, instant messaging, email, web surfing and other computer-based applications. I replaced SMS (short messaging service) with social networking and added other mobile applications to reflect current media consumption trends. The MMI consists of two sections. The first section included 13 questions, asking participants how many hours per week they spend using each form of media. The second section asked participants for each form of media as a primary medium, how frequently they concurrently used each other form of media. This section included 13 subsections of 12 questions each for a total of 157 questions. For each media pair, participants rated their concurrent usage as "Never", "A little of the time", "Some of the time", or "Most of the time". These responses were coded as 0, 0.33, 0.66, and 1 respectively, in accordance with the original MMI. Responses were summed according to the following formula:

$$MMI = \sum_{i=1}^{13} \frac{m_i \times h_i}{h_{total}}$$

Where m_i is the mean number of media concurrently used while using primary medium, i; h_i is the number of hours per week spent using the primary medium, i; and h_{total} is the total number of hours per week spent using all media forms.

Abbreviated Media Multitasking Index. The AMMI contained 13 questions, asking participants for each of the 13 forms of media included in the modified MMI, how frequently they concurrently consume any other form of media. For each primary media source, participants rated their concurrent usage as "Never", "A little of the time", "Some of the time", or "Most of the time" which were coded as 0, 0.33, 0.66, and 1 respectively. Responses were summed to produce an unweighted AMMI score. I also calculated weighted AMMI scores according to the following formula:

$$wAMMI = 12 \times \sum_{i=1}^{13} \frac{am_i \times h_i}{h_{total}}$$

Where am_i is the frequency rating the participant gave for each primary medium, i is reported in

the AMMI; h_i is the number of hours per week spent using the primary medium as reported in the MMI, i; and h_{total} is the total number of hours per week spent using all media forms as reported in the MMI. Multiplying by 12 recovers the difference in sizes between weighted AMMI and MMI scores as the MMI reflects sums of 12 concurrent media forms for each primary medium while the AMMI reflects a single score on the same scale.

Design

Participants were administered a brief demographic questionnaire followed by the three-part multitasking questionnaire online. All questions were accessible at once on a single webpage. The MPI was the first section of the questionnaire, followed by the AMMI, then the MMI. Order of questionnaires was not counterbalanced. Because the AMMI is a shorter version of the same questions presented in the MMI, that section appeared directly before the MMI so that participants did not answer the AMMI thoughtlessly out of either fatigue or annoyance at the apparent repetition of questions. Since the MMI is the longest of the three parts, it was the last section of the questionnaire as to not inflict fatigue effects on the MPI and to mitigate the risk of participants dropping out after completing the MMI. I believed that these risks were greater than the potential of order effects given the similarity between MMI and AMMI questions. Either design choice admittedly carries its inherent problems and I chose to forego counterbalancing.

Results

MMI scores (*M* = 4.04; *SD* = 1.67) mirrored those from Ophir et al. (*M* = 4.38; *SD* = 1.52) (2009) and were normally distributed. AMMI scores (*M* = 8.07; *SD* = 1.81) were normally distributed and were larger by a factor of two. Weighted AMMI scores (*M* = 8.81; *SD* = 1.82) were normally distributed. I computed Pearson's r for AMMI and MMI's correlations to each questionnaire score. There was no significant correlation between MMI scores and MPI scores ($r(30) = 0.14$, 95% CI [-0.21, 0.47]), nor was there a significant correlation between AMMI scores and MPI scores ($r(30) = 0.23$, 95% CI [-0.12, 0.54]) nor between weighted AMMI scores and MPI scores ($r(30) = 0.12$, 95% CI [-0.23, 0.45]). There was a moderate positive correlation between MMI scores and AMMI scores ($r(30) = 0.49$, $p < .005$) as seen in Figure 1 and a moderate positive correlation between MMI scores and weighted AMMI scores ($r(30) = 0.35$, $p < .05$) as seen in Figure 2. There was a strong positive correlation between AMMI scores and weighted AMMI scores ($r(30) = 0.78$, $p < .001$).

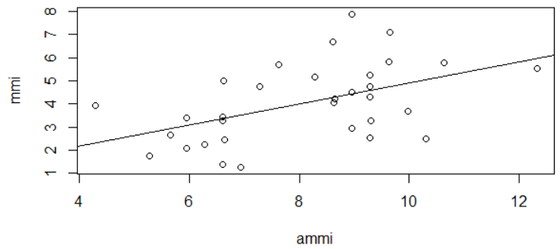

Figure 1. Scatterplot of MMI and AMM scores with line of best fit

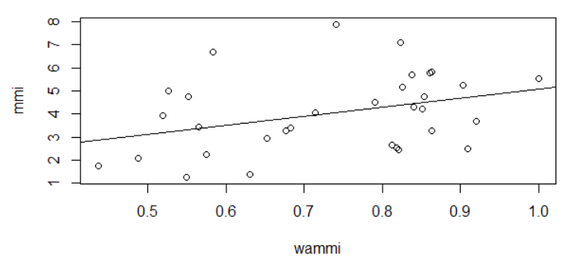

Figure 2. Scatterplot of MMI and AMM scores with line of best fit

Discussion

My findings supported the hypothesis that an abbreviated version of the Media Multitasking Inventory could capture the same information in fewer questions. Even with a very small sample size, the AMMI produced scores that correlated positively with MMI scores, indicating that the AMMI and MMI have convergent validity and measure the same construct. Because scores on the MPI were not correlated with scores on the MMI or AMMI, I was able to demonstrate discriminant validity both between the MPI and MMI and between the MPI and AMMI. This indicates that the AMMI is sufficient to measure media multitasking behavior and the longer MMI is not necessary for assessing that trait. Likewise, the AMMI is not merely a measure of multitasking preference but a measure of actual behavior.

MMI and AMMI scores showed similar distributions and standard deviations, but the means of weighted and unweighted AMMI scores were roughly double those of MMI scores. This may be an effect of over-generalization on the part of participants as they readily remember incidents of media multitasking when asked the more general AMMI questions, but when forced to recall more specific incidents of multitasking on the MMI, they can only think of incidents for relatively few media combinations. This may also be an artefact of the frequency with which scores of zero occur in the calculation of MMI scores. While the weighting of media types by usage attempts to negate this effect, an unequal distribution of the type of multitasking leads to overall lower scores in the MMI. For example, if a participant always listens to music while reading print materials but uses no other forms of media concurrently with print, the MMI would reflect a relatively low multitasking index for print materials while the AMMI would reflect a high multitasking index for the same medium. A response of "Never" would be less common in the AMMI as it is more likely for participants to recall a single instance of multitasking in general for a primary media than they might be for a specific pairing of media since the general question would necessarily encompass all pairings.

A bias against extremes may also lead to the lower scores on the MMI as participants may be more inclined to answer "Never" to questions regarding specific media multitasking pairings as seen in the MMI than they would to the general multitasking questions from the AMMI. Future studies of the AMMI could indicate whether this effect persists with usage of the AMMI. As the MMI was developed to consider standard scores comparing frequent media multitaskers to infrequent media multitaskers rather than raw score, the high degree of difference in raw scores should not affect the way the AMMI is applied. Furthermore, there is no a priori reason to believe multitasking scores should look more like those found for the MMI or the AMMI. Future observational research could indicate whether the MMI scores or AMMI scores more accurately reflect participants' real multitasking behavior.

I decided to include weighted AMMI scores in my analysis to see if weighting multitasking behavior by media type usage frequency would lead to AMMI scores that were more similar to MMI scores since this weighting is done in the MMI. Because weighting did not lead to a stronger correlation between MMI and AMMI scores, I do not believe that weighting is necessary. Since there is no need to weight, it is not necessary to include questions about how many hours participants use each form of media (the first part of the MMI) withinin the AMMI. As weighting multitasking situations by frequency did not provide any added value in this study and not weighting allows for *fewer* total questions, I do not recommend including a weighted component in future studies of the AMMI. Future testing of the AMMI can help to reveal whether weighting shows any benefit over the AMMI for larger samples or if it is similarly without benefit. Observational studies can likewise help to reveal whether the frequencies participants provide for weighting are accurate to their behavior.

By reducing the amount of questions needed to assess a participant's trait media multitasking behavior, the trait can be more easily assessed

and therefore better studied. Reducing the amount of fields in the media multitasking survey from 144 to either 13 (for researchers interested in unweighted AMMI scores) or 26 (for those interested in weighted scores) will allow for a much wider usage of the index when studying media consumption and multitasking behavior, potentially leading to lower dropout rates in online studies. The shorter time to administer the index will also help minimize fatigue induced by measuring media multitasking behavior, a side-effect of the MMI that may have led researchers to avoid using it in past studies.

The MMI and AMMI share some inherent flaws. Because both are self-report assessments of behavior, the accuracy with which they measure a participant's behavior is questionable. Self-report biases for this trait have not been studied, so it is unclear if participants are homogeneously skewing their reports or if their self-report errors are simply introducing noise into the results. Since the MMI and AMMI ask about specific forms of media, both print and online, it is possible that the medium a participant uses to complete the questionnaire may bias their responses. This is particularly true when the questionnaire is administered outside of lab conditions and/or online as participants may well be engaging in the sorts of multitasking behaviors that are being assessed while completing the MMI or AMMI, further biasing their self-reports. This particular flaw is especially relevant to this initial study of the AMMI as all data was collected from online participants in environments where they may have been engaging in media multitasking behavior.

The MMI and AMMI also share a flaw in the vagueness of potential responses with options such as "A little of the time", "Some of the time", and "Most of the time". This flaw is compounded by an arbitrary coding system that equates these responses to numerical values. For the purposes of this study, I decided to keep the same wording and coding of responses that was present in the original MMI study for maximum comparability. Going forward, it would be beneficial to reword the responses on the AMMI to be more specific, potentially by including answers such as "Never". "25% of the time", "50% of the time", and "75% of the time", and "Every time". Doing so would allow for more accurate reporting of behavior as it would avoid the vagueness the current responses allow.

I hope to replicate my findings with a larger and more diverse sample. If the AMMI can be further studied to verify that it measures the same underlying construct as the MMI, this would justify expanding the use of the AMMI into research areas where the MMI has typically been implemented. Some research has already been done on the effects of media multitasking on engagement while switching between contexts of work and entertainment (Brumby, Du Toit, Griffin, Tajadura-Jiménez, & Cox, 2014) as well as effects of media multitasking on engagement with particular sources of entertainment (Bardi, Rohm, & Sultan, 2010). This type of research is valuable to technology developers and media producers and consumers alike. I hope that the greater ease in studying media multitasking behavior afforded by AMMI enables designers to optimize technology for users according to their actual behavior, and media multitaskers can have a greater awareness and understanding of their behavior.

Author Note:

Sandy Gould at the University College London Interaction Centre supervised this research and provided indispensable guidance. Duncan Brumby at the University College London Interaction Centre provided additional support and made the lab available to the author.

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References

Bardhi, F., Rohm, A. J., & Sultan, F. (2010). Tuning in and tuning out: Media multitasking among young consumers. *Journal of Consumer behavior, 9(4),* 316-332. doi:10.1002/cb.320

Brumby, D. P., Du Toit, H., Griffin, H. J., Tajadura-Jiménez, A., & Cox, A. L. (2014). Working with the television on: an investigation into media multitasking. *Proceedings of the Extended Abstracts of the 32nd Annual ACM Conference on Human Factors in Computing Systems.* 1807-1812. doi:10.1145/2559206.2581210

Junco R., & Cotton SR (2010) Perceived academic effects of instant messaging use. *Computers and Education 56:* 370-378. https://doi.org/10.1016/j.compedu.2010.08.020

Loh, K. K., & Kanai, R. (2014). Higher media multitasking activity is associated with smaller gray-matter density in the anterior cingulate cortex. *PloS One, 9(9),* e106698. https://doi.org/10.1371/journal.pone.0106698

Lottridge, D. M., Rosakranse, C., Oh, C. S., Westwood, S. J., Baldoni, K. A., Mann, A. S., & Nass, C. I. (2015). The effects of chronic multitasking on analytical writing. *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems.* 2967-2970. doi: 10.1145/2702123.2702367

McLeod, P. (1977). A dual task response modality effect: Support for multiprocessor models of attention. *The Quarterly Journal of Experimental Psychology, 29(4),* 651-667. http://dx.doi.org/10.1080/14640747708400639

Ophir E., Nass C., & Wagner A.D. (2009) Cognitive control in media multitaskers. *Proceedings of the National Academy of Sciences of the United States of America 106:* 15583-15587. doi: 10.1073/pnas.0903620106

Pea, R., Nass, C., Meheula, L., Rance, M., Kumar, A., Bamford, H., ... & Zhou, M. (2012). Media use, face-to-face communication, media multitasking, and social well-being among 8-to 12-year-old girls. *Developmental psychology, 48(2),* 327. http://dx.doi.org/10.1037/a0027030

Poposki, E. M., & Oswald, F. L. (2010). The multitasking preference inventory: Toward an improved measure of individual differences in polychronicity. *Human Performance, 23(3),* 247-264. http://dx.doi.org/10.1080/08959285.2010.487843

Sanbonmatsu, D. M., Strayer, D. L., Medeiros-Ward, N., & Watson, J. M. (2013). Who multi-tasks and why? Multi-tasking ability, perceived multi-tasking ability, impulsivity, and sensation seeking. *PloS one, 8(1),* e54402. https://doi.org/10.1371/journal.pone.0054402

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Anthony is currently the Project Coordinator for Dr. Patricia Kerig's lab at the University of Utah. His specific research interests include trauma, callous-unemotional traits, and the psychophysiological mechanisms underlying youth involvement in the justice system. Anthony graduated from Fordham University in May 2016 with a BS in Psychology and is pursuing graduate school for clinical psychology with a forensic focus.

Was there a particular experience that sparked your research interests?

My research interests were largely shaped by an internship I did with a re-entry program when I was in college. I had the opportunity to work directly with individuals getting released from NY State Prisons to the NYC shelter system, suffering from severe mental illness and/or substance use issues. The social inequality and level of trauma exposure they experienced as youth gave me a first-hand look at the forensic population's high level of risk and vulnerability.

Who has been an influential person in your life?

Academically, Dr. Keith Cruise of Fordham University has been the most influential. He was my academic advisor from day one as a psych major, mentored my senior thesis, and still continues to guide me. My research interests have largely been shaped through talking with him, working with him, and opportunities that he has connected me to.

When and where are you the most productive?

I'm most productive anywhere that isn't my apartment, and that doesn't have windows. Preferably, I have no idea what time it is.

Where do you see yourself in 10 years?

In ten years I see myself finished with grad school, continuing to pursue knowledge of how to best help at-risk youth.

The Impact of Substance Use and Trauma Reactions on Treatment Outcomes in a City Court Treatment Program

Anthony Fortuna
Fordham University

Treatment courts are alternative-to-incarceration programs offered to qualifying offenders, that require participants to take part in treatment for mental health conditions, along with rehabilitative services to reduce recidivism. The present study examined factors influencing treatment court outcome. Specifically, substance use issues and level of active symptoms of Posttraumatic Stress Disorder [PTSD] were measured. Data for 79 individuals was collected in a city drug treatment court program, which serves offenders convicted of substance-related offenses. Logistic regression analyses were utilized to examine the relationship between level of substance use issues and negative treatment outcomes, and also to test the level of active symptoms of PTSD as a predictor of treatment outcomes. Consistent with prior research, substance use issues significantly predicted a greater likelihood of negative treatment outcome. However, the level of PTSD symptoms was not a significant predictor of negative treatment outcome. These results suggest level of substance use, as measured in this study, should be a prominent treatment target within the program.

Treatment courts are special courts that serve as alternative-to-incarceration programs for offenders (i.e. justice-involved individuals, individuals under the supervision of the criminal justice system) that qualify. Qualifying offenders (e.g. non-violent felons or misdemeanor offenders with substance use or mental health issues) are required to take part in treatment programs for their substance use or mental health condition(s), as well as treatment services to reduce risk for re-arrest or recidivism, (Rossman & Zweig, 2012). According to the National Institute of Justice, there are currently over 3,400 drug treatment courts in the United States, and this number continues to increase (National Institute of Justice, 2015). Treatment courts started out as drug courts for adult offenders with substance use issues, but have expanded in type and number (e.g. programs for juveniles, repeat DWI offenders, mental health courts; Huddleston, Marlowe, & Casebolt, 2008). With the increase in treatment court popularity, many scholars have turned their attention to figuring out what factors influence success or failure as a treatment court participant. The current study will look at the impact of both substance use and posttraumatic stress reactions on participant outcome in these programs. Findings can help increase the effectiveness of these programs through more

informed treatment planning upon participants' intake.

In creating treatment plans for clients, treatment court case managers and administrators connect clients to external treatment programs. Program placement is based on recidivism risk and client needs, both of which are assessed at program entry. One significant risk factor, identified as a changeable risk factor and a predictor of recidivism risk in adult offenders (e.g., criminogenic need), is substance use. This indicates that offenders with substance use problems are less likely to succeed in these types of treatment court programs if treatment services are not matched to the identified substance use need (Andrews, Bonta, & Wormith 2006). This is largely due to risk factors associated specifically with continued substance use, including the increased likelihood of contact with law enforcement associated with substance use (e.g. buying and using illicit substances, risky behavior while under the influence), as well as failing treatment court programs that require participants to remain substance-free. These risk factors are minimized when treatment services (e.g. detox, rehab) target substance use. A related phenomenon is the prevalence of comorbid substance use and active reactions to trauma (i.e. active symptoms of Post Traumatic Stress Disorder [PTSD]). Co-occurring substance use and PTSD is estimated to be between 53% and 65% in offender samples (Kessler, Sonnega, Bromet, Hughes, & Nelson, 1995; Proctor & Hoffman, 2012; Sindicich et al., 2014). The most common explanation for this relationship is the "self-medication" hypothesis, which theorizes that PTSD is a risk factor for substance use, and substance use serves as a coping mechanism for symptoms of PTSD (i.e. substance use as a response to active PTSD symptoms; Khantzian, 1997). This makes treating substance use issues much more difficult, as active symptoms of PTSD would be the trigger (i.e. underlying cause) for substance use. In treatment programs targeting substance use and requiring participants to remain substance-free, those with active, unaddressed symptoms of PTSD would be at a significant disadvantage. This gives reason to believe that active PTSD symptoms may impact the association between level or severity of substance use and treatment program outcomes (i.e. premature dropout, failure to comply with treatment services, re-arrest). As such, it is critical to investigate the impact of PTSD symptoms on treatment court outcomes. If research supports that PTSD symptoms are related to negative outcomes, it will be very important to address this mental health factor through case management and treatment planning.

Treatment Court Effectiveness

Although treatment court programs have greatly increased in popularity over the last two and a half decades, data on program effectiveness requires further elaboration (Gifford, Eldred, McCutchan & Sloan, 2014; Mitchell, Wilson, Eggers, & Mackenzie, 2012; Rossman & Zweig, 2012). One example of this is Mitchell and colleagues (2012), who conducted a meta-analysis on the effectiveness of drug treatment courts in reducing criminal recidivism. The researchers examined 154 separate program evaluations (92 adult drug courts, 34 juvenile drug courts, and 28 DWI drug courts), which involved over 35,000 treatment court participants. Adult, juvenile, and DWI drug court programs all had significant effects on participants, significantly reducing likelihood of criminal recidivism in relation to the comparison group of traditional court participants. The average recidivism rate for traditional court participants was 50%, while treatment court participants had a recidivism rate of 38%.

Outcome studies conducted by Gifford and colleagues (2014), and Rossman and Zweig (2012) provided results in line with Mitchell and colleagues (2012). Results indicated decreased recidivism rates for those participating in treatment court versus those who did not, thus providing modest support in favor of treatment court effectiveness. Overall, treatment courts were successful in lowering recidivism rates among participants who completed the program; however, there is no evidence supporting that the effectiveness of treatment courts is being maximized. Even if treatment courts are more effective in reducing recidivism when comparable cases are tracked in traditional court settings, the goal is to create programs that are maximally effective. To truly maximize effectiveness, evaluations of program effectiveness must look more specifically at client-level treatment predictors, which was not the case for the three articles mentioned above.

Substance Use Disorder Symptoms as a Criminogenic Need

Andrews, Bonta, and Wormith (2006) identified what are known as the "Central Eight" criminogenic risk and need factors (i.e. dynamic, changeable factors), which consist of history of antisocial behavior, antisocial personality pattern, antisocial cognition, antisocial associates, family and marital circumstances, school and work, leisure and recreation, and substance abuse. These eight factors are what Andrews et al. (2006) have identified to be the most important risk and needs factors to take into account when determining level of treatment and attempting to decrease criminal recidivism. Bonta, Blais, and Wilson (2013) conducted a meta-analysis testing the effects associated with the "Central Eight" factors. Their meta-analysis examined outcomes across 96 unique samples involving 28,600 participants. Of the eight factors, substance use had the largest effect size on general recidivism.

This finding is of significant interest given high rates of substance abuse or dependence observed in offender populations. Peters, Greenbaum, Edens, Carter, and Ortiz (1998) found that of the 400 state prison inmates included in their sample, 74% were found to have a lifetime substance abuse or dependence disorder, with over 50% of the inmate sample being diagnosed in the 30 days prior to their incarceration. Fazel, Bains, and Doll (2006) found that in their sample of 7,563 prisoners, substance use or dependence disorder was observed in 48% of male participants and 60% of female participants. Belenko and Peugh (1998) conducted a similar study and found that of the 1.4 million inmates included in their study, approximately 80% (81% of state inmates, 80% of federal inmates, 77% of local jail inmates) were seriously involved with drugs or alcohol. Although substance use disorders have such a high prevalence in offender populations, offenders are also commonly afflicted with mental health issues.

The Impact of Post Traumatic Stress Disorder Symptoms

In addition to substance use issues, offender populations also have a very high prevalence of co-occurring mental health disorders. Additionally, comorbid substance use and mental health disorders have been linked to an increased risk of criminal recidivism (Messina, Burdon, Hagopian, & Prendergast, 2004). To properly treat individuals who have either substance use disorders or co-occurring disorders, the elevated risk of recidivism they experience must be effectively reduced. To do this, the relationship between substance use and co-occurring substance use and mental health disorders, and negative outcomes (e.g. treatment failure, recidivism) needs to be better understood. Focusing on specific, highly prevalent mental health disorders that commonly co-occur with substance use disorders holds promise as a means to improve treatment program specificity and reduce recidivism.

PTSD is one of the most common comorbid disorders with substance use disorders, especially in forensic populations (Proctor & Hoffman, 2012; Sindicich et al., 2014). Proctor and Hoffman (2012) studied 176 male inmates from a United States jail facility, all of which qualified

for a substance dependence diagnosis. The researchers found that the highest comorbidity with substance dependence was PTSD, with 97 (55%) inmates fitting this diagnostic profile. Sindicich and colleagues (2014) found that in their sample of 30 male inmates, 27 (90%) had a history of substance dependence, with 17 (56.7%) meeting criteria for PTSD and the remaining 13 (43.3%) experiencing sub-threshold symptoms (i.e. all 30 inmates experienced some form of PTSD related symptoms, with 27 of the 30 experiencing comorbid substance dependence and PTSD symptoms). Sindicich and colleagues (2014) specifically detailed the complex trauma exposure that the prisoners experienced. For example, the mean number of traumatic event types endorsed (e.g. victim of any sexual abuse, victim of assault, witnessing a serious injury or death at any point, etc.), was 4.1 (*SD* = 1.84) for each of the 30 inmates (Sindicich et al., 2014). This number does not take into account the frequency of each type of traumatic exposure (e.g. number of times sexually abused, number of times a victim of assault, number of times witnessing serious injury or death, etc.) to reflect the diversity and severity of exposure that is characteristic of this population.

The mechanisms linking PTSD and substance use have been hypothesized through various conceptual models, but longitudinal research expresses the most support for PTSD as a risk factor for substance use (i.e. the "self-medication" hypothesis; Addington & Duchak, 1997; Dixon, Haas, Weiden, Sweeney & Francis, 1991; Goswami, Mattoo, Basu, & Singh, 2004; Khantzian, 1997). Under the "self medication" hypothesis, individuals typically develop substance use as a coping mechanism for post-traumatic stress reactions. In other words, it is hypothesized that those who have comorbid substance use and PTSD have reinforced the habit as a result of alleviating symptoms.

Since PTSD is supported as the most common co-occurring disorder with substance use, and also because co-occurring substance use and mental health disorders are linked to higher risk of negative outcomes (e.g. treatment program failure, recidivism), it is possible that PTSD symptoms have an influence on the relationship between substance use and outcome. More specifically, the severity of PTSD symptoms may strengthen the association between substance use issues and negative treatment outcomes. Since individuals with only substance use issues have high recidivism risk, we would expect the comorbid presence of PTSD symptoms to exacerbate this risk.

Present Study

The overall aim of the present study was to examine the impact of substance use problems as a criminogenic risk factor, and the impact of PTSD symptoms for clients in a city treatment court offender rehabilitation program. Prior research has established substance use as a significant risk factor for recidivism and negative treatment court outcomes. However, researchers have not yet addressed to what extent PTSD symptoms impact outcomes for treatment court participants with substance use problems. Individuals experiencing PTSD symptoms might have a more difficult time responding to their overall treatment and substance use treatment in particular. In other words, PTSD symptoms may exacerbate substance use and make the individual even less responsive to treatment than they would be with substance use issues alone, given the common use of substances in response to PTSD reactions and the prevalence of comorbid substance use and PTSD in the offender population. As such, the main study hypotheses were as follows: (1) level of substance use problems assessed at treatment program intake would predict negative treatment program outcomes and (2) level of PTSD symptoms would also predict negative treatment program outcomes.

Evidence supporting both hypotheses has implications for pre-treatment assessments and designing more effective treatment plans. Support for hypothesis 1 reinforces substance use as a significant risk factor in offender rehabilitation programs aimed at reducing recidivism risk. Support for hypothesis 2 would imply active symptoms of PTSD are also a significant risk factor in programs aimed at offender rehabilitation.

Method

Participants

	Mean	SD	Range
Age (years)	37.30	11.80	18-63
	n (%)		
Gender			
Male	70 (88.6)		
Female	9 (11.4)		
Race			
Alaska Native	1 (1.3)		
American Indian	2 (2.5)		
Asian	2 (2.5)		
Black	41 (51.9)		
Native Hawaiian/Other Pacific Islander	1 (1.3)		
White	17 (21.5)		
Level of Education			
1st-8th Grade	3 (3.8)		
9th-11th Grade	38 (48.1)		
Table 1 (continued)			
High School Diploma/ Equivalent	29 (36.7)		
Some College	8 (10.1)		
Bachelor's or Higher	1 (1.3)		

Table 1. Demographics

The participants in this study were enrolled in a New York City drug treatment court program from January 2015 to October 2015. To be admitted into the drug treatment court program, case managers assess individuals who committed a misdemeanor or non-violent felony drug offense within the county jurisdiction for eligibility. Based on the case manager's assessment, participation in the program can be mandated by a judge as an alternative to serving time in a correctional facility. To participate in the program, eligible individuals must enter a guilty plea, and sign a court mandate outlining the conditions of the program. As participants in the program, individuals were required to meet on a weekly basis with their assigned program case manager, be placed in and regularly attend external treatment program for their respective conditions (e.g. substance use or mental health issues), and remain drug free (i.e. participants are urinalysis tested for drug and alcohol use on a weekly basis). Participants in the program were included in this study if they had complete intake information and were enrolled in the program during the specified dates noted above (i.e. in the program for at least 6 months at time of data collection). Participants were excluded if complete intake information was not available (e.g. no PCL-5, GPRA), or if they were not in the program longer than 6 months at the time of data collection. See Table 1 for participant descriptive information.

