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## UBC UJP

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Dear fellow students, researchers, and faculty,

I am delighted to present the fifth volume of the *UBC Undergraduate Journal of Psychology* (UBCUJP). UBCUJP aims to provide an avenue for undergraduate researchers to share their research with the scientific community. It has been a great pleasure for me to work with a team of tireless undergraduate students in advancing this mission.

This year’s volume showcases high-quality original research papers and reviews across the broad spectrum of psychology. From research on electroconvulsive therapy using an animal model to the effects of nonverbal behaviors on perceptions of dominance and prestige, all these papers are poised to advance concepts and methods used in psychology. I am extremely proud of all the hard work and contributions of our student authors, and I hope readers will be inspired by the questions and issues raised by our papers.

Lastly, I would like to thank everyone who has contributed to UBCUJP. The publication of this journal would not be possible without my managing editor, Aaron Zhuo, my wonderful team of editors, and the gracious help of our reviewers and graduate student advisors. I would also like to thank our faculty advisor, Dr. Steven Barnes, for his mentorship and unwavering support for promoting undergraduate research in our department. It has truly been a privilege to work with such a dedicated and diverse team.

Congratulations to all our authors on their achievement and to every individual who made this publication successful. I wish UBCUJP all the best in its years to come.

Sincerely,

Kevin Chi
Editor-in-Chief
*UBC Undergraduate Journal of Psychology*
University of British Columbia’s Undergraduate Journal of Psychology (UBC UJP) is an annual, student-run, peer-reviewed journal. Our goal is to provide a platform for undergraduates at UBC to showcase their research. We believe that the months of dedicated work our undergraduates devote to their research papers should result in more than a mark for a class and then quickly left behind. Instead, these research papers provide a fantastic opportunity for undergraduates to experience the peer-review and editorial process while also being a valuable resource for faculty members and fellow students to learn about the research happening in our scientific community.

Our focus is three-fold:

1. To undergraduate authors we offer a valuable and rare experience into the peer-review, editorial, and publication process.

2. To our editorial board and reviewers, we offer the opportunity to develop reviewing, critical thinking, leadership and managerial skills that are essential for success in graduate studies and future careers. Being involved with UBCUJP is also a great opportunity to network with faculty members, graduate students and other motivated undergraduates.

3. To graduate students and faculty members, we offer the chance to engage and mentor undergraduate students in greater depth.

We hope the journal itself will offer a unique peek into various developing projects around the research labs of UBC’s Department of Psychology.

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The Effects of Electrically-Induced Seizures on Hippocampal Neurogenesis and Cell Maturation in Mice – A Pilot Study

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Abstract

Major Depressive Disorder depicts a profound health concern across Canada and is highly correlated with a decrease in life quality. Depression treatments have revealed a link to the generation of new neurons in the hippocampus. Electroconvulsive Therapy (ECT) has been one of the most effective treatments for drug resistant patients. However, the reasons for its efficacy remain largely unknown. In this pilot study, we examined the effects of electrically-induced seizures on adult hippocampal neurogenesis in mice (N=7). We hypothesized that cell growth and survival are stimulated by Electroconvulsive Stimulation (ECS), and that treatment induces more complex dendritic morphology in immature neurons. We used immunohistochemistry and categorization methods to analyze neuronal markers. The results show that neuronal growth, but not cell survival, was induced by ECS. Categorization of cell maturity revealed a significant increase in sham immature cells and a trend of increased dendritic branching in the ECS treatment group. Thus, we conclude that maturation factors of hippocampal neurons may play a role in ECT treatment efficacy.

Keywords: depression, electroconvulsive therapy, electrical stimulation, neurogenesis, cell maturation

Major Depressive Disorder (MDD) is a complex and recurrent mental illness that imparts profound burdens on those who are affected. After cardiovascular disease, depression is the most prominent source of disability in the workplace in both Canada and the United States (Dewa, Lesage, Goering, & Craveen, 2004; Weng et al., 2004) and it accounts for the biggest portion of all mood disorders (Patten et al., 2015). In Canada, 11.3% of adults are affected at least once in their lifetime (Lam et al., 2016). Suicide ideation, sadness, and sleep impairment are common depressive symptoms of changes in mood, basic drives, and cognitive disturbances (Warner-Schmidt & Duman, 2006). In addition, research repeatedly confirms that severe depression is highly associated with suicidal behaviours and completions (Blair-West, 1999; Conwell, 2011).

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The Role of the Hippocampus in Depression

In behavioral neuroscience, the manifestation of such heterogeneous symptoms have been connected to the brain’s limbic system. The limbic system is a set of brain structures that is involved in many functions, such as mood regulation, memory, and learning, and has been associated with structural and neurochemical changes observed in individuals with MDD (Drevets, 2001; Warner-Schmidt & Duman, 2007). The hippocampus is anatomically connected with other limbic structures involved in mood regulation and has been of special interest in understanding depression etiology and treatments. This is supported by observations of hippocampal-dependent cognitive dysfunction in patients with MDD (Bremner et al., 2004; Drevets, 2001; & Gould et al., 2007).

In addition to cognitive impairment, we can also see effects of depression on physiological and biochemical levels in the hippocampus. The hippocampus shows high numbers of receptors for stress hormones and thus plays a profound role in the regulation of stress hormones called glucocorticoids. This influences the hypothalamic-pituitary-adrenal (HPA) axis, a neuroendocrine marker of depression, as well as its negative feedback regulation (Gold & Chrousos, 2002; Holsboer & Barden, 1996; Sapolsky, 2001; Synder et al., 2011; Young et al., 1991). Negative feedback is a mechanism important for keeping a system’s homeostasis, therefore optimizing functioning. High levels of glucocorticoids can impact cell loss and atrophy affecting the feedback inhibition and thus behavior (McEwen, 1999; Sapolsky, 2001).

Such impairments are observed in people with depression and it has been well documented that depressed patients show a significant hippocampal volume loss compared to control participants (Frodl et al., 2002; MacQueen et al., 2003; Saarelainen et al., 2003; Sheline et al., 2003; Vermetten et al., 2003). Reasons for the decreased hippocampal volume might be excitotoxicity damage to the hippocampus due to long-term exposure of elevated glucocorticoids as shown in animal models of depression and postmortem studies of depressed patients (Campbell & MacQueen, 2003; Scott et al., 2000). Another explanation is a trend towards serotonin receptor loss as serotonergic dysfunction seems to be an indicator of MDD (Sheline, Mittler, & Mintun, 2002). In sum, stress, cell damage and loss are common phenomena observed in depressed patients and points out that the hippocampus is likely to play a vital role in this pathology.

Antidepressant Treatments Are Linked to Hippocampal Neurogenesis

It is suggested that atrophy of the hippocampus seems to be attributed to stress-induced decreases in cell birth and growth in the adult hippocampus (Zhao, Deng, & Gage, 2008). Evidence shows that cell division in the region where neurogenesis occurs, the subgranular zone (SGZ), is supressed by the stress hormone corticosterone (Zhao et al., 2008). In contrast, pharmacological antidepressant treatments increase neurogenesis and neurotrophic factors (Duman, 2004a, 2004b; Encinas et al., 2006). For instance, fluoxetine and serotonin treatments increase cell proliferation, a marker of a functioning HPA axis (Warner-Schmidt & Duman, 2006). Neurogenesis seems to be a crucial factor in antidepressant-induced efficacy.

Animal studies show that antidepressant treatments elicit neuroprotective effects (Sheline, Gado, & Kraemer, 2003), and that increased adult hippocampal neurogenesis buffers depressive-like behaviours in mice (Olesen, Wörtwein, Folke, & Pakkenberg, 2017; Synder et al., 2011, Santarelli et al., 2003). Researchers have concluded that functional and structural plasticity is needed for the therapeutic effects observed in chronically depressed
individuals (Duman et al., 1997; Nestler et al., 2002). Thus, neurogenesis is moderated by stress and may play a crucial role in the therapeutic effects seen in treated depressed individuals (Warner-Schmidt & Duman, 2006; Zhao et al., 2008).

**Electroconvulsive Therapy as Effective Antidepressant Treatment**

Due to high prevalence of depression across the population, treatments for depression have long been the focus of research. Although many treatments exist, they widely differ in their effectiveness and it is difficult to determine why some work better than others. Electroconvulsive therapy (ECT) is a highly effective course of action, and just as pharmaceutical drugs, ECT is linked to significantly increased neurogenesis in the hippocampus throughout adulthood (Bolwig, 2011; Olsen et al., 2017). In fact, ECT has been shown to be more effective (Kho, van Vreeswijk, Simpson, & Zwinderman, 2003). A study examining the therapeutic effects of ECT in patients diagnosed with MDD reported 87% remission following ECT for those completing the entire course of treatment and showed first responses after only three treatment units (Husain et al., 2004). In contrast, pharmacotherapy has a typical response rate of 50-60% and only 35% to 45% of patients achieve remission (Trivedi, Rush, Pan, & Carmody, 2001). Nonetheless, due to its convulsive nature, such as induction of generalized seizures, ECT is mostly only used as a last resort in severely depressed and drug-resistant patients (Husain et al., 2004; Zhao et al., 2008). In order to investigate how therapeutic effects of ECT help relieve depressive symptoms, it is necessary to understand electrically-induced changes at the cellular level.

**Positive effects of ECT.** A rodent model of ECT has shown that electrically-induced seizures increase hippocampal neurogenesis after chronic corticosterone treatment. The results showed that a decrease of 75% in neurogenesis of corticosterone-treated rats was counteracted by a single ECS. This suggests that ECS increases neurogenesis even in the presence of elevated levels of glucocorticoids (Hellsten et al., 2002). In addition, newly born cells also show substantial survival, maturation, and integration after ECS administration. This is supported by Scott and colleagues (2000) who reported a two-fold increase of newborn neurons in ECS rats compared to controls four weeks after treatment. More recent studies showed a long-term survival of newly born neurons for up to 12 months (Olsen et al., 2015, 2017). Beyond increasing cell numbers, ECS administration also increases neuronal spine maturation, an important factor in cell integration and functionality (Zhao et al., 2008). Interestingly, seizure research shows that if cells survive an extended duration of electrical activity, such newborn neurons experience an acceleration in maturation and functional integration (Overstreet-Wadiche, Bromberg, Bensen, & Westbrook, 2006). Overall, many factors that are important for optimal neuronal communication are enhanced due to electrical stimulation, and neurogenesis appears to underlie the clinical effect of ECT (Hellsten et al., 2002; Madsen et al., 2000; Scott et al., 2000).

**Negative effects of ECT.** Despite the strong evidence of increased neurogenesis and positive clinical effects, ECT is also related to adverse side effects. Human studies showed that patients commonly experience anterograde and retrograde amnesia immediately after treatment, and up to six months. In addition, negative changes in cognition, learning, and memory have been observed hours or days after treatment (Scott et al., 2000). Such changes include confusion, disorientation, and reduced recall ability. Other abnormalities such as aberrant cell development, for example, reverse dendrite formation and migration into the hilus were reported.
ELECTRICALLY-INDUCED SEIZURES AND NEUROGENESIS

(Madsen et al., 2000). Nevertheless, research has failed to detect gross structural damage following seizure induction (Scott et al., 2000). Interestingly, just as seizure activity enhances cellular growth, it also induces cell death at different stages of cell development (Kuhn, Dickinson-Anson, & Gage, 1996), an important component crucial for cellular homeostatic maintenance. Even so, beneficial effects of ECS seem to outweigh its negative counterparts.

In summary, ECS causes cell birth, maturation, integration, as well as cell death, all of which are important factors to mediate adequate brain functionality (Figure 1). In depression, such functionality is impaired. Therefore, we are interested in how ECS influences the stages of the cellular life cycle.

With this in mind, the primary goal of this study is to elucidate the effects of electrically-induced seizures on adult hippocampal neurogenesis and cell maturation in mice. In order to pursue this goal, we tested three interrelated hypotheses. First, in line with previous research, we expect to see evidence for an increase in cell survival in mice exposed to ECS compared to the unstimulated controls. Second, we hypothesize that the total number of immature neurons is significantly higher in stimulation groups. And third, we expect to show a greater dendritic complexity in immature neurons following electrically-induced stimulation when compared to the control group.

**Methods**

**Animals**

This pilot study used a common strain, C57BL/6, of inbred laboratory mice (N = 8). At the beginning of the study, the mice were 3-4 months of age and weighed 25-40 g. Animals were group-housed under standard conditions with free access to food and water. The light/dark cycle was 12h:12h with the lights turned on at 8:00 am. All animals were randomly chosen from various litters that were born at approximately the same time. The group consisted of four mice receiving sham-ECS (control) and four mice administered with active ECS. Due to one death during experimental set-up, final data analysis was conducted on three mice in the control (sham) ECS group. Thus, the number of animals per group needs to be considered when interpreting the results after analysis.

**Experimental Procedure**

**Electroconvulsive stimulation.** All procedures were performed in accordance with the guidelines of the Canadian Council on Animal Care and the University
of British Columbia Animal Care Committee. ECS was administered every second day for a total of 10 stimulations. The experiment was conducted over a course of 20 days, and animals were sacrificed on day 21 (Figure 2). The treatment was administered with a constant current of 20 mA – 23 mA (0.5 µm pulse width, 0.5 s pulse duration, 50 Hz frequency). Animals remained in a seizure state for about 20-30 seconds after stimulation. After each sham-ECS and active ECS, mice were returned to their home cages.