Measures

The measures employed in this study were the Post Traumatic Stress Disorder Checklist for the DSM-V (PCL-5), the Government Performance Results Modernization Act assessment (GPRA), and client outcome in the program measured at six months after intake.

PCL-5. The PCL-5 is a 20-question interview conducted as a part of the program's intake assessment. Each item is scored on a Likert-type scale from 0 to 4 (e.g. *Not at all, A little bit, Moderately, Quite a bit, Extremely*) yielding a total possible score from 0 to 80. PCL-5 total score can be used to indicate level of active PTSD symptoms. Wortmann et al. (2016) conducted a psychometric analysis of the PCL-5, utilizing a sample of 912 present service members and recently retired service members being treated at an Army Medical Center, and reported

reliability and validity estimates. The assessment was administered to study participants at baseline, and then 2 weeks post treatment, and yielded strong internal consistency, with Cronbach's alphas of α = .91 at baseline, and α = .95 at follow-up, concluding that the PCL-5 is psychometrically sound. Bovin et al. (2015) also conducted a study testing the psychometric properties of the PCL-5 in a veteran sample (*N* = 140) and reported strong internal consistency (α = .96) for the total score, strong test-retest reliability (*r* = .84), and high convergent and discriminant validity.

GPRA. The GPRA assessment (i.e. Government Performance and Results Act) is a self-report, descriptive assessment that was also conducted at intake for clients in this treatment court program. The GPRA includes sections on demographics, substance use history for the thirty days prior to arrest, mental health symptoms, treatment goals, etc. For this study, the demographics section was used to retrieve information on participant gender, race, ethnicity, age, and education level. The substance use history section was also used to create a dynamic substance use composite scale unique to this study, indicating level of substance use issues in the thirty days prior to arrest. To create this original composite, questions involving specific substances used, along with functional impairment due to substance use, were utilized. Participants received a score of one for each individual substance used in the thirty days prior to arrest (e.g. a participant who reported using only crack, marijuana and heroin received a score of 3). The maximum score for substances used was 23. The functional impairment due to substance use was calculated based on three GPRA questions detailing living conditions and patterns of functional impairment due to substance use. These items were scored from 0 to 3, based on the participant's response (e.g., *Not at all, Somewhat, Considerably, Extremely*); therefore, the maximum score of the impairment composite was 9. The substances use and functional impairment due to substance use composites were then summed to create an overall composite substance use problems score. The GPRA total substance use composite demonstrated strong internal consistency in this study, yielding a Cronbach's alpha of α = .70.

Treatment Outcome. Program outcome, taken at six months after program enrollment, was the outcome variable utilized in this study. Participant outcomes were dummy coded, as either positive (1) or negative (0), as outlined by program guidelines for success or failure. The drug treatment court program provided all outcome data, as it was based on their guidelines for program success or termination. A positive outcome refers to any compliant client who either successfully graduated the program, or was still enrolled in treatment at the 6-month mark. A negative outcome refers to any client who was terminated from the program (i.e. non-compliant with program rules). This was the result of being warranted by the program and judge (e.g. positive drug urinalysis, absconded from program), or after being rearrested on a new charge.

Procedure

This study employed a short-term longitudinal research design. The independent variables utilized were level of substance use problems and PTSD symptoms, both of which were measured at intake. The dependent variable was treatment program outcome (e.g. success or failure), measured at 6-months post-intake. This study was entirely archival with assessment data extracted from patient records. To ensure the privacy of study participants, all data were de-identified and exported into a research database with participant data identified with a unique research ID. All study procedures were reviewed and approved by the Fordham University Institutional Review Board.

Data analysis consisted of calculating descriptive statistics for all study variables to explore patterns of substance use and PTSD symptoms as measured by the GPRA and PCL-5, respectively. A series of binary logistic regression analyses were conducted in SPSS to evaluate study hypotheses.

Results

Baseline assessments measuring level of substance use issues (GPRA) and active PTSD symptoms (PCL-5) were used in the analyses testing the study hypotheses. In the current sample, 55 individuals acknowledged some form of substance use in the 30 days prior to their arrest, varying in type and degree of use, with an average of 2.75 (*SD* = 2.37) different substances used out of 27 possible substances queried on the GPRA. Participants had an average impairment score of 1.92 (*SD* = 2.69) with impairment scores ranging from 0 to 9. Item level results of the GPRA substance use and impairment are reported in Tables 2 and 3 respectively.

The average score for participants that completed the PCL-5 was 12 (*SD* = 17.5), with 8 (10.26%) scoring above 33, which is the threshold identified in current research on the PCL-5 as indicative of a PTSD diagnosis (Wortmann et al., 2016; Bovin et al., 2015). Item level results for the PCL-5 assessment can be found in Table 4. PCL-5 data was missing for one participant (*n* = 78) due to lack of availability in program records.

Measured at six months after intake, 61 (79.2%) participants were classified as having a positive program outcome. This included 6 (7.8%) individuals that were successful graduates, and 55 (71.4%) that were compliant in the program at the 6-month post-intake date. At the 6-month post-intake date, 16 (20.8%) participants were classified as having a negative program outcome. Ten participants (13.0%) were warranted by a judge and 6 (7.8%) were rearrested for an entirely new crime while receiving treatment. Treatment outcomes were examined for significant differences by demographic variables (e.g., gender, race/ethnicity, education level) and resulted in non-significant frequency differences indicating no need to control for demographic differences in the regression analyses.

To test study hypotheses, a logistic regression analysis was conducted, including the GPRA Substance Use composite and PCL-5 total score as predictors of negative program outcome. Results of the regression model were statistically significant, χ^2 (2, *N* = 75) = 7.763, *p* = .021, and accounted for 16% of the variance in program outcome (*Nagelkerke's* R^2 = .159). Level of substance use (β = .187, *p* = .016) significantly predicted negative treatment outcome in this model. However, in this model the PCL-5 total score (β = -.030, *p* = .190) was not a significant predictor of negative program outcome.

Discussion

The current study employed logistic regression analyses to test if treatment outcomes could be predicted based on level of substance use, and level of active symptoms of Post Traumatic Stress Disorder (PTSD) among participants in a city court treatment program. The current study hypotheses were constructed to evaluate to what extent an important criminogenic need (substance use) along with PTSD symptoms impacted negative court outcomes. Results provided support for the first hypothesis; however, no evidence was provided in support of this study's second hypothesis.

The logistic regression analysis conducted to test hypothesis 1 produced significant results. This is consistent with Bonta, Blais, and Wilson (2013), whose results supported level of substance abuse as one of the strongest predictors of negative treatment outcomes. This result is also consistent with research by Andrews et al. (2006), who identified substance abuse as a criminogenic need factor that should be addressed in treatment planning in offender rehabilitation programs. In clinical settings, this means that substance use issues need to be addressed in order to minimize the likelihood of negative outcomes, and also that level of

substance use issues should be addressed as a dynamic risk factor. The city treatment court program that this sample was taken from should utilize the GPRA substance use report measures to influence the level and type of treatment each client receives, based on level of substance use issues.

For hypothesis 2, the logistic regression conducted did not produce significant results. Increasing score on the PCL-5 did not have a significant main effect on predicting likelihood of negative treatment outcomes. This result is inconsistent with what was expected, given the known comorbidity of substance use and PTSD in offenders, and also the reinforcing "self-medicating" behaviors that commonly exist with individuals with these comorbid conditions.

Implications

Given the evidence in support of hypothesis 1, there are direct implications for the treatment court program. Since the level of substance use issues in the 30 days prior to arrest experienced by program participants can be interpreted dynamically, and reflected a greater likelihood of program failure with an increase in substance use issues, initial treatment engagement should consider focusing on the level of recent use. For example, since the GPRA assessment is administered at intake, the participant's initial treatment contacts should include substance use treatment based on the severity of current use. This may include referring individuals to more intensive substance use counseling, or simply acknowledging that they will need to work with program staff to target ways to manage substance use while awaiting referrals to treatment and/or during early stages of substance use treatment. More intensive services within the program can include submitting more regular and random drug testing, and/or be considered for detoxification and rehabilitation services prior to starting general substance counseling. It may be feasible for individuals with less severe substance use issues to be safely referred to outpatient substance use treatment services, paired with mental health services (e.g. behavioral health treatment, mental health counseling, psychiatric services) if applicable, to address other mental health issues commonly associated with substance use.

Although there was no evidence in support of hypothesis 2, this does not mean active symptoms of PTSD do not need to be addressed in these types of treatment court programs. If future research can support active PTSD symptoms as a significant risk factor for negative treatment outcomes, then treatment plans should address this through appropriate mental health services to minimize this risk.

Limitations and Future Research Directions

The current study involved several limitations that likely impacted results including: lack of variation in substance use issues and symptoms of PTSD, lack of information on the type and level of treatment each client received, follow-up length, sample size, and the nature of the treatment court program that this sample was taken from.

First, the sample did not provide as much variation in level of substance use issues and symptoms of PTSD as expected. Although the level of active PTSD symptoms (i.e. PCL-5 score) was being treated as a dynamic scale, the vast majority of scores fell in the low or moderate range. Sixty-nine (89.6%) individuals in this study scored below the threshold indicative of a PTSD diagnosis. Average PCL-5 total scores indicated relatively low endorsement of PTSD symptoms, which may have impacted use of the total score as a predictor of negative program outcome. This finding does not necessarily suggest that high scores are not a significant target when treatment planning. However, what this result does suggest is that the level of PTSD symptoms is not predictive of a negative program outcome. What is clear from the data is that of the small percentage of participants who scored above the PTSD threshold on the PCL-5, all endorsed active substance use (n = 8, 100%). This result is consistent with the literature on co-occurring disorders among offender populations. Given that patterns of substance use and level of PTSD symptoms were known to program staff it is possible that these offenders were referred to and received different treatment relative to offenders without this pattern. It is also possible that participants who scored high on the PCL-5 alone were referred to specific treatment programs that targeted these symptoms.

This leads to the fact that this study did not take into account the type or level of treatment that each participant was receiving due to lack of availability. The only information accessible to the researchers was the location that treatment was being delivered and broad modality (e.g. mental health counseling, behavioral health, substance counseling, mentally ill chemical abuse; inpatient, outpatient, rehab). Additionally, many participants participated in several different programs throughout their time in the treatment court. In future studies, treatment dosage and the specific treatment types should be tracked, given level of treatment also greatly influences the treatment outcome. The models tested in the study were limited based on the assumption that all participants were provided with an equivalent level of treatment, which may or may not be the case. Level of treatment participants receive should be assessed based on residential versus day program, and the level of treatment that each specific program typically provides (i.e. the level of addiction or mental illness that a program typically serves).

The 6-month treatment outcomes employed in this study were an additional limitation. The treatment outcomes utilized in this study indicated short-term success or failure, when long-term success is the goal in gauging successful offender rehabilitation programming. Future research should look to incorporate longer outcomes (i.e. test long-term treatment success). Another limitation was the power of this study, in that a larger sample size would have increased the ability to detect smaller effect sizes with greater precision. A larger sample would also provide greater variation in the level of substance use issues, along with level of active PTSD symptoms. Another contributor to lack of variation in substance use issues and active levels of PTSD was the nature of the program that was utilized. To qualify for the program, participants only needed to be convicted of a substance-involved crime (i.e. criminal possession, criminal sale, etc.), which does not explicitly imply functional impairment associated with a pattern of actual use. Additionally, since these crimes are non-violent felonies and misdemeanor in nature, they tend to be lower risk in relation to other offender populations. Programs including higher and lower risk offenders should be employed in the future in order to gain a more representative sample of offenders in terms of overall recidivism risk level (e.g. potential exposure to trauma), and substance use. This would also enhance external validity, since a sample with more diverse offenders would need to extend beyond a single, specialty treatment court.

The nature of the GPRA substance use composite developed in this study must also be addressed, given a higher score not only reflected higher impairment due to substances, but also a greater number of substances used in the 30 days prior to arrest, rather than taking into account the amount that each substance was used (e.g. an individual that used crack for all 30 days scored lower on the GPRA substance use composite than an individual that used both crack and marijuana for one day each, before taking functional impairment into account). This decision was made to maximize objectivity in the self-report, since the recollection of whether an individual used a substance requires less judgment than the amount of days an individual used a substance. It must also be highlighted that the substance use composite is unique to this study, and there is no existing literature validating this method of measuring substance

use issues. Nonetheless, participant score on this composite was a significant predictor of negative treatment outcome. This means that method of measuring substance use problems may be indicative of other issues (e.g. behavioral, psychological, environmental), linked to the number of substances used, as opposed to the amount each substance was used. The associations that emerged were in line with hypothesis 1 so further replication can provide support for this method of measuring substance use issues. Further replication of this study's results, in line with the aforementioned suggestions for future research, can help to provide a better answer for this research question.

Conclusion

This study found that even in the context of a treatment court specifically designed for offenders with substance-related offenses, the level of substance use during the 30-days prior to program intake is a significant predictor of negative treatment outcomes. This result is consistent with substance use as a significant risk factor. This finding also reinforces the idea that it would be helpful for treatment program staff to address frequent and recent substance use. The development of engagement and supervision strategies that immediately address the potential functional impairment associated with recent substance use patterns can potentially increase the likelihood of a positive program response.

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References

Addington, J., & Duchak, V. (1997). Reasons for substance use in schizophrenia. *Acta Psychiatrica Scandinavica, 96(5),* 329-333. doi:10.1111/j.1600-0447.1997.tb09925.x

Andrews, D.A., Bonta, J., & Wormith, J.S. (2006). The recent past and near future of risk and/or need assessment. *Crime and Delinquency, 52,* 7-27. doi: 10.1177/0011128705281756

Belenko, S. & Peugh, J., 1998. *Behind Bars: Substance Abuse and America's Prison Population.* New York: National Center on Addiction and Substance Abuse at Columbia University.

Bonta, J., Blais, B., & Wilson, H.A. (2013). T*he prediction of risk for mentally disordered offenders: a quantitative synthesis.* User Report 2013-01. Ottawa (Canada): Public Safety Canada.

Bovin, M. J., Marx, B. P., Weathers, F. W., Gallagher, M. W., Rodriguez, P., Schnurr, P. P., & Keane, T. M. (2015). Psychometric properties of the PTSD checklist for diagnostic and statistical manual of mental disorders-fifth edition (PCL-5) in veterans. *Psychological Assessment, 27,* 1-13. doi: 10.1037/pas0000254

Dixon, L., Haas, G., Weiden, P. J., Sweeney, J., & Frances, A. J. (1991). Drug abuse in schizophrenic patients: clinical correlates and reasons for use. *Am J Psychiatry, 148,* 224-230. doi: 10.1176/ajp.148.2.224

Fazel, S., Bains, P., & Doll, H. (2006). Substance abuse and dependence in prisoners: A systematic review. *Addiction, 101,* 181-191. doi: 10.1111/j.1360-0443.2006.01316

Gifford, E.J., Eldred, L.M., McCutchan, S.A., Sloan, F.A. (2014). The effects of participation level on recidivism: A study of drug treatment courts using propensity score matching. *Substance Abuse Treatment, Prevention, and Policy, 9*, 1-8. Retrieved from http://www.substanceabusepolicy.com/content/9/1/40

Goswami, S., Mattoo, S. K., Basu, D., & Singh, G. (2004). Substance-abusing schizophrenics: do they self-medicate?.*AmericanJournalonAddictions,* 13(2), 139-150. doi:10.1080/10550490490435795

Huddleston, C. W., Marlowe, D. B., & Casebolt, R. (2008). *Painting the current picture: A national report card on drug courts and other problem-solving court programs in the United States.* Washington, DC: National Drug Court Institute.

Kessler, R.C., Sonnega, A., Bromet, E., Hughes, M., Nelson, C.B. (1995). Posttraumatic stress disorder in the national comorbidity survey. *Archives of General Psychiatry, 52,* 1048-1060. doi:10.1001/archpsyc.1995.03950240066012

Khantzian, E. J. (1997). The self-medication hypothesis of substance use disorders: a reconsideration and recent applications. *Harvard Review of Psychiatry, 4*, 231-244. doi:10.1007/978-1-4613-1837-8_7

Messina, N., Burdon, W., Hagopian, G., & Prendergast, M. (2004). One year return to custody rates among co-disordered offenders. *Behavioral Sciences & the Law, 22,* 503-518. doi: 10.1002/bsl.600

Mitchell, O., Wilson, D.B., Eggers, A., & Mackenzie, D.L. (2012). Assessing the effectiveness of drug courts on recidivism: A meta-analytic review of traditional and non-traditional drug courts. *Journal of Criminal Justice, 40,* 60-71. doi:10.1016/j.jcrimjus.2011.11.009

National Institute of Justice. (2015). *Drug Courts.* Washington, DC: National Institute of Justice. Retrieved from http://www.nij.gov/topics/courts/drug-courts/pages/welcome.aspx

Peters, R.H., Greenbaum, P.E., Edens, J.F., Carter, C.R., & Ortiz, M.M. (1998). Prevalence of DSM-IV substance abuse and dependence disorders among prison inmates. *The American Journal of Drug and Alcohol Abuse, 24,* 573-587. doi: 10.3109/00952999809019608

Proctor, S.L., & Hoffman, N.G. (2012). Identifying patterns of co-occurring substance use disorders an mental illness in a jail population. *Addiction Research and Theory, 20*, 492-503. doi: 10.3109/16066359.2012.667853

Rossman, S.B., & Zweig, J.M. (2012, May). *What have we learned from the Multisite Adult Drug Court Evaluation? Implications for practice and policy.* Alexandria, VA: National Association of Drug Court Professionals. Retrieved from http://www.nadcp.org/sites/default/files/nadcp/Multisite%20Adult%20Drug%20Court%0Evaluation%20-%20NADCP.pdf.

Sindicich, N., Mills, K. L., Barrett, E. L., Indig, D., Sunjic, S., Sannibale, C., Rosenfeld, J., & Najavits, L. M. (2014). Offenders as victims: post-traumatic stress disorder and substance use disorder among male prisoners. *The Journal of Forensic Psychiatry & Psychology.*

Wortmann, J. H., Jordan, A. H., Weathers, F. W., Resick, P. A., Dondanville, K. A., Hall-Clark, B., ... Litz, B.T. (2016). Psychometric analysis of the PTSD checklist-5 (PCL-5) among treatment-seeking military service members. *Psychological Assessment, 28*, 1-12. doi: 10.1037/pas0000260

Appendix

Table 2.

GPRA Item-Level Substances Used Responses (N = 79)

	Item	Item Anchor	
During the past 30 days, have you used or experienced the following:		Yes *n* (%)	No *n* (%)
1.	Any alcohol	32 (40.5)	47 (59.5)
2.	Alcohol to Intoxication (5+drinks in one sitting)	9 (11.4)	70 (88.6)
3.	Alcohol to intoxication (4 or fewer drinks in one sitting and felt high)	19 (24.1)	60 (75.9)
4.	Illegal Drugs	49 (62.0)	30 (38.0)
5.	Both alcohol and drugs	22 (27.8)	57 (72.2)
6.	Cocaine/Crack	21 (26.6)	58 (73.4)
7.	Marijuana/Hashish	36 (45.6)	43 (54.4)
8.	Heroin	12 (15.2)	67 (84.8)
9.	Morphine	1 (1.3)	78 (98.7)
10.	Dilaudid	0 (0)	79 (100)
11.	Demerol	1 (1.3)	78 (98.7)
12.	Percocet	0 (0)	79 (100)
13.	Darvon	0 (0)	79 (100)
14.	Codeine	0 (0)	79 (100)
15.	Tylenol 2, 3, 4	1 (1.3)	78 (98.7)
16.	OxyContin/Oxycodone	3 (3.8)	76 (96.2)
17.	Non-prescription methadone	0 (0)	79 (100)
18.	Hallucinogens/psychedelics	3 (3.8)	76 (96.2)
19.	Methamphetamine or other amphetamine	0 (0)	79 (100)
20.	Benzodiazepines	5 (6.3)	74 (93.7)
21.	Barbiturates	0 (0)	79 (100)
22.	Non-prescription GHB	0 (0)	79 (100)
23.	Ketamine	1 (1.3)	78 (98.7)
24.	Other tranquilizers	0 (0)	79(100)
25.	Inhalants	0 (0)	79 (100)
26.	Other illegal drugs	5 (6.3)	74 (93.7)

Table 3.

GPRA Item-Level Responses for Functional Impairment Due to Substance Use (N = 79)

Item	Item Anchor				
During the past 30 days	Not at all *n* (%)	Somewhat *n* (%)	Considerably *n* (%)	Extremely *n* (%)	N/A *n* (%)
1. How stressful have things been for you because of your use of alcohol or other drugs?	33 (41.8)	19 (24.1)	2 (2.5)	12 (15.2)	13 (16.5)
2. Has your use of alcohol or other drugs caused you to reduce or give up important activities?	46 (58.2)	7 (8.9)	5 (6.3)	5 (6.3)	16 (20.3)
3. Has your use of drugs or alcohol caused you to have emotional problems?	43 (54.4)	11 (13.9)	4 (5.1)	5 (6.3)	16 (20.3)

Table 4.

PCL-5 Item-Level Responses (N = 78)

Item	Response (Score value)						
In the past month, how much were you bothered by:	Not at all *n* (%)	A little bit *n* (%)	Moderately *n* (%)	Quite a bit *n* (%)	Extremely *n* (%)	Refused *n* (%)	Don't know *n* (%)
1. Repeated, disturbing, and unwanted memories of a stressful experience?	51 (65.4)	10 (12.8)	5 (6.4)	7 (9.0)	4 (5.1)	1 (1.3)	0
2. Repeated, disturbing dreams of the stressful experience?	63 (80.7)	6 (7.7)	2 (2.6)	3 (3.9)	3 (3.9)	1 (1.3)	0
3. Suddenly acting or feeling as if the stressful experience were happening again (as if you were actually back there reliving it)?	62 (79.5)	7 (9.0)	4 (5.1)	2 (2.6)	2 (2.6)	1 (1.3)	0
4. Feeling very upset when something reminded you of the stressful experience?	52 (66.7)	9 (11.5)	4 (5.1)	6 (7.7)	6 (7.7)	1 (1.3)	0
5. Having strong physical reactions (e.g. heart pounding, trouble breathing, sweating) when something reminded you of the stressful experience?	62 (79.5)	4 (5.1)	5 (6.4)	5 (6.4)	1 (1.3)	1 (1.3)	0
6. Avoiding memories, thoughts, or feelings related to the stressful experience?	53 (67.9)	8 (10.3)	7 (9.0)	7 (9.0)	2 (2.6)	1 (1.3)	0
7. Avoiding external reminders of the stressful experience (e.g. people, places, conversations, activities, objects, or situations)?	56 (71.8)	6 (7.7)	6 (7.7)	7 (9.0)	2 (2.6)	1 (1.3)	0
8. Trouble remembering important parts of the stressful experience?	65 (83.3)	1 (1.3)	3 (3.9)	5 (6.4)	3 (3.9)	1 (1.3)	0
9. Having strong negative beliefs about yourself, other people, or the world (e.g. I am bad, there is something seriously wrong with me, no one can be trusted, the world is completely dangerous)?	62 (79.5)	5 (6.4)	4 (5.1)	3 (3.9)	3 (3.9)	1 (1.3)	0
10. Blaming yourself or someone else for the stressful experience or what happened after it?	56 (71.8)	10 (12.8)	4 (5.1)	5 (6.4)	2 (2.6)	1 (1.3)	0
11. Having strong negative feelings such as fear, horror, anger, guilt, or shame?	55 (70.5)	9 (11.5)	5 (6.4)	4 (5.1)	4 (5.1)	1 (1.3)	0
12. Loss of interest in activities that you used to enjoy?	55 (70.5)	9 (11.5)	4 (5.1)	5 (6.4)	4 (5.1)	1 (1.3)	0
13. Feeling distant or cut off from other people?	51 (65.4)	7 (9.0)	8 (10.3)	5 (6.4)	6 (7.7)	1 (1.3)	0
14. Trouble experiencing positive feelings (e.g. being unable to feel happiness or loving feelings for people close to you)?	57 (73.1)	11 (14.1)	3 (3.9)	3 (3.9)	3 (3.9)	1 (1.3)	0
15. Irritable behavior, angry outbursts, or acting aggressively?	56 (71.8)	9 (11.5)	4 (5.1)	4 (5.1)	4 (5.1)	1 (1.3)	0
16. Taking too many risks, or doing things that can cause you harm?	49 (62.8)	13 (16.7)	9 (11.5)	2 (2.6)	4 (5.1)	1 (1.3)	0
17. Being “super-alert” or watchful, or on guard?	51 (65.4)	7 (9.0)	4 (5.1)	4 (5.1)	11 (14.1)	1 (1.3)	0
18. Feeling jumpy or easily startled?	60 (76.9)	3 (3.9)	7 (9.0)	3 (3.8)	4 (5.1)	1 (1.3)	0
19. Having difficulty concentrating?	56 (71.8)	11 (14.1)	1 (1.3)	6 (7.7)	3 (3.9)	1 (1.3)	0
20. Trouble falling or staying asleep?	52 (66.7)	8 (10.3)	5 (6.4)	6 (7.7)	6 (7.7)	1 (1.3)	0

Karen Marie Kwaning
University of California, Berkeley

Karen Marie Kwaning graduated with honors from the University of California, Berkeley in 2016 with a Bachelor of Arts in Psychology and a minor in Ethnic Studies. She has developed her interests in the intersection of social oppression and health as a research assistant at the UC Berkeley School of Public Health and at the UC Berkeley Social Interactions Laboratory. Karen will be applying to medical school to pursue her passion for social justice work and healthcare. In her free time, she enjoys listening to her favorite podcasts: The Read, The Friend Zone, and Gettin' Grown. Karen also loves traveling, having conversations over coffee, Beyoncé, and spending time with loved ones.

Was there a particular experience that sparked your research interests?

As a college student, I was deeply disturbed by the rise in police brutality against racial minorities, especially against Black individuals. Protests erupted throughout the Bay Area during my junior and senior years, and I felt a sense of urgency to do something to address police violence. At the time, I was a research assistant in a Psychology Department lab, and I decided to initiate an investigation on how emotions can impact racial stereotyping and dehumanization. Through my research, I hoped to start open conversations about police violence, particularly about the psychological factors that contribute to racial discrimination, and to contribute to ongoing psychology research investigating racial implicit bias.

Who has been an influential person in your life?

My younger brother, Andrew Kwaning, has been the most influential person in my life. He has been my biggest cheerleader and constantly encourages me to chase after my wildest dreams and to do what I am most passionate about. He is one of my biggest role models and I aim to emulate his patience, kindness, and free thinking in everything that I do. With his support, I have been able to achieve everything that I once thought was impossible!

When and where are you the most productive?

I am the most productive in the mornings and early evenings. During these times, I produce my best work in quiet coffee shops with reliable WIFI. Also, listening to music and sipping coffee allows me to focus on my work. To ensure that I am productive throughout my day, I like to formulate a realistic to-do list on my phone, allow myself 15-20 minute breaks during my work time, and treat myself with a small reward, like watching an episode of my favorite Netflix series, at the end of a long day.

Where do you see yourself in 10 years?

In 10 years, I hope to have obtained an M.D. and MPH to further explore my interests in the nexus of racism and health. By this time, I also hope to be completing a residency program and conducting original public health research that contributes to improving healthcare delivery for socioeconomically marginalized communities, practicing as a physician, and starting a family!

Awe, Racial Stereotyping, and Dehumanization

Karen Marie Kwaning
University of California, Berkeley

Stereotyping and dehumanization contribute to intergroup racial discrimination and prejudice. Research has progressed on the associations of positive emotion, stereotyping, and dehumanization. However, the relationships between awe, stereotyping, and dehumanization remain understudied. Awe has several features including the sense that one is part of a larger category (e.g., the human species). Given these aspects of awe, we investigate whether awe, compared to a joy and neutral condition, attenuates the following: (Study 1) stereotype endorsement of African Americans; (Study 2) blatant dehumanization ratings of African Americans relative to White Americans, and; (Study 3) animalistic dehumanization of African Americans relative to White Americans. Results demonstrate that (in Study 1) there is a marginally significant lower stereotype endorsement of African Americans among awe participants, (in Study 2) awe increases blatant dehumanization of African Americans, and (in Study 3) awe increases animalistic dehumanization of African Americans compared to White Americans. This investigation extends the research and theories of awe's influence on intergroup and interpersonal relationships.

The continuous epidemic of police brutality and state-sanctioned violence is influenced by dehumanizing and stereotyping Black Americans and other Americans of socioeconomically marginalized backgrounds (Correll, Park, Judd, & Wittenbrink, 2002; Correll, Urland, & Ito., 2005; Nieuwenhuys, Savelsbergh, & Oudejans, 2012). For example, in 2012 twelve-year-old Tamir Elijah Rice was shot immediately after encountering police at a city park (Lee, 2013). Tamir may have been shot because Black boys are seen as less innocent and older than their White counterparts (Goff, Jackson, Di Leone, Culotta, & DiTomasso, 2014). Police officers believing racial stereotypes could lead to feelings of anxiousness that predispose them to shoot (Nieuwenhuys et al., 2012) and prejudice could increase threat perception of an African American individual (Bahns, 2017). Police officers' authoritative power could also increase implicit bias and stereotyping through early face processing of racial minority groups, which could enhance expressions of racial bias (Schmid & Amodio, 2017). Dehumanizing Black children by associating Blacks with apes could predict racial disparities in police violence against children (Goff et al., 2014). Therefore, stereotyping, dehumanization, and emotion play important roles in police brutality against African Americans. Additionally, emotion can potentially be targeted to attenuate stereotyping and dehumanization in efforts to prevent police violence. Current empirical research demonstrated that positive emotions lead an individual to rely on heuristic thinking, which is thinking based on our basic knowledge or impression of a subject (Lambert, Khan, Lickel,

& Fricke, 1997; Fredrickson, 2001). Still unknown, though, is whether the positive emotion of awe attenuates stereotyping and dehumanizing a person belonging to a racial out-group.

Emotions affect the way we process information and how we perceive and interact with others (Lambert et al., 1997; Fredrickson, 2001; Hodson & Costello, 2007; Waytz & Epley, 2012; Haslam & Loughnan, 2014; Bar-Tal, 1989). Positive emotions such as joy, pride, and happiness result in less attributional processing due to cognitive distraction; this makes relying on stereotypes and heuristic thinking easier (Lambert et al., 1997; Fredrickson, 2001). Although there is growing research on the association of positive emotions and stereotyping, there is minimal research on whether the positive emotion of awe attenuates stereotyping and there are limited investigations on the effect of general positive emotion on explicit and implicit forms of dehumanization. Therefore, in the present research, we investigate awe's influence on explicit stereotype endorsement of African Americans and explicit dehumanization, which is demonstrated by actively likening African Americans to apes (Haslam, 2006), and implicit dehumanization, which can be demonstrated by failing to recognize that African Americans can have complex characteristics (e.g., passionate and ambitious) (Haslam, 2006).

Awe and Social Hierarchy

Awe is a distinct emotion (Ekman, 1992) that can manifest in response to something of significant threat, beauty, ability, virtue, or supernatural causality (Keltner & Haidt, 2003) and belongs to a category of positive emotions that include joy, pride, love, contentment, amusement, and compassion (Shiota & Keltner, 2005). Awe is characterized by two central appraisals: 1) perceptual vastness and 2) cognitive accommodation (Keltner & Haidt, 2003). Perceptual vastness implies that one is in the presence of something and/or someone that they perceive as greater than themselves and is "any stimulus that challenges one's accustomed frame of reference in some dimension." Cognitive accommodation refers to the state in which one adjusts their current mental schema to update any perceived deviations that are taken into account (Shiota, Keltner, & Mossman, 2007).

Awe plays a role in maintaining social hierarchies. For example, Keltner and Haidt (2003) note that primordial awe towards a powerful individual, that is, a form of awe that emerged in the context of homo sapien evolution in small tribes of our hunter-gatherer past - may have reinforced social hierarchies. They also note that modern Americans experience awe in the presence of individuals "morally admirable" (e.g., heroes and political leaders). Keltner and Haidt (2003) propose that experiencing awe reinforces and justifies social hierarchy by motivating allegiance to a leader. Therefore, awe may play an important role in whether an individual engages in hierarchy-enhancing legitimizing mechanisms, such as racial stereotyping and dehumanization, in order to maintain a racial status quo (Pratto, Sidanius, Stallworth, & Malle, 1994). Pratto et al. (1994) suggest that social hierarchies allow dominant groups to keep more resources for themselves. For example, they posit that institutional discrimination can be driven by anti-Black racism and deprives Blacks from receiving public benefits. Therefore, since awe can affect social hierarchy and, in turn, how resources are allocated, it is important to investigate how other aspects of awe can help deconstruct oppressive social hierarchies.

Empirical research demonstrates that awe is associated with increased generosity, ethicality, prosociality, and decreased entitlement (Piff, Dietze, Feinberg, Stancato, & Keltner, 2015). Hence, awe may foster egalitarian values that discourage people from using racial stereotypes and dehumanizing others. However, to our knowledge, there are no empirical studies examining the influence of awe on racial stereotyping and dehumanization. Therefore, to anticipate awe's potential attenuating effects

on the stereotype endorsement of African Americans and the explicit and implicit dehumanization of African Americans (i.e. two forms of hierarchy-enhancing mechanisms), we first describe the effects of emotion on stereotyping, conceptualizations of dehumanization, and the effects of emotion on explicit and implicit dehumanization.

Emotion and Stereotyping

Our emotions can motivate us to use racial stereotypes to maintain a social hierarchy. For example, as previously discussed, Keltner and Haidt (2003) suggest that an individual who is in awe of a leader may feel a strong sense of commitment to maintain a hierarchy that establishes their leader's and their in-group's superior position. Therefore, awe can play a role in whether a person may use a hierarchy-enhancing mechanism, like stereotyping, to uphold an in-group's status quo. Accordingly, there are many perspectives on how negative and position emotions may motivate a person to stereotype.

There is mixed consensus on how emotions impact stereotyping. Negative emotions such as anger and frustration can cause one to rely on harmful racial stereotypes (Bar-Tal, et al., 1989). However, negative emotions can also influence an individual to fully process detailed, individuating information about a person and, in turn, may help cause a person to rely less on heuristic thinking (Lambert et al., 1997). Meanwhile, research demonstrates that positive emotions can facilitate stereotyping. For example, Bodenhausen, Kramer, & Süsser (1994) found that happy individuals had a greater reliance on stereotypes compared to individuals in a neutral mood. Further psychological studies suggest that happiness can increase self-focused attention (Salovey, 1992; Silvia & Abele, 2002). Increased self-focused attention diverts attention away from outside information, thereby increasing the likelihood that an individual depends on heuristics and stereotypes.

Barbara Fredrickson's *broaden-and-build theory* (2001) posits that positive emotions (e.g., joy, interest, contentment, pride, and love) broaden one's mindset so that many thoughts and actions may come to mind. Therefore, through broadening one's scope of attention, cognition, and action, one is not inclined to focus on specific details and nuances and will be more likely to stereotype others (Fredrickson, 2001). In turn, racial stereotyping can result in unfair judgments of Black targets (e.g., Blacks are likely to be found guilty of committing a crime) (Pratto et al., 1994; Sagar & Schofield, 1980; Goff et al., 2014; Boetcher, 2009; Welch, 2007). Racial stereotyping also allows minority groups to justify oppressive social structures (Jost & Banaji, 1994). Ultimately, these consequences of emotion-triggered stereotyping can maintain racial hierarchy.

Although positive emotions have been empirically demonstrated to facilitate heuristic processes, distinct features of awe may help attenuate stereotyping. Since awe is a collective positive emotion that promotes collaboration with members of different groups and shifts attention away from the self, we set forth with this investigation to see whether awe attenuates the tendency to engage with the hierarchy-enhancing mechanism of racial stereotyping.

Theoretical Conceptualizations of Dehumanization

Dehumanization is another hierarchy-enhancing mechanism that contributes to racial prejudice and discrimination. People have the tendency to liken out-group members to non-human animals (Boccato, Capozza, Falvo, & Durante, 2008; Haslam, 2006; Saminaden, Loughnan, & Haslam, 2010). In particular, the dehumanization of Black people is exacerbated by stereotypical and racial depictions disseminated through various media outlets that liken them to apes and deny them membership of the human species (Haslam, 2006; Goff, Eberhardt, Williams, & Jackson, 2008). Before exploring

dehumanization's association with positive and negative emotion, we first define the two forms of dehumanization–blatant dehumanization and animalistic dehumanization–that will be the focus of the current research studies. There are other forms of dehumanization (e.g, infrahumanization, mechanistic dehumanization; superhumanization; Castano & Giner-Sorolla, 2006; Haslam, 2006; Waytz, Hoffman, & Trawalter, 2015) but they are beyond the scope of this paper.

First, explicit *blatant dehumanization* involves "openly held beliefs about the inherent inferiority of other groups relative to the in-group" and generate overt expressions of blatant dehumanization based on "low out-group status, intergroup competition, or perceived threat" (Kteily, Bruneau, Waytz, & Cotterill, 2015). Kteily et al. (2015) note that individuals who express blatant dehumanization are more likely to accept the idea that some groups are superior to others. Therefore, blatant dehumanization can also serve as an index of one's endorsement of social hierarchy.

Second, the *Dual Model of Dehumanization* (Haslam, 2006) defines dehumanization as denying humanness to an individual and introduces the concept of animalistic dehumanization. *Animalistic dehumanization* involves denying someone uniquely human (UH) characteristics that distinguish a human from animals (e.g., "Passionate", "Humble", "Irresponsible", "Reserved"), and. Animalistic dehumanization is associated with feelings of disgust and revulsion to something we perceive as below the self and/or in-group, whereas mechanistic dehumanization is associated with perceiving the other as "cold, robotic, passive, and lacking in depth" (Haslam, 2006). Historically, by likening Blacks to apes and product-producing machines, this type of dehumanization helps justify the idea that Blacks are racially inferior.

Emotion and Dehumanization

There is limited research on positive emotion and dehumanization. Past research has demonstrated that participants who were primed to feel disgust by being exposed to photographs portraying an open-heart surgery, a dirty toilet, and a cockroach on a plate of food endorsed the strongest associations of out-group members with animals (Buckels & Trapnell, 2013). Interpersonal disgust and high social dominance orientation have also been found to predict dehumanizing perceptions of immigrants (Hodson & Costello, 2007; Goff, et al., 2008).

There is also limited research on what can attenuate dehumanization of out-groups. A recent study has noted that participants dehumanize a Black target when the target is categorized with multiple criteria and that classifying a Black target with multiple criteria and priming participants with their human identity was the best condition for reducing dehumanization (Albarello & Rubini, 2012). However, awe is an emotion that is associated with a sense that one is part of a larger category (e.g., community, a culture, the human species) and shifts attention toward larger entities and diminishes the individual self (Piff, et al., 2015, 2015; Keltner & Haidt, 2003). In other words, feeling that one's goals and needs are insignificant after experiencing awe could incite prosocial behavior, help foster an inclusive interconnected network, and may potentially motivate individuals to work toward racial social justice. Therefore, we propose that positively-valenced awe may attenuate the dehumanization.

Hypotheses and Overview of Research

We investigate whether awe reduces two hierarchy-enhancing mechanisms that maintain oppressive social structures: racial stereotyping and dehumanization. Study 1 was designed first to assess the effect of awe on racial stereotyping. In Study 1, we investigate the endorsement of negative stereotypes of African Americans between participants randomly assigned to the awe and a neutral condition. Studies 2 and 3 were designed to assess awe's effect on implicit and explicit forms of dehumanization. In Study 2, we investigate whether awe compared to a joy and neutral condition is associated with less blatant dehumanization of African Americans relative to White Americans. Finally, in Study 3 we tested participants to see whether awe compared to participants in a neutral condition is associated with less implicit dehumanization (i.e., animalistic dehumanization) of African Americans relative to White Americans. Specifically, we tested the following hypotheses:

Hypothesis 1. Awe will be associated with less endorsement of negative stereotypes of African Americans compared to a neutral emotion.

Hypothesis 2. Experiencing awe will lead to less blatant dehumanization of African Americans (and other target groups) relative to Whites compared to a joy and neutral condition.

Hypothesis 3. Experiencing awe will lead to less animalistic dehumanization of African Americans relative to Whites compared to a neutral condition.

Study 1: Awe & Endorsement of Negative Stereotypes of African Americans

The objective of Study 1 was to investigate whether experiencing awe–compared to a neutral emotion–attenuated racial stereotyping of African Americans.

Method

Participants

We recruited a total of 93 White Americans through Amazon Mechanical Turk (M_{age} = 37.43, *SD* = 14.04; 31.18% male). To ensure the quality of data, inclusion criteria were (a) identifying as a White American, (b) being born in the U.S., and (c) passing all attention check questions.

Materials and Procedure

We informed participants that they would be asked to write about a personal experience and complete an activity. At the end of the study, participants provided demographic information, were debriefed, and allocated thirty cents for their participation.

Mood induction. We experimentally induced awe and a neutral affect by having participants recall a prototypical experience of a target emotion - a well-validated technique for inducing specific emotions (e.g. Griskevicius et al., 2010). Participants in the awe condition were first given the following definition of awe: "When experiencing awe, people usually feel like they are in the presence of something or someone that is so great in terms of size or intensity that their current understanding of the world, their surroundings, or themselves is challenged in some way." We also provided participants an emoticon of how the emotion is often expressed (see Appendix A).

We asked participants in this condition if they understood the definition of awe. If participants indicated that they understood the definition of awe by selecting "yes", they were given the following instructions: "Please take a few minutes to think about a particular time, fairly recently, which you encountered a natural scene that caused you to feel awe. This might have been a sunset, a view from a high place, or any other time you were in a natural setting that you felt was beautiful. Please write at least 5 sentences describing the experience, your accompanying emotions, and provide as much detail as possible."

We gave participants in the neutral condition the following instructions: "Please recall a time that you did laundry. Please describe your memory with 5-10 sentences. Please include details with the following information: what happened, when it happened, and who and/or what was involved." We did not provide an emotion to participants in the neutral condition.

Manipulation check. To ensure that relative to other emotions the memory recall

activities were effective in eliciting awe and a neutral emotion in each respective randomly allocated group, participants were asked at the end of the survey to rate the following emotions: happiness, amusement/joy, awe, fear, sadness, anger, gratitude, pride, and compassion. Participants rated their responses on a scale from 1 (*not at all*) to 7 (*extremely*). Participants were also asked to explain the study's hypothesis in one to two sentences.

Endorsement of negative stereotypes of African Americans. Following Levy, Stroessner, & Dweck (1998), was used to measure racial stereotyping. Participants were asked to rate the extent to which they thought the following six beliefs are true depictions of African Americans: "Uneducated"; "Violent"; "Irresponsible"; "Lazy"; "Loud"; and "Undisciplined." These traits are common stereotypical words often used to describe African Americans. Items were rated from 1 (*not at all true*) to 5 (*extremely true*). Internal reliability was α = .87.

Results

Manipulation Check

Our manipulation check indicated participants in the awe condition experienced a more intense state of awe than participants in the neutral condition. There was a significant difference in the emotion rating of awe between participants in the awe (M = 5.55, SD = 1.37) and the neutral (M = 1.75, SD = 1.41) conditions; $t(91)$ = 13.14, $p < 0.0001$. Therefore, the mood manipulation was successful. Additionally, none of the participants correctly guessed the hypothesis of this study.

Effects of Mood Induction on Stereotype Endorsement

We calculated an independent samples t-test on participants' ratings of stereotypical traits of African Americans. Participants in the awe condition (M = 2.18, SD = 0.82) had a marginally significant lower stereotype endorsement of African Americans compared to participants in the neutral condition (M = 2.54, SD = 1.04); $t(91)$ = -1.82, p = .07 (see Figure 1).

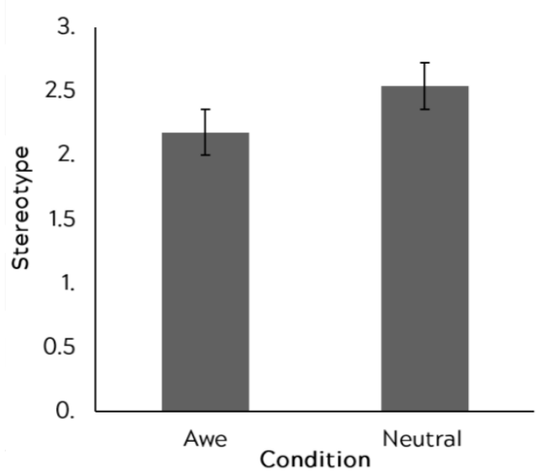

Figure 1. Difference in the endorsement of negative stereotypes of African Americans in Study 1. The bar graph depicts differences in stereotype endorsement between participants in the awe condition (M = 2.18, SD = 0.82) and neutral condition (M = 2.54, SD = 1.04), t(91) = -1.82, p = 0.07.

Discussion

Our results suggest that participants who experienced awe, compared to those who experienced a neutral emotion, may be less likely to believe that African Americans are uneducated, violent, irresponsible, lazy, loud, and undisciplined compared to those who did not experience awe. This finding is consistent with our first hypothesis that individuals experiencing awe are less likely to endorse racial stereotypes of African Americans. However, a few questions still remain. First, in this study we only compared participants primed with awe with participants in a neutral condition. Previous psychological literature has demonstrated that positive emotion, in general, can increase stereotype endorsement (e.g. Bodenhausen et al., 1994). Therefore, it must be further investigated whether awe is a unique positive emotion that attenuates stereotype tendencies. Furthermore, this study measured individuals' attitudes toward out-group members without asking their attitudes toward their in-group members. Therefore, it is unclear whether awe exacerbates or lessens social hierarchy.

Study 2: Awe & Blatant Dehumanization

In order to address remaining questions from Study 1, the objective of Study 2 was to investigate whether awe–compared to a joy and neutral condition–attenuates the explicit, blatant dehumanization of African Americans relative to White Americans.

Method

Participants

We recruited a total of 125 White Americans through Amazon Mechanical Turk (M_{age} = 39.31, SD = 13.40; 44% male). The same inclusion criteria from Study 1 were used.

Materials and Procedure

We informed participants that they would be asked to view a video and then complete an activity that would take a total of 10-20 minutes to complete. At the end of the study, participants provided demographic information, were debriefed, and allocated thirty cents for their participation.

Mood induction. Participants in the awe condition watched a five-minute video featuring different natural imagery (e.g. snow-capped mountains and the ocean). Participants in the joy condition watched a five-minute clip of BBC One's comedy sketch show *Walk on the Wilde Side* featuring different animals that were overdubbed with voice-overs. In the neutral condition, participants watched a five-minute video of a man building a brick wall.

Manipulation check. We gave participants the same measure used in Study 1.

Blatant dehumanization. We tested how participants rated racial out-group members compared to in-group members using the Ascent of Man blatant dehumanization measure (Kteily et al., 2015). We gave participants the following instructions: "People can vary in how human-like they seem. Some people seem highly evolved whereas others seem no different from lower animals. Using the image below as a guide, indicate using the sliders how evolved you consider the average member of each group to be."

Below the Ascent of Man image (see Appendix B), participants were to rate the following groups: Whites, African Americans, Latinos/Latinas, Asian Americans, Native Americans, Bi-racial/Multi-racial Americans. Participants used a continuous slider ranging from 0 (least 'evolved') to 100 (most 'evolved') to rate the different groups. As calculated in Kteily et al. (2015) study, blatant dehumanization scores were calculated by subtracting the Ascent rating of the target out-group (i.e., African Americans) from the Ascent rating of the in-group (i.e., Whites). Internal reliability was α = .76. Group presentation order was randomized across participants.

Results

Manipulation Check

There was a significant difference in the emotion rating of awe between the awe (M = 5.38, SD = 1.61), joy (M = 2.77, SD = 1.77), and neutral (M = 2.25, SD = 1.48) conditions; $F(2, 122) = 48.43$, $p < 0.0001$. Additionally, none of the participants correctly guessed the hypothesis of this study.

Blatant Dehumanization

We conducted a 2 (emotion condition: awe and neutral) x 5 (out-group: African American, Latinos/Latinas, Asian Americans, Native Americans, Bi-racial/Multi-racial Americans)

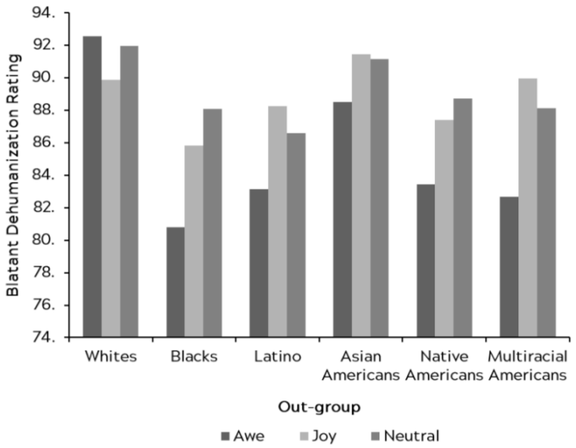

Figure 2. Average blatant dehumanization ratings for all racial groups for Study 2. Scale ranged from 0 (least 'evolved') to 100 (most 'evolved').

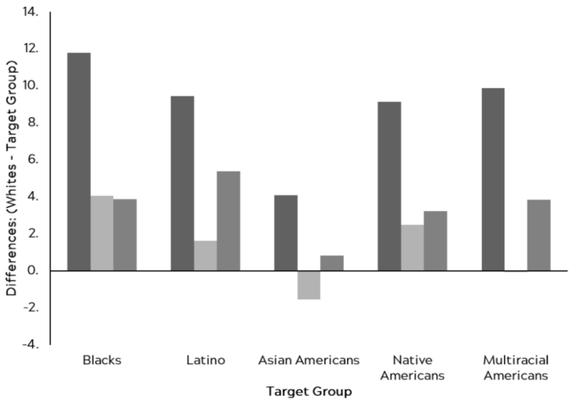

Figure 3. Relative blatant dehumanization scores relative to White Americans for Study 2. Negative numbers indicate that White Americans were blatantly dehumanized to a greater extent than the target racial group.

multivariate analysis of variance (MANOVA). The emotion condition was a between-groups variable while the out-group factor was a within-subjects variable. There was a main effect for the out-group factor such that participants rated White Americans as more human relative to other racial out-groups $F(5, 118) = 4.33$, $p < 0.001$.

Participants in the awe condition had the highest blatant dehumanization tendency toward African Americans ($M = 11.77$, $SD = 22.28$). Participants had the next highest average blatant dehumanization tendency toward Bi-racial/Multi-racial Americans ($M = 9.88$, $SD = 20.81$). Native Americans ($M = 9.14$, $SD = 19.92$) and Latinos/Latinas ($M = 9.44$, $SD = 17.89$) were similarly blatantly dehumanized while participants blatantly dehumanized Asian Americans the least ($M = 4.07$, $SD = 17.76$) (see Figures 2 and 3).

Participants in the neutral condition had the highest blatant dehumanization tendency toward Latinos/Latinas ($M = 5.37$, $SD = 21.32$). Participants similarly dehumanized African Americans ($M = 3.88$, $SD = 18.22$), Native Americans ($M = 3.22$, $SD = 18.39$), and Bi-racial/Multi-racial Americans ($M = 3.82$, $SD = 21.10$). Similar to participants in the awe condition, Asian Americans were blatantly dehumanized the least ($M = .82$, $SD = 18.35$). A Bonferroni post hoc test revealed a marginally statistically significant finding that African Americans were more blatantly dehumanized in the awe condition compared to participants in the neutral condition, $t(87) = 1.75$, $p = .08$. There were no statistically significant differences in how Latinos/Latinas, Asian Americans, Native Americans, and Bi-racial/Multi-racial Americans were blatantly dehumanized between participants in the awe condition and in the neutral condition.

Further, to investigate the extent that participants perceive members of racial out-groups as less evolved than White Americans, we calculated a relative blatant dehumanization score by subtracting the average blatant dehumanization score of White Americans from the average blatant dehumanization score of all racial out-groups. We found a marginally statistically significant difference in the blatant dehumanization score of non-White racial groups between participants in the awe ($M = 8.86$, $SD = 17.55$), joy ($M = 1.30$, $SD = 6.12$), and neutral ($M = 2.33$, $SD = 18.53$) conditions, $F(2, 122) = 2.87$, $p = .06$. Our Bonferroni post hoc test revealed that participants in the awe condition blatantly dehumanized racial out-groups to a greater extent compared to participants in the awe condition, though this finding was marginally statistically significant $t(88) = 2.26$, $p = .07$. There were no statistically significant differences in blatant dehumanization scores of racial out-groups between participants in the awe condition and neutral condition, $t(87) = 1.61$, $p = .24$, and between participants in the neutral condition and joy condition, $t(71) = .57$, $p = .83$.