**BrdU injection.** To identify newly born neurons, each mouse was injected with 200 mg/kg of BrdU. The agent was dissolved in phosphate-buffered saline (PBS) and injected intraperitoneally. This dose was administered on day 2 of the ECS treatment.

**Perfusions and Tissue Preparation**

On day 21, all animals were anesthetized with an intraperitoneal injection of 15% chloral hydrate and transcardially (through the heart) perfused with 0.9% saline and 4% paraformaldehyde on 0.1 M phosphate buffer (PB, pH 7.4). The brains were excised from the skull and post-fixed in 4% paraformaldehyde for 72 h at 4°C. Then, the brains were placed in a 0.1 M PBS/.1% (w/v) sodium azide solution at 4°C until sectioning. The tissue was sectioned using a vibrating microtome (Leica Vibratome 1000 S) at 40 µm. The resulting sections were placed in cryoprotectant at -20°C until used for immunohistochemistry.

**Immunohistochemistry**

We used a process of selectively imaging antigens, immunohistochemistry, to visualize the cell markers BrdU and DCX. Every sixth section (1 in 6 series) was used for immunostaining and approximately eight sections per animal were quantified. Immunohistochemistry was performed on free-floating brain sections. All markers were stained using the same basic protocol with the exception of different primary and secondary. The protocol was as follows.

The staining was done over a course of 3 days. On the first day sections were washed in PBS (10 min x 5) and then rested in a 3% hydrogen peroxide/PBS mix for 30 minutes. After another wash of PBS (10 min x 3), the tissue was incubated for 60 minutes at 37°C in hydrogen chloride. Next, 0.1 M of Borate Buffer was used on the tissue for 10 minutes at a pH of 8.5 and washed with PBS (5 min x 3). Finally, the tissue was submerged in blocking buffer for 60 minutes and was incubated in primary antibody for 48 hrs at 4°C.

On day 3, sections were washed with PBS (10 min x 3) and incubated for 2 hours at room temperature with the secondary antibody. After a second PBS wash, tissue was immersed in avidin-biotin complex (ABC) for 2 hours. This was followed by one more PBS wash (10 min x 3) and stained using 0.0333% DAB dissolved in 0.00768% H2O2. Lastly, the tissue was mounted on section slides after a final wash of PBS.

**Primary and secondary.** To visualize each marker, different primary and secondary antibodies were used. For staining BrdU, we used the primary mouse anti-BrdU (1:250) and the secondary antibody Goat Anti-Mouse (1:250). DCX was stained using rabbit anti-DCX (1:1000) primary and Goat anti-rabbit (1:500) secondary.

**Analysis of Immunohistochemical Labeling**

All analyses were conducted by individuals blind to the experimental conditions. The total number of BrdU, and DCX in the dentate gyrus were determined by profile counting methods. Sections were examined at 40x magnification. One hemisphere was quantified and used for statistical analyses.

**Categorization.** To semi-quantify the morphology of the DCX-positive cells, dendritic branching in a subset
of DCX-positive cells from each mouse was categorized. This was done according to the method outlined by Plumppe and colleagues (2006). We randomly selected between 80 and 120 cells per animal using a meander scan method, which prevents from bias selection of cells. Each cell was assigned to one of six categories based on the presence and extent of its apical dendrites (see Figure 3). The criteria for category discrimination are as listed in Lussier, Romay-Tallón, Kalynchuk, & Caruncho (2010). Morphology states in categories one and two are labeled as immature, categories three and four as intermediate and categories five and six are described as mature state.

Statistical Analyses

All statistical analyses were performed using Statistical Package for the Social Sciences (SPSS v 21.0, Chicago, IL). After the completion of labeling and categorization, we examined the statistical significance of group differences. We used the independent t-test to compare the averages of total numbers of BrdU, and DCX positive cells in active-ECT versus sham-ECT groups. DCX categorization was analyzed by conducting independent t-tests for each category comparing animals in control and treatment groups. The analysis of these markers was used to determine survival rates, as well as the amount and complexity of immature neurons respectively. Inference testing significance was set to $p < .05$.

Results

The study's objective was to demonstrate the effects of electrically-induced seizures on cell survival, immature cell number and complexity. To test these hypotheses, we first addressed the effects on cell survival. Second, we used DCX immunostaining to examine immature cell number and dendritic complexity.

Cell Survival and Number of Immature Neurons

Figure 4 shows the effect of ECS treatment on total numbers of BrdU positive cells compared to controls. The independent t-test revealed no significant

Figure 4. Averages of total number of BrdU+ cells in Sham. Error bars denote the mean ± standard errors of the mean.

Figure 5. Averages of total number of DCX+ cells in Sham and ECS groups. Error bars denote the standard errors of the mean. * denotes a significant difference between the Sham and ECS groups, $p < .05$. 
difference in total numbers of BrdU positive cells in the ECS treatment group (\(M = 27.50, SD = 21.86\)) when compared to the control group (\(M = 9.00, SD = 6.56\)); \(t(5) = 1.6, p = .19, d = 1.14\). Figure 5 shows the effect of ECS treatment on the total number of DCX positive cells. An independent t-test analysis revealed a significant difference in immature neurons in ECS mice (\(M = 510.38, SD = 148.01\)) compared to control mice (\(M = 192.50, SD = 26.25\)); \(t(5) = -3.59, p = .02, d = 2.99\). Figure 6 displays images of DCX positive cells at a 10x magnification in the sham and ECS group.

**Dendritic Complexity**

Different stages of dendritic complexity (categories 1 to 6) of immature neurons were analyzed. Figure 7 compares the effect of ECS on DCX positive cells between treatment and control group in each category by percentage of cells. Category two revealed a significantly higher percentage of immature neurons in the sham group (\(M = 16.43, SD = 1.29\)) compared to the ECS group (\(M = 13.01, SD = 1.70\)); \(t(5) = 2.87, p = .03, d = 2.26\). All other categories showed no significant difference. The results of the independent t-test analysis for categories in dendritic branching are as listed in Table 1.

**Table 1.** Independent t-test Analysis for Immature Neuron Categorization. Mean Percentages, Standard Deviations, Effect Sizes as well as P-values are Presented for Each Stage of Dendritic Complexity (categories 1 to 6), \(N = 7\). Note. Percentages were quantified using a stereological investigator that randomly selected subsets of cells from five sections per animal. \(*p < .05\).
**Discussion**

The mechanisms by which ECT reduces depression in humans remain largely unknown. The purpose of this pilot study was to elucidate possible factors influencing ECT efficacy by investigating the role of electrically-induced seizures on neurogenesis in an animal model. Recent research has shown that depressive-like behaviours in rodents are rescued by ECS administration and that neurogenesis is required for this effect (Schloesser et al. 2015). We hypothesized that if neurogenesis is important in mediating therapeutic effects, then electrical stimulation will affect the stages of neurogenesis by increasing the likelihood of neuron integration. Thus, we expected to see an increase in overall cell survival, a larger total number of immature neurons, as well as greater dendritic complexity of such neurons. Our results reveal interesting findings that give rise to future directions in examining the effects of ECS on neurogenesis.

**ECS Affects Maturation but Not Survival**

First, we examined the effects of cell survival due to electrically-induced seizures. Although our results showed no evidence of enhanced cell survival due to ECS, we recognize that this null finding might be due to the small sample size (N = 7). Previous research has repeatedly confirmed that ECS induces survival as well as proliferation (Scott et al., 2000; Olesen et al., 2017). Therefore, we see our small sample size as a major limitation. It could increase the probability of a type II error as well as the chance that the subjects in each condition were not representative of the greater population. Future pilot studies should thus use a sufficient sample size. In addition, it would be interesting to also investigate cell proliferation along with its survival. This would help replicate previous work showing that ECS is involved in the generation of new adult-born neurons and not just their survival, an important first step in investigating adult hippocampal neurogenesis.

Despite the small sample size, this study revealed significant results elucidating the effects on immature neurons. ECS groups showed an almost 3-fold increase in the number of DCX+ cells, a marker of neuronal maturation. This result underlines the hypothesis that maturation of neurons is affected by electrical stimulation, and therefore its likelihood of cellular communication. However, successful communication between neurons requires circuitry integration which can be indicated by the complexity of dendritic branching. Thus, we used dendritic categorization to determine the complexity of the immature cells.

**ECS Affects Dendritic Morphology**

As a marker of maturation in neuronal cells, DCX is expressed in immature neurons and occurs in a wide range of morphological complexity, from no dendritic branching to well defined branching as shown in Figure 3. Generally, the more complex a cell is, the greater the likelihood that it is ready to send and receive signals and as such, increased possibility for communication may play a role in ECT efficacy. We categorized cells that tested positive for doublecortin (DCX+) and hypothesized that levels of less mature DCX+ cells (categories 1 to 4) are higher in controls and levels of more complex DCX+ cells (categories 5 to 6) are higher in the ECS group. The results validated an increased immature DCX+ morphology in the sham group. Furthermore, we found a trend that the percentage of more complex morphology tends to be higher in the ECS group, but it did not pass statistical significance. Although the latter was not significant, there are important implications when looking at the combination of our results.

**Implications of Number and Complexity of DCX+ Cells**

Category 6, the cells with most complex branching, showed a mean difference of 8% in complex DCX cells. However, due to great variability in the ECS group, this category did not reach significance. In
comparison, category 2 (no branching), having lower variability, revealed a significance in immature DCX+ cells with a mean difference of 3%. Despite this limitation in variability, results are still meaningful in respect to our hypothesis that maturation is altered by ECS.

Both DCX number and complexity support the important idea of an increased chance in functional integration. First, the number of DCX+ cells is significantly lower in controls, suggesting a reduced chance of functional integration compared to ECS animals. Second, in addition to possessing fewer immature cells in controls (Figure 5), more of these cells are of limited complexity (category 2), lacking dendritic branching (Figure 6). This further reduces the chance for neurons to functionally communicate. Lastly, we see a reversed trend of more complex morphology in DCX+ cells in the stimulation group, showing that neurons in the ECS groups have greater possibility to integrate into the circuitry. In sum, our results suggest an increased likelihood of cellular integration and communication due to ECS effecting neuronal maturation processes.

Other research on dendritic morphology and ECS also revealed evidence that ECS increases cell complexity (Schlosser et al., 2015). More specifically, they found an increase in tertiary dendrites in all groups treated with ECS. This effect was sustained even in groups treated with CORT, a corticosteroid. Such stress hormones have been found in depressed animals and humans (Sapolsky, 2001). Our findings and previous research lead us to the conclusion that electrical stimulation increases the maturation process of immature cells and therefore might play a role in treatment efficacy.

**Strengths, Limitations and Future Directions**

A strength of this study is that it examines the effects of electrically-induced seizures on neurons in different stages of their development while past research has mostly focused on total numbers of immature neurons but failed to address other aspects of maturation (Scott et al., 2000; Madsen et al. 2000). DCX, a marker of immature neurons, is expressed as soon as fate determination occurs and lasts until the final stage of a mature granule cell begins (Zhao et al., 2008). Thus, DCX can capture a six-week long window of development. This window will include immature neurons of various degrees of complexity. Categorization of such complexity allowed us to create a more detailed analysis of neuronal branching. To the best of our knowledge, this is the first study using this approach in an ECS model in mice.

Although this method has shown promising results in observing a difference in dendritic complexity between treatment and control group, there are limitations to our approach. The small sample size may have left important trends undetected due to high variability within the groups.

Additionally, there are other limitations that need to be noted. First, when examining DCX+ tissue we found evidence of aberrant morphology (Figure 8). In seizure research such abnormal growth has been repeatedly observed as a result of electrical stimulation (Parent et al., 2006). Aberrant changes in morphology, such as reverse dendrite formation and migration effect a cell’s functionality (Madsen et al., 2000). In other words, if a neuron possesses complex branching but migrates into the opposite direction or appears to be upside down, it will not be able to successfully communicate. Therefore, an important next step would be to identify the percentage of aberrant versus normal dendritic morphology in both groups. Identifying if normal and more complex morphology may outweigh abnormal growth in ECS groups can further our understanding to what extent maturation is involved in ECS efficacy.

Second, although our study highlights the importance of maturation as an indicator for a greater likelihood of neuronal connectivity, it does not tell us whether or not more complex neurons are actually active. Adult-born granule cells respond to behavioural stimuli and network activity (Deng,
Such activity can be captured by examining the expression of immediate early genes (IEGs). Future studies should examine key markers of neuronal activation, such as labeling FBJ osteosarcoma oncogene (Fos) or cytoskeletal-associated protein (Arc) which play a crucial role in synaptic plasticity.