Discussion

Relative blatant dehumanization scores indicate the extent that participants perceive members of racial out-groups as less evolved than White Americans. Although our finding was marginally significant, and contrary to our hypothesis, participants in the awe condition blatantly dehumanized African Americans more than participants in the joy and neutral condition. Kteily et al. (2015) explain that, "individuals expressing blatant dehumanization are also those who are more likely to accept the notion that some groups are superior to other groups." Kteily et al. (2015) also found that blatant dehumanization is associated with the social dominance orientation-dominance (SDO-D) sub-dimension (e.g., "Superior groups should dominate inferior groups") that measures the extent that one agrees with group hierarchy. As previously discussed, the social dominance orientation theory posits that, "societies minimize group conflict by creating consensus on ideologies that promote the superiority of one group over others" (Pratto, et al., 1994). Social dominance orientation theory also suggests that prejudice and discrimination against out-groups can be predicted by one's emotional affiliation with one's in-group. This is also explained by social identity theory, which implies that to maintain a positive in-group image and to feel superior, in-group members may discriminate against out-group members (Pratto, et al., 1994). Therefore, since awe is an emotion that is associated with feeling more connected to others (Shiota et al., 2007; Van Cappellen & Saroglou, 2012), the present findings suggest that in the case of explicit dehumanization, White participants may have felt relatively more closely connected to their in-group than with an African American out-group. However, it is unclear whether awe has the same effect on implicit dehumanization of an African American out-group.

Study 3: Awe & Animalistic Dehumanization

In our final study, we tested to see whether experiencing awe leads to the dehumanization of Africans Americans relative to White Americans on the implicit level. Therefore, Study 3 explores whether participants attribute an equal amount of uniquely human traits to both White Americans and African Americans by using trait-attribution activity commonly used to assess individuals' extent of implicitly dehumanizing out-group members (e.g. Haslam, 2006).

Method

Participants

We recruited a total number of 161 White American participants through Amazon Mechanical Turk ($M_{age} = 37.39$, $SD = 13.39$; 34.80% male). We used the same inclusion criteria from Study 1.

Materials and Procedure

Mood induction. We randomly assigned participants to the awe or neutral condition and gave them the same mood induction task used in Study 2.

Animalistic dehumanization. Following the procedures of Kteily et al. (2015), we asked participants to make UH trait attributions toward White Americans and African Americans. We gave participants the following instructions: "Please rate the extent of how appropriate or inappropriate you think the traits listed below

describe White Americans (African Americans), in general, as a group." We gave participants the following nineteen traits that Kteily et al. (2015) adapted from Haslam, Bain, Douge, Lee, & Bastian (2005) using sliders ranging from 0 (*not at all*) to 100 (*to a very great extent*): "Ambitious", "Imaginative", "Passionate", "Polite", "Humble", "Rude", "Stingy", "Irresponsible", "Reserved", "Active", "Friendly", "Comfortable", "Uncooperative", "Unemotional", "Timid", "Shy", "Nervous", "Curious", and "Selfless". As reported in Kteily et al.'s (2015) study, UH dehumanization trait-words used an equal number of positive and negative traits ("Ambitious", "Imaginative", "Passionate", "Humble", "Irresponsible", "Reserved", "Rude", and "Stingy"). We calculated difference scores for blatant dehumanization ratings for White Americans relative to Africans Americans. Therefore, higher scores reflected a greater attribution of UH traits to Whites relative to African Americans. Internal reliability was α = .67. Word presentation order was randomized across participants.

Results

Mood Induction

There was a significant difference in the emotion rating of awe between the awe (M = 4.58, SD = 2.07) and the neutral (M = 2.32, SD = 1.65) conditions; $t(125) = 7.63$, $p < 0.0001$. Additionally, none of the participants correctly guessed the hypothesis of this study.

Animalistic Dehumanization

We conducted a 2 (group: White Americans vs. African Americans) x 2 (condition: awe vs. neutral) multivariate analysis of variance (MANOVA). We observed a significant main effect of group such that participants attributed more UH traits toward White Americans (M = 46.07 SD = 1.06) than to African Americans (M = 42.83, SD = .95) $F(1, 159) = 21.55$ $p < 0.0001$. However, we did not observe a main effect for condition; $F(1, 159) = .08$, *ns*.

Participants in the awe condition attributed more UH traits to White Americans (M = 46.42 SD = 1.50) than to African Americans (M = 41.97 SD = 1.06) while participants in the neutral condition had a relatively equal attribution of UH traits to White Americans (M = 45.71 SD = 1.50) and African Americans (M = 43.69 SD = 1.35). However, the interaction between group and condition was not significant $F(1, 159) = 1.73$, p = .19 (see Figure 4).

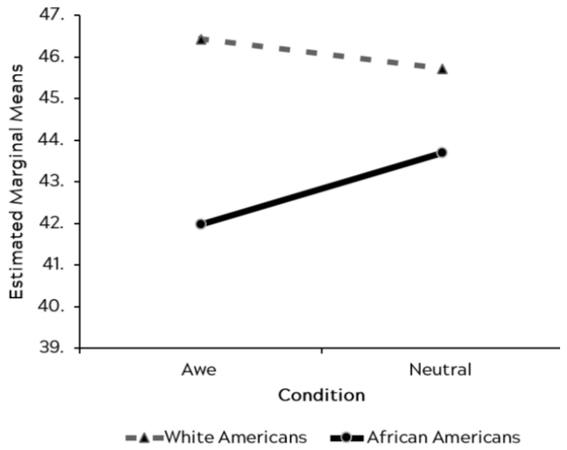

Figure 4. Average uniquely human (UH) trait attribution toward White Americans and African Americans by condition for Study 3. Higher averages reflect greater attribution of human essence to the target racial group.

Discussion

Animalistic dehumanization is classified as an implicit form of dehumanization that causes one to liken an individual to an animal (Haslam, 2006). Similar to our Study 2 results, participants dehumanized African Americans to a greater extent than White Americans. Unfortunately, because our interaction term was non-significant, we were unable to further assess how awe might differently affect in-group versus out-group dehumanization. This interaction could be clarified by future investigations that compare participants in an awe condition to participants in joy condition.

General Discussion

This present study aimed to investigate whether awe attenuates racial stereotyping and the dehumanization of African Americans relative to White Americans. We hypothesized that participants primed with an awe emotion, compared to participants in a neutral condition, would have a lower endorsement of stereotypical traits, a lower blatant dehumanization tendency, and a lower animalistic dehumanization tendency toward African Americans relative to White Americans. We observed that participants in the awe condition compared to those in the neutral condition did not believe that the racially stereotypical characteristics of being uneducated, violent, irresponsible, lazy, loud, and undisciplined were true depictions of African Americans. Contrary to our hypotheses, however, awe-primed participants had a marginally significant higher blatant dehumanization tendency toward African Americans than toward White Americans. They also attributed less uniquely human traits to African Americans than to White Americans. Taken together, the results of this present study suggest that although participants primed with awe are less likely to endorse stereotypical traits of African Americans, awe may potentially make one feel more connected to one's in-group relative to the out-group thereby facilitating dehumanization of the out-group.

Our finding that awe may attenuate endorsement of racial stereotypes has important implications for overcoming bias against African Americans and possibly other racial minorities. If individuals are less likely to stereotype after experiencing awe, awe-inducing activities can be used to foster relationships between members of different racial groups. For example, Piff et al. (2015) demonstrated that participants who were induced with awe after viewing eucalyptus trees in-person, compared to those who viewed a side of a building, were more likely to help others, make ethical decisions, and had a lower sense of entitlement. Therefore, outside activities in an awe-inducing environment are examples of how experiencing awe may help facilitate cooperative and healthy relationships between individuals of different racial backgrounds in the workplace and school settings. Interaction between people of different racial groups is important because a lack of exposure to out-group members can cause in-group members to judge out-group members' behaviors as ambiguous and can cause them to rely on common racial stereotypes (Bar-Tal, 1989).

Limitations

This current investigation demonstrates awe's effect on the endorsement of negative stereotypes of African Americans compared to a neutral condition, and is among the first to contribute findings on the effect of awe on explicit and implicit dehumanization of an African American out-group. However, our investigation had limitations and many unanswered questions. While our findings show that participants primed with awe are less likely to stereotype an African American, future studies should include a social desirability scale in order to assess how honest participants were when completing our measures (Crowne & Marlowe, 1960). It is also possible that our participants experienced a weak sense of awe. Keltner and Haidt (2003) state that awe is fleeting, rare, and oftentimes experienced in person. Therefore, it can be difficult to induce a strong sense of awe through a video. Other priming methods that can better produce an authentic feeling of awe such as visiting a beautiful natural environment or writing about a time that one experienced awe (Piff et al., 2015; Shiota et al., 2007).

Since our participant sample was mainly composed of White women, our findings may not reflect the stereotyping and dehumanization tendencies of White men and people of other racial minorities who experience awe. On one hand, Plant, Hyde, Keltner, & Devine (2000) found that women are believed to experience and express awe more frequently than men. On the other

hand, Kenworthy, Barden, Diamond, & del Carmen (2011) found that there is no gender difference in racial stereotyping and dehumanizing African Americans. Therefore, future studies can explore whether there is an effect of gender and race in experiencing awe and racial stereotyping and dehumanizing African Americans.

The age range of our samples was broad and stereotyping and dehumanization others while experiencing awe may differ among younger and older adults. For example, Mather, Johnson, and De Leonardis (1999) found that stereotyping could increase among older adults. Furthermore, Mikels, Larkin, Reuter-Lorenz, & Carstensen (2005) found that older adults tend to remember and pay more attention to positively-valenced stimuli. This suggests that older adults may experience a stronger sense of awe and are more likely to act on their implicit bias compared to younger adults.

Additionally, since we used Amazon Mechanical Turk, participants may be concerned with completing as many tasks as possible while compromising the quality of their responses. Without the supervision of a research assistant in a laboratory, there is no way to ensure that participants are thoroughly completing our measures at an appropriate pace and paying attention to our mood inducing videos.

Future Directions

Some of our findings and other limitations could be addressed by future research.

Our Study 1 findings contradict current research supporting that positive emotions lead to a higher tendency to use stereotypes (Bodenhausen et al., 1994; Wegener, Petty, & Smith, 1995; Lambert et al., 1997; Isen, Means, Patrick, & Nowicki, 1982; Lambert et al., 1997; Schwarz, 1990). Although our results demonstrate that awe leads to less racial stereotyping compared to a neutral condition, we cannot conclude whether awe is a unique positive emotion that attenuates stereotype tendencies. Therefore, future studies should investigate how the positive emotion of awe differs from other positive emotions (e.g. happiness) in order to conclude whether an attenuation of stereotyping is a unique consequence of experiencing awe.

Our findings from Study 2 did not support our original hypothesis that awe would attenuate the explicit, blatant dehumanization of African Americans relative to White Americans. Further, our findings from Study 3 demonstrate that there was an increased implicit endorsement of animalistic dehumanization toward African Americans relative to White Americans when participants were exposed to the same awe-priming video used in Study 2. We speculate that there is a possibility that the awe video elicited threat-based awe instead of positively valenced awe. Gordon et al. (2016) found that threat-based awe is associated with a lower sense of self-control, greater feelings of fear, and increased sympathetic autonomic arousal. This may have contributed to a greater sense of closeness to one's in-group and/or could have led to the tendency to denigrate out-group members. Therefore, following suit to Gordon et al. (2016) future investigations should include an appraisal measure (Smith & Ellsworth, 1985) to assess whether participants' awe experience was positive or threat-based.

Future investigations can explore whether this is related to awe's association with a lower need for cognitive closure (Shiota et al., 2007). Since empirical studies have demonstrated that low levels of the need for cognitive closure - a clear opinion on judgmental topic that avoids any confusion or ambiguity (Ask & Granhag, 2005) - correlate with experiencing the positive emotion of awe (Shiota et al., 2007), the need for cognitive closure may serve as a moderator in a process of "unfreezing" stereotypes and encouraging careful processing of information (Dijksterhuis, Van Knippenberg, Kruglanski, & Schaper, 1996; Fox & Elraz-Shapira, 2005) when experiencing awe.

Conclusion

Some of our most memorable moments are when we feel a profound sense of awe. This study demonstrated that there is a marginally significant association between awe and lower stereotype endorsement toward African Americans, a marginally significant association between awe and blatant dehumanization of African Americans relative to White Americans, and an increase animalistic dehumanization toward African Americans relative to White Americans when experiencing awe. Studies investigating awe's effect on racial stereotyping and dehumanization will contribute to better our understanding of the connection between emotion and oppressive social organization.

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References

Albarello, F., & Rubini, M. (2012). Reducing dehumanisation outcomes towards Blacks: The role of multiple categorisation and of human identity. *European Journal of Social Psychology, 42(7)*, 875-882.

Algoe, S. B., & Haidt, J. (2009). Witnessing excellence in action: The 'other-praising'emotions of elevation, gratitude, and admiration. *The Journal of Positive Psychology, 4(2)*, 105-127.

Ask, K., & Granhag, P. A. (2005). Motivational sources of confirmation bias in criminal investigations: The need for cognitive closure. Journal of Investigative Psychology and *Offender Profiling, 2(1)*, 43-63.

Bahns, A. J. (2017). Threat as justification of prejudice. *Group Processes & Intergroup Relations, 20(1),* 52-74.

Bar-Tal, D. (1989). Delegitimization: The extreme case of stereotyping and prejudice. In *Stereotyping and prejudice* (pp. 169-182). Springer New York.

Boccato, G., Capozza, D., Falvo, R., & Durante, F. (2008). The missing link: Ingroup, outgroup and the human species. *Social Cognition, 26(2),* 224.

Bodenhausen, G. V., Kramer, G. P., & Süsser, K. (1994). Happiness and stereotypic thinking in social judgment. *Journal of personality and social psychology, 66(4),* 621.

Boetcher, J. F. (2009). Race stereotypic crimes and juror decision making: Hispanic, black, and white defendants. Retrieved from http://digitalscholarship.unlv.edu/thesesdissertations/97/

Buckels, E. E., & Trapnell, P. D. (2013). Disgust facilitates outgroup dehumanization. Group Processes & Intergroup Relations, 1368430212471738.

Castano, E., & Giner-Sorolla, R. (2006). Not quite human: infrahumanization in response to collective responsibility for intergroup killing. *Journal of Personality and Social Psychology, 90(5),* 804.

Correll, J., Park, B., Judd, C. M., & Wittenbrink, B. (2002). The police officer's dilemma: Using ethnicity to disambiguate potentially threatening individuals. *Journal of Personality and Social Psychology, 83(6)*, 1314-1329. http://doi.org/10.1037//0022-3514.83.6.1314

Correll, J., Urland, G. R., & Ito, T. A. (2005). Event-related potentials and the decision to shoot: The role of threat perception and cognitive control. *Journal of Experimental Social Psychology, 42(1),* 120-128. http://doi.org/10.1016/j.jesp.2005.02.006

Crowne, D. P., & Marlowe, D. (1960). A new scale of social desirability independent of psychopathology. *Journal of Consulting Psychology, 24(4),* 349.

Dijksterhuis, A. P., Van Knippenberg, A. D., Kruglanski, A. W., & Schaper, C. (1996). Motivated social cognition: Need for closure effects on memory and judgment. *Journal of Experimental Social Psychology, 32(3),* 254-270.

Ekman, P. (1992). An argument for basic emotions. *Cognition & emotion, 6(3-4)*, 169-200.

Fredrickson, B. L. (2001). The role of positive emotions in positive psychology: The broaden-and-build

theory of positive emotions. *American psychologist, 56(3),* 218.

Fox, S., & ElRaz-Shapira, Y. (2005). Perceived group variability and dispositional need for closure. *Current Psychology, 24(4),* 218-230.

Goff, P. A., Eberhardt, J. L., Williams, M. J., & Jackson, M. C. (2008). Not yet human: Implicit knowledge, historical dehumanization, and contemporary consequences. *Journal of Personality and Social Psychology, 94(2),* 292-306. http://doi.org/10.1037/0022-3514.94.2.292

Goff, P. A., Jackson, M. C., Di Leone, B. A. L., Culotta, C. M., & DiTomasso, N. A. (2014). The essence of innocence: Consequences of dehumanizing Black children. *Journal of personality and social psychology, 106(4),* 526.

Gordon, A. M., Stellar, J. E., Anderson, C. L., McNeil, G. D., Loew, D., & Keltner, D. (2016). The dark side of the sublime: Distinguishing a threat-based variant of awe.

Griskevicius, V., Shiota, M. N., & Neufeld, S. L. (2010). Influence of different positive emotions on persuasion processing: a functional evolutionary approach. *Emotion, 10(2),* 190.

Haslam, N. (2006). Dehumanization: An integrative review. *Personality and Social Psychology Review, 10(3),* 252-264.

Haslam, N., Bain, P., Douge, L., Lee, M., & Bastian, B. (2005). More human than you: attributing humanness to self and others. *Journal of personality and social psychology, 89(6),* 937.

Haslam, N., & Loughnan, S. (2014). Dehumanization and infrahumanization. *Annual Review of Psychology, 65*, 399-423.

Hodson, G., & Costello, K. (2007). Interpersonal disgust, ideological orientations, and dehumanization as predictors of intergroup attitudes. *Psychological Science, 18(8),* 691-698.

Isen, A. M., Means, B., Patrick, R., & Nowicki, G. (1982). Some factors influencing decision making strategy and risk-taking. In *Affect and cognition: The 17th annual Carnegie Mellon symposium on cognition* (pp. 241-261).

Jost, J. T., & Banaji, M. R. (1994). The role of stereotyping in system-justification and the production of false consciousness. *British Journal of Social Psychology, 33(1),* 1-27.

Keltner, D., & Haidt, J. (2003). Approaching awe, a moral, spiritual, and aesthetic emotion. *Cognition & Emotion, 17(2),* 297-314. http://doi.org/10.1080/02699930302297

Kenworthy, J. B., Barden, M. A., Diamond, S., & del Carmen, A. (2011). Ingroup identification as a moderator of racial bias in a shoot-no shoot decision task. *Group Processes & Intergroup Relations, 14(3)*, 311-318.

Kteily, N., Bruneau, E., Waytz, A., & Cotterill, S. (2015). The ascent of man: Theoretical and empirical evidence for blatant dehumanization. *Journal of Personality and Social Psychology, 109(5),* 901.

Lambert, A. J., Khan, S. R., Lickel, B. A., & Fricke, K. (1997). Mood and the correction of positive versus negative stereotypes. *Journal of Personality and Social Psychology, 72(5),* 1002.

Lee, C. (2013). Making race salient: Trayvon Martin and implicit bias in a not yet post-racial society.

Levy, S. R., Stroessner, S. J., & Dweck, C. S. (1998). Stereotype formation and endorsement: The role of implicit theories. *Journal of Personality and Social Psychology, 74,* 1421.1436.

Mather, M., Johnson, M. K., & De Leonardis, D. M. (1999). Stereotype reliance in source monitoring: Age differences and neuropsychological test correlates. *Cognitive Neuropsychology, 16(3-5),* 437-458.

Mikels, J. A., Larkin, G. R., Reuter-Lorenz, P. A., & Carstensen, L. L. (2005). Divergent trajectories in the aging mind: changes in working memory for affective versus visual information with age. *Psychology and Aging, 20(4)*, 542.

Nieuwenhuys, A., Savelsbergh, G. J., & Oudejans, R. R. (2012). Shoot or don't shoot? Why police officers are more inclined to shoot when they are anxious. Emotion, 12(4), 827.

Piff, P. K., Dietze, P., Feinberg, M., Stancato, D. M., & Keltner, D. (2015). Awe, the small self, and prosocial behavior. Journal of Personality and Social Psychology, 108(6), 883-899. http://doi.org/10.1037/pspi0000018

Plant, E. A., Hyde, J. S., Keltner, D., & Devine, P. G. (2000). The gender stereotyping of emotions. *Psychology of Women Quarterly, 24(1),* 81-92.

Pratto, F., Sidanius, J., Stallworth, L. M., & Malle, B. F. (1994). Social dominance orientation: A personality variable predicting social and political attitudes. *Journal of Personality and Social Psychology, 67(4),* 741.

Sagar, H. A., & Schofield, J. W. (1980). Racial and behavioral cues in black and white children's perceptions of ambiguously aggressive acts. *Journal of Personality and Social Psychology, 39(4),* 590.

Salovey, P. (1992). Mood-induced self-focused attention. *Journal of Personality and Social Psychology, 62(4)*, 699.

Saminaden, A., Loughnan, S., & Haslam, N. (2010). Afterimages of savages: Implicit associations between primitives, animals and children. *British Journal of Social Psychology, 49(1),* 91-105.

Schmid, P. C., & Amodio, D. M. (2017). Power effects on implicit prejudice and stereotyping: The role of intergroup face processing. *Social Neuroscience, 12(2)*, 218-231.

Schwarz, N. (1990). Feelings as information: informational and motivational functions of affective states. Guilford Press.

Shiota, M. N., & Keltner, D. (2005). What do emotion words represent? *Psychological inquiry, 16(1), 32-37.*

Shiota, M. N., Keltner, D., & Mossman, A. (2007). The nature of awe: Elicitors, appraisals, and effects on self-concept. *Cognition & Emotion, 21(5),* 944-963. http://doi.org/10.1080/02699930600923668

Silvia, P. J., & Abele, A. E. (2002). Can positive affect induce self-focused attention? Methodological and measurement issues. *Cognition & Emotion, 16(6),* 845-853.

Smith, C. A., & Ellsworth, P. C. (1985). Patterns of cognitive appraisal in emotion. *Journal of Personality and Social Psychology, 48(4),* 813.

Van Cappellen, P., & Saroglou, V. (2012). Awe activates religious and spiritual feelings and behavioral intentions. *Psychology of Religion and Spirituality, 4(3),* 223.

Waytz, A., & Epley, N. (2012). Social connection enables dehumanization. *Journal of Experimental Social Psychology, 48(1),* 70-76. http://doi.org/10.1016/j.jesp.2011.07.012

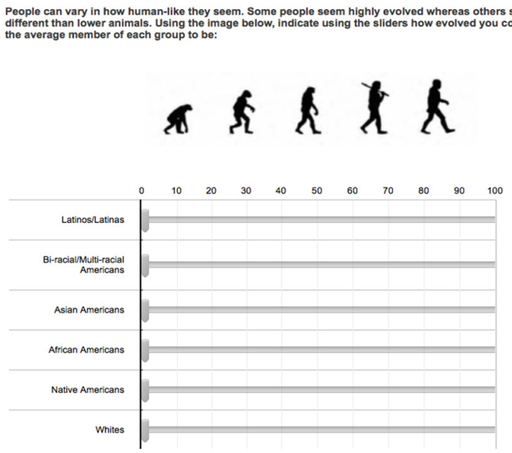
Waytz, A., Hoffman, K. M., & Trawalter, S. (2015). A Superhumanization Bias in Whites' Perceptions of Blacks. *Social Psychological and Personality Science, 6(3),* 352-359. http://doi.org/10.1177/1948550614553642

Wegener, D. T., Petty, R. E., & Smith, S. M. (1995). Positive mood can increase or decrease message scrutiny: the hedonic contingency view of mood and message processing. *Journal of Personality and Social Psychology, 69(1),* 5.

Welch, K. (2007). Black Criminal Stereotypes and Racial Profiling. *Journal of Contemporary Criminal Justice, 23(3)*, 276-288. http://doi.org/10.1177/1043986207306870

Appendix A: Awe Emoticon

Appendix B: *Ascent of Man* Blatant Dehumanization Measure



Christopher Lyons
Williams College

Chris is a current senior at Williams College who fell in love with psychology as a first year student in his massive introductory psychology lecture. After his master's program in medical sciences at Boston University, he hopes to attend medical school and becoming a board-certified pediatric neurosurgeon.

Was there a particular experience that sparked your research interests?

Conducting independent research projects in my 300-level neuroscience and psychology classes helped spark an interest in research for me that extended beyond the confines of the classroom, and I'm hoping to continue doing research in the fields of neuropsychiatry and neurobiology.

Who has been an influential person in your life?

My parents, grandparents, and professors (specifically Professor Stroud and Professor Carter) have always pushed me to be a better version of myself day in and day out, and I'm eternally grateful to all of them.

When and where are you the most productive?

I'm ironically the most productive at night time in our student center dining hall, Paresky–although it's usually pretty noisy, I enjoy the background noise and like being able to take breaks to chat with friends.

Where do you see yourself in 10 years?

In 10 years, I'd like to be finished with medical school and in my residency for neurosurgery (while also starting to pay back the mountain of student loans).

Megan Steele
Williams College

Megan Steele recently graduated from Williams College in Williamstown, Massachusetts. She received a Bachelors of Arts degree in Psychology and Chemistry in June 2016. She is now a research assistant in the Neurology Department at Beth Israel Deaconess Medical Center in Boston, MA. The lab she is working in researches the neurobiology of sleep and narcolepsy. She intends on applying to Clinical Psychology Graduate programs this year. In her free time she has been learning how to climb the aerial silks.

Was there a particular experience that sparked your research interests?

I have always been interested in the biological basis of mental illness, specifically depression, borderline personality disorder, and schizophrenia. This interest was shaped by classes I attended at Williams and an internship at an adult day health center. Chris and I talked about how we could combine our different research interests, and we decided to focus on internalizing symptoms and cognition.

Who has been an influential person in your life?

My thesis advisor, Amy Gehring. I was an undergraduate research assistant in her lab for four years, including the summers between semesters. Eventually I took ownership of my own project which evolved into my chemistry thesis. Through that experience I learned that I loved research and she was a valuable mentor as a women in science.

When and where are you the most productive?

I am the most productive in a coffee shop or a library after I have had a cup of coffee. I am not a morning person and probably get the most work done in the late afternoon or evening.

Where do you see yourself in 10 years?

In 10 years, I hope to have my Ph.D. in clinical psychology. I would like to have gained experience conducting research and practicing as a clinician. In addition, I would hopefully be involved in volunteer work that gives back to my local community.

Internalizing Symptoms, Cognitive Styles, and Recall Bias

Christopher Lyons and Megan Steele
Williams College

Depression and anxiety can interfere with normal cognitive abilities to such an extent that negative emotional material impairs overall functioning. Rumination and co-rumination, both considered maladaptive cognitive styles, are associated with internalizing symptoms and negative emotional cognitive bias. In the present study, our aim was to test the hypothesis that greater depression and anxiety symptoms, as well as greater levels of rumination and co-rumination, are associated with increased negative recall bias; this was defined as the ratio of negatively valenced words to positively valenced words recalled. Data were collected from 78 Williams College students via self-report measures and were analyzed using correlational and hierarchical linear regression. Results indicated that there were positive correlations between depressive and anxiety symptoms, rumination and depressive symptoms, as well as rumination and anxiety symptoms. However, co-rumination correlations were not significant. In addition, anxiety symptoms were negatively correlated with negative recall bias. Results and future directions for research are discussed.

Major depression is a debilitating disorder that adversely affects many parts of an individual's daily life. Emotional responses to depression are often directly related to one's cognitive style when appraising and attending to negative emotional experiences. The resource allocation theory postulates that the amount of mental resources available to perform cognitive operations is limited, and that depression occupies a substantial amount of these resources (Ellis & Ashbrook, 1988). Therefore, individuals with depression often show signs of reduced cognitive ability during tasks that require considerable mental effort, which indicates that depression may be taking up too much cognitive "space".

Similarly, the affective interference hypothesis (Siegle, Ingram, & Matt, 2002) posits that people with depression often have reduced cognitive resources because much of those resources are being used to process emotional material. Research has shown that cognitive processes, such as working memory, are affected when emotional material is presented to an individual with depression. For example, people with depression showed greater intrusion effects for negative words they were told not to remember as compared to positive words (Joormann & Gotlib, 2008). MacLeod, Mathews, and Tata (1986) used a visual attention paradigm to examine encoding bias in a group of people diagnosed with either depression or anxiety. The participants were presented with words on two parts of a screen, one threatening and one neutral. Immediately after the words disappeared a small dot showed up on either side. The clinically anxious participants had an attentional bias for the threatening words, resulting in delayed detection latencies when the dots were presented in the vicinity of those words. The results show how emotional stimuli can affect cognitive processes for people with anxiety. However, no studies have examined the specificity of the interaction between depression, anxiety, and negative recall bias. Our study adds to the existing literature by clarifying the interaction between internalizing symptoms and negative recall bias by examining them separately.

One cognitive style that has been particularly well studied is rumination. Rumination is defined as "repetitive thinking that focuses one's attention on one's depressive symptoms and on the implications, causes, and meaning of these symptoms;" it drains cognitive resources and is usually characterized by a lack of action toward any meaningful outcome (Joormann & Arditte, 2008; Nolen-Hoeksema, Wisco, & Lyubomirsky, 2008). Thus it is possible that individuals with greater levels of rumination will have a recall bias for mood-congruent stimuli. Beckwé and Deroost (2015) observed this phenomenon in a population of persistent negative thinkers. They found that participants who were high in rumination had difficulty disengaging from words associated with negative personality traits as compared to low ruminators; but the low ruminators did not show a bias toward either positive or negative trait words. Taken together, this evidence suggests that rumination plays a key factor in the cognitive attentional process, possibly by depleting mental resources and biasing depressed individuals toward stimuli that is congruent with a sad or negative mood. Our study looks to fill a gap in this literature by focusing on rumination levels in college students, as most studies on rumination focus on adolescence or adulthood outside of an academic setting (for an exception, see Yang, Ding, Dai, Peng, & Zhang, 2015).

When rumination occurs with close peers it is called co-rumination, although few studies have examined the role of co-rumination in attentional biases or cognitive resource depletion (Stone et al 2011). Rose (2002) defines co-rumination as "excessively discussing personal problems within a dyadic relationship and [it] is characterized by frequently discussing problems, [and] discussing the same problem repeatedly." Co-rumination influences daily mood, and a daily diary study found that co-rumination moderated the relationship between daily stressful events and depressive symptoms in individuals with high baseline levels of co-rumination (Waller et al, 2014). Additionally, it was found that women co-ruminated more than men, and that co-ruminating with a close confidant predicted the worst within-day decline in mood and an increase in depressive symptoms (White & Shih, 2012).

Little research has focused on the potential relationship between rumination and co-rumination. If the two cognitive styles work through similar mechanisms higher levels of rumination should be associated with higher levels of co-rumination, and vice versa. Moreover, if co-rumination also depletes cognitive resources then individuals high in co-rumination would have a negative recall bias. The present study expands upon the literature by examining the relationship between rumination and co-rumination, as well as the association between co-rumination and recall of positively and negatively valenced words.

The primary aim of the study was to examine the association of depressive symptoms, anxiety symptoms, rumination, and co-rumination with negative recall bias. The relationship between each construct and negative recall bias was evaluated separately. Negative recall bias was defined as the ratio of correctly remembered negatively valenced words to positively valenced words. Participants were all students enrolled at Williams College. First, the participants were told to remember a list of 10 positive and 10 negative words that were presented in a random order. Next, a cognitively challenging

set of Raven matrices was presented. Then the participants were asked to recall as many of the positive and negative words as possible. Lastly, the participants completed self-report measures of depressive symptoms, anxiety symptoms, rumination levels, and co-rumination levels. We predicted that (a) depressive symptoms would be positively associated with negative recall bias, (b) anxiety symptoms would be positively correlated with negative recall bias, (c) rumination levels would be positively associated with negative recall bias, and (d) co-rumination levels would be positively associated with negative recall bias.

Method

Participants

Participants (N = 97) were Williams College students recruited through social media posts, email messages, and personal acquaintances of the investigators. The final number of participants (N = 70) was obtained after excluding partial responses to the survey. Participants ranged from 17 to 22 years old (*M* = 19.95, *SD* = 1.19), and there were 60 females (76.9%). Every academic class year was represented; 20.8% were freshman, 14.3% were sophomores, 32.5% were juniors, and 32.5% were seniors. Self-reported ethnicity was Caucasian/White, 69.2%; Asian, 12.8%; Latino/Hispanic, 9.0%; African-American/Black, 7.7%; Bi-racial/multiple ethnicities, 5.1%; Native American, 2.6%; and other, 3.8%. An error occurred during data collection and the ethnicity percentages sum to greater than 100%. Compensation for participation included the chance to win two free pizzas. The identity of the participants remained anonymous throughout the experiment, and the only identifiable information was an email address the participant chose to submit for the pizza raffle that was not linked to their responses.

Measures

Depressive and anxiety symptoms. Depressive and anxiety symptoms were measured using a subset of questions from the Depression Anxiety and Stress Scale (DASS; Lovibond, P., & Lovibond, S., 1995). The DASS-21 is a self-report measure that was designed to assess depression, anxiety, and stress and it contains 21 items. The 7-question depression subscale was used to measure depressive symptoms and the 7-question anxiety subscale was used to measure anxiety symptoms. Participants read each statement and rated them 0 (*never*), 1 (*sometimes*), 2 (*often*), or 3 (*almost always*) depending on how relevant each statement was to them in the last week. Statements included "I couldn't seem to experience any positive feelings" on the depression subscale and "I felt I was close to panic" on the anxiety subscale. Higher scores indicated higher levels of either depressive or anxiety symptoms. The *DASS* depression subscale demonstrated good internal consistency (Cronbach's α = 0.773); and the DASS anxiety subscale had acceptable consistency (Cronbach's α = 0.627).

Rumination. Levels of rumination were assessed using a subset of questions on the Responses Styles Questionnaire (RSQ; Nolen-Hoeksema, 1991). A factor analysis conducted by Treynor, Gonzalez, and Nolen-Hoeksema (2003) suggested that the two components of rumination on the RSQ are reflective pondering and ruminative brooding. Based on evidence that the two subscales differentially predict depression symptoms, only the five items that address ruminative brooding were used in the present study (Treynor et al., 2003). Participants were asked how often during periods of stress they thought things like "Why can't I handle things better?" or "What am I doing to deserve this?" Higher scores indicated higher levels of brooding. The RSQ demonstrated acceptable internal reliability (Cronbach's α = 0.773).

Co-rumination. The 27-item co-rumination questionnaire (CRQ; Rose, 2002) was used to assess co-rumination. The CRQ was originally designed to evaluate the extent that someone co-ruminates with their closest same-sex friend; however for the present study the questionnaire was adapted to assess co-rumination with close friends regardless of gender. The participants were asked to rate the accuracy of statements such as "When we talk about a problem that one of us has, we talk for a long time about all the possible reasons why the problem might have happened" and "When I have a problem, my friend tries really hard to keep me talking about it." The CRQ had excellent internal consistency (Cronbach's α = 0.966).

Negative recall bias. Negative recall bias was defined as the ratio of negative to positive words remembered. The words were taken from the Affective Norms for English Words (ANEW) database, which contains information about the arousal and valence rating on a 9-point scale for over 1,000 English words (Bradley & Lang, 1999). Nouns with a valence rating of 2 or less were considered negative, and the nouns with a valence rating of 8 or more were considered positive. The words were chosen so that they did not differ on arousal rating or average word length (Joormann & Gotlib, 2008). The list contained 10 positively valenced words (loved, joyful, champion, happy, pleasure, success, triumphant, passion, humor, delight) and 10 negatively valenced words (tragedy, terrified, disaster, cruel, nightmare, loneliness, failure, poison, betray, rejected). The positive and negative words were presented in a random order.

Distraction task. Raven's Progressive Matrices were administered as a distraction task (Raven, J., & Court, J. H., 1998). The matrices were designed to test reasoning ability, and the participants had to identify correctly the missing portion of a pattern.

Procedure

Participation in the survey occurred on the participant's own computers. First, everyone completed a consent form and a demographic form, which included items about age, ethnicity, gender, and class year. Individuals were told that they were taking a survey about mood and memory; then they were asked to remember a list of randomly presented positive and negative words. Each word appeared for a few seconds on the center of the screen before it disappeared and the next word was presented. After viewing all 20 words, participants completed four Raven's progressive matrices of moderate difficulty as a distraction task. After completing the matrices, participants were asked to recall as many of the words as they could by typing the words into a blank text box. Lastly, participants completed the DASS, RSQ, and CRQ. Participants were debriefed at the end of the survey, and the phone numbers for campus resources including psychological services at the student health center were provided.

Data Analysis

Demographic information was evaluated with frequency and descriptive analyses. Bivariate correlational analyses were utilized to test for relationships among depression, anxiety, rumination, and co-rumination. Hierarchical linear regression was used to test for relationships between the measures and negative recall bias. All statistical analyses were conducted with SPSS.

Results

This study examined the associations between depressive symptoms, anxiety symptoms, rumination, co-rumination, and negative recall bias in a community sample of young adults. Means, standard deviations, and bivariate correlations for all variables are presented in Table 1. Depressive symptoms were significantly and positively associated with anxiety symptoms (r = .455, p < .01). Further, depressive symptoms were significantly and positively associated with rumination (r = .444, p < .01). Anxiety symptoms were significantly and positively associated with rumination (r = .491, p < .01). However, co-rumination was not significantly associated with depressive symptoms, anxiety symptoms,

Correlations Between the Continuous Variables, Means, and Standard Deviations

	1	2	3	4	5	*M*	*SD*
1. Depression	--					.53	.42
2. Anxiety	.46**	--				.67	.47
3. Rumination	.44**	.49** .17	--			2.27	.64
4. Co-rumination	.13		.12	--		2.35	.81
5. Negative recall bias	.04	-.20	.06	-.13	--	0.83	.60

*Table 1. Note: N ranges from 73 to 77. ** p < .01. Depression = mean of the DASS depression subscale (P. Lovibond & S. Lovibond, 1995); anxiety = mean of DASS anxiety subscale (P. Lovibond & S. Lovibond, 1995); rumination = mean of RSQ (Nolen-Hoeksema, 1991); co-rumination = mean of CRQ (Rose, 2002); negative recall bias was defined as the ratio of negative words recalled to positive words recalled.*

Hierarchical Multiple Regression Analyses Predicting Negative Recall Bias

	b	*B*	*t*	*p*
1. Depression	.056	.044	.379	.706
2. Anxiety	.-.285	-.198*	-1.75	.085
3. Rumination	.059	.063	.543	.589
4. Co-rumination	-.097	-.128	-1.09	.281

*Table 2. Note: * = indicates value approached significance, b = unstandardized regression coefficient, β = standardized regression coefficient, t = t-value, p = significance value.*

rumination, or negative recall bias. In addition, negative recall bias was not significantly associated with depressive symptoms, anxiety symptoms, rumination, or co-rumination.

Four hierarchical regression analyses were conducted to examine predictors of negative recall bias. For each analysis, the main effects for the predictor variables (depression, anxiety, rumination, and co-rumination) were entered on the first step. All predictor variables entered into the regression were centered. Results are shown in Table 2.

Research Question 1: Do Depressive Symptoms Predict Negative Recall Bias?

In the first analysis examining depressive symptoms, main effects indicated that depressive symptoms were not significantly associated with negative recall bias (β = .044, p = .706). People with higher levels of depressive symptoms did not remember more negative words than positive words.

Research Question 2: Do Anxiety Symptoms Predict Negative Recall Bias?

In the second analysis examining anxiety symptoms, main effects indicated that the relationship between anxiety symptoms and negative recall bias was marginally significant (β = -.198, p = .085). Individuals with fewer anxiety symptoms recalled slightly more negative words than positive words.

Research Question 3: Does Rumination Predict Negative Recall Bias?

In the third analysis, main effects indicated that rumination was not significantly associated with negative recall bias (β = .063, p = .589). This finding does not support the hypothesis that rumination would be associated with biased recall for negative words.

Research Question 4: Does Co-Rumination Predict Negative Recall Bias?

In the final analysis, main effects indicated that co-rumination was not significantly associated with negative recall bias (β = -.128, p = .281). Participants who reported a tendency to co-ruminate did not remember more negatively valenced words than positive.

Together these findings suggest that there is an association between anxiety symptoms and negative recall bias; but not an association between depression, rumination, or co-rumination and negative recall bias.

Discussion

The goal of the current study was to explore how internalizing symptoms, rumination, and co-rumination can affect cognitive ability, specifically working memory. Research has demonstrated that individuals with depression have both attentional and memory biases (Joormann & Arditte, 2008; Matt, Vásquez, & Campbell, 1992). In addition, there is some evidence that individuals with anxiety have a negative memory bias (Foa, Gilboa-Schechtman, Amir, & Freshman, 2000). It was predicted that both depression and anxiety would be associated with negative recall bias. Depression is often characterized by rumination; however, there is little research about the relationship between memory biases and rumination (MacLeod, Mathews, & Tata, 1986; White & Shih, 2012). Therefore, the present study was designed to address these gaps in the literature.

The results provided an interesting insight into the ways that internalizing symptoms can affect the recall of positive and negative stimuli. First, it was predicted that greater depressive symptoms would be correlated with a higher negative recall bias. However, the results did not support this hypothesis. This was surprising because previous research has shown that people with depression remember more negative than positive words (Joormann & Gotlib, 2008). It is possible that biases for negative emotional material are not present prior to the onset of depression, but instead are a consequence of the disorder. Future research should explore the onset of memory biases in people with depression, and how it might change over the course of illness. Moreover, Joormann and Arditte (2008) assessed recall after one week, while in the present study recall was assessed the same day. Additional research will be needed to clarify the effect of depression on long and short-term memory. Lastly, numerous epidemiological and clinical studies have shown that there is a high comorbidity between depression and anxiety (Joormann & Arditte, 2008). In the present study depressive symptoms were significantly, positively correlated with anxiety symptoms, thus contributing to the well-established literature examining internalizing symptoms.

Second, it was hypothesized that greater anxiety symptoms would be correlated with a higher negative recall bias. However higher levels of anxiety were associated with a *decreased* negative recall bias; the direction of this association was unexpected (Table 2). It is important to note that the DASS anxiety subscale (P. Lovibond & S. Lovibond, 1995) had low internal consistency (Cronbach's α = 0.63), so caution should be used when interpreting these results. These findings were inconsistent with the study conducted by Foa et al. (2000), which found that people with generalized social phobia had greater biased recall for negative facial expressions. Negative recall bias might be present in specific anxiety disorders, but not all of them (Joormann & Arditte, 2008). A valuable direction for future research will be to examine the specificity of the relationship between cognitive biases and anxiety disorders. Also, research should explore the differences in cognitive bias for certain stimuli such as negative faces, pictures, or words.

Third, it was predicted that rumination would be positively associated with biased recall for negative stimuli. The resource allocation theory proposes that working memory has a limited capacity, and that depression and rumination occupy a significant portion of an individual's resources (Joormann & Arditte, 2008; Levens, Muhtadie, & Gotlib, 2009). Consistent with that theory and previous research, depression and rumination were positively correlated (Table 1). However, there was no relationship between rumination and negative recall bias; this could be attributed to the low variability in the depression symptom measure (Table 1). Rumination might only be associated with a memory bias among people with a substantial level of depressive symptoms, people with dysphoria or current diagnosis of major depression. In addition, the focus of ruminative thoughts are often on an

individual's depressive symptoms (Joormann & Arditte, 2008). Perhaps people who ruminate are more likely to remember negative stimuli only if the content is personally relevant.

Lastly, because depression and co-rumination are often associated (White & Shih, 2012), and there is a well-established connection between depression and cognitive biases (Joormann & Arditte, 2008), it was hypothesized that there would be a relationship between co-rumination and greater negative recall bias. However, co-rumination did not predict negative recall bias. Furthermore, co-rumination was not correlated with depression, anxiety, or rumination. This is inconsistent with previous research demonstrating that co-rumination is associated with higher levels of depressive symptoms in girls and young adolescents (White & Shih, 2012). The findings of the present study should be replicated in a larger community sample of young adults, and the results from males and females should be analyzed separately.

Limitations and Future Directions

This study has several implications for clinical intervention and treatment. In this sample rumination and depression were correlated, therefore if rumination has a causal role in depression then teaching skills to alleviate rumination (such as problem-solving and positive distraction tasks) would work to alleviate depressive symptoms. This could prevent recurrence of depressive symptoms by teaching protective cognitive strategies. Similarly, it would be important to teach skills to alleviate internalizing symptoms (i.e. mindfulness, behavioral activation) because that will reduce symptoms of both depression and anxiety.

Nonetheless, it is important to acknowledge certain limitations of this experiment. The DASS anxiety subscale had low internal consistency; therefore, it is important to use caution when interpreting the association between less anxiety and greater negative recall bias. Second, all of the measures were self-report, which is less reliable than interview-based assessments. Third, there was low power to identify potential effects due to the small sample size. It would be valuable for future research to replicate these findings in a larger sample, using semi-structured interviews to assess depression and anxiety symptoms instead of self-report questionnaires. Lastly, negative recall bias was limited to words. Negative recall bias of visual and auditory stimuli as it relates to depression, anxiety, and rumination could also be examined.

Depression is a debilitating illness characterized by sustained negative mood and biases in cognitive processing; depression is also often comorbid with anxiety disorders. It is important to identify risk factors that precede the development of depression or anxiety because they could be useful intervention targets. This study provides evidence that depressive symptoms are positively correlated with both anxiety symptoms and rumination in a community sample of undergraduate students. A prevention program targeted to college students should teach problem-solving skills designed to reduce rumination because this would alleviate both depression and anxiety symptoms.

References

Beckwé, M., & Deroost, N. (2016). Attentional biases in ruminators and worriers. *Psychological Research, 80(6),* 952-962. doi: 10.1007/s00426-015-0703-8

Bradley, M. M., & Lang, P. J. (1999). *Affective Norms for English Words (ANEW): Technical manual and affective ratings.* Gainesville, FL: The Center for Research in Psychophysiology. doi:10.1.1.306.3881

Ellis H. C., & Ashbrook P. W. (1998). Resource allocation model of the effects of depressed mood states on memory. In K. Fiedler & J. Forgas J (Eds.), *Affect, cognition and social behavior.* Toronto, Canada: Hogrefe International.

Foa, E. B., Gilboa-Schechtman, E., Amir, N., & Freshman, M. (2000). Memory bias in generalized social phobia: Remembering negative emotional expressions. *Journal of Anxiety Disorders, 14(5)*, 501-519. http://doi.org/10.1016/S0887-6185(00)00036-0

Joormann, J., & Arditte, K. (2008). Cognitive aspects of depression. In I. H. Gotlib & C. L. Hammen (Eds.), *Handbook of Depression* (3rd ed.). New York: Guilford Press.

Joormann, J., & Gotlib, I. H. (2008). Updating the contents of working memory in depression: Interference from irrelevant negative material. *Journal of Abnormal Psychology, 117(1),* 182-192. http://dx.doi.org/10.1037/0021-843X.117.1.182

Levens, S. M., Muhtadie, L. & Gotlib, I. H. (2009). Rumination and impaired resource allocation in depression. *Journal of Abnormal Psychology, 118(4),* 757-766. http://dx.doi.org/10.1037/a0017206

Lovibond, P. F., & Lovibond, S. H. (1995). The structure of negative emotional states: Comparison of the Depression Anxiety Stress Scales (DASS) with the Beck Depression and Anxiety Inventories. *Behaviour Research and Therapy, 33(3),* 335-342. http://doi.org/10.1016/0005-7967(94)00075-U

Matt, G. E., Vázquez, C., & Campbell, W. K. (1992). Mood-congruent recall of affectively toned stimuli: A meta-analytic review. *Clinical Psychology Review, 12(2),* 227-255. https://doi.org/10.1016/0272-7358(92)90116-P

Nolen-Hoeksema, S. (1991). Responses to depression and their effects on the duration of depressive moods. *Journal of Abnormal Psychology, 700(4),* 569-582. http://dx.doi.org/10.1037/0021-843X.100.4.569

Nolen-Hoeksema, S., Wisco, B.E., & Lyubomirsky, S. (2008). Rethinking rumination. *Perspectives on Psychological Science, 3(5),* 400-424. https://doi.org/10.1111/j.1745-6924.2008.00088.x

Raven, J., & Court, J. H. (1998). Manual for Raven's progressive matrices and vocabulary scales. Oxford: Oxford Psychologists Press.

Rose, A. (2002). Co-rumination in the friendships of girls and boys. Child Development, 73(6), 1830-1843. doi:10.1111/1467-8624.00509

Siegle, G. J. Ingram, R. E. & Matt, G. E. (2002). Affective interference: An explanation for negative attention biases in dysphoria? *Cognitive Therapy and Research, 26(1)*, 73-87. doi:10.1023/A:1013893705009

Treynor, W., Gonzalez, R., & Nolen-Hoeksema, S. (2003). Rumination reconsidered: A psychometric analysis. *Cognitive Therapy and Research, 27(3)*, 247-259. doi:10.1023/A:1023910315561

White, M. E., & Shih, J. H. (2012). A daily diary study of co-rumination, stressful life events, and depressed mood in late adolescents. *Journal of Clinical Child & Adolescent Psychology, 41(5)*, 598-610. doi:10.1080/15374416.2012.706518

Yang, W., Ding, Z., Dai, T., Peng, F., & Zhang, J. X. (2015). Attention bias modification training in individuals with depressive symptoms: A randomized controlled trial. *Journal of Behavior Therapy and Experimental Psychiatry, 49* (Part A), 101-111. http://doi.org/10.1016/j.jbtep.2014.08.005

Arielle Pistiner
Binghamton University

Arielle Pistiner is a junior at Binghamton University. She is an Integrative Neuroscience major with a Health and Wellness Minor. Arielle was a part of Binghamton's first cohort of the Freshman Research Immersion program, which gave her the opportunity to do this kind of research as an undergraduate. She is on the executive board of Binghamton's Pre-Dental Society, and is a Binghamton Student Ambassador. She plans to pursue a career in the health field, specifically working with children.

Was there a particular experience that sparked your research interests?

All throughout high school, I was always completely fascinated with science, especially neuroscience-related advancements. I knew that research would be a vital part of my college career. My senior year of high school I found out that I was invited to be a part of Binghamton University's first cohort of a new program called the Freshman Research Immersion Program (FRI). This program allowed me to be a part of a community of about 30 or so other students who were also given the opportunity to conduct neuroscience research right upon entering college as a freshman. The faculty and various people I met in this program further sparked my interest in research and inspired me to continue.

Who has been an influential person in your life?

An extremely influential person in my college career thus far has been my research professor, Dr. Corinne Ostock-Kiessling. When I came into college, I wasn't entirely sure if I was ready for 2 years of research right away as a freshman, and wasn't sure what it would entail. Dr. Kiessling integrated me into the process right away, and showed me just how amazing science can really be. She served as a great role model, and embodied everything I aspired to be: a powerful female in the scientific world. Dr. Kiessling influenced my love for research immensely, and always reminded me of the importance of the "behind the scenes" research. Because of her, I now view neuroscience research as a meaningful and fulfilling aspect of my life as well. Her love for teaching and science also inspired me to become a teaching assistant for the FRI Neuroscience Program myself and help others get the same fulfillment from research as I did.

When and where are you the most productive?

I am most productive in the afternoon and night (not a morning person!). I get work done most efficiently in the total quiet rooms of my library at Binghamton University - most specifically the "white room". I am at my best after a full cup of coffee and listening to my favorite music.

Where do you see yourself in 10 years?

In 10 years, I see myself as some sort of health professional, most likely a pediatric dentist. I hope, at that point, to have done more research in the areas of neuroscience or stem cell biology. Whatever I end up doing, I have no doubt that I see myself working with children and their families to help improve their lives both mentally and physically. I would especially love to have an impact on the pediatric special needs population.

Lakshmi Hareendran
Binghamton University

Lakshmi Lara Hareendran is a junior at Binghamton University. She is pursuing an Integrative Neuroscience degree and hopes to one day have a career in the medical field. She was born in Queens, New York and is passionate about giving back to the community she was raised in. She loves to to try new things, so being a part of the Freshmen Research Immersion Program's inaugural class was both an honor and a perfect fit. Aside from academics, she loves dancing, traveling, magic and spending time with friends and family.

Was there a particular experience that sparked your research interests?

I had seen a research fair at the hospital I volunteered in, and all the presentations were so interesting and the people explaining them seemed so passionate and knowledgable that it made me want to be a part of that world.

Who has been an influential person in your life?

As cliche as it sounds- my parents have been my biggest inspirations and influences. Their unconditional and unwavering support and faith in me is my biggest motivation.

When and where are you the most productive?

I am the most productive in quiet areas of the library in the mornings.

Where do you see yourself in 10 years?

I see myself traveling and seeing more of the world with friends and family. I hope to have a job in the medical field, and to be successful in whatever line of work I pursue. Overall, hopefully happy and healthy ten years from now!

Katherine Chemakin
Binghamton University

Katherine Chemakin is a junior at Binghamton University. She thoroughly enjoys research and hopes to graduate with a degree in Integrative Neuroscience (with honors) and continue on to medical school, to pursue an M.D./Ph.D. She is currently working in a research lab on campus that investigates different neuroreceptors involved Parkinson's Disease. She is currently the president of the MEDLIFE chapter on campus that organizes trips to work in medical clinics in third world countries. She is also the executive board secretary of Phi Delta Epsilon which is the only international premedical fraternity. She enjoys tennis, art, and traveling.

Was there a particular experience that sparked your research interests?

I was given the opportunity to be part of the Freshman Research Program at Binghamton University and being a part of that program really sparked my interest in research. Being able to learn how to do research while actually conducting research that contributes to the scientific community really allowed me to get a very hands on research experience that allowed my interest in research to grow.

Who has been an influential person in your life?

My mother has been the most influential person in my life. She is one of the hardest working and loving people I know. She has done nothing for herself. Every minute of her working is so that she can give my brother and I the best possible life and opportunities. Her love and dedication are what inspire me to be a better person and just as hard working. She has been the most supportive of my goals in becoming a doctor and conducting research; thanks to her, I have been able to accomplish as much as I have.

When and where are you the most productive?