Lastly, our study has addressed only two stages of adult neurogenesis: survival and maturation. However, cell death is an equally important part of the natural progressions of neuronal cells in the hippocampus (Liu et al., 2017). Apoptosis, also known as programmed cell death, has its role in many biological processes, such as embryogenesis, aging, etiology of disease, and neurogenesis (Rhenehan et al., 2001). Research suggests that a balance of apoptosis is crucial for healthy cellular development. For instance, an overregulation of apoptosis can cause degeneration, as seen in neurodegenerative diseases such as dementia. On the other hand, underregulation can cause exponential cell growth, the characteristics of cancer (Liu et al., 2017; Renehan, Booth, & Potten, 2001). Interestingly, increased cell death occurs due to extensive seizure-induction, such as in kindling models mimicking seizure pathology. Yet research examining therapeutic seizure administration, for example ECS, reports no difference in total volume or cell loss (Olesen et al., 2015). Examining specific markers for cell death in ECS has been scarce. Thus, apoptosis may be a stimulus for cell birth which indicates a possible compensatory role of neurogenesis (Gould & Tanapat, 1997). The death of old and the generation of new neurons may enable hippocampal processes, such as learning, due to replacing old cells with new ones (Arbrous, Koehl, & Le Moal, 2005). Future research should identify how cell loss affects the stages of neurogenesis to yield important implications in understanding the effects and side effects of ECT.

Overall, this study serves to further investigate the revenues of the beneficial effects of ECT. If our understanding of underlying mechanisms of ECT efficacy grows, then we can be more confident in exploring treatment recommendations and possibly target depression at earlier stages of severity. This is especially important as ECT has been largely used as a last resort for severely depressed and drug resistant patients (Hellsten et al., 2000). Thus, research on this domain can help reduce long trial periods of antidepressant administration and therefore reduce health care expenditure. Most importantly, a better understanding allows professionals to treat patients earlier, ultimately increasing their quality of life.

Declaration of Conflicting Interests
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Functional Connectivity for the Diagnosis of Attention-Deficit Hyperactivity Disorder in Infants

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Abstract

Attention-deficit hyperactivity disorder (ADHD) is a neurodevelopmental disorder associated with poor outcomes in many domains; for example, individuals with ADHD are significantly more likely to attempt suicide, to fail to complete high school, to be fired, and to be incarcerated. In response to recent research employing functional connectivity MRI (fcMRI) and machine learning to diagnose autism spectrum disorder in early infancy, this article considers the possibility of this technique for the diagnosis of ADHD. The article reviews the current state of research on the disorder, focusing on connectivity differences in the ADHD brain. The article then reviews the precedent of infant fcMRI research, as well as existing studies employing MRI and machine learning for diagnostic purposes. Future research applying this technique to the diagnosis of ADHD in infancy is proposed. It appears that this method may prove useful in the early and accurate diagnosis of ADHD, allowing for early intervention and the avoidance of negative outcomes.

Keywords: ADHD, neurodevelopmental disorders, functional connectivity, machine learning, biomarkers, infancy

Functional connectivity is an area of intense interest in modern neuroscience that involves correlating the activity of different brain regions. Through functional connectivity analysis, we have been able to better characterize many psychiatric disorders, as well as gain insight into the mechanisms of the developing brain. Recently, progress has been made in using functional connectivity to predict psychopathology, from as early as infancy in some cases, but this has not yet been attempted for ADHD. This review first introduces the disorder, the consequences associated with it, and the current challenges in its diagnosis. It then reviews literature on functional connectivity in ADHD, functional connectivity in infancy, and functional connectivity in diagnosis. Finally, it considers the potential of a new biomarker approach to ADHD diagnosis that, in the future, may be able to address some of the challenges the disorder presents and lead to better outcomes.

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An Introduction to ADHD

ADHD is a neurodevelopmental disorder characterized by “a persistent pattern of inattention and/or hyperactivity-impulsivity that interferes with functioning or development” (American Psychiatric Association, 2013). It affects an estimated 3.4% of children in the general population (Polanczyk, Salum, Sugaya, Caye, & Rohde, 2015), and its prevalence seems to decline in adulthood to 2.5% (Simon, Czobor, Bálint, Mészáros, & Bitter, 2009). However, because the presentation of the disorder changes with development, its prevalence in adults is still uncertain (Simon et al., 2009).

Causes

ADHD is highly heritable, with studies from multiple countries indicating a heritability of around .71 - .90 (Thapar, Cooper, Eyre, & Langley, 2012). Several genes that are consistently associated with ADHD have been identified, but the effect size for each is small, and thus they have no predictive value (Thapar et al., 2012). It is likely that a complex interplay between a great many genes is responsible for the genetic component of the disorder rather than any individual genes (Thapar et al., 2012). A multitude of environmental factors are also associated with increased risk of ADHD, but there is little evidence to support any causal relationships, with the exception that severe, early social deprivation is likely a causal risk factor (Thapar et al., 2012).

Pathophysiology

Meta-analysis of task-based fMRI studies has shown substantial hypoactivation of the frontoparietal control network (involved in executive function) and the ventral attentional network (involved in attention to stimuli) in individuals with ADHD (Cortese et al., 2012). These individuals also showed a substantial hyperactivation of the default mode network (DMN; involved in internally-focused tasks, e.g. mind-wandering) and several areas involved in sensory processing (Cortese et al., 2012). On a neural level, animal models have suggested the implication of deficits in dopaminergic, noradrenergic, and sometimes serotonergic neurotransmission (Russell, 2011). Behaviourally, these abnormalities manifest as deficits in many neuropsychological domains, including response inhibition, vigilance, working memory, planning, timing, storage aspects of memory, reaction time variability, and decision-making (Thapar & Cooper, 2016).

Diagnosis

The diagnosis of ADHD is based on behavioural symptoms. According to the DSM-5, diagnosis requires at least six symptoms of inattention and/or hyperactivity and impulsivity that are not explained by another condition. The symptoms must be present before the age of twelve, be present in at least two settings, and cause impairment in the patient’s functioning (American Psychiatric Association, 2013). The assessment process usually involves clinical interviews with the patient, the patient’s family, and/or other informants, depending on the patient’s age. Standardized ADHD behaviour rating scales may be used, and some clinicians may employ neuropsychological testing (National Resource Center on ADHD, 2018).

There are problems with this diagnostic process. Concerns that ADHD may be overdiagnosed are often raised by healthcare professionals as well as the media, and as a result, the public often views the disorder with suspicion, which can harm the individuals diagnosed with it (Thomas, Sanders, Doust, Beller, & Glasziou, 2015). Prevalence estimates vary wildly (Thomas et al., 2015), highlighting the subjectivity of the behavioural symptoms; there is generally poor agreement between informants as to whether a patient exhibits them (Snyder, Rugino, Hornig, & Stein, 2015). A differential diagnosis is hard to achieve, as there is considerable overlap between the symptoms of ADHD and those of other disorders (American Psychiatric Association, 2013). Additionally, as ADHD is typically treated with stimulants (e.g. amphetamine, methylphenidate; Thapar & Cooper, 2016), there is the potential for individuals to seek a diagnosis in order to obtain these drugs for recreational use or performance enhancement.
Problems in the diagnosis of mental disorders based on behavioural symptoms are not restricted to ADHD; this was recognized by the US National Institute of Mental Health in their Research Domain Criteria (RDoC) project, which seeks to better classify mental disorders based on their pathophysiology of dysfunctional brain circuits (Insel et al., 2010). In line with this idea, the diagnosis of ADHD based on brain circuitry should be examined.

**Prognosis**

The impact of ADHD on one’s quality of life can be devastating. A recent systematic review found that ADHD was associated with poor outcomes related to health, education, employment, and crime (Erskine et al., 2016). For example, individuals with ADHD are almost three times more likely to suffer mental disorders; there are significant associations between ADHD and bipolar disorder, depression, panic disorder, substance use disorders, and others (Erskine et al., 2016). Individuals with ADHD are also significantly more likely to be expelled from school, to have no tertiary education, to be fired from jobs, and to be incarcerated (Erskine et al., 2016). They are about three times more likely to have driving accidents with injury, and twice as likely to attempt suicide (Erskine et al., 2016). Another systematic review concluded that without treatment, patients with ADHD have significant functional impairment and health-related quality of life deficits (Coghill, Banaschewski, Soutullo, Cottingham, & Zuddas, 2017).

**Treatment**

Treatment for ADHD may involve stimulants, non-stimulant medications, and/or behavioural interventions. Stimulant medications are the first-line treatments for school-aged children, adolescents, and adults, as there is robust evidence demonstrating their effectiveness in reducing core ADHD symptoms (American Academy of Pediatrics (AAP), 2011; Thapar & Cooper, 2016). Stimulant treatment has an effect size of approximately 1.0 [effect size (treatment mean - control mean)/control SD] in children (AAP, 2011). Behavioural interventions do not show the same level of effectiveness as medications and using both in conjunction does not produce a significant benefit over medication alone in reducing core symptoms, but they may be helpful for reducing associated symptoms and improving functioning (AAP, 2011; Thapar & Cooper, 2011).

With regard to long-term outcomes, treated individuals fair significantly better in terms of academics, antisocial behavior, driving, non-medicinal drug use/addictive behavior, obesity, occupation, services use, self-esteem, and social function outcomes than untreated individuals (Shaw et al., 2012). However, even with treatment, individuals with ADHD still experience these poor outcomes compared to healthy controls (Shaw et al., 2012). Additionally, most patients with ADHD do not receive adequate treatment for several reasons: patients often discontinue use of their medication or use it inconsistently, physicians often fail to monitor their patient’s response closely enough to properly titrate medication dosage, and combination therapy (medication and behavioural intervention) is not often used despite evidence that it leads to better outcomes (Manos, Giuliano, & Geyer, 2017).

There has been interest in the potential of early intervention to improve treatment outcomes. It is theoretically plausible that treating ADHD very early in childhood could alter the harmful course of the disorder. The brain undergoes drastic changes in the first years of life, with levels of neurogenesis, synaptogenesis, and synaptic pruning at their peak; this may present a window during which treatment could permanently alter the brain’s connectivity. Early intervention would also avoid the complicating factors of comorbid conditions and dysfunctional learned behavioural patterns (Halperin, Bédard, & Curchack-Lichtin, 2012).

So far there is some promising evidence to support this theory. Correlational studies have shown that aerobic fitness in early childhood predicts differences in brain function associated with improved cognitive abilities related to executive function, which are impaired in ADHD (Halperin,
Training programs for school-aged children with ADHD that target attention and cognition have led to changes in brain structure and function, as well as improvements in ADHD symptoms (Halperin, Bédard, & Curchack-Lichtin, 2012). A variety of parent behaviour training programs have been attempted for the treatment of ADHD in preschoolers, and systematic review indicates there is strong evidence supporting their effectiveness in reducing ADHD symptoms, and these benefits appear to last beyond the end of the treatment (Charach et al., 2013).

The same systematic review found six good or fair quality studies examining the efficacy of stimulants for preschool children, all of which showed improvement of ADHD symptoms upon treatment (Charach et al., 2013). The Preschool ADHD Treatment Study (PATS), a large randomized clinical trial funded by the US National Institute of Mental Health, found methylphenidate treatment to be efficacious in reducing ADHD symptoms in children aged 3-5 years (Greenhill et al., 2006). Follow-up to PATS offered some evidence for long-term benefit of treatment in the preschool years, but there were many limitations to the follow-up studies (Riddle et al., 2013). Research in adults with ADHD has found that stimulant administration significantly reduces abnormalities in functional connectivity (Cary et al., 2017), which suggests that stimulants could have a profound effect on the connections of the developing brain.

While more research is needed to determine whether early intervention could indeed alter the course of ADHD pathophysiology and lead to improved outcomes, the theoretical rationale and preliminary evidence are promising.

**Functional Connectivity in ADHD**

Analysis of the brain’s connectivity is a popular technique in modern neuroscience. One common method is resting state functional connectivity MRI (rs-fcMRI), first described by Biswal, Yetkin, Haughton, & Hyde (1995). It involves correlating spontaneous fluctuations in the blood-oxygen-level dependent (BOLD) signal in different brain areas during resting state to determine the way these structures are functionally connected (Biswal et al., 1995).

Many studies have found that individuals with ADHD exhibit abnormal patterns of functional connectivity compared to healthy controls. It has been consistently demonstrated that individuals with ADHD show reduced or absent anticorrelations between the cognitive control network (CCN) and the DMN (Posner, Park, & Wang, 2014). The DMN – consisting of the posterior cingulate cortex, medial prefrontal cortex, angular gyrus, and temporal cortex – is associated with engagement in internal tasks, such as daydreaming and retrieving memories, and it becomes suppressed when individuals direct their attention to external, goal-directed tasks (Buckner et al., 2008). Conversely, the cognitive control network (CCN) – which consists of the anterior cingulate cortex/pre-supplementary motor area, dorsolateral prefrontal cortex, inferior frontal junction, anterior insular cortex, dorsal pre-motor cortex, and posterior parietal cortex – is associated with cognitive control processes such as inhibitory control and working memory (Cole & Schneider, 2007). The two networks are anticorrelated, meaning they work in opposition to each other, but this opposition is significantly weaker in individuals with ADHD (Posner et al., 2014). In addition, many studies have shown that connectivity within the DMN is reduced in ADHD, particularly between two central nodes of the network: the posterior cingulate cortex and the medial prefrontal cortex (Posner et al., 2014). These nodes are some of the most consistently activated regions in DMN research, and their connection is thought to integrate salient information (coordinated from memory and perception by the posterior cingulate) with one’s current affective and cognitive experience (processed in the medial prefrontal cortex) to guide decision-making (Andrews-Hanna, Smallwood, & Spreng, 2014).