I am very much a morning person. I am the most productive in my room in the morning. I will wake up around 7 am and start working right away with a large kettle of tea.

Where do you see yourself in 10 years?

In 10 years, I hope to be working on/finishing getting my M.D./Ph.D. I want to continue doing neurodegenerative research hopefully still with Parkinson's disease and then once I am done with the program, go into my residency in medical school.

Kayla Silow-Carrol
Binghamton University

Kayla Silow-Carroll is a junior at Binghamton University. She is an Integrative Neuroscience major and was part of Binghamton's Freshman Research Immersion program, which gave her the opportunity to do this kind of research as an undergraduate. She plans to pursue a career in the health care field. Kayla enjoys spending time outdoors and reading.

Was there a particular experience that sparked your research interests?

Prior to being accepted to the Freshman Research Immersion program at Binghamton University, I did not have any research experience. It was through this program that I learned how vast and interesting the world of scientific research could be, and that I could personally contribute to scientific progress. My professors encouraged me to work closely with my peers and taught me the importance of delegation. My experience has taught me that research studies take many hours of hard work and diligence, and that I might not always see the results that I want to see. However, as much scientific information already exists in the world, there is more knowledge to be gained and every research study can be a significant contribution.

Who has been an influential person in your life?

My high school dean showed me the importance of following my passions and helping others however I can. She led a group that emphasized the empowerment of young women and encouraged the girls of my high school to overcome any limitations they think have been set for them. It was because of her that I felt confident enough to go into the field of science, and would like to one day work with children in order to inspire them the same way that I was inspired.

When and where are you the most productive?

I am most productive during the day in Binghamton University's campus library.

Where do you see yourself in 10 years?

In 10 years, I see myself working with children in a profession that will benefit their mental or physical health, while starting a family of my own.

Effects of Receptor-Specific Dopamine Drugs on the Treatment of Cognitive Deficits in Parkinson's Disease

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Dopamine (DA) drugs are often the chosen treatment for motor and cognitive deficits that accompany Parkinson's disease (PD). This study examines the effects of receptor-specific dopamine drugs on the treatment of cognitive deficits associated with PD. For this study, adult male Sprague Dawley rats (N = 22) received sham, DA mild, DA severe, or dual acetylcholine (Ach) + DA lesions. Rats of each group were tested on a baseline to determine the effects of the lesion only, and were then put through a series of behavioral tests with dopamine drug treatments in order to test the efficiency of these drugs in treating Parkinsonian-like cognitive deficits. Specifically, behavioral tests evaluated the memory, attention ability, gait, and spatial working memory of the rats. The results of this study showed that the dual lesioned rats experienced the most Parkinsonian-like deficits, and that the D2 agonist, quinpirole, is a drug that should be further investigated.

Parkinson's disease (PD) is a crippling, neurodegenerative disorder that impairs the motor and cognitive abilities of those affected by it. When it comes to neurodegenerative disorders, PD is the second most common, right behind Alzheimer's disease (Gibrat et al., 2009). PD is classified by a dopamine (DA) loss in the striatum, and an acetylcholine (Ach) loss in the basal forebrain, both of which impair motor and cognitive abilities. The ultimate cause for this disorder is unknown, but could be attributed to genetic and/or environmental causes, and as of now there is no cure, just treatment to manage its symptoms (Gibrat et al., 2009). Common symptoms of PD include difficulty with memory, depression, tremors, bradykinesia, and often dementia as well (Calne, 1993).

Since PD is a disorder that affects both DA and Ach in the brain, and these neurotransmitters are responsible for learning and encoding memories, cognitive deficits often result (Hasselmo, 2006). Ach lesions damage overall memory and impair the ability to encode information and make use of spatial learning. The toxin used to induce an Ach lesion is IgG-192 Saporin. This loss of Ach affects spatial memory and cognition (Hasselmo, 2006). After a subject is injected with this toxin, it has been shown that less Ach appears in the brain. Subjects that received 192 IgG Saporin injections into the medial septal (MS) displayed significantly less Ach in the MS when analyzed after staining compared to control (Dashniani, Krushvili, Rusadze, Mataradze, & Beselia, 2015). In the spatial alternation task testing the effect of the IgG-192 Saporin, Dashniani et al. (2015) found that rats treated with 192 IgG Saporin had significantly less arms entries compared to the control group. This is significant because it shows a decline in the spatial memory and cognitive ability of the rats being tested, proving that the loss of Ach causes these detrimental effects.

DA in the brain is responsible for various roles such as locomotor activity, learning, memory, and cognition (Arnsten, Cai, Steere, & Goldman-Rakic, 1995). Lesions with the toxin 6-OHDA are used to produce dopaminergic deficits of this kind (Deumens, Blokland, & Prickaerts, 2002). After subjects were injected with this toxin, it has been shown that rat-models do indeed display deficits characteristic of DA loss in the brain when made to perform various behavioral tasks. Rats the received a 6-OHDA lesion showed significant motor coordination deficits when tested on rotorod when compared to sham (Carvalho et al., 2013).

The present study carried out experiments to determine the effects of receptor specific drugs on the treatment of PD at different stages and a series of behavioral tests were used. Prior to the behavioral testing, rats were given sham, mild DA, severe DA, and dual Ach + DA lesions. The DA lesions were made with 6-OHDA and the Ach lesions made with IgG-192 Saporin. After the rats were lesioned, they were tested without treatment first in order to get a preliminary baseline for each task. Then, rats were tested with vehicle, L-DOPA, SKF81297, and quinpirole and tested again after this. L-DOPA is a drug that is a precursor to DA, and targets all DA receptors. SKF81297 is a drug that is a DA D1 receptor agonist, and quinpirole is a drug that is a DA D2 receptor agonist.

Locomotor chamber testing was used as a baseline test to measure the anxiety levels and movement of the lesioned rats over a period of 60 minutes. This test was used to observe these levels at baseline, before drug administration. The Michigan Complex Motor Control Task (MCMCT) test was used to measure the attention abilities and the motor/gait abilities of the lesioned rats before and after drug administration. Lastly, Morris Water Maze testing was used to test the rats' spatial memory and physical ability to swim both before and after drug administration as well. It was hypothesized that the rat's motor and cognitive abilities through the series of behavioral tests would improve after drugs were administered and one would be able to see which drug most efficiently made up for the deficiencies induced by the lesions of DA and Ach.

Method

Subjects

The subjects of this study were adult male Sprague-Dawley rats (N = 22). All rats were 10 weeks old at the start of the study and were obtained from the vendor, Harlan. The rats were held in a colony room temperature of 20- 22 degrees Celsius, with light/dark cycle times of 12/12 hours beginning at 7am. Rats were pair-housed in plastic cages that were 8 inches tall, 8.5 inches wide, and 18 inches long with 1 inch of wood shavings as bedding on the bottom. Rats had free access to water and standard lab chow throughout the experiment. The rats were cared for in accordance with the guidelines of the Institutional Animal Care and Use Committee at Binghamton University and the "Guide for the Care and Use of Laboratory Animals" (Institute for Laboratory Animal Research, National Academies Press 2011).

Surgery

In order to create rat models that displayed symptoms of PD rats were administered with sham (n = 6), DA mild (n = 5), severe DA (n = 5), and dual Ach + DA (n = 6) lesions. Before lesions were made, rats were anesthetized with inhalant isoflurane (2-3% in oxygen, 1000 cc/min) and Buprenorphine (0.03 mg/kg) was used as a pre-operative analgesic. In order to achieve these deficits for this dual-lesioned group, both the basal forebrain and striatum were lesioned. The Ach toxin IgG-192 Saporin (200 µg/µL) was administered bilaterally to the basal forebrain

through an intracerebroventricular (ICV) injection to the coordinates relative to bregma: AP -0.55 mm, ML ± 2.40 mm; DV -8.20 mm (Paxinos & Watson, 2006). For the DA portion of the dual lesion for these 6 rats, the toxin 6-OHDA was injected to the striatum. 3 µg/µL (2 µL total volume) of the 6-OHDA was administered bilaterally to the striatum to two sites through a intrastriatal injection to the coordinates relative to bregma: ML ± 3.00 mm, ± 4.20 mm; AP 0.40 mm, -1.30 mm; and DV -5.00 mm, -5.00 mm; respectively.

For the DA-only lesions (mild n = 5 rats, and severe n = 5 rats), the toxin 6-OHDA was utilized as well. The mild DA lesioned rats received the same striatal DA lesion as the dual lesioned rats. However, a vehicle (saline solution) lesion was also administered to the basal forebrain through an intracerebroventricular injection for the mild DA lesioned rats to the same coordinates that the IgG-192 Saporin was administered to for the dual lesioned rats. For the severe DA lesions, 6-OHDA (3 µg/µL, 2 µL/site) was administered bilaterally to the striatum to 4 sites at the following coordinates relative to bregma: ML ± 2.60 mm, ± 3.00 mm, ± 4.20 mm, ± 4.50 mm; AP 1.30 mm, 0.40 mm, -0.40 mm, -1.30 mm; DV -5.00 mm, -5.00 mm, -5.00 mm, -5.00 mm; respectively. Sham rats were injected with vehicle (saline + 0.1% ascorbic acid) at the same coordinates. After surgery, all rats went through a 3-week recovery period. The first 10 days of this period the subjects received supplemental food to aid in recovery (such as soft chow, fruit, and peanut butter) and they were also handled during this time.

Procedure

In this experiment, a mixed design was conducted. The between-subjects variable was lesion, and the within-subjects variable was drug treatment. After the rats were lesioned, they were put through a baseline test of locomotor chambers to test the effect of the lesion alone. After this baseline, the rats were then habituated to each of the behavioral tests that were to be done: MCMCT for 4 days, and Morris Water Maze for 3 days. Rats were then put through baseline testing for each of these behavioral tests: 4 days for MCMCT and 4 days for Morris Water Maze, to evaluate the effect of lesion without drugs. Lastly, treatments were then administered before the completion of these tests to evaluate the drugs' effects on the treatment of cognitive deficits. Rats performed MCMCT and Morris Water Maze on treatment for 5 days each. DA drugs were administered to the rats in order to test the contributions of DA receptors to the treatment of PD at different stages. L-DOPA was administered subcutaneously at a dose of 4 mg/kg (LD4) and 12 mg/kg (LD12), given with Benserazide (15 mg/kg). SKF81297 (SKF) dissolved in 20% DMSO and 80% dH2O was administered at 0.8 mg/kg, quinpirole dissolved in dH2O was administered at 0.2 mg/kg, and the vehicle received 0 mg/kg of a drug. Behavioral testing for both tests occurred directly 1 hour after drug injection.

Behavioral testing. ***Locomotor chamber.*** This test is an assessment of motor ability in which the rat is placed in a chamber 41 cm long x 41 cm wide x 30.5 cm high. This chamber has sensors to detect the rat's every move while inside of it. These infrared photocell arrays are synced with a program running Versamax and Versadat software which "analyzes patterns of photo beam breaks to measure horizontal and vertical movements" (Lindenbach et al., 2011). The rat is placed in the locomotor chamber and left there for 1 hour. The computerized locomotor chamber records the distance traveled (cm), movement time, time spent in center, rearing activity, and stereotypy. Stereotypy is characterized by persistent repetition of an act such as constant grooming and rotations. Stereotypy is counted by the amount of times a rat triggers a beam successively without triggering any adjacent beams (Lindenbach et al., 2011). The data for this test was expressed in intervals over time (5-60 minute with 5 minute intervals in between each reading).

Morris Water Maze. This test is an assessment of cognitive ability in which the rat is placed in a large tub of water with an escape platform placed in one of its quadrants. The tub is 210 cm in diameter and 51cm in height. The platform is 11cm x 11 cm and is placed so that the top is 1-2 cm below water level. This tests the rat's spatial recognition ability. The rats were habituated for this test for at least three days until they could locate the escape platform in the tub in order to be removed from the tub. A maximum of 60 seconds was given to the rats to find the platform in each trial. Rats were placed in the tub from different entering points in order to more efficiently test their spatial recognition (Vorhees, 2006). Rats performed three trials from each location, with a total of 12 trials per rat. In this test, latency to platform was measured for each trial using a timer.

Michigan Complex Motor Control Task (MCMCT). The MCMCT test assesses both motor and cognitive ability, however it specifically focuses on attention ability (Kucinski, Paolone, Bradshaw, Albin, & Sarter, 2013). Kucinski and colleagues (2013) stated that this apparatus was intended to expose connections between deficiencies in behaviors such as complex movement, gait and balance, and attentional control deficits. It was also intended to highlight freezing of movement, loss of balance and poor rebalancing skills after movement errors and falls. The apparatus consists of a 2 meter long rod with a square 2.54 cm^2 rotating beam placed horizontally, rotating (10 rpm) while the distractor of a door is presented. The door distractor is 10 cm wide and 11 cm above the rod, placed a meter away from the starting platform. The rats must effectively maintain their posture on the rotating rods without giving in to the distractor, which ultimately tests their attentional control deficits (Kucinski et al., 2013). The rats must do this for three trials each while walking from the starting platform to the home cage at the end of the rod. Latency to platform and foot slips were measured and recorded for this test.

Results

In Figure 1, the baseline analysis of lesion-induced changes in spontaneous motor activity for locomotor chamber testing is shown.

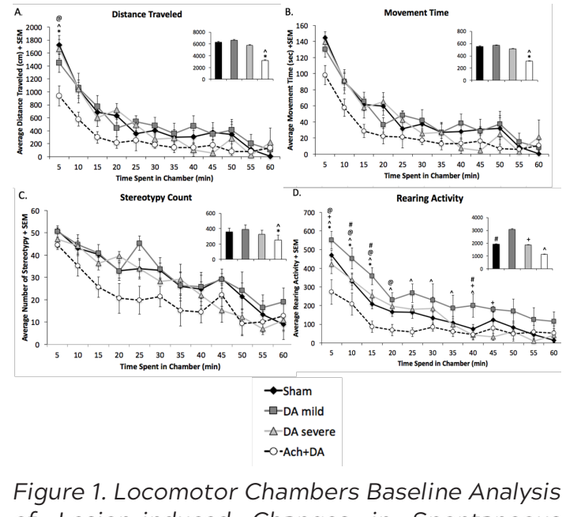


*Figure 1. Locomotor Chambers Baseline Analysis of Lesion-induced Changes in Spontaneous Motor Activity. Each rat (N = 22) was placed into a locomotor chamber for an hour. The rats were divided into four groups: sham (n = 6), DA mild lesion (n = 5), DA severe lesion (n = 5), and Ach + DA dual lesion (n = 6). A variety of motor activities were monitored and the average and ± SEM were recorded. The upper right corner of each graph displays the sum totals of each respective movement activity. Post Hoc analysis was used to assess the effect of lesion (A-D) and lesion vs. time (A and D only) annotated by: *p < 0.05 Sham vs. Ach+DA, #p < 0.05 Sham vs. DA Mild, +p < 0.05 DA Mild vs. Severe, ^p < 0.05 DA Mild vs. Ach+DA, @p < 0.05 DA Severe vs. Dual.*

This figure encompasses the 4 parameters that were tested using locomotor chamber: distance traveled (1A), movement time (1B), stereotypy count (1C), and rearing activity (1D). In order to analyze significance for the effect of lesion, effect of time, and interaction of lesion vs. time

for the locomotor chamber data, we ran separate multivariate 4 (lesion) x 12 (time) mixed-design ANOVAs. An ANOVA was also run to test the significance of our anxiety data for total time in center of the locomotor chamber testing (Figure 2).

The statistical analysis for total distance traveled (Figure 1A) showed that there was an effect of time [$F(11, 198) = 55.829$, $p < 0.001$] and an effect of lesion [$F(3,18) = 3.283$, $p = 0.045$]. A post-hoc analysis of lesion showed that both the sham and mild DA lesioned rats traveled longer distances than the dual lesioned rats ($p < 0.05$). There was also a significant interaction of lesion vs. time [$F(33, 198) = 1.788$, $p = 0.008$). A Fisher's LSD post-hoc test revealed that for times 5-20, the dual lesioned rats traveled less distance than the sham, mild DA, and severe DA lesioned rats ($p < 0.05$). Additionally, at time 40, it was found that the mild DA lesioned rats traveled more distance than the severe DA lesioned rats ($p < 0.05$).

For movement time, the statistical analysis (Figure 1B) showed that there was an effect of lesion [$F(3, 18) = 3.112$, $p = 0.052$] and an effect of time [$F(11, 198) = 60.931$, $p < 0.0001$]. The post-hoc analysis of lesion found that both the sham and mild DA lesioned rats showed a higher average movement time than that of the dual lesioned rats ($p < 0.05$). The interaction between time and lesion [$F(33, 198) = 1.363$, $p = 0.102$] was not significant for this parameter.

The statistical analysis done for stereotypy count (Figure 1C) also showed that there was an effect of lesion [$F(3, 18) = 3.120$, $p = 0.052$] and an effect of time [$F(11, 198) = 26.417$, $p < 0.001$]. Post-hoc analysis of lesion found that the data for both the sham and mild DA lesioned rats showed a significant difference to that of the dual lesioned rats ($p < 0.05$) in that both had a higher stereotypy count than that of the dual lesioned rats. The interaction between time and lesion [$F(33, 198) = 0.891$, $p = 0.641$] was not significant for this parameter.

The statistical analysis for rearing activity (Figure 1D) showed that there was an effect of lesion [$F(3, 18) = 7.028$, $p = 0.003$] and an effect of time [$F(11, 198) = 46.330$, $p < 0.001$]. Sham, mild DA, and severe DA lesioned rats showed a significantly higher average rearing activity than that of the dual lesioned rats ($p < 0.05$). This analysis also revealed a significant interaction between lesion and time [$F(33, 198 = 1.540$, $p = 0.039$]. A Fisher's LSD post-hoc analysis revealed that for time 5, the sham lesioned rats performed more rearing activity than the dual lesioned rats, the mild DA lesioned rats performed more than the severe DA lesioned rats, and both the mild DA and severe DA lesioned rats performed more than the dual lesioned rats ($p < 0.05$). For times 10 and 15, the sham lesioned rats performed less than the mild DA lesioned rats, and the dual lesioned rats performed significantly less than the sham, mild DA, and severe DA lesioned rats ($p < 0.05$). For times 20 and 25, the severe DA lesioned rats performed more than the dual lesioned rats ($p < 0.05$) and from times 20-40 and 50, the mild DA lesioned rats performed more than the dual lesioned rats ($p < 0.05$). Also, at time 40, mild DA lesioned rats performed significantly more than sham and severe DA lesioned rats, and significantly more than severe DA lesioned rats at time 45 as well ($p < 0.05$). Lastly, at time 50, mild DA lesioned rats performed significantly more than dual lesioned rats ($p < 0.05$).

The statistical analysis for anxiety, time in center (Figure 2), showed that there was a significant effect of time [$F(11, 196) = 8.432$, $p < 0.001$]. The effect of lesion [$F(3,18) = 2.3623$, $p = 0.105$] and interaction between time and lesion [$F(33, 198) = 1.203$, $p = 0.221$] was not significant for this parameter.

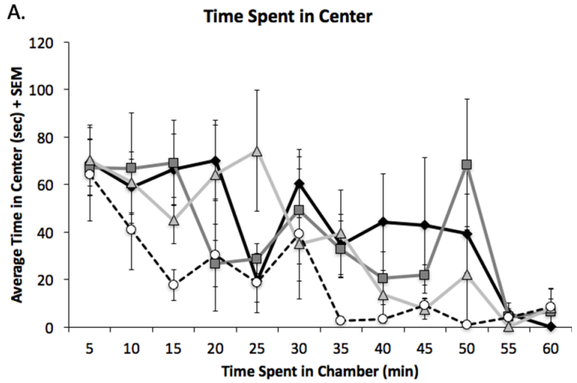


Figure 2. Locomotor Chamber Baseline Analysis of Lesion-induced Changes in Anxiety. Each rat (N = 22) was placed into a locomotor chamber for an hour. The rats were divided into four groups: sham (n = 6), DA mild lesion (n = 5), DA severe lesion (n = 5), and Ach + DA dual lesion (n = 6). The level of anxiety was monitored and the average and ± SEM was recorded over an hour period (Graph A). Graph B displays the sum totals of each respective movement activity. Multivariate ANOVA and post Hoc analysis revealed a major effect of time ($p < 0.05$).

Morris Water Maze

In Figure 3, the effect of lesion and DA treatment on spatial memory ability in Morris water maze is shown.

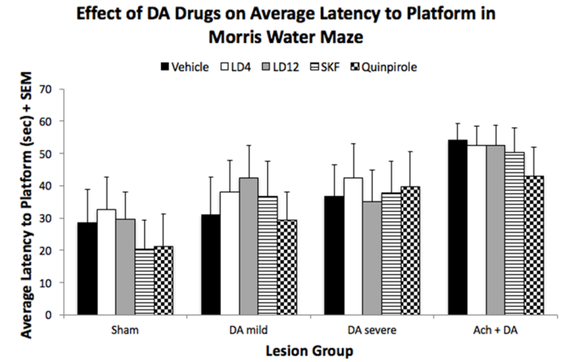


Figure 3. Effect of DA Lesion and Treatment on Spatial Memory Ability in Morris Water Maze. Each rat (N = 22) was tested on its ability to use spatial working memory to finds its way to a platform from four different quadrants in a tub of water while on different dopamine drug treatments. The treatments tested were vehicle, L-Dopa (4 and 12 mg/kg), SKF81297 (0.8 mg/kg) and quinpirole (0.5 mg/kg). The rats were divided into four groups: sham (n = 6), DA mild lesion (n = 5), DA severe lesion (n = 5), and Ach + DA dual lesion (n = 6). This graph shows the overall average latency to the platform + SEM from all four quadrants over all trials. For the rats performance in the Morris Water Maze ANOVA analysis revealed there was a main effect of treatment ($p < 0.05$).

A 4 (lesion) x 5 (treatment) mixed-design ANOVA was run for the Morris Water Maze and showed a significant effect of treatment [$F(4, 72) = 2.722$, $p = 0.036$], regardless of lesion. A significant difference was found between rats treated with LD 4 and LD 12 compared to those treated with quinpirole in that LD 4 had a higher average latency to platform. The effect of lesion [$F(3,18) = 2.478$, $p = 0.094$] and the interaction of treatment and lesion [$F(12, 72) = 0.580$, $p = 0.852$] were not significant for this parameter.

Michigan Complex Motor Control Task (MCMCT)

Figure 4 shows the effect of lesion and DA treatment on attention ability in MCMCT performance.

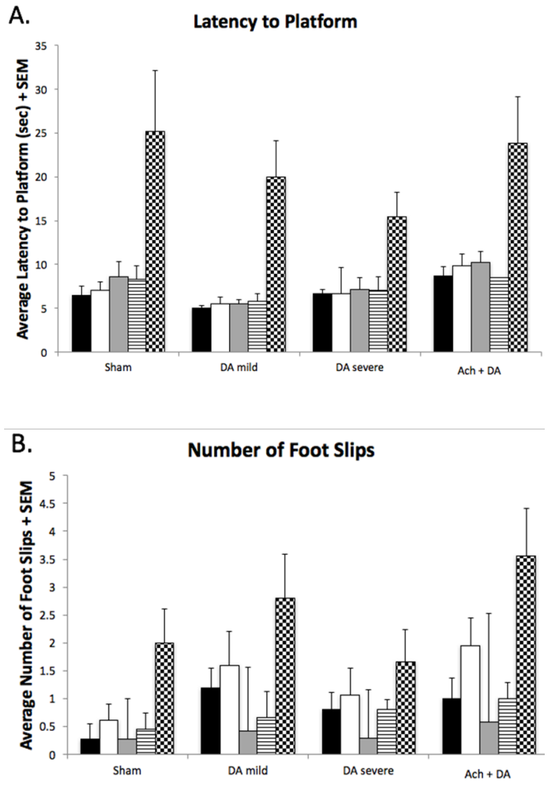


Figure 4. Effect of DA Lesion and Treatment on Attention Ability in MCMCT Performance. Each rat (N = 22) was tested on its ability to travel from a platform to its cage while on different dopamine drug treatments. The treatments tested were vehicle, L-Dopa (4 and 12 mg/kg), SKF81297 (0.8 mg/kg) and quinpirole (0.5 mg/kg). The rats were divided into four groups: sham (n = 6), DA mild lesion (n = 5), DA severe lesion (n = 5), and Ach + DA dual lesion (n = 6). Graphs A shows the average measured latency to the platform + SEM. Graphs B shows measured average number of foot slips + SEM while crossing the device. ANOVA statistical analysis revealed that for the Latency to the platform (A) there was only a main effect of treatment ($p < 0.05$) and for the Number of Foot Slips (B) there was a main effect of lesion and treatment ($p < 0.05$).

For latency to platform (Figure 4A), a 4 (lesion) x 5 (treatment) mixed-design ANOVA showed a significant effect of treatment [$F(4, 72) = 28.544$, $p < 0.001$]. A significant difference was found between rats treated with quinpirole compared to rats treated with vehicle, LD 4, LD12, and SKF81297 in that rats treated with quinpirole performed significantly worse and had a much higher average latency to platform than the other treatments. The effect of lesion [$F(3, 18) = 1.986$, $p = 0.152$] and the interaction between treatment and lesion [$F(12, 72) = 0.579$, $p = 0.852$] were not significant for this parameter of MCMCT.

This same statistical analysis was done for number of foot slips (Figure 4B) and it showed a significant effect of lesion [$F(3, 18) = 13.208$, $p < 0.001$] and effect of treatment [$F(4, 72) = 13.966$, $p < 0.001$]. The interaction between treatment and lesion [$F(12, 72) = 0.736$, $p = 0.712$] was not significant for this parameter of MCMCT. The post-hoc revealed that sham lesioned rats slipped less than mild DA and dual lesioned rats ($p < 0.05$). Also, it showed that rats treated with quinpirole had more foot slips than rats treated with the other drugs ($p < 0.05$).

Discussion

This study evaluated rats' motor and cognitive abilities through a series of behavioral tests, and sought to determine which DA drug most efficiently made up for the deficiencies induced by the lesions of DA and Ach.

For the locomotor data, it was found that both the sham and mild DA lesioned rats traveled significantly longer distances (Figure 1A), and moved significantly more (Figure 1B) than the dual lesioned rats. Except for rearing activity (where DA severe reared significantly more than DA mild) the DA severe lesion did not show any significantly different motor behaviors in the locomotor chambers. Since locomotor chambers was a baseline test with no treatments administered, the dual lesion imposed greater motor deficiencies than the sham and mild DA lesions, regardless of treatment. It was found that both the sham and mild DA lesioned rats had a significantly higher stereotypy count (Figure 1C) than that of the dual lesioned rats. Lastly, it was found that the dual lesioned rats showed significantly less rearing activity than the other lesion groups (Figure 1D). This suggests that the dual lesion caused the most deficits within the rats, considering that it has been shown that both DA and Ach pathways are crucial for the maintenance of accurate motor performance (Levin, McGurk, Rose, & Butcher, 1990). Many disorders that are characterized by motor symptoms, including PD, result from lesions at basal ganglia level, the chemical functioning of the basal ganglia relies heavily on the relationship between cholinergic and dopaminergic systems (Parent & Hazrati, 1995). Thus, loss of Ach may reduce proper muscle movement (Zaborszky, Pol, & Gyengesi, 2012). This supports why rats that were given Ach lesions as well as DA lesions performed worse than rats that were solely given dopaminergic lesions. Time spent in the center illustrates that rats of all lesions experienced anxiety equally, which could have been attributed to many different factors such as exposure to the new atmosphere of a locomotor chamber.

Spatial working memory ability was assessed using the Morris Water Maze test. It was found that rats treated with L-DOPA 4 had a higher average latency to platform than rats treated with L-DOPA 12 and quinpirole. This suggests that L-DOPA, regardless of lesion, may be a drug that needs to be taken in higher doses in order to be as or more effective than drugs such as quinpirole. Since L-DOPA is one of the most widely used drugs for PD, it is essential to know the exact effects that both a low and a high dose has on the subject. Another perspective to why the L-DOPA 4 made the rats perform worse is that there is currently evidence "that the DA metabolism formed by L-DOPA generates free radicals such as nitric oxide, which may cause damage through the nitrosative stress" (Ramirez-Garcia, Palafox-Sanchez, & Limon, 2015). Since this drug is commonly used to treat the motor deficits that come with PD, further investigation should be done on L-DOPA to determine if this nitrosative stress is the reason why the drug makes rats perform worse cognitively. On the other hand, quinpirole helped the rats perform better than rats treated with L-DOPA4. This suggests that quinpirole is a drug that effectively aids in spatial working memory.

Attention ability was assessed using the MCMCT test. Interestingly, rats treated with quinpirole performed significantly worse, meaning they had a longer latency and more foot slips, than rats treated with L-DOPA 4, L-DOPA 12, and SKF. This contrasts the effects that quinpirole had on the rats for Morris Water Maze testing. During MCMCT testing, the quinpirole-treated rats exhibited anxious, obsessive-compulsive disorder (OCD)- like behavior. For example, when placed on the rotating rod, the rats showed constant checking behaviors and often tremors. Since MCMCT is a behavioral test that evaluates gait and attention ability, this could be why the quinpirole had a different effect in this case than the positive spatial working memory effect it had for Morris Water Maze. Studies have shown that deficits in Ach can impair the ability for rats to retain memory about previously encountered objects (novel object recognition) but have little impairment on spatial working memory (Winters & Bussey, 2005). This may explain why the dual Ach + DA group was able to perform better in the Morris Water Maze (which required spatial working memory) but was very hindered in the MCMCT. The effect of the lesion inhibiting novel object recognition (the encountered door on the rod) may have added onto the deficit caused by the quinpirole, causing the Ach+ DA group to be very inept at the MCMCT test. Other, previous studies have shown that D2 receptor agonists, like quinpirole, do improve tasks of working memory, some studies have show that Bromocriptine (a D2 receptor agonist) enhanced spatial working memory while also impairing ability to reverse a learned probabilistic discrimination (Mehta,

Swainson, Ogilvie, Sahakian, & Robbins, 2001). Another study previous to Mehta et al., (2001) tested OCD-like compulsive checking behaviors in rats treated with quinpirole, it was found that rats performed behavioral acts that were ritual-like and when exploring would stop at very few places to explore other than their preferred spot, that they would remain localized to (Szechtman, Sulis, & Eilam, 1998). Lastly, the current data showing worsened performance with quinpirole can further be related to a previous quinpirole study done on monkeys. In Arnsten et al.'s (1995) experiment, it was found that in young adult monkeys, higher doses of quinpirole caused dyskinesia and hallucinations. This study implied that the drug actions at the D2 auto-receptors caused the impairments in delayed response and fine motor performance.

The main limitation of this study was the lack of neurochemical evidence to confirm DA and Ach depletion due to lesion. Although samples were taken for HPLC (high performance liquid chromatography), they were not analyzed to completion. Due to this, it cannot be concluded with certainty that the behavioral results of the study were influenced by lesion. Even though there is no neurochemical data, the locomotor data collected off-treatment provides behavioral support for lesion presence and intensity, mainly the dual Ach+DA lesion. In regards to the dual Ach+DA group, a possible limitation of the study is that there was no Ach-only lesion group. Therefore, the results of the Ach+DA group cannot be conclusively attributed to either the isolated depletion of Ach or the combination of simultaneous Ach and DA depletion. Another possible limitation of this study would be the amount of testing days that the rats were subjected to for the Morris Water Maze and MCMCT testing. For both tests, multiple days of baseline and drug testing were done which may have caused fatigue in the rats. A solution to this problem for future research would be to increase the amount of rest days between test days. Another possible limitation of this study could be the handling of the rats during treatment injections. Rats were injected by different experimenters on different days, which caused inconsistency with the administration of injections. A solution to this possible limitation would be to have one experimenter exclusively administer the injections to all the rats throughout the entirety of the study.

This study gave way to some ideas for future research regarding the DA drugs SKF and quinpirole. The results for rats tested with SKF81297 did not show any outstanding, significant differences to those treated with L-DOPA, while quinpirole did show some compared to those treated with any other drugs. This study showed that quinpirole is a drug that needs to be further investigated, due to its conflicting results in aiding spatial working memory versus aiding attention ability. It should also be further investigated due to its ability to induce potential OCD-like behavior in rats, which could be detrimental to humans and potentially affect their daily lives while taking this drug. In order to further investigate quinpirole, a study could be done that encompasses a wider variety of lesions, possibly adding a more severe Ach lesion to evaluate its effects on the loss of that neurotransmitter more in depth. In conclusion, the quinpirole effects on memory and attention ability is an essential discovery. Uncovering the mechanisms underlying these actions may lead to the development of a more effective treatment for PD that covers both motor and cognitive deficits in humans without the anxious, OCD-like, side effects

References

Arnsten, A., Cai, J., Steere, J., & Goldman-Rakic, P. (1995). Dopamine D2 Receptor Mechanisms Contribute to Age Related Cognitive Decline: The Effects of Quinpirole on Memory and Motor Performance in Monkeys. *The Journal of Neuroscience, 15*(5), 3429-3439.

Calne, D. B., D.M. (1993). Treatment of Parkinson's Disease. *The New England Journal of Medicine, 329*(14).

Carvalho, M. M., Campos, F. L., Coimbra, B., Pêgo, J. M., Rodrigues, C., Lima, R., Rodrigues, A. J., Sousa, N., & Salgado, A. J. (2013). Behavioral characterization of the 6-hydroxidopamine model of Parkinson's disease and pharmacological rescuing of non-motor deficits. *Molecular Neurodegeneration, 8*(1), 1-14.

Dashniani, M., Krushvili, L., Rusadze, K., Mataradze, S., & Beselia, G. (2015). Effects of immunotoxic and electrolytic lesions of medial septal area on spatial short-term memory in rats. *Georgian Med News, 98-103*.

Deumens, R., Blokland, A., & Prickaerts J. (2002). Modeling Parkinson's Disease in Rats: An Evaluation of 6-OHDA Lesions of the Nigrostriatal Pathway. *Experimental Neurology, 175*(2), 303-317.

Gibrat C, Saint-Pierre M, Bousquet M, Levesque D, Rouillard C, Cicchetti F (2009). Differences between subacute and chronic MPTP mice models: investigation of dopaminergic neuronal degeneration and *α*-synuclein inclusions. J *Neurochem 109*: 1469-1482.

Hasselmo, M. E. (2006). The Role of Acetylcholine in Learning and Memory. Current Opinion in *Neurobiology, 16*(6), 710-715.

Kucinski, A., Paolone, G., Bradshaw, M., Albin, R. L., & Sarter, M. (2013). Modeling Fall Propensity in Parkinson's Disease: Deficits in the Attentional Control of Complex Movements in Rats with Cortical-Cholinergic and Striatal-Dopaminergic Deafferentation. *The Journal of Neuroscience, 33*(42), 16522-16539.

Levin, E. D., McGurk, S. R., Rose, J. E., & Butcher, L. L. (1990). Cholinergic-dopaminergic interactions in cognitive performance. *Behavioral and Neural Biology, 54*(3), 271-299.

Lindenbach, D., Ostock, C. Y., Eskow Jaunarajs, K. L., Dupre, K. B., Barnum, C. J., Bhide, N., & Bishop, C. (2011). Behavioral and Cellular Modulation of L-DOPA-Induced Dyskinesia by *β*-Adrenoceptor Blockade in the 6-Hydroxydopamine-Lesioned Rat. *Journal of Pharmacology and Experimental Therapeutics, 337*(3), 755-765.

Mehta, M. A., Swainson, R., Ogilvie, A. D., Sahakian, B. J., & Robbins, T. W. (2001). Improved short-term spatial memory but impaired reversal learning following the dopamine D2 agonist bromocriptine in human volunteers. *Psychopharmacology, 10-20*.

Parent, A., & Hazrati, L. (1995). Functional anatomy of the basal ganglia. I. The cortico-basal ganglia-thalamo-cortical loop. *Brain Research Reviews, 20*(1), 91-127.

Paxinos G., & Watson C. (2006). The Rat Brain in Stereotaxic Coordinates. *New York: Academic Press*.

Ramirez-Garcia, G., Palafox-Sanchez, V., & Limon, I.D. (2015). Nitrosative and cognitive effects of chronic L-DOPA administration in rats with intra-nigral 6-OHDA lesion. *Neuroscience, 492-508*.

Szechtman, H., Sulis, W., & Eilam, D. (1998). Quinpirole induces compulsive checking behavior in rats: A potential animal model of obsessive-compulsive disorder (OCD). *Behavioral Neuroscience, 112*(6), 1475-1485.

Winters, B. D., & Bussey, T. J. (2005), Removal of cholinergic input to perirhinal cortex disrupts object recognition but not spatial working memory in the rat. *European Journal of Neuroscience, 21*: 2263-2270.

Zaborszky, L., Pol, A. V., & Gyengesi, E. (2012). The Basal Forebrain Cholinergic Projection System in Mice. *The Mouse Nervous System, 684-718*.

Alanna Wormwood
Clarkson University

Alanna Wormwood is a Behavioral Specialist Assistant at Upstate Cerebral Palsy. She graduated from Clarkson University in 2015 with Bachelors degrees in Psychology and History. During her undergraduate career she did extensive research in the Social Development and Health Psychology Lab, focusing on the topics of peer victimization, mental health, and cognitive processing. She has co-authored a chapter in Bullying: Prevalence, Psychological Impacts, and Intervention Strategies and presented oral and poster presentations on the subject regionally and nationally. She plans to pursue a Master's degree in Behavioral Psychology.

Was there a particular experience that sparked your research interests?

I attended a STEM themed summer camp when I was in middle school that greatly influenced my interest in research, particularly in the field of psychology. It made me curious about studying human behavior, and that fascination has followed me to my college career. I became particularly interested in cognitive processing after reading a book about cognitive processing therapy for individuals with PTSD.

Who has been an influential person in your life?

My entire family has been hugely influential. From a young age, my parents encouraged me to express myself freely and always strive for greatness. My grandmother always nurtured my love of learning, and taught me to be proud of myself.

When and where are you the most productive?

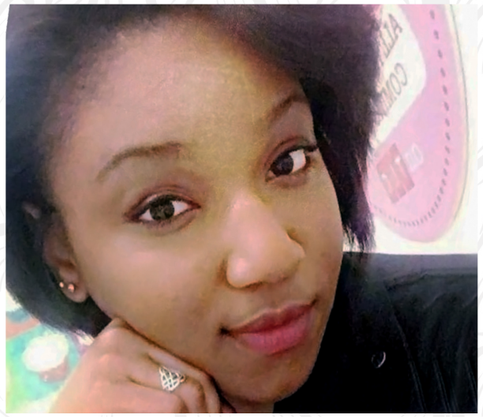
I am the most productive extremely late at night, usually after 2 am. I enjoy working when the rest of the world has slowed down and become quiet. I am usually most productive in my own home, curled up on the couch or cozy at my desk.

Where do you see yourself in 10 years?

I hope to be continuing my work with individuals with intellectual disabilities as a behavior specialist for Upstate Cerebral Palsy.

Aaliyah S. Gibbons
Clarkson University

Aaliyah Gibbons is completing her Master's degree in Biomedical Studies at Drexel University's College of Medicine. She recently graduated from Clarkson University in May of 2016 with a Bachelor's degree in Biology and Social Science. During her undergraduate career she did research in the Social Development and Health Psychology Lab, focusing on peer victimization and mental health. She has also presented oral and poster presentations on the subject both regionally and nationally. She plans to pursue a Doctor of Osteopathic Medicine degree and specialize in both Adolescent and Forensic Psychiatry.



Was there a particular experience that sparked your research interests?

I can't really narrow down one particular experience that led to my interest in my research because I find it being applicable to so many of my past and current experiences. That's the best part about studying peer victimization. It's something so relatable and I really enjoy being able to share my findings with others.

Who has been an influential person in your life?

The most influential person in my life is definitely my mother. She's always encouraged me to ask why and to never stop searching until I find an answer to my questions. She continues to inspire my thirst for knowledge even to this day.

When and where are you the most productive?

I'm most productive when normal people are asleep. So I tend to get most of my work done very early in the morning/ very late at night, always with a large cup of coffee (light and sweet).

Where do you see yourself in 10 years?

In 10 years, I hope to be a successful clinical psychologist, hopefully either working in correctional facilities or in patient settings.

Depression and Social Anxiety Mediate the Association Between Peer Victimization and Cognitive Processing Styles

Alanna Wormwood, Aaliyah S. Gibbons, and Jennifer M. Knack
Clarkson University

Peer victimization has been a heavily discussed topic in recent psychological literature. Numerous studies have concluded that peer victimization can cause an individual to develop mental health issues like depression and social anxiety, but less is known about the way peer victimization affects the way a person processes information. We examined the connections between peer victimization, mental health, and cognitive processing. College students (N = 174) completed online questionnaires about their social experiences, depressive symptoms, social interaction anxiety, and cognitive processing styles. As expected, mediation analyses yielded support for the hypothesis that peer victimization predicted an increase in depressive symptoms. An increase in depressive symptoms then predicted an increase in social interaction anxiety. This increase in depression and social interaction anxiety predicted a decrease in rational and experiential processing. In addition, when depression and social anxiety were simultaneously entered into a mediation model, depression uniquely mediated the link between peer victimization and cognitive processing. Understanding the role cognitive processing plays in an individual's response to peer victimization, especially in terms of mental health and cognitive processing, provides information for understanding the clinical impacts of peer victimization.

Peer victimization is defined as perpetual and intentional aggression by a peer(s) of higher power directed at someone of lower power (Olweus, 1993). Peer victimization produces a fairly predictable pattern of pathology (Baumeister & Leary, 1995; Gardner, Pickett, & Brewer, 2000) including higher levels of depression and anxiety (Asher, Parkhurst, Hymel, & Willams, 1990; Bogart et al., 2014; Hawker & Boulton, 2000; McDougall, Hymel, Vaillencourt, & Mercer, 2001). In addition, peer victimization and poor mental health negatively affect an array of areas in a victim's life including cognitive, behavioral, social, emotional, and academic domains (Hannish & Guerra, 2002, Arsenault, Walsh, Trzesniewski, Newcombe, Caspi, & Moffitt, 2006). In this study, we were especially interested in the cognitive correlates of peer victimization and poor mental health. For example, people who were peer victimized were more likely to attribute others' ambiguous behaviors to hostile intents (e.g., Crick & Dodge, 1994). Although there is evidence that cognitive processing might be negatively affected by peer victimization, many researchers have assessed proxies of cognitive processing such as behavioral (e.g., submissive or aggressive behavior) or emotional (e.g., anger, fear) responses rather than actual cognitive processing (Perry, Hodges, & Egan, 2001; Hanish & Guerra, 2002). In the current study, we examined whether mental health problems (i.e., depression, social anxiety) mediated the association between peer victimization and cognitive processing in an attempt to understand how social stressors such as peer victimization affect rational and experiential ways of processing information.

Cognitive Processing and Peer Victimization

Social cognitive psychologists examined cognitive processing within a duel system framework (Evans, 2008). Although there is an array of dual processing system theories (see Evans, 2008 for a review), each theory distinguishes between a fast, unconscious, automatic processing style and a slow, conscious, deliberate processing style. In this paper, we refer to these two systems as experiential cognitive processing and rational cognitive processing, respectively (Björklund & Bäckström, 2008; Knack, Rex-Lear, Wormwood, & Gibbons, 2014; Pacini & Epstein, 1999; Schutte, Thorsteinsson, Hine, Foster, Cauchi, & Binns, 2010). The experiential cognitive processing system is a learning system characterized by automatic instinct. Experiential processing is preconscious, intuitive, rapid, influenced by affect, and primarily nonverbal. People high in experiential processing would indicate that they "rely on intuitive impressions" and "trust initial feelings about people" (Pacini & Epstein, 1999). In contrast, the rational cognitive processing system is an inferential system characterized by reason and logic. Rational processing is conscious, analytical, relatively slow, affect free, and primarily verbal. People high in rational processing would indicate that they "have a logical mind" and "have a clear, explainable reason for decisions" (Pacini & Epstein, 1999).

Rational and experiential processing typically operate in an independent but synchronized manner to enable an individual to process and react to external information. Bernstein and colleagues (2008, 2010) demonstrated a change in cognitive processing based on social experiences by examining individuals' responses to real versus fake smiles. Bernstein and colleagues argued that facial expressions such as real smiles versus fake smiles provided social cues about how receptive potential interaction partners might be to these social cues. Their study showed that individuals interpreted social cues differently based on their social experiences. Individuals who had experienced social rejection in their life paid more attention to social cues, namely whether a smile was real or fake. This connection suggests an adaptive change in someone's cognitive processing style based on perceived social cues during a social interaction. People who recalled a time when they were rejected/excluded were more accurate in identifying whether a smile was real or fake. These people also reported their sense of belonging in a group felt more threatened compared to people who recalled a time when they were accepted/included or those in the control group who simply wrote down a detailed account of the previous morning. Bernstein et al. argued that this ability to distinguish between real and fake smiles was adaptive because being able to effectively attend to social cues should bolster attempts to successfully reconnect with others. Indeed, Bernstein et al. (2010) demonstrated that people who reported being rejected/excluded preferred to work with people who exhibited real smiles rather fake smiles compared with people who reported being accepted/included or the detailed account of their day. It is possible that this shift in ability to accurately detect whether someone's smile is real or fake indicates a decrease in rational processing and an increase in experiential processing. That is, people who reported rejection/exclusion might have relied less on, analytical, slow processing and more on intuitive, rapid processing. In the current study, we explored this possibility by examining the association between peer victimization and rational and experiential processing.

One tenant of Dodge's social information processing theory is that social information is processed in light of an individual's own experiences, social schemas, and knowledge of social rules/norms (Crick & Dodge, 1994; Harris, 2009; Knack et al., 2014). For example, bullied children were more likely to attribute their peers' actions (particularly ambiguous actions) to hostile intentions compared to non-bullied children (e.g., Perry, Hodges, & Egan, 2001). Children who were both bullied and made critical self-referent attributions were most at risk for concurrent internalizing problems (Prinstein, Cheah, & Guyer, 2005). According to Perry, Hodges, and Egan (2001), children who were bullied were able to generate effective solutions to negative social experiences when removed from the actual bullying experiences. During negative social experiences, however, they tended to respond ineffectively (e.g., submission, angry but ineffectual retaliation, aggression, passive aggressive actions). This discrepancy may be driven by heightened emotional responses (i.e., more experiential processing) and decreased logical responses (i.e., lower rational processing). In contrast, Helmond, Overbeek, Brugman, and Gibbs (2014) found that in some cases, changes in cognitive processing resulted in externalizing problems (e.g., antisocial, delinquent, and aggressive behavior). Taken together, these studies provided evidence that negative social experiences such as peer victimization affect cognitive processing.

Role of Mental Health in Peer Victimization

Individuals who were peer victimized were more maladjusted (e.g., higher social anxiety, higher depression) compared to individuals who were not peer victimized (Hawker & Boulton, 2000; Rapee & Spence, 2004; Rigby, 2000; Ttofi, Farrington, Lösel & Loeber, 2011). This association between mental health and peer victimization commonly persists into adulthood; many adults being treated for comorbid depression and anxiety disorders at outpatient clinics have a history of victimization in their childhood and/or adolescence (Gladstone, Parker, & Mahli, 2006; Lund et al., 2008). Beyond peer victimization, mental health problems are also associated with specific cognition patterns. For example, Teasdale (1988) hypothesized that cognitive processing is an important factor in the persistence and intensity of depression. This hypothesis, referred to as cognitive vulnerability to depression, also contends that certain life events such as peer victimization can perpetuate depressive symptoms. In a number of cases, these depressive symptoms were maladaptive enough to require clinical attention (Kaltiala-Heino & Fröjd, 2011; Lewinsohn, Rhode, & Seeley, 1998; Charman 1994). Although correlated, depression and social anxiety are distinct concepts (Gibb, Coles, & Heimberg, 2005). Given that both depression and anxiety are associated with peer victimization and cognition, we examined whether these mental health problems mediate the association between peer victimization and cognitive processing.

Depression. Depression is characterized by extreme sadness and typically does not remit when the external cause dissipates. In fact, depression often occurs without an external cause (Belmaker & Agam, 2008). Researchers demonstrated that negative social experiences were a risk factor for depression (Hawker & Boulton, 2000; Gilbert, 1992; Boulton & Smith, 1994; Rudolph, Troop-Gordon, Hessel, & Schmidt, 2011). Relative to the current study, peer victimization is robustly associated with depression (Hawker & Boulton, 2000; Slee, 1995; Vaillancourt et al., 2011).

In his cognitive triad of depression, Beck (1976) proposed that cognitive distortions accompany depression; these cognitive distortions suggest depression is linked with altered cognitive processing. People who were depressed viewed themselves as useless, helpless, and unlovable which often led to feelings of inadequacy, hopelessness, and pessimism (Beck, 1976). Depressed individuals also viewed the world as more unfair and unjust and had more suicidal thoughts or tendencies than people who were not depressed (Beck, 1976). According to Beck, the triad of depression includes negative thoughts about the self, world, and immediate environment as well as the future. The association between depression and cognitive processing is bidirectional; in addition to depression affecting cognitive processing, changes in cognitive processing predict increased feelings of depression (Beckham et al., 1986). The cognitive theory of depression postulated that these altered perceptions of the self, the world, and the future are related to depressive schemas activated in response to stressors (Haaga, Dyck, & Ernst, 1991; Kovacs & Beck, 1978). Indeed, Rudolph et al. (2001) found that children with depressive symptoms were more likely to have more negative conceptions in general than those children without depressive symptoms. In the current study, we expected that the social stress of peer victimization would predict higher levels of depression and, in turn, poorer cognitive processing. In addition, children with higher depressive symptoms were also more sensitive to social cues about their social status than children without depressive symptoms (Rudolph et al., 2001). We expected that peer victimized emerging adults with depressive symptoms would similarly be sensitive to social cues; we expected this sensitivity would manifest as social anxiety. Thus, we also expected that higher levels of depression due to being peer victimized would predict higher levels of social anxiety.

Social interaction anxiety. Social interaction anxiety is apprehension or worry felt during actual or anticipated social situations and is assessed by examining participants' self-reported cognitive, affective, and behavioral reactions to hypothetical social interaction situations (Heimberg et al., 1992; Mattick & Clarke, 1998; Weeks, Coplan, & Kingsbury, 2009). Social anxiety is characterized by fear or apprehension of being negatively evaluated by other people. Socially anxious individuals tend to negatively focus on themselves rather than their peers during social interactions and are likely to ruminate on negative social interactions.

Social anxiety has also been associated with a skewed perception of and altered attention to social cues (Beck, Emery, & Greenberg, 1985; Hartman, 1983; Leary, 1983). For example, socially anxious people showed a bias in recognition of negative facial expressions compared to non-anxious people (Davis, McKone, Dennett, O'Connor, O'Kearney, & Polermo, 2011). Anxiety changes how information is processed by changing what an individual pays attention to. There is also evidence that children who were socially anxious believed they lacked necessary social skills and appeared nervous in social situations (Cartwright-Hatton, Hodges, & Porter, 2003; Cartwright-Hatton, Tschernitz, & Gomersall, 2005). However, observers were unable to distinguish between anxious and non-anxious children (Cartwright-Hatton et al., 2005). Social anxiety also influences an individual's perception of obstacles and their ability to overcome them. For example, social anxiety among smokers was associated with cognitive vulnerabilities such as perceiving more barriers to stopping smoking as less manageable compared to the perceptions among non-anxious smokers (Buckner, Zvolensky, Jeffries, & Schmidt, 2014). Together these studies show a correlation between anxiety and cognitive processing. We anticipated that social anxiety would also predict deficits in cognitive processing in our study.

Current Study

There is substantial research demonstrating an association between peer victimization and mental health problems (e.g., Craig 1998; Hawker & Boulton, 2000; McDougal et al., 2001). There is also research suggesting that peer victimization is associated with indicators of differential cognitive processing (e.g., attributions, behavioral responses to peer aggression; see Knack et al., 2014). However, less is known about the mechanisms through which peer victimization affects rational and experiential

cognitive processing. In the current study, we sought to fill this gap in knowledge by examining whether mental health problems (i.e., depression and social interaction anxiety) mediated the relationship between peer victimization and cognitive processing. First, we expected that peer victimization would be associated with cognitive processing. Specifically, we hypothesized that higher levels of peer victimization would predict lower rational processing and lower experiential processing. Second, we hypothesized that mental health problems would mediate these associations such that peer victimization would predict higher depression which would predict higher social interaction anxiety which, in turn, would affect rational and experiential processing.

Method

Participants

Participants were college students (N = 174) enrolled in an introductory psychology class at a small engineering university in upstate New York. Fifteen participants were excluded from analyses due to either incorrect completion of the online surveys or missing data resulting in a final data set of 159 participants (103 male, 55 female; 1 participant did not report sex; M_{age} = 18.94, SD = 1.24 years). Most participants were freshmen (67.9%) or sophomores (16.4%). The majority of participants were White (80.5%). Students earned partial course credit for participating.

Materials and Procedure

Participants completed an online survey that assessed their experiences of peer victimization, levels of depression and social interaction anxiety, and cognitive processing style. This online survey was completed as part of a larger project and was conducted in accordance with the ethical guidelines of the American Psychological Association and approved by the Institutional Review Board.

Peer victimization. We used two scales to assess peer victimization. First, a revised version of the Children's Social Experiences Questionnaire (CSEQ; Crick & Grotepher, 1995) for college students (see Knack, Iyer, & Jensen-Campbell, 2012) was used to measure self-reported overt victimization (e.g., "How often does another person hit you?"), relational victimization (e.g., "How often does a person who is mad at you try to get back at you by not letting you be in their group anymore?"), and prosocial behavior (e.g., "How often do you say something nice to another person?"). In this study, we were only interested in peer victimization and therefore did not use the prosocial behavior subscale. Participants indicated how frequently they were peer victimized on a 5-point Likert scale (1 = never, 5 = all the time). Moderate reliability was found for overt (α = .76) and relational (α = .82) peer victimization.