Studies have also found abnormalities in the cortico-striato-thalamo-cortical (CSTC) loops of individuals with ADHD. As implied by its name, these loops are neural circuits that project from the cortex to the striatum and thalamus, and back to the cortex.
There are several of these loops, but the ones that are implicated with ADHD are the cognitive loop – involving the dorsolateral prefrontal cortex – and the limbic loop – involving the orbitofrontal and anterior cingulate cortices – which are thought to be involved in executive function and emotional regulation, respectively (Posner et al., 2014). Individuals with ADHD show reduced connectivity in both loops compared to healthy controls (Posner et al., 2014).

Abnormalities have also been found in the ventral attention network, which is composed of the right temporal-parietal junction and the right ventral frontal cortex and is involved in the bottom-up directing of attention to salient stimuli (Fox, Corbetta, Snyder, Vincent, & Raichle, 2006). Compared to healthy controls, individuals with ADHD show significantly reduced resting state functional connectivity within the ventral attentional network (McCarthy et al., 2013).

A recent study found an increase in connectivity between the right inferior frontal cortex and the medial prefrontal cortex (part of the DMN) in children with ADHD (Bos et al., 2017). The right inferior frontal cortex is critical for response inhibition (Aron & Poldrack, 2005), and its hyperconnectivity to the medial prefrontal cortex may reflect an intrusion of the DMN into its function.

A different approach to brain connectivity analysis is based on the existence of “hub” regions within the brain that are highly connected with other regions and are therefore important for global information integration. These hub regions are more densely connected with each other than with other regions, forming a “rich club” organization (van de Heuvel & Sporns, 2011). Analysis of this organization in ADHD has shown hypoconnectivity within the rich club, and hyperconnectivity outside the rich club, compared to control (Ray et al., 2014). Computational models predict that disruption of the rich club connections leads to dramatically reduced global efficiency of communication (can de Heuvel & Sporns, 2011), and so ADHD brains may be inefficient in global communication. As executive functions rely on the integration of information, abnormalities in the rich club may be implicated in the executive function deficits seen with ADHD. More research is needed on the cognitive and behavioural correlates of these differences in rich club connectivity.

Overall, much evidence has been presented to suggest that functional connectivity in individuals with ADHD is substantially different from functional connectivity of the general population. Fortunately, stimulant medications have been shown to reduce these differences to some extent (Cary et al., 2017).

**Functional Connectivity in Infancy**

Resting-state functional connectivity MRI can be applied fairly easily in infants; it does not require them to perform any tasks, and it is unlikely to cause distress to the infant as it is typically done during natural sleep (Gao, Lin, Grewen, & Gilmore, 2016). This also avoids the issue of having to keep the infants still during the procedure, which often makes neuroimaging impossible.

Many studies have demonstrated functional connectivity between primary sensory areas from birth, and even in utero (Gao et al., 2016). During the first year, functional networks undergo much development, particularly in sensory association networks and the DMN. These networks show limited correlation at birth but are adult-like by the end of the first year (Gao et al., 2014). The anticorrelation between the dorsal attention network (involved in directing spatial attention) and the DMN which has been extensively researched in adults, also first appears at one year of age (Gao et al., 2016). The salience network – which connects the thalamus to the anterior insula, anterior cingulate, and prefrontal regions – and is involved in the integration of internal and external stimuli to assign salience, has also been observed in neonates (Alcauter et al., 2014). During the first year, connections within the network become stronger, and salience network connectivity at one year has been found to significantly predict working memory at two years of age (Alcauter et al., 2014).

Signs of psychopathology have also been observed in infant functional connectivity. Infants
exposed to prenatal maternal depression, which is associated with future development of many psychiatric disorders, showed atypical functional connectivity between the amygdala and the dorsal prefrontal cortex at around 6 weeks of age (Posner et al., 2016). Prenatal exposure to a variety of illicit drugs, which is also associated with psychopathology, is associated with a variety of functional connectivity abnormalities in infancy (Gao et al., 2016). Studies have also found abnormal functional connectivity patterns in infants with autism spectrum disorder (ASD) and Down’s syndrome (Gao et al., 2016).

Functional Connectivity in Diagnosis

Machine learning paradigms using rs-fcMRI have been able to classify individuals into diagnostic categories based on their functional connectivity. There have been several studies of this nature involving individuals with neurodevelopmental disorders (Mathews & Fair, 2014; Greene et al., 2016; Eloyan et al., 2012; Zhu et al., 2008; Emerson et al., 2017).

The first study to use this technique in ADHD used Fischer discriminative analysis to distinguish between children with ADHD and typically-developing controls based on resting state fMRI and achieved a classification accuracy of 85% (Zhu et al., 2008). A study of a much larger sample used several different methods and had a final classification accuracy of 61% (Eloyan et al., 2012).

A recent study was able to achieve a classification accuracy of 96.6% in using fcMRI to predict future diagnosis of ASD, another neurodevelopmental disorder, in 6-month-old infants (Emerson et al., 2017). The study recruited infants at high familial risk for ASD and collected fcMRI data at 6 months. At 24 months, the infants were evaluated for ASD on several behavioural and cognitive measures. The researchers then used a “leave-one-out” technique on the fcMRI data, in which one infant at a time was removed from the group to serve as the “test case”, and the rest were used as the “training set”. For each test case, they determined features (functional connections between regions) that were significantly correlated with the infant’s future ASD behaviour and performed a leave-one-out cross-validation of the features within the training set to determine the final set of features for the test case. These features were then used to train a linear classifier to distinguish between fcMRI data of infants with and without ASD.

Following the training of a classifier for each individual infant in this way, they used a leave-one-out approach to predict the classification of each infant. That is, the test case was classified by the classifiers of each of the infants in the training set, and the final classification was derived from the average of these. This procedure was repeated for each infant. In this way, each infant was classified based on an independent group of infants. It is important to note that the external validity of this study is still limited, as the infants classified were the same as the ones used to train the classifier. Future studies could address this by testing the classifier on an independent group of infants after training it.

Functional Connectivity in ADHD Diagnosis

As previously discussed, research demonstrates clear differences in the functional connectivity between individuals with and without ADHD, and a few studies have attempted with some success to classify individuals with and without ADHD using MRI and machine learning. For such a classification process to be a viable tool for diagnosis, a higher level of accuracy is necessary. The method, described above, employed by Erskine et al. for the diagnosis of ASD has not yet been attempted for ADHD, but a similar approach could prove successful given the similarities between the two disorders. That is, they both display significant differences in functional connectivity compared to typically developing children; they are both neurodevelopmental disorders; and they both have standardized behaviour rating scales associated with them. The scales allow for the determination of brain-behaviour features, which are crucial to the classification process. More evidence is necessary to establish whether the procedure would indeed be successful for ADHD, but it presents a promising course for future research.
What is particularly promising about such a diagnostic method is its ability to detect the disorder in infancy. As previously discussed, early intervention has the potential to alter the harmful course ADHD currently tends to follow, and early intervention requires early detection. While accurate diagnosis based on behaviour is challenging in older children and adults, it is almost impossible in very young children, for whom hyperactivity and inattention are hardly exceptional qualities. If infants at high familial risk could be screened for the disorder and accurately diagnosed with a simple MRI scan, the children could be treated as soon as possible. Additionally, by determining the specific fcMRI biomarkers of ADHD, treatments could be developed to specifically target these abnormalities.

Conclusion

If properly developed, an fcMRI and machine learning approach to diagnosis has the potential to be an excellent tool that could improve the quality of life for individuals affected by ADHD. There are currently many difficulties in the diagnosis of ADHD: the DSM criteria are based solely on reported behaviour, which is a subjective measure that can easily lead to misdiagnosis and can be manipulated by individuals seeking performance-enhancing drugs. Thus, a biomarker approach is greatly needed. Diagnosing ADHD in infancy would also open the door to early intervention, which could, based on the existing evidence, reduce symptom severity and related comorbidities. Given the dire outcomes often associated with this disorder, research concerning better diagnosis and treatment for it are much warranted.

Declaration of Conflicting Interests

The author(s) declared they have no conflicts of interests with respect to their authorship or the publication of this article.

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Testing the Role of Perfectionism in Attachment Style and Sexual Functioning in Women

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Abstract

Many previous studies have shown a connection between insecure attachment and poorer sexual outcomes. However, the mechanism of the attachment-sexual dysfunction link remains inconclusive. Recent studies have identified perfectionism as a possible nexus that connects attachment and sexual functioning. The aim of the present study aimed to conduct a preliminary test on the proposed mediating role of perfectionism. According to the perfectionism social disconnection model, it is hypothesized that insecure attachment is associated with poor sexual functioning because of the perceived social disconnection that arises from perfectionism. In this current study, 501 female undergraduates completed an anonymous online questionnaire containing questions about sexual functioning, attachment styles, and perfectionism. Findings demonstrated that insecure attachment was correlated with more sexual anxiety and less sexual arousal. Interpersonal perfectionism was significantly correlated with sexual anxiety and sexual arousal. No significant mediating effect was found between insecure attachment and poor sexual functioning. Overall, perfectionism does not appear to be a mediating factor for attachment style and sexual functioning, despite its evident correlations with both variables.

Keywords: perfectionism, attachment style, sexual functioning, perfectionism social disconnection model, sexual anxiety, sexual arousal, insecure attachment

Research has demonstrated links between adult insecure attachment styles and impaired sexual functioning. Consistent findings have highlighted the role of insecure attachment in the onset and development of poor outcomes for sexual functioning, such that individuals with insecure attachment tended to report having higher sexual anxiety, less sexual arousal, lower sexual satisfaction, and more sexual problems (Davis et al., 2006; Butzer & Campbell, 2008; Birnbaum, 2007; Brassard, Shaver, & Lussier, 2007). Despite the growing body of research on the attachment-sexual dysfunction link, research on its mechanism remains scarce. Recently, there has been preliminary evidence that suggests perfectionism relates to attachment problems and various sexual dysfunctional outcomes (Snell, 2001; Stoeber et al., 2013). In this present study, perfectionism was tested to address this knowledge gap by using the perfectionism social disconnection model as a framework (PSDM) (Hewitt et al., 2006).
According to the PSDM, it is hypothesized that insecure attachment is associated with poorer sexual functioning because of social disconnection that arises from perfectionistic behaviours. This paper will explore the relationship between attachment styles and sexual functioning, followed by a literature review on perfectionism, and will conclude with the hypothesized application of PSDM on the interaction between perfectionism, attachment, and sexual functioning. Psychopathology, from as early as infancy in some cases, but this has not yet been attempted for ADHD. This review first introduces the disorder, the consequences associated with it, and the current challenges in its diagnosis. It then reviews literature on functional connectivity in ADHD, functional connectivity in infancy, and functional connectivity in diagnosis. Finally, it considers the potential of a new biomarker approach to ADHD diagnosis that, in the future, may be able to address some of the challenges the disorder presents and lead to better outcomes.

Attachment and Sexual Functioning

According to attachment theory, early interactions with caregivers act as a prototype of later intrapersonal and interpersonal relationships, and disruption to a secure relationship can therefore have lasting consequences that persist into adulthood (Bowlby, 1969). One’s early relationship is believed to be the foundation of the internal working model for later romantic and sexual relationships. Indeed, research has suggested that different relationships and outcomes related to sexual functioning are associated with three adult attachment styles (Brennan & Shaver, 1995).

Individuals with anxious attachment tend to score high on the anxiety dimension of insecure attachment. Anxious attachment has been associated with heightened fear of abandonment and sexual anxiety, in addition to less sexual arousal (Brennan & Shaver, 1995; Davis et al., 2006; Birnbaum, 2007). Individuals with anxious attachment are also more likely to regard negative sexual experiences as relationship strife (Birnbaum & Laser-Brandt, 2002).

Individuals with avoidance attachment tend to score high on the avoidance dimension of insecure attachment. Avoidance attachment has been associated with less confidence in partners, less likelihood of engaging in sexual activity, higher level of sexual anxiety, and less sexual arousal (Brennan & Shaver, 1995; Tracy et al., 2003; Davis et al., 2006; Birnbaum, 2007).

Individuals with secure attachment are defined as those who score low on anxious and avoidance dimensions of insecure attachment. Compared to insecure attachment styles, secure attachment has been associated with the highest level of trust in others (Brennan & Shaver, 1995).

Overall, a large body of research has suggested that insecure attachment is associated with more sexual anxiety, less sexual arousal, and greater impairment in sexual functioning. In the present study, it was hypothesized that insecure attachment would be positively correlated with sexual anxiety, and negatively correlated with sexual arousal.

Perfectionism, Attachment, and Sexual Functioning

Perfectionism is conceptualized as a multidimensional personality construct that can pose as a significant vulnerability to psychopathology and distress. According to the comprehensive model of perfectionistic behaviour, perfectionism is a complex construct that encompasses perfectionistic traits (trait component) and perfectionistic self-presentation (intrapersonal component) respectively (Hewitt, Flett, & Mikail, 2017).

The three dimensions of perfectionistic traits reflect one’s need to be perfect. Self-oriented
perfectionism refers to a requirement and drive for the self to be perfect. Other-oriented perfectionism is characterized as the tendency to require perfectionism from others, like expecting others, such as children and partners, to achieve very difficult goals. Lastly, socially prescribed perfectionism is the perceived requirement of perfectionism from others, where one feels compelled to achieve others’ expectations to be perfect.

In contrast, perfectionistic self-presentation is the expression of perfectionistic traits and a need to display perfection to others (Hewitt et al., 2003). The first facet is perfectionistic self-promotion, which refers to one’s active effort in displaying and promoting one’s perfection to others. Non-display of imperfection is the second facet of perfectionistic self-presentation, which involves avoiding or concealing any behavioural imperfections from others. Finally, non-disclosure of imperfection is similar to non-display of imperfection, where one intentionally avoids any verbal admission of imperfections.

Recently, there has been preliminary evidence that suggests perfectionism relates to both attachment problems and various sexual dysfunctional outcomes. Snell (2001) found that perfectionism was associated with insecure attachment and greater sex guilt. Regression analyses showed that interpersonal perfectionism (i.e. socially prescribed perfectionism) is exclusively maladaptive to various sexual outcomes such as sexual anxiety, sexual esteem, and sexual optimism (Stoeber & Harvey, 2016). In the current study, it was hypothesized that insecure attachment would be positively correlated with interpersonal perfectionism (socially prescribed perfectionism and all three facets of perfectionistic self-presentation). As well, it was predicted that perfectionism would correlate with poorer sexual functioning, namely more sexual anxiety and less sexual arousal.

The Perfectionism Social Disconnection Model

The PSDM (Hewitt et al., 2006) posits that perfectionism is developed and maintained by insecure attachment, where psychological disorders and dysfunctional outcomes are the result of such social disconnections (see Figure 1). Using the PDSM framework, I propose one mechanism in which insecure attachment relates to poor sexual functioning. Due to early inconsistent caregiver responses, individuals with insecure attachment develop heightened relational needs and a compromised sense of self. Subsequently, perfectionism becomes a coping mechanism for insecure attachment: individuals become more likely to endorse perfectionistic behaviours to gain acceptance and belongingness with others. Engaging in sexual activities with a partner can be an extremely vulnerable experience where one’s imperfections can be seen. For individuals who are more insecurely attached and perfectionistic, sex can become especially distressing. This accumulation of perfectionistic expectations regarding one’s sexual performance can induce marked sexual anxiety and negative effects, which ultimately and adversely impacts sexual functioning.

Additionally, perfectionism also predisposes individuals to hypersensitivity to rejection. In the face of sexual difficulties, individuals may anticipate rejection or interpret partners’ behaviours as disengaging. Sexual problems therefore become a notable threat to self-worth and social connectedness. To overcome such distress and anxiety, individuals become more motivated to engage in perfectionistic behaviour, which perpetuates a negative cycle of insecure attachment, perfectionism, and sexual dysfunction. Ultimately, perfectionism becomes the mechanism for individuals with insecure attachment to cope with distress that arises from sexual activities. Therefore, according to the PDSM, it is hypothesized that perfectionism will mediate the relationship between attachment and sexual functioning.
**Figure 1.** Perfectionism social disconnection model

**Figure 2.** Structural model of mediation between attachment and sexual anxiety. All paths were significant at **p < .01, *p < .05.**

**Figure 3.** Structural model of mediation between attachment and sexual arousal. Path was significant at **p < .01.
Methods

Participants

Undergraduate females who were over the age of 18 were eligible to participate. 501 participants were recruited via the human subject pool of a large Canadian university. The mean age of the participants was 19.98 years ($SD = 2.78$, range = $18 – 60$). With respect to ethnicity, 39.9% of the participants self-identified as Chinese, 35.7% as Euro-Caucasians, and 24.4% as other groups. For current relationship status, 54.5% of females were single and not sexually active, 28.5% were sexually active and in a monogamous relationship, 9.2% were single but sexually active, 6.6% were in a monogamous relationship but not sexually active, and 1.2% were sexually active in an open relationship. The mean number of previous romantic relationships was 1.54 ($SD = 1.68$, range = $0 – 12$). The average number of previous sexual partners was 1.87 ($SD = 3.78$, range = $0 – 40$). Of the female participants, 54.3% never had a sexual partner, 28.7% had 1 to 3 partners, and 17.0% had 4 or more partners.

Measures

Multidimensional Perfectionism Scale The Multidimensional Perfectionism Scale (MPS) (Hewitt & Flett, 1991) is a 45-item instrument that assesses perfectionism. The multidimensionality of perfectionism is measured through three respective subscales: self-oriented, other-oriented, and socially prescribed perfectionism. Participants are instructed to rate each item according to their degree of agreement on a 7-point Likert scale. The MPS has shown good internal consistency, where Cronbach’s $\alpha$ of .83, .76, and .83 were found for self-oriented, other-oriented, and socially prescribed perfectionism respectively.

Perfectionistic Self-Presentation Scale The Perfectionistic Self-Presentation Scale (PSPS) (Hewitt et al., 2003) is a 27-item scale that measures perfectionistic self-presentation, the interpersonal expression of perfectionism. Specifically, three facets of perfectionistic self-presentation are assessed: perfectionistic self-promotion, non-display of imperfection, and nondisclosure of imperfection. Participants are instructed to rate their agreement with each statement on a 7-point Likert scale. Good internal consistency is evident in the PSPS, where Cronbach’s $\alpha$ of .90, .90, and .80 were found for perfectionistic self-promotion, nondisplay of imperfection, and nondisclosure of imperfection respectively.

Sexual Arousability Inventory-Expanded The Sexual Arousability Inventory-Expanded (SAI-E) (Hoon, Hoon, & Wincze, 1976) is a 28-item self-report scale that evaluates participants’ perceived sexual arousability and sexual anxiety in various sexual activities. Participants are asked to rate how aroused and anxious they feel on a 7-point Likert scale from repulsive to extremely arousing, and relaxing to extremely anxiety producing. The SAI-E has exhibited excellent internal consistency (Cronbach’s $\alpha$ of .93).

Experiences in Close Relationships-Revised The Experiences in Close Relationships-Revised (ECR-R) (Fraley, Waller, & Brennan, 2000) is a 36-item scale that assesses two adult attachment styles – anxious attachment and avoidant attachment. Consisting of statements about cognitions and emotions within romantic relationships, participants are instructed to rate each item on a 7-point scale from 1 (strongly disagree) to 7 (strongly agree). ECR has demonstrated excellent internal consistency for attachment avoidance (Cronbach’s $\alpha$ of .75) and attachment anxiety (Cronbach’s $\alpha$ of .89).

Results

Bivariate correlations

Attachment and Sexual Functioning Pearson’s $r$ correlations showed patterns of significant positive associations between both attachment anxiety and
### Table 1. Inter-correlations among study variables

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
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<th>7</th>
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<tbody>
<tr>
<td>1. Sexual Anxiety</td>
<td>---</td>
<td>-.256*</td>
<td>.272**</td>
<td>.283**</td>
<td>.175**</td>
<td>.127**</td>
<td>.195**</td>
<td>.129**</td>
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<td>2. Sexual Arousal</td>
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<td>.005</td>
<td>.344**</td>
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<td>3. Anxious attachment</td>
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<td>.150**</td>
<td>.05</td>
<td>.319**</td>
<td>.284**</td>
<td>.342**</td>
<td>.259**</td>
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<td>4. Avoidance attachment</td>
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<td>.04</td>
<td>.07</td>
<td>.251**</td>
<td>.09</td>
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<td>.384**</td>
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<tr>
<td>5. MPS-Self</td>
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<td>.363**</td>
<td>.419**</td>
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<td>7. MPS-Social</td>
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<td>.348**</td>
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<td>8. PSFS-Self</td>
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<td>.686**</td>
<td>.659**</td>
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<tr>
<td>9. PSFS-Nondisplay</td>
<td>---</td>
<td>.628**</td>
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<td>10. PSFS-Nondisclosure</td>
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</table>

* *p < .05 (2-tailed)

** *p < .001 (2-tailed)

### Table 2. Main effect of variables in predicting sexual anxiety

<table>
<thead>
<tr>
<th>Predictors</th>
<th>Effect</th>
<th>SE</th>
<th>LLCI</th>
<th>ULCI</th>
<th>z</th>
<th>P</th>
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<tr>
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<td>MPS-Other</td>
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<td>MPS-Social</td>
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### Table 3. Main effect of variables in predicting sexual arousal

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<th>Predictors</th>
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<th>ULCI</th>
<th>z</th>
<th>P</th>
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</thead>
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<tr>
<td>Anxious attachment</td>
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<td>Avoidance attachment</td>
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<td>-5.97</td>
<td>&lt;.001</td>
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<tr>
<td>MPS-Self</td>
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<td>.06</td>
<td>-.11</td>
<td>.14</td>
<td>.21</td>
<td>.852</td>
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<tr>
<td>MPS-Other</td>
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<td>.514</td>
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<tr>
<td>PSFS-Nondisclosure</td>
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<td>.08</td>
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<td>.569</td>
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### Table 4. Indirect effect size of perfectionism variables in mediating anxious attachment and sexual anxiety

<table>
<thead>
<tr>
<th>Variables</th>
<th>Effect</th>
<th>SE</th>
<th>BootLLCI</th>
<th>BootULCI</th>
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</thead>
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<td>.048</td>
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<td>MPS-Other</td>
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<td>.055</td>
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<td>.015</td>
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<td>.032</td>
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<td>.034</td>
<td>-.094</td>
<td>.039</td>
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</table>
attachment avoidance with poorer sexual functioning. Both attachment anxiety and attachment avoidance were positively correlated with sexual anxiety and negatively correlated with sexual arousal (see Table 1).

**Attachment and Interpersonal Perfectionism**

Pearson’s $r$ correlations revealed that attachment anxiety positively correlated with all forms of interpersonal perfectionism (see Table 1). Attachment avoidance was only significantly associated with two forms of interpersonal perfectionism, which were socially prescribed perfectionism ($r = .25, p < .01$) and nondisclosure of imperfection ($r = .39, p < .01$). As suggested, there appeared to be a stronger relationship between attachment anxiety and interpersonal perfectionism.

**Interpersonal Perfectionism and Sexual Functioning**

All dimensions of interpersonal perfectionism were positively and significantly correlated with sexual anxiety (see Table 1). In addition, socially prescribed perfectionism ($r = -.13, p = .005$) and nondisclosure of imperfection ($r = -.17, p < .01$) were the only two dimensions of perfectionism that significantly correlated with sexual arousal. These bivariate correlations indicated that socially prescribed perfectionism and nondisclosure of imperfection were the strongest forms of perfectionism in predicting both sexual anxiety and sexual arousal.

**Multiple Linear Regression**

For sexual anxiety, only three of eight predictors showed a significant relationship with the criterion (see Table 2). Namely, anxious attachment ($\beta = .17, t(366) = 3.06, p = .002$), avoidance attachment ($\beta = .25, t(366) = 4.45, p < .001$), self-oriented perfectionism ($\beta = .17, t(366) = 2.70, p = .007$) were found to be significant predictors of sexual anxiety. However, none of the five other perfectionism dimensions were significant predictors of sexual anxiety ($p > .05$). Overall, insecure attachment and perfectionism were found to account for 16.7% of the variability in sexual anxiety, $F(8,366) = 9.16, p < .001$. For sexual arousal, only two of the insecure attachment styles, anxious attachment ($\beta = .11, t(365) = 2.02, p = .004$) and avoidance attachment ($\beta = -.34, t(365) = -.597, p < .001$) were significant predictors of sexual arousal. None of the perfectionism dimensions were significant predictors of sexual arousal ($p > .05$) (see Table 3). Altogether, insecure attachment and perfectionism accounted for 14.2% of variability in sexual arousal, $F(8, 365) = 7.56, p < .001$. Overall, from the values given in Table 2 and Table 3, perfectionism did not significantly predict sexual functioning beyond attachment styles.

**Bootstrap Mediation Analysis**

To identify the direct and indirect effects of insecure attachment on sexual functioning, multiple regression analyses and bootstrapping were used. These analyses yielded significance tests of specific paths and confidence intervals for mediation effects. Two structural models were henceforth constructed (see Figure 2 and Figure 3). Bootstrap mediation analysis revealed that direct effect of anxious attachment on sexual anxiety was significant ($c = .25, 95\% CI = .15 – .36$) (see Table 4). However, the total indirect effect was not significant ($c = .03, 95\% CI = -.03 – .08$), suggesting that perfectionism did not mediate the relationship between anxious attachment and sexual

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**Table 5. Indirect effect size of perfectionism variables in mediating avoidance attachment and sexual arousal**

<table>
<thead>
<tr>
<th>Variables</th>
<th>$\delta$ Effect</th>
<th>SE</th>
<th>BootLL CI</th>
<th>BootUL CI</th>
</tr>
</thead>
<tbody>
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<td>MPS-Self</td>
<td>.001</td>
<td>.007</td>
<td>−.01</td>
<td>.020</td>
</tr>
<tr>
<td>MPS-Other</td>
<td>−.005</td>
<td>.006</td>
<td>−.024</td>
<td>.003</td>
</tr>
<tr>
<td>MPS-Social</td>
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<td>.016</td>
<td>−.043</td>
<td>.020</td>
</tr>
<tr>
<td>PSPS-Self</td>
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<td>.009</td>
<td>−.026</td>
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</tr>
<tr>
<td>PSPS-Nondisplay</td>
<td>.004</td>
<td>.007</td>
<td>−.006</td>
<td>.025</td>
</tr>
<tr>
<td>PSPS-Nondisclosure</td>
<td>−.026</td>
<td>.026</td>
<td>−.079</td>
<td>.027</td>
</tr>
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</table>
anxiety. Similarly, the direct effect of avoidance attachment on sexual arousal was significant ($c = −.28, 95\% \text{ CI} = −.39 – −.18$). However, the total indirect effect of perfectionism on sexual arousal was not significant ($c = −.04, 95\% \text{ CI} = −.09 – .01$) (see Table 5). Again, due to the non-significant total indirect effect, it was suggested that perfectionism did not mediate the relationship between avoidant attachment and sexual arousal.

**Discussion**

This present study involved a test of the perfectionism social disconnection model, where it was hypothesized that insecure attachment relates to poor sexual functioning through social disconnection that arises from perfectionistic behaviours. Current findings demonstrated a link between attachment style and sexual functioning. Consistent with past studies from Davis et al. (2006) and Birnbaum (2007), insecure attachment was found to be positively correlated with sexual anxiety and negatively associated with sexual arousal. Furthermore, findings suggested that attachment anxiety was more strongly related to interpersonal perfectionism, as anxious attachment was positively correlated with all forms of interpersonal perfectionism, whereas attachment avoidance only significantly correlated with two forms of interpersonal perfectionism. All dimensions of interpersonal perfectionism were positively correlated with sexual anxiety. Additionally, only socially prescribed perfectionism and nondisclosure of imperfection were exclusively correlated with less sexual arousal. Overall, as predicted, these findings are similar to Snell (2001) and Stoeber (2013), where interpersonal perfectionism was found to correlate with poorer sexual functioning. Contrary to expectations, regression analyses and bootstrapping mediation analyses demonstrated that perfectionism did not mediate the relationship between insecure attachment and poor sexual functioning, suggesting that the attachment-sexual dysfunction link cannot be explained by perfectionism.

The current study presented a preliminary test of using the PSDM in attempt to investigate the mechanism of insecure attachment and sexual dysfunctions. However, the data thus far showed inconclusive evidence that such a mediation exists. A possible explanation about the absence of a mediation is that the current conceptual framework is flawed. Past literature has consistently demonstrated a link between insecure attachment and sexual dysfunctions (Brennan & Shaver, 1995; Stefanou & McCabe, 2012; Dunkley et al., 2016), yet research on perfectionism and sexuality is still in its infancy. To date, only two studies have found significant correlations connecting perfectionism to both attachment problems and poor sexual outcomes (Snell, 2001; Stoeber et al., 2013). It is plausible that the small association found between perfectionism and sexual functioning is due to the variables’ sheer associations with attachment. According to attachment theory, early relationships with caregivers have marked effects on individuals’ self-model and others-model (Bowlby, 1969). Asymmetry between a child’s need and caregiver’s response can adversely impair an individuals’ self-esteem and sense of mistrust of others (Feeney & Noller, 1990), thereby posing insecure attachment as a risk factor for psychopathology and sexual dysfunctions. For instance, an individual who scores high in attachment anxiety is likely to have lower self-esteem and feel less trust toward their partner. The individual may therefore have a greater to desire to achieve perfection in attempt to improve one’s self-esteem. The individual may also find engaging in sexual activities as dissatisfying because of the perceived lack of trust and intimacy with their partner.

Another limitation lies in the level sexual experience in our samples. The current sample consists mostly of young university students who have little to no sexual experience. The average number of previous romantic relationships was 1.54, with over 50% of the participants reporting having never had a sexual partner. A lack of insight into the subject matter might have influenced the validity of reported sexual anxiety and sexual arousal.
Overall, results of the current study were consistent with previous literature on attachment styles and sexual functioning, where insecure attachment was associated with more sexual anxiety and less sexual arousal. Findings also suggested interpersonal perfectionism correlates with poorer sexual functioning. Contrary to my prediction, mediation hypotheses were not supported by the analyses. As one of the preliminary studies to test the role of perfectionism in attachment and sexual functioning, this study provided initial evidence that sexual dysfunction is not developed from insecure attachment through perfectionism. It is our hope that insight into the mechanism in the attachment-sexual dysfunction link extends to the current understanding of the subject, which will ultimately better inform treatment of sexual dysfunction.

Declaration of Conflicting Interests
The author(s) declared they have no conflicts of interests with respect to their authorship or the publication of this article.

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References


Yours vs. Mine: How Reward and the Self Affect Memory

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Department of Psychology, University of British Columbia

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Abstract

People show a bias for their own objects: they have better memory for them and rate them as having a higher value. In this experiment, we examined if incentive influences people to remember objects owned by others just as much as their own. We hypothesized that when memorization of other-owned objects is paired with higher reward, the memory bias for self-owned objects will be reduced. After being told they would later be rewarded for each item remembered, participants learned that objects were either owned by themselves or by the experimenter. Reward was in the form of cash payout that was either equally (10 cents and 10 cents) or unequally weighted (10 cents and 15 cents) towards other-owned objects, meaning that other-owned objects would earn the participant more money per object remembered. All money earned could be spent on candy in the lab. In the subsequent ‘old/new’ memory test, self-owned objects were recognized significantly more than other-owned objects. Reward payout had no effect on recognition. Possible explanations are that during the learning phase, participants may have forgotten about the reward structure, or that the magnitude of the reward may have been too low. Further research could examine introducing a loss paradigm to increase salience towards other-owned objects.

Keywords: ownership, reward, memory, self-other, self-referencing effect, encoding, cognitive, bias

From a very young age we are taught the difference between what is ‘mine’ versus what is ‘yours’. Taking ownership of objects is a ubiquitous experience of life, which comes with many cognitive advantages. The benefit of ownership is demonstrated by the ‘self-referencing effect’: stating that something is ‘mine’ (a form of self-referencing) increases attention and memory greatly towards the self-owned items versus similar items owned by others (Cunningham et al., 2008; Symons & Johnson, 1997; Truong et al., 2016; Turk et al., 2011). The self-referencing effect has been expanded on by research by Sui and Humphreys (2012) who demonstrated that perceptual matching of objects is more quickly learned for self-owned versus other-owned objects, and that enduring associations between the self and objects can be acquired more rapidly for each object presented. Further research has shown that the self-referencing effect can be moderated depending on a person’s physical manipulation of objects in their environment; moving objects closer to yourself increases recognition of self-owned objects more

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than pushing those objects away from yourself (Truong, Chapman, Chisholm, Enns, & Handy, 2016). Therefore, saying that a set of objects is ‘mine’ leads to a rapid and enduring increase in recognition of those specific objects, and is even activated as an extension of a person’s physical body.

Studies have also examined areas of the brain that are involved in the self-referencing effect. Specifically, neuroimaging points to various medial subcortical regions involved in higher activation for self-referent over other-referent processing, including the ventromedial prefrontal cortex (vmPFC), the supragenual anterior cingulate cortex (sgACC), and the posterior cingulate cortex (pCC; Northoff et al., 2006). The self-attention network (SAN) model proposes that these areas modulate visual cortex activity, leading to the biasing of attention to self-related stimuli (Sui & Humphreys, 2015). Therefore, these brain regions are key nodes to the self-referencing effect.

Research has also examined a variety of stimuli to test the extent of the self-referencing effect. Early studies focused on looking at the self-referencing effect with trait words such as ‘Are you creative?’ versus ‘Is George Bush modest?’ and found that information explicitly processed with reference to the self holds a memory advantage over material that was encoded in relation to another person (Symons & Johnson, 1997). The self-referencing effect has also been induced with novel objects that were presented in rapid succession to the participants (Sui & Humphreys, 2015) and with participants who were given arbitrary pairings of geometric shapes (Sui & Humphreys, 2012). Thus, the stimuli can be trait words, novel or geometric objects, and they do not have to be exclusively familiar to the person to induce the self-referencing effect.

Although there is extensive literature detailing the stimuli used to test the self-referencing effect (Symons & Johnson, 1997), whether this effect can be modulated has yet to be examined. One modulator that has the potential to shift the self-referencing effect is reward. Reward is a powerful motivator that facilitates cognitive processes such as memory and attention, and increases effort intensity, effort duration, and effort direction (Bonner & Sprinkle, 2002). The reward circuit in the brain overlaps with some of the same subcortical and cortical areas that are involved in self-referent processing, with the main center of overlap being the vmPFC (Pujara & Koenigs, 2014). Furthermore, Greck and colleagues (2008) demonstrated that there is a cognitive valuation system that encodes self-relatedness and reward in other cortical regions, namely the nucleus accumbens (NAcc), the ventral tegmental area (VTA) and the vmPFC. If the value given to ownership and reward act on the same brain areas, then increasing reward may have the potential to reduce the memory bias towards self-owned items by increasing the incentive to remember other-owned items. To investigate this possibility, we designed an experiment in which participants would be incentivized to remember other-owned objects through higher monetary gain. We hypothesized that when memorization of experimenter-owned objects is paired with higher reward, the memory bias for self-owned objects will be reduced. We predicted that when reward payout is equal, the participant will recognize more self-owned objects over experimenter-owned; we also predicted that when reward payout is unequal, the participant will recognize more experimenter-owned items over self-owned items relative to the equal condition group.

Methods

Participants

Initially, 111 (89 female and 22 male) University of British Columbia psychology undergraduate students were recruited. Participants were given half a course
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credit in exchange for completing the experiment. This study was conducted with approval from the Research Ethics Board of the University of British Columbia and in accordance with the provisions of the World Medical Association Declaration of Helsinki.

Procedure

The procedure was adapted from our previous work on self and attention (Truong et al., 2016). All participants completed the experiment on a laptop. At the beginning of the experiment, they learned that their ability to correctly remember the object-owner pairings would earn them money to spend on candy in the lab. In the equal reward condition, the earnings for the self-owned objects and experimenter-owned objects were both 10 cents for each item remembered. In the unequal reward condition, the self-owned objects would earn the participant 10 cents per item and the experimenter-owned objects would earn the participant 15 cents per item. Each item was randomly assigned to either condition. The candy rewards were displayed on a table in the lab with $3.00 at the lowest end, $5.00 in the middle, and $7.00 being the highest. The most expensive reward was chosen to be very difficult to reach, as determined in a pilot study. Participants in the control group could earn a maximum of 10 dollars, and participants in the experimental group could earn a maximum of 15 dollars. Participants were not explicitly told how much they could potentially earn in both conditions.

Stimuli

Inquisit 4 Lab software (Version 4, Millisecond Software, 2014) was used for delivering the stimuli. The items chosen for presentation were everyday items, such as a chair, lamp, and apple. The reason these items were chosen was to represent common items that people interact with, increasing the ecological validity of the study. Photographs of the items were displayed on a white background in the computer program. The items were randomly assigned to be ‘old’ or ‘new’. Old items were items that appeared in the learning task and carried over into the memory task, and new items were ones that appeared for the first time in the memory task only. The set of stimuli for each participant was randomly chosen from a pool of 327 images of objects.

Learning task. Participants looked at a fixation cross in the middle of the screen for 500 milliseconds, then they were shown a border. The color of the border was either blue or green and denoted ownership. A green border indicated that the object appearing inside was self-owned, and a blue border indicated that the object appearing inside was experimenter-owned. After the color was shown, a picture of an object appeared inside the border (see Figure 1). Participants were instructed to respond to the object by pressing ‘E’ for the objects that had a blue border for experimenter-owned objects, and pressed ‘I’ for the objects with a green border for self-owned objects to acknowledge that they recognized whether the object was self-owned or experimenter-owned. 50 self-owned and 50

Figure 1. Typical trial sequences for the learning task and the memory task presented to the participant using Inquisit Lab 4 computer software. The border in the learning task is colored either blue for experimenter owned objects, or green for self-owned objects. No border is presented in the memory task.
experimenter-owned objects were presented to the participant in a randomized order, with each object appearing for 1.5 seconds. At the end of the learning task, participants could pause momentarily before the memory task began.

**Memory task.** For each trial of the memory task, participants looked at a fixation cross for 500 milliseconds and then viewed an object presented with no border instead of a colored one. Participants were given all the objects they had seen in the learning task in a randomized order, as well as 100 new objects for a total of 200 objects. The goal of this task was for participants to indicate whether an object was ‘new’ or ‘old’. New objects were ones that the participant had seen for the first time, and old objects were ones that the participant had recognized from the learning task. Participants had to indicate whether the object was old by pressing ‘O’ or new by pressing ‘N’ to report what they did or did not recognize, respectively. Each object appeared for 1.5 seconds. At the end of the experiment, participants were given feedback about their performance. They were informed of the correct number of self-owned objects identified, and the correct number of experimenter-owned objects identified, as well as how many false responses they made. Lastly, they were told how much ‘money’ they earned based on the correct number of objects identified and were invited to purchase candy from the ‘Lab store’ with that money.

**Data analysis**

A 2 (ownership) x 2 (reward) repeated measures analysis of variance (ANOVA) test was used (α = .05). Statistical analyses were performed on IBM SPSS statistical software package (version 24, IBM SPSS statistics, 2017). Levene’s test indicated that the assumption of homogeneity of variance was not violated, with the variances between subjects being the same for each level of the reward factor; $F(1, 91) = 0.539, p = .47$ for the self condition, and $F(1, 91) = 0.09, p = .77$ for the other condition. Additionally, the assumption of homogeneity of variance for the variance of the reward factor within the ownership conditions was not violated, $F(45, 46) = 0.919, p = .39$. Therefore, the assumptions for the ANOVA were met.

**Participant exclusion.** Participants were excluded from the analyses if they made more than 25% false responses, which are defined as when the participant reported the object was ‘old’ when it was actually ‘new’. This threshold was chosen as a reasonable cutoff during the pilot study to exclude participants who did not understand the instructions, or who intentionally disregarded the instructions of the experiment by repeatedly pressing ‘O’ or ‘N’.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Ownership</th>
<th>Mean (M)</th>
<th>Standard Deviation (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(10-10) Equal</td>
<td>self</td>
<td>32.70</td>
<td>9.07</td>
</tr>
<tr>
<td>Reward</td>
<td>other</td>
<td>29.67</td>
<td>9.73</td>
</tr>
<tr>
<td>(10-15) Unequal</td>
<td>self</td>
<td>31.3</td>
<td>8.95</td>
</tr>
<tr>
<td>Reward</td>
<td>other</td>
<td>28.55</td>
<td>8.97</td>
</tr>
</tbody>
</table>

**Table 1. Notes.** Mean scores (M) and standard deviations (SD) for objects correctly remembered as a function of ownership and reward.
pressing the same button. Out of 111 initial participants, 93 (20 male, age: $M = 21.35$ years, $SD = 2.80$ and 73 female, age: $M = 20.74$ years, $SD = 2.83$) were included in the analysis, with 46 participants in the equal reward condition (10/10) and 47 in the unequal reward condition (10/15).

**Results**

The 2x2 ANOVA with ownership as a within-subjects factor and reward condition as a between-subjects factor revealed a main effect of ownership condition ($F(1, 91) = 34.05$, $p < .001$, $\eta^2_p = .272$) such that recognition was higher for self-owned objects relative to other-owned objects. This result replicated the previously established self-referencing effect.

Unexpectedly, there was no main effect of reward condition ($F(1, 91) = 0.47$, $p = .50$, $\eta^2_p = .005$) and no ownership by reward interaction ($F(1,91) = 0.08$, $p = .78$, $\eta^2_p = 0.001$; see Figure 2). As shown in Figure 2, when reward payout was equal (10/10), participants had better memory for self-owned objects ($M = 32.70$, $SD = 9.07$) than experimenter-owned objects ($M = 29.67$, $SD = 8.95$). Similarly, when reward payout was unequal (10/15), participants still had better memory for self-owned objects ($M = 31.30$, $SD = 9.73$) than experimenter-owned objects ($M = 28.55$, $SD = 9.04$). In other words, offering greater monetary reward for remembering experimenter-owned objects did not significantly affect the memory bias for self-owned objects.

**Discussion**

We predicted that when the reward condition was equal, participants’ recognition of self-owned objects would be higher than experimenter-owned objects. We also predicted that when the reward condition was unequally weighted towards experimenter-owned objects, the participants’ recognition of experimenter-owned objects would be increased relative to the equal condition group. The results of the equal reward condition replicated previous findings in that there was better memory for self-owned items compared to experimenter-owned items, demonstrating the self-referencing effect (Cunningham et al., 2008; Symons & Johnson, 1997; Truong et al., 2016; Turk et al., 2011). However, the results of the unequal reward condition show that even when participants were incentivized by higher monetary gain for remembering experimenter-owned objects, they still remembered self-owned objects better.

These findings are important because they suggest not only the robustness of the self-referencing effect itself, but how increased incentive has little effect to sway it, even though both ‘valuation systems’ (reward and ownership) are observed to be carried out in the same cortical regions (Greck et al., 2008). This effect is observed despite the ecological advantage in acquiring as much money as one can, as money is valued and can be used instrumentally for biologically related incentives (Lea & Webley, 2006). The potency of the self-referencing effect over monetary gain may be in part due to the attentional prioritization of self-owned objects, which amplifies the saliency of self-owned objects.
owned objects over additional monetary gain. For example, a study by Truong, Roberts, and Todd (2017) demonstrated that self-owned objects have a prior entry effect: when both self-owned items and experimenter-owned items were simultaneously presented, self-owned items were more likely to be perceived first. Therefore, monetary reward may not have the same capability of capturing the participant’s attention as strongly as ownership can.

Research has also shown that there is pre-existing value attributed to ownership. Ownership increases perceived item value and positivity towards that item (Beggan, 1992). This is known as the endowment effect, where objects that become part of a person’s self concept gain value (Beggan, 1992; Pachur & Scheibehenne, 2012; Thaler, 1980). It may be that the endowment effect had a role to play by increasing the perceived value of the self-owned objects over the rewarded value of experimenter-owned objects. Therefore, monetary gain was already competing with the value that is attributed to ownership and the self. This too would support the notion that the cognitive value assigned to self-owned items supersedes the cognitive value that is placed on monetary gain.

Limitations and Strengths

This study is not without its limitations. One limitation is that we did not record the ethnicity of our participants. Research has shown that individuals from interdependent cultures experience the self-referencing effect less strongly than individuals from independent cultures (Truong et al., 2017). However, the human subject pool (HSP) from which we recruited participants is culturally heterogeneous. Knowing that our sample consisted of people from interdependent cultural backgrounds as well, we would expect the self-referencing effect to be less pronounced. What our findings show is that the self-referencing effect is still robust even with our diverse sample.

Another limitation is that although participants were given the reward structure at the beginning of the learning task, they were not reminded of the reward structure during the learning phase of the experiment. Therefore, there is the potential for participants to have forgotten about the reward manipulation during the learning task.

Furthermore, the magnitude of the reward may not have been large enough to incentivize participants to remember experimenter-owned objects over self-owned objects. Although the cumulative monetary gain was significant due to the large number of objects presented, the 5-cent difference in each item’s value may not have been large enough.

Lastly, although reward and the self are processed in the same cortical areas and are shown to involve the same ‘valuation system’, it could be that reward and the self are not fungible; the value attributed to monetary gain may not be an appropriate substitute for the cognitive value of the self. Therefore, any monetary reward value may not have an effect in reducing the memory bias that ownership creates.

To explore these limitations and understand this effect further, future research could examine modifying the reward paradigm with the aim of finding an effect of reward on ownership. In this study, monetary reward was given to the participant for each object correctly identified. A follow up study could endow the participants with money, and then penalize them when they fail to recognize the objects. This shift in the reward paradigm could have an effect because of the principle of loss aversion; the cognitive experience of loss is more noticeable than the cognitive experience of gain (Kahneman & Tversky, 1979). As previously stated, the cognitive value of money may have been overshadowed due to attentional biasing and the endowment effect. Therefore, framing the reward structure as a loss of
money may allow for the reward incentive to be more pronounced than the value of ownership, and thus modulate the self-referencing effect.

These findings reveal the distinct way in which monetary reward interacts with ownership and conceptualizes ownership as a strong cognitive bias that is not easily overcome. When it comes to reward, even though receiving money makes people feel good, it is clear that the processes that underlie our behavior have an inherent bias towards the reward gained from the self, and by extension, ownership. So, despite humanity’s best efforts to remain modest, it seems that people cannot avoid being self-oriented.

Declaration of Conflicting Interests
The author(s) declared they have no conflicts of interests with respect to their authorship or the publication of this article.

References


Kangaroo Care’s Effect on Infant-Caregiver Relationships: What does the Research Say?

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Abstract

Kangaroo care has emerged in the last half-century as a form of therapy for some of the health challenges faced by low birth weight/premature infants. The World Health Organization (WHO) defines Kangaroo Care (KC) as prolonged skin-to-skin contact between mothers and their infants initiated at the hospital and continued at home, where caregivers receive adequate support and follow up by medical professionals (World Health Organization, 2003). KC provides safety and thermal protection for low birth weight infants, is beneficial to mother-infant relationships and to infant is an effective way to prevent infants from contracting an infection (WHO, 2003). KC is practiced across the world: in impoverished regions, KC is used to mediate resource scarcity, and in other parts of the world it is used because of its associations with many positive outcomes. KC has been used in developed nations including Canada, France, Sweden, the United States, England, and the Netherlands to promote infant-caregiver bonding (Tessier et al., 1998). This literature review discusses some of the research on KC and its effect on infant-caregiver relationships. The review demonstrates that research has been characterized by methodological limitations, including inconsistencies in the definition and practice of KC, biases, and limitations to validity and generalizability. Furthermore, suggestions for research on KC’s effect on the rest of the infant’s life are proposed. The possibility that the benefits of KC to infant-caregiver relationships are optimized within a certain timeframe of infant development is also discussed.

Keywords: kangaroo-care, attachment, preterm, infant-caregiver-relations, skin-to-skin-contact, NICU

Kangaroo care (KC) is characterized by continuous or intermittent skin-to-skin contact between an infant’s and caregiver’s chest while the infant’s head is secured in a sideways position to prevent airway obstruction (Athanasopoulou & Fox, 2014). The infant may wear a hat, socks, and/or a diaper, and is usually covered by the caregiver’s clothes or a blanket for warmth (Athanasopoulou & Fox, 2014). Named for its similarities to marsupial caregiving, KC first emerged in Bogotá, Colombia in an effort to mitigate the strain of overcrowding and lack of medical resources available for premature and low birthweight infants (Athanasopoulou & Fox, 2014; Tessier et al., 1998). Nursing staff at the Instituto Materno Infantil developed a way to use parents as natural incubators; premature infants were placed naked between the mother’s breasts with access to continual feeding, and kept warm via bodily contact (Feldman, 2004). By the 1990s, KC was also practiced...

Research has demonstrated positive effects of KC on the well-being of infant recipients, and positive psychological effects for infants and their families (Athansopoulou & Fox, 2014). Benefits for the infant include improved cognitive development, reduced rates of infection, as well as positive outcomes in sleep and crying, weight gain, heart and respiratory rates, temperature, oxygenation and energy expenditure (Athansopoulou & Fox, 2014). Infant-family relations have shown positive outcomes in maternal mood, mother-infant interaction, and caregiver sense of competence (Athansopoulou & Fox, 2014; Tessier et al., 1998).

The goal of this review is to assess some of the literature regarding KC and its effect on infant-caregiver relationships. Some of the methodological limitations of KC research are addressed, including inconsistencies in the definition and practice of KC. The review also identifies some gaps in existing literature and recommends areas for further research, namely KC’s effect beyond the first year of life, and KC’s optimization within a particular timeframe of infant development. Lastly, the review suggests that KC’s beneficial influence on caregiver-infant relationships may be understood in terms of the transactional model of development.

**Continuous v.s. Intermittent Kangaroo Care**

KC involves continuous or intermittent application. Continuous KC is more common in developing countries where modern medical technology may be unavailable or cannot be used properly due to a shortage of skilled staff, inadequate maintenance, and/or intermittent power supply (WHO, 2003). However, continuous KC is still used in some NICUs with adequate access to modern healthcare resources. Continuous KC involves continuous skin-to-skin contact between the mother and her child until at least the 40th week; ideally, continuous KC involves breast-feeding, discharge only once the infant is medically stable, and thorough follow up by medical professionals (Athansopoulou & Fox, 2014). Follow up can vary from as often as once a day immediately after discharge, to weekly, and eventually monthly (Athansopoulou & Fox, 2014; WHO, 2003). Contrarily, intermittent KC is typically used in developed countries. Unlike continuous KC, the duration of intermittent KC is gradually decreased over several days. It is used to facilitate bonding between caregiver and infant (Athansopoulou & Fox, 2014).

**Early Research of KC**

One of the earliest studies to evaluate the impact of KC was conducted by Tessier et al. in Colombia in 1998. It was informed by the general bonding hypothesis which states early skin-to-skin contact between mother and infant results in the formation of stronger bonds (Tessier et al., 1998). Tessier et al. (1998) hypothesized that amongst infant-mother dyads with premature/low health infants, KC may produce major changes in mother attachment behaviours and perceptions. Researchers conducted a randomized controlled trial of 488 mother-infant dyads who did not differ with respect to sociodemographic background, conditions of labour or pregnancy, or neonatal variables. The experimental group practiced KC at home and the traditional care (TC) control group received treatment at the participating hospital’s NICU until discharge when the infant reached a weight of ~1700 grams (Tessier et al., 1998). TC infants with adequate access to modern healthcare resources. Continuous KC involves continuous skin-to-skin contact between the mother and her child until at least the 40th week; ideally, continuous KC involves breast-feeding, discharge only once the infant is medically stable, and thorough follow up by medical professionals (Athansopoulou & Fox, 2014). Follow up can vary from as often as once a day immediately after discharge, to weekly, and eventually monthly (Athansopoulou & Fox, 2014; WHO, 2003). Contrarily, intermittent KC is typically used in developed countries. Unlike continuous KC, the duration of intermittent KC is gradually decreased over several days. It is used to facilitate bonding between caregiver and infant (Athansopoulou & Fox, 2014).

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received the same outpatient care and follow up as KC infants (Tessier et al., 1998).

All infants were evaluated at birth and at term (40 weeks) by a team of nurses, psychologists, and social workers. Mothers were interviewed after 24 hours in the hospital, and then again once their infant had reached a gestational age of 41 weeks. Gestational age is the age of preterm infant measured in weeks from their mother’s last menstrual cycle rather than their date of their birth (WHO, 2003). At this age, a 15-minute feeding sequence was also conducted. It was videotaped and then scored according to the Nursing Child Assessment Feeding Scale. Interviews and evaluations were conducted by the same psychologists throughout the study. Consequently, the study was only quasi-blind (Tessier et al., 1998).

Tessier et al. (1998) observed that mothers from the KC group reported greater feelings of competence than mothers in the TC group. The researchers hypothesized that increased sense of competence was derived from greater feelings of control over the stress and worry of infant health status amongst KC mothers (Tessier et al., 1998). Moreover, differences in feelings of competence between the KC and TC groups gradually decreased as the delay between birth and either KC or TC intervention increased (Tessier et al., 1998). However, KC mothers also reported feeling more isolated than mothers in the TC group, which researchers attributed to a sense of burden and lack of social support (Tessier et al., 1998). Based on the interviews and feeding sequences, Tessier et al. (1998) observed a “subjective bonding effect” (p. 8) amongst those mothers who had practiced KC, which was related to an improved perception of their infant. The mother’s perception of their infant was measured using the Mother’s Perception of Premature Birth Questionnaire (Tessier et al., 1998).

After observing the “subjective bonding effect” (Tessier et al., 1998, p. 8) and improved sense of competence observed in KC mothers, the researchers recommended the active promotion of KC to caregivers of preterm infants, both in hospitals and after early discharge. They advised KC should be practiced as soon as possible until 40 weeks gestational age, with earlier implementation producing better results. Researchers also suggested social support for the KC mother to alleviate feelings of isolation, although details of what such support may entail were not specified (Tessier et al., 1998).

While Tessier et al.’s (1998) results may be uplifting in the pursuit of improving low-health infant care and caregiver-infant relations, particularly in the context of preterm/low weight births, it problematic that the qualitative assessments which informed the study’s findings were done by the same individuals responsible for the induction of kangaroo care. Moreover, those same individuals were not blind to which mother-infant dyads received KC or did not (Miles, Cowan, Glover, Stevenson, & Neena, 2005). Consequently, response bias may have been an issue in the Tessier et al. (1998) study, possibly resulting in an exaggeration of the benefits of kangaroo care, especially given the sensitive content of the research and the matter of publication bias (Miles et al., 2005).

Research and Limitations of Decreased KC Intervals

A more recent study conducted by Miles et al. (2005) does not support the findings of Tessier et al. (1998). The study was designed to test the hypothesis that skin-to-skin contact would significantly reduce neonatal endogenous cortisol response and maternal postnatal depression, as well as improve infant and maternal outcomes. The study was a prospective controlled trial which used intention-to-treat analysis. The study took place across two NICUs in which infants born prior to 32 weeks gestation (with a mean gestational age of 28 weeks) received standard care or skin-to-skin contact for 20 minutes once daily over four weeks. There were no significant differences between the standard care and the KC infant-mother dyads in measures of maternal caregiving confidence, maternal mental health, or maternal attachment. These measures were evaluated at discharge from the hospital, four months post-birth, and one-year post birth, respectively. It is noteworthy that the study also assessed infant memory, behavior,
Developmental Literature Review

There are some limitations to Miles et al. (2005) study. The researchers note that there was a wide variation in the amount of KC administered between KC group participants, although the specifics are not reported (Miles et al., 2005). Furthermore, Miles et al. (2005) did not distinguish between continuous and intermittent kangaroo care. The 20 minutes of skin-to-skin contact within the study seems quite short when compared to the WHO recommendation of at least 60 minutes of uninterrupted KC per session (WHO, 2003). Notably, the WHO recommends 60-minute sessions because the frequent changes associated with shorter session times may be stressful for the infant (WHO, 2003). In general, the absence of the specification and adherence to the procedures of KC is something that has been identified in the literature surrounding the practice (Chan, Valsangkar, Kajeepeta, O Boundy, & Wall, 2016). In the case of Miles et al. (2005) it is possible that in addition to deviating from correct KC implementation, short KC sessions caused undue stress among infants who received the treatment, further influencing the results.

Moreover, the study of Miles et al. (2005) does not mention matching mothers on any variables other than they were all from a multicultural urban population (Miles et al., 2005, p. 448) served by either Hammersmith Hospital or Queen Charlotte’s and Chelsea Hospital in London. Possible confounds amongst participants therefore decrease the internal validity of the study. Differences in socioeconomic status (SES) between the hospital catchment areas are a possible confound for participants because the British hospital system is organized using geographical catchments. Additionally, parental education levels, relationship status, or employment are some confounding variables that have been controlled for in similar research (Feldman, Eidelman, Sirota, & Weller, 2002).

Further Research Supporting KC Benefits

A study conducted in 2002 by Feldman et al. examined the effects of KC on maternal and paternal perceptions, parent-infant interactions, and infant cognitive development amongst premature infants and their parents. The study’s findings contradict the outcomes of Miles et al. (2005), while supporting those of Tessier et al. (1998). Feldman et al. (2002) hypothesized that mothers who practiced KC intervention would be less depressed and have a more positive perception of their infant than mothers whose premature infants received standard incubator care. The researchers reasoned that decreased depression and improved perception of infants would result in increased maternal behaviours amongst KC mothers, including gaze and touch (Feldman et al., 2002). Feldman et al. (2002) also anticipated that parents in the KC group would be more sensitive to their infant, thereby providing a more suitable environment to meet their child’s developmental needs (Feldman et al., 2002). It was also hypothesized that infants in the KC group would be more alert, have more agreeable temperaments compared to infants in the control group, and improved psychomotor development (Feldman et al., 2002).

Feldman et al. (2002) compared 73 preterm infants who received KC with 73 control infants who received standard incubator care, as well as their respective mothers and fathers. KC was performed in the hospital, for a minimum of 1 hour a day for 14 days. It consisted of skin-to-skin contact between the infant and the area between their caregiver’s breasts while seated in a standardized rocking chair. To eliminate possible confounds, the study matched the infants and parents on several variables, including SES, parent education, parent employment, infant birth weight, gestational age, and APGAR (Appearance, Pulse, Grimace, Activity, Respiration) scores. Participants were assessed at 37 weeks pre-discharge in a university laboratory, at 3 months in the family’s home, and finally participants returned to
KANGAROO CARE AND CAREGIVER RELATIONSHIPS

Adam D. Tutinka

The results of the Feldman et al. (2002) study indicate that KC is beneficial to parental perceptions, parental behavior and infant development, regardless of the infant’s medical status. Those mothers who practiced KC showed decreased symptoms of depression and perceived their children as “more normal and less divergent from the average infant” (Feldman et al., 2002, p. 19). At six months, mothers in the KC group were observed to be more sensitive, warm, adaptive to their infant’s unique health status, and resourceful during mother-infant interactions. Similarly, at six months the infants who received KC were rated as more socially alert according to the Coding Interactive Behaviour Rating system of parent-infant interaction. KC infants also had higher Bayley developmental scores in the mental and motor domains. Lastly, the homes of parents from the KC group were rated more sensitive, with more suitable stimulation according to the developmental needs of the preterm infants. The researchers concluded that KC has a positive impact on early infant development, as well as mothering and fathering across the first six months of life (Feldman et al., 2002).

The greatest limitation of the Feldman et al. (2002) study is that randomization of participants was precluded by the fact that KC is a standard rather than an experimental care option in Israel, where the study was conducted (Feldman et al., 2002). As a result, matched parent-infant dyads received either KC or incubator care. This was determined by geographical catchments; one hospital practiced KC, the other standard incubator care. Although Feldman et al. (2002) appear to have matched participants on a greater number of variables than Miles et al. (2005), effectively reducing the likelihood of confounds, differences in quality of practice between hospitals represents one potential confounding variable. It is possible that a set of staff in one of the NICUs performed their jobs more effectively, for example. Notably, however, assessments made at all stages of the study by Feldman et al. (2002) were conducted by trained, reliable research assistants or psychologists who were blind to group assignment. In comparison to that of Tessier et al. (1998), the findings of Feldman (2002) provide evidence for the benefits of KC without the limitation of the potential response bias present in Tessier et al. (1998). Although there was a lack of randomization and possible differences between participating hospitals, the research of Feldman et al. (2002) substantiates the trend that KC is beneficial to relationships between preterm infants and their caregivers. Lastly, in comparing the results of Feldman et al. (2002) with those of Miles et al. (2005), it appears that KC interval length may have an influence on the beneficial outcomes of the practice; KC intervals in the Miles et al. (2005) study were 20 minutes over 4 weeks, whereas those of the Feldman et al. (2002) study were 60 minutes over 14 days.

Intermittent KC in the Collectivistic Cultural Context

A study conducted by Cho et al. (2016) in South Korea corroborates some of Feldman et al. (2002) findings. The study was designed to determine the effect of KC on the physiological functions of premature infants, as well as to analyze differences in mother-infant attachment, and differences in maternal stress between recipients and non-recipients of KC (Cho et al., 2016). The study was quasi-experimental because it used a non-equivalent control group design. The KC experimental group and routine-care control group consisted of 20 infants born before 33 weeks of gestation (2016).

During Cho et al.’s (2016) research, KC was practiced in accordance with 2003 WHO guidelines, apart from the duration of the sessions. Mothers sat at a 60-degree angle with the infant in skin-to-skin contact with their bare chest, infants wore only a diaper and hat, and their head was turned sideways on their mother’s chest. KC sessions lasted thirty minutes and occurred three times a week for a total of ten sessions. At the onset of the experiment, a pretest was conducted that measured body weight, heart rate, respiration rate, oxygen saturation, body temperature, maternal attachment and maternal

the laboratory to be assessed again at 6 months (Feldman et al., 2002).
stress. These same measures were repeated in a post-test following exposure to KC or routine care. Maternal attachment and maternal stress were measured using a modified version of Müller’s (1994) infant attachment inventory and a modified version of the Parental Stress Scale developed by Miles et al. Both measures were self-report questionnaires (Cho et al., 2016).

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The study by Cho et al. (2016) found a significant difference in mother-infant attachment between participants in the KC group and participants in the standard care group. KC groups were found to have improved maternal affection and attachment, and improved relationships between the mother and the infant. In addition, a significant reduction in stress was observed in mothers who practiced KC compared to the routine care control group (Cho et al., 2016). Based on these findings, Cho et al. (2016) concluded that KC can help to reduce maternal stress and recommended its inclusion as a major nursing intervention for preterm infants and their mothers in South Korea (Cho et al., 2016).

This study is limited by its small sample size, so the results have low generalizability. Additionally, infants in the KC group were more mature at birth on average than those in the routine care group. The lack of randomization and the non-equivalency in maturation between the KC and routine care group may have influenced results and threatened internal validity (Cho et al., 2016). However, considered alongside the findings of Feldman et al. (2002) and Tessier et al. (1998), the findings of Cho et al. (2016) provide a good incentive to further investigate the benefits of KC. Notably, the primarily collectivistic South Korean cultural context of the Cho et al. (2016) study precludes comparison of results with studies conducted in primarily individualistic cultures. Therefore, the research of Cho et al. (2016) is ideally suited to incentivize further research on the effects of KC in collectivistic cultures only; additionally, the findings may provide a basis for cross-cultural research on the effect of KC in individualistic versus collectivistic cultures.

Limitations to the Research Reviewed

There are notable issues that surround the reviewed research in this paper. Such limitations include researcher bias, confounding variables, low internal validity, small sample sizes, low generalizability, and failure to consistently explain or adhere to a comprehensive definition of KC. Specifically, the differences between KC in alternative research contexts has sometimes been neglected in the literature. The continuous KC of Tessier et al. (1998) versus the intermittent KC of Miles et al. (2005) constitutes one such case. Future research would benefit by accounting for confounds, and divergent definitions of KC.

Future Investigation

A comparison of the studies reviewed in this paper reveals several gaps in the literature. Research that examines the long-term effects of KC would fill a largely unexplored niche—no research reviewed in this paper investigated respective areas of interest beyond the first year of the infant participant’s life. Research that explores KC’s long-term effect on attachment and caregiver-child relationships would be a similarly novel investigation. Additionally, the
research of Tessier et al. (1998) and