Second, we used the Direct and Indirect Aggression Survey (DIAS; Bjorkqvist, Lagerspetz, & Osterman, 1992) which is a 24-item measure that consists of three subscales to assess physical (e.g., "How often do other people take things from you?"), verbal (e.g., "How often do other people call you names?"), and indirect victimization (e.g., "How often do people gossip about you?"). Participants indicated how frequently they experienced peer victimization on a 5-point Likert scale (1 = never, 5 = very often). Moderate reliability was found for physical (α = .73), verbal (α = .81), and indirect (α = .90) peer victimization.

Composite score for peer victimization. We next examined the correlations between the five subscales of peer victimization assessed using the CSEQ AND DIAS (i.e., self-reported overt victimization, relational victimization, physical victimization, verbal victimization, and indirect victimization). Given that all five dimensions were correlated (range of r's: .21–.74, p's < .01), we created an overall peer victimization composite score by averaging all of the peer victimization items together (α = .93).

Depression. The Depression Inventory (Beck, Steer, & Brown, 1996) is a 20-item questionnaire used to examine depressive symptoms in participants (e.g., "I feel sad often," "I don't like to be around other people," and "I often feel down"). Participants indicated their response on a 4-point Likert scale (0 = never, 3 = always). High reliability was found for depressive (α = .92) symptoms.

Social interaction anxiety. The Social Interaction Anxiety Scale (SIAS; Mattick & Clarke, 1998) is a 20-item scale used to assess participants' level of social anxiety (i.e., fear of interacting in groups and fear of scrutiny). Participants indicated their responses to items (e.g., "I have difficulty making eye contact with others," "I worry about expressing myself in case I appear awkward," "I feel I will say something embarrassing when talking") on a 5-point Likert scale (0 = not at all characteristic of me, 4 = extremely characteristic of me). High reliability was found for social anxiety (α = .91).

Cognitive processing style. The Rational-Experiential Inventory (REI) is a 40-item inventory used to assess thinking style to determine if an individual processes information rationally or experimentally (Pacini & Epstein, 1999). Participants indicated their responses on a 5-point Likert scale (1 = completely false, 5 = completely true). The REI is comprised of two subscales, namely the rationality scale (e.g., "I have a logical mind," "I usually have a clear, explainable reason for my decisions") and the experiential scale (e.g., "I like to rely on my intuitive impressions" and "I trust my initial feelings about people"). Moderate reliability was found for rational (α = .88) and experiential (α = .88) thinking.

Results

Descriptive Statistics and Correlations

First, we examined the descriptive statistics of the variables (see Table 1). Although the composite for peer victimization was normally distributed with a skewness of .63 (SE = .19) and kurtosis of -.19 (SE = .38), the highest participants' composite score was 2.89 on a scale with a maximum score possibility of 5 indicating that most participants reported low to moderate frequency of peer victimization (but not high frequency).

	M	*SD*	Min	Max	Skewness	Kurtosis
Peer victimization	1.56	0.41	1	2.89	0.63	-0.19
Depression	17.66	11.56	0	60	0.65	0.22
Social interaction anxiety	26.23	14.42	0	58	-.01	-0.83
Rational processing	71.61	10.12	41	100	-0.06	0.23
Experiential processing	67.45	9.54	44	97	0.74	0.92

Table 1. Descriptive statistics.

Next, we examined the correlations between variables. As expected, participants who reported higher levels of peer victimization also reported higher levels of depression (r = .21, p < 0.01) and marginally higher levels of social anxiety (r = .11, p = .16). Also, as expected, participants with higher levels of depression had lower levels of rational and experiential cognitive processing (see Table 2).

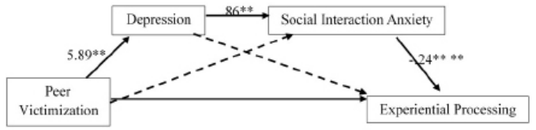
	Rational cognitive processing	Experiential cognitive processing
Peer victimization	-.06	-.03
Depression	-.35*	-.23*
Social anxiety	-.36*	-.35*

Note: * p < .01

Table 2. Correlations between Peer Victimization and Mental Health and Cognitive Processing

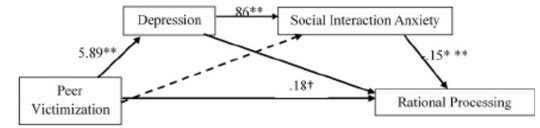
Participants with higher levels of social anxiety similarly had lower levels of rational and experiential cognitive processing. Contrary to expectations, there were no direct correlations between peer victimization and rational (r = -.06, *ns*) and experiential (r = -.03, *ns*) cognitive processing styles (see Table 2).

Hypothesized Mediation Tests



Note: $^{**}p < .01$; Indirect effect = -1.21, CI_{lower} = -2.93, CI_{upper} = -.30

Figure 1. Mental health mediates the association between peer victimization and experiential cognitive processing style



Note: $^{\dagger}p < .06$; $^{*}p < .05$; $^{**}p < .01$; Indirect effect = -.78, CI_{lower} = -2.15, CI_{upper} = -.10 (full sequential mediation through depression and social interaction anxiety); Indirect effect = -1.04, CI_{lower} = -3.04, CI_{upper} = -.004 (mediation through depression only)

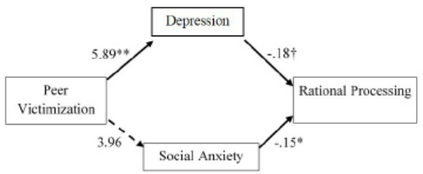
Figure 2. Mental health mediates the association between peer victimization and rational cognitive processing style

Next, we examined whether depression and social interaction anxiety mediate the relationship between peer victimization and cognitive processing styles. We conducted two path analyses using the PROCESS macro model 6 in SPSS (Hayes, 2013). We entered peer victimization as the predictor, depression as the first mediator, social anxiety as the second mediator, and cognitive processing styles as the outcome variables. As expected, there were full sequential mediation effects. In other words, peer victimization predicted higher levels of depression which predicted more social anxiety; higher levels of social anxiety in turn predicted both lower experiential processing (see Figure 1) and lower rational processing (see Figure 2).

In addition, depression mediated the association between peer victimization and rational processing. In other words, peer victimization predicted higher levels of depression which predicted lower levels of rational processing (see Figure 2). These results provide evidence that depression and social anxiety mediate the association between peer victimization and cognitive processing.

Supplemental Analyses

In addition to examining the mediation of depression and social interaction anxiety sequentially, we also examined whether depression and anxiety independently mediate the association between peer victimization and cognitive processing when entered into a mediation model simultaneously. We conducted two path analyses using the PROCESS macro model 4 in SPSS (Hayes, 2013). We entered peer victimization as the predictor, depression and social anxiety as mediators, and cognitive processing styles as the outcome variables. We found that depression mediated the association between peer victimization and rational processing; however, there was no evidence that anxiety was a significant mediator (see Figure 3). Contrary to expectations, neither depression nor anxiety mediated the association between peer victimization and experiential processing.



Note: $^{\dagger}p < .06$; $^{*}p < .05$; $^{**}p < .01$; Indirect effect of depression = -1.04, CI_{lower} = -3.04, CI_{upper} = -.004; Indirect effect of social anxiety = -.61, CI_{lower} = -2.62, CI_{upper} = .04 (not significant)

Figure 3. Depression uniquely mediates the association between peer victimization and rational cognitive processing style

Discussion

The purpose of this study was to examine whether mental health problems (i.e., depression, social anxiety) mediated the association between peer victimization and cognitive processing. As expected, we found evidence that depression and social anxiety mediated the association between peer victimization and cognitive processing. First we found that higher levels of peer victimization predicted higher levels of depression. Second, these higher levels of depression predicted higher levels of social anxiety. Third, these higher levels of social anxiety predicted lower rational processing and lower experiential processing. In addition to this sequential mediation model, we also examined depression and social anxiety as mediators simultaneously. In this model, we found that depression uniquely mediated the link between peer victimization and lower cognitive processing (i.e., social anxiety was not a significant mediator). Our results indicate that peer victimization and mental health problems negatively affect both rational (e.g., logical) and experiential (e.g., intuitive) processing.

Our findings are in line with other studies that suggested individuals with higher levels of depression perceive information differently than individuals who are less depressed (Coyne & Gotlib, 1983; Gotlib, Kasch, Traill, Joormann, Arnow, & Johnson, 2004; Rudolph & Clark, 2001; Williams, Watts, MacLeod, & Matthews, 1997). Individuals who are more depressed tend to perceive the world and their experiences more realistically (i.e., as it actually is) whereas people who are less depressed tend to perceive the world and their experiences in more optimistic or positive ways. Although realistic experiences can be positive and vice versa, in these situations, individuals with lower levels of depression perceived their experiences more optimistically than their peers with higher levels of depression (Alloy & Ahrens, 1987; Crocker, Alloy, & Kayne, 1988; Szu-Ting Fu, Koutstaal, Poon, & Cleare, 2012). Other researchers (e.g., Dunning & Story, 1991) have found that individuals with higher levels of depression are more likely to over-predict the likelihood of aversive events occurring. Our findings indicate that individuals who are peer victimized use rational and experiential processing at lower levels compared to people who are not peer victimized. Individuals who are peer victimized are less likely to think logically and analytically (i.e., rational processing) and are also less likely to rely on their own feelings and intuitions (i.e., experiential processing) than people who do not report being peer victimized when the underlying mechanisms are higher levels of depression and social interaction anxiety. Our findings suggest that people who are peer victimized might benefit from counseling services in order to remain cognitively engaged with their social experiences and environment.

Given the lower levels of cognitive processing, our results suggest that higher-order cognitive processes such as decision making and problem solving could be negatively affected by peer victimization and the associated mental health problems. For example, a decrease in rational and experiential processing could help explain why peer victimized individuals perform worse in school than their non-victimized peers (Vaillancourt et al., 2011). It is possible that students who employ lower experiential processing are less likely to trust themselves and, in turn, more likely to second-guess their answers on homework or examinations whereas students who employ lower rational processing are less likely to logically eliminate incorrect answers and use appropriate analytical problem-solving skills. It is concerning that our results suggest peer victimization reduces both types of cognitive processing. We find these results concerning because our data are indicating that someone who is peer victimized experiences negative consequences in lower levels of cognitive processing (i.e., both rational and experiential processing are reduced). In other words, our data suggest that an individual might be less likely to use both logic and gut instincts which are both important in adapting to social

settings. However, despite this concern, there are clinical steps that might help with the reduction of rational and experiential processing.

Although our study provides preliminary evidence that peer victimization predicts poorer cognitive processing, we must acknowledge that our data are correlational in nature and assessed at a single point in time rather than longitudinally. Although we hypothesized that peer victimization would negatively affect mental health and in turn reduce cognitive processing, the relationships between these variables are likely more complex than indicated here with correlational data. Additional longitudinal research is needed to further understand these associations and whether basic cognitive processing affects higher-order cognitive processing (e.g., problem-solving, decision making). However, despite these limitations, this study indicates that being the target of peer victimization negatively affects mental health and, in turn, reduces cognitive processing.

It is also likely that there is a cyclical relationship such that individuals who employ lower rational and experiential cognitive processing may be at higher risk for future victimization and mental health problems (e.g., La Greca, 2001). Although previous researchers have suggested high social anxiety is not necessarily linked with poorer social skills (e.g., Cartwright-Hatton et al., 2005), people who are socially anxious *believe* they are less socially skilled and appear more nervous during social interactions. Other researchers (e.g., Rudolph & Clark, 2001) have found that depressed children do exhibit poorer social skills and are aware of these deficiencies. It is possible that peer victimized individuals may benefit from cognitive-focused therapy that systematically addresses the cognitive, behavioral, and affective correlates of depression and social anxiety.

Our findings identify important preliminary associations between peer victimization, mental health, and cognitive processing that could play a crucial role in developing more effective clinical techniques to counteract the effects of peer victimization. Current clinical techniques have a fairly low success rate in restoring an individual's mental health; most therapeutic techniques aim to rectify depression and anxiety while ignoring the underlying problem (i.e., peer victimization). Many techniques also fail to examine cognitive processing all together. For example, many counselors choose to use client centered therapy with individuals experiencing depression or anxiety. Although talking through problems may have short term success, it ignores complex cognitive processing and may increase the likelihood of mental health problems reappearing overtime. It is also possible that changes in higher order cognitive processing such as problem solving or decision making may perpetuate the effects of peer victimization further. For example, individuals may feel more helpless or hopeless while experiencing peer victimization because their problem solving ability has been altered. Our research suggests it is important to address cognitive processing that is often ignored/overlooked and therefore left unresolved during typical clinical interventions.

References

Alloy, L.B. & Ahrens, A.H. (1987). Depression and pessimism for the future: Biased use of statistically relevant information in predictions for self-versus others. *Journal of Personality and Social Psychology, 52,* 366-378. doi: 10.1037/0022-3514.52.2.366

Arseneault, L., Walsh, E., Trzesniewski, K., Newcombe, R., Caspi, A., Moffitt, T. (2006). Bullying victimization uniquely contributes to adjustment problems in young children: A nationally representative cohort study. *Pediatrics, 118,* 130-138. doi: 10.1542/peds.2005-2388

Asher, S.R., Parkhurst, J.T., Hymel, S., & Williams, G.A. (1990). Peer rejection and loneliness in childhood. In S.R. Asher and J.D. Coie (Eds.) *Peer Rejection in Childhood* (pp. 253-273). New York, NY: Cambridge University Press.

Baumeister, R.F. & Leary, M. R. (1995). The need to belong: Desire for interpersonal attachments as a fundamental human motivation. *Psychological Bulletin, 117,* 497-529. doi: 10.1037/0033-2909.117.3.497

Beck, A.T., Steer, R.A., & Brown, G.K. (1996). Manual for the Beck Depression Inventory-II. San Antonio, TX: Psychological Corporation.

Beck, A. T., Emery, G., & Greenberg, R. L. (1985). *Anxiety Disorders and Phobias: A Cognitive Approach*. Cambridge, MA: Basic Books.

Belmaker, R.H. & Agam, G. (2008). Major depressive disorder. *New England Journal of Medicine, 358,* 55-68.

Bernstein, M.J., Young, S.G., Brown, C.M., Sacco, D.F., & Claypool, H.M. (2008). Adaptive responses to social exclusion: Social rejection improves detection of real and fake smiles. *Psychological Science, 19,* 981-983. doi: 10.1111/j.1467-9280.2008.02187

Bernstein, M., Sacco, D., Brown, C., Young, S., & Claypool, H. (2010). A preference for genuine smiles following social exclusion. Journal of *Experimental Social Psychology, 46*, 196-199. doi:10.1016/j.jesp.2009.08.010

Björklund, F. & Bäckström, M. (2008). Individual differences in processing styles: Validity of the Rational-Experiential Inventory. Scandinavian *Journal of Psychology, 49,* 439-446. doi: 10.1111/j.1467-9450.2008.00652

Bogart, L., Elliott, M., Klein, D., Tortolero, S., Mrug, S., Peskin, M., et al. (2014). Peer victimization in fifth grade and health in tenth grade. Official *Journal of the American Academy of Pediatrics, 10,* 439-447. doi: 10.1542/peds.2013-3510

Boulton, M.J. & Smith, P.K. (1994). Bully/victim problems in middle-school children: Stability, self-perceived competence, peer perceptions and peer acceptance. *British Journal of Developmental Psychology, 12,* 315-329. doi: 10.1111/j.2044-835X.1994.tb00637.x

Buckner, J.D., Zvolensky, M.J., Jeffries, E.R., & Schmidt, N.B. (2014). Robust impact of social anxiety in relation to coping motives and expectancies, barriers to quitting, and cessation-related problems. *Experimental and Clinical Psychopharmacology, 22,* 341. doi:10.1037/a0037206

Cartwright-Hatton, S., Hodges, L., & Porter, J. (2003). Social anxiety in childhood: The relationship with self and observer rated social skills. *Journal of Child Psychology and Psychiatry, 44*, 737-742. doi: 10.1111/1469-7610.00159

Cartwright-Hatton, S., Tschernitz, N., & Gomersall, H. (2005). Social anxiety in children: Social skills deficit, or cognitive distortion? *Behaviour Research and Therapy, 43*, 131-141. doi:10.1016/j.brat.2003.12.003

Coyne, J.C. & Gotlib, I.H. (1983). The role of cognition in depression: A critical appraisal. *Psychological Bulletin, 94,* 472. doi: 10.1037/0033-2909.94.3.472

Craig, W. (1998). The relationship among bullying, victimization, depression, anxiety, and aggression in elementary school children. *Personality and Individual Differences, 24*, 123-130. doi:10.1016/S0191-8869(97)00145-1

Crick, N. & Dodge, K. (1994). A review and reformulation of social information-processing mechanisms in children's social adjustment. *Psychological Bulletin, 115*, 74-101. doi: 10.1037/0033-2909.115.1.74

Crocker, J., Alloy, L.B., & Kayne, N. T. (1988). Attributional style, depression, and perceptions of consensus for event. *Journal of Personality and Social Psychology, 54,* 840-846. doi:10.1037/0022-3514.54.5.840

Davis, J.M., McKone, E., Dennett, H., O'Connor, K.B., O'Kearney, R., & Polermo, R. (2011). Individual differences in the ability to recognize facial identity are associated with social anxiety. *Plos One, 6*, 1-7.

Dunning, D. & Story, A.L. (1991). Depression, realism, and the overconfidence effect: Are the sadder wiser when predicting future actions and events? *Journal of Personality and Social Psychology, 61*, 521-532. doi: 10.1037/0022-3514.61.4.521

Evans, J. (2008). Dual-Processing accounts of reasoning, judgment, and social cognition. *Annual Review of Psychology, 59,* 255-278. doi: 10.1146/annurev.psych.59.103006.0 93629

Gardner, W.L., Pickett, C.L., & Brewer, M.B. (2000). Social exclusion and selective memory: how the need to belong influences memory for social events. *Personality and Social Psychology Bulletin, 26,* 486-496. doi: 10.1177/0146167200266007

Gibb, B.E., Coles, M.E., & Heimberg, G.R. (2005). Differentiating symptoms of social anxiety and depression in adults with social anxiety disorder. *Journal of Behavior Therapy and Experimental Psychiatry, 36*, 99-109. doi:10.1016/j.jbtep.2004.08.002

Gilbert, P. (1992). Depression: The Evolution of Powerlessness. New York: Guilford Press.

Gladstone, G., Parker, G., & Malhi, G., (2006). Do bullied children become depressive and anxious adults? A cross-sectional investigation of the correlates of bullying and anxious depression. *Journal of Nervous Mental Disorders, 194*, 201-208. doi: 10.1097/01.nmd.0000202491.99719.c3

Gotlib, I., Kasch, K., Traill, S., Joormann, J., Arnow, B., & Johnson, S. (2004). Coherence and specificity of information-processing biases in depression and social phobia. *Journal of Abnormal Psychology, 113,* 386-398. doi: 10.1037/0021-843X.113.3.386

Haaga, D., Dyck, M., & Ernst, D. (1991). Empirical status of cognitive theory of depression. *Psychological Bulletin, 110*, 215-236. doi: 10.1037/0033-2909.110.2.215

Hanish, L.D. & Guerra, N.G. (2002). A longitudinal analysis of patterns of adjustment following peer victimization. *Development and Psychopathology, 14*, 69-89. doi: 10.1017/S0954579402001049

Harris, M. (2009). *Bullying, Rejection, and Peer Victimization: A Social Cognitive Neuroscience* Perspective. New York: Springer.

Hartman, L.M. (1983). A metacognitive model of social anxiety: Implications for treatment. *Clinical Psychology Review, 3*, 435-456. doi: 10.1016/0272-7358(83)90023-5

Hawker, D S. & Boulton, M. J. (2000). Twenty years' research on peer victimization and psychosocial maladjustment: A meta-analytic review of cross-sectional studies. *Journal of Child Psychology and Psychiatry, 41,* 441-455. doi: 10.1111/1469-7610.00629

Heimberg, R.G., Horner, K.J., Juster, H.R., Safren, S.A., Brown, E.J., Schneier, F.R., & Liebowitz, M.R. (1992). Psychometric properties of the Liebowitz Social Anxiety Scale. *Psychological Medicine, 29*, 199-212. doi: 10.1016/S0005-7894(05)80308-9

Knack, J.M., Iyer, P.A., & Jensen-Campbell, L.A. (2012). Not simply "in their heads:" Individual differences associated with victimization and health. *Journal of Applied Social Psychology, 42,* 1625-1650. doi: 10.1111/j.1559-1816.2012.00898.x

Knack, J.M., Rex-Lear, M., Wormwood, A., & Gibbons, A. (2014). Coping strategies and cognitive processes related to peer victimization and the role of intervention programs. In P. Triggs (Ed.). *Bullying: Prevalence, psychological impacts, and intervention strategies.* (pp. 1-23). Hauppauge, NY: NOVA Publishers.

Kaltiala-Heino, R. & Fröjd, S. (2011). Correlation between bullying and clinical depression in adolescent patients. *Adolescent Health, Medicine, and Therapeutics, 2,* 37-44. doi: 10.2147/AHMT.S11554

Kovacs, M. & Beck, A.T. (1978). Maladaptive cognitive structures in depression. *American Journal of Psychiatry, 135*, 525-533.

La Greca, A.M. (2001). *The peer group: Friends or foes? In: W. K. Silverman and P. A. Treffers (Eds.), Anxiety disorders in children: Theory, research and practice.* London: Cambridge University Press.

Leary, M.R. (1983). *Understanding Social Anxiety: Social, Personality and Clinical Perspectives.* Beverly Hills, CA: Sage Publications.

Lewinsohn, P., Rohde, P., & Seeley, J. (1998). Major depressive disorder in older adolescents: prevalence, risk factors, and clinical implications. *Clinical Psychology Revolution, 18,* 765-794. doi: 10.1016/S0272-7358(98)00010-5

Lund, R., Kragelund Nielsen, K., Hjorth Hansen, D., Kriegbaum, M., Molbo, D., Due, P., & Christensen, U. (2008). Exposure to bullying at school and depression in adulthood: A study of Danish men born in 1953. *European Journal of Public Health, 19,* 111-116. doi: http://dx.doi.org/10.1093/eurpub/ckn101

Mattick, R.P., & Clarke, J.C. (1998). Development and validation of measures of social phobia and scrutiny fear and social interaction anxiety. *Behavior Research and Therapy, 36,* 455-470. doi:10.1016/S0005-7967(97)10031-6

McDougall, P., Hymel, S., Vaillancourt, T., & Mercer, L. (2001). *Interpersonal Rejection: The Consequences of Childhood Peer Rejection.* New York, NY: Oxford University Press.

Olweus, D. (1993). *Bullying at school: What we know and what we can do.* Cambridge, MA: Blackwell (ED 384 437).

Pacini, R. & Epstein, S. (1999). The relation of rational and experiential information processing styles to personality, basic beliefs, and the ratio-bias phenomenon. Journal of Personality and *Social Psychology, 76,* 972-987. doi: 10.1037/0022-3514.76.6.972

Perry, D.G., Hodges, E.V., & Egan, S.K. (2001). Determinants of Chronic Victimization by Peers. In J. Juvonen & S. Graham (Eds.) *Peer Harassment in School: The Plight of the Vulnerable and Victimized,* (pp. 73-104). New York, NY: The Guilford Press.

Prinstein, M.J., Cheah, C.S., & Guyer, A.E. (2005). Peer victimization, cue interpretation, and internalizing symptoms: Preliminary concurrent and longitudinal findings for children and adolescents. *Journal of Clinical Child and Adolescent Psychology, 34,* 11-24. doi: 10.1207/s15374424jccp3401_2

Rapee, R. & Spence, S. (2004). The etiology of social phobia: Empirical evidence and an initial model. *Clinical Psychology Review, 24*, 737-767. doi:10.1016/j.cpr.2004.06.004

Rigby, K. (2000). Effects of peer victimization in schools and perceived social support on adolescent well-being. Journal of Adolescence, 23, 57-68. doi:10.1006/jado.1999.0289

Rudolph, K.D., Troop-Gordon, W., Hessel, E.T., & Schmidt, J.D. (2011). A latent growth curve analysis of early and increasing peer victimization as predictors of mental health across elementary school. *Journal of Clinical Child & Adolescent Psychology, 40*, 111-122 doi: 10.1080/15374416.2011.533413

Rudolph, K. D. & Clark, A. G. (2001). Conceptions of relationships in children with depressive and aggressive symptoms: Social-cognitive distortion or reality? *Journal of Abnormal Child Psychology, 29,* 41-56. doi: 10.1023/A:1005299429060

Schutte, N., Thorsteinsson, E., Hine, D., Foster, R., Cauchi, A., & Binns, C. (2010). Experiential and rational processing styles, emotional intelligence and wellbeing. *Australian Journal of Psychology, 62,* 14-19. doi: 10.1080/00049530903312865

Slee, P.T. (1995). Peer victimization and its relationship to depression among Australian primary school students. *Personality and Individual Differences, 18,* 57-62. doi:10.1016/0191-8869(94)00114-8

Szu-Ting Fu, T., Koutstaal, W., Poon, L., & Cleare, A. J. (2012). Confidence judgment in depression and dysphoria: The depressive realism vs. negativity hypotheses. *Journal of Behavior Therapy and Experimental Psychiatry, 43*, 699-704. doi:10.1016/j.jbtep.2 011.09.014

Teasdale, J.D. (1988). Cognitive vulnerability to persistent depression. *Cognition & Emotion, 2*, 247-274. doi: 10.1080/02699938808410927

Ttofi, M., Farrington, D., Lösel, F., & Loeber, R. (2011). Do the victims of school bullies tend to become depressed later in life? A systematic review and meta-analysis of longitudinal studies. *Journal of Aggression, Conflict and Peace Research, 3,* 63-73. doi: 10.1108/17596591111132873

Vaillancourt, T., Duku, E., Becker, S., Schmidt, L.A., Nicol, J., Muir, C., & MacMillan, H. (2011). Peer victimization, depressive symptoms, and high salivary cortisol predict poorer memory in children. *Brain and Cognition, 77*, 191-199. doi: 10.1016/j.bandc.2011.06.012

Weeks, M., Coplan, R.J., & Kingsbury, A. (2009). The correlates and consequences of early appearing social anxiety in young children. *Journal of Anxiety Disorders, 23*, 965-972. doi:10.1016/j.janxdis.2009.06.006

Williams, J.M.G., Watts, F.N., MacLeod, C.M., & Mathews, A. (1997). Cognitive psychology and the emotional disorders (2nd Ed.). New York, NY: Wiley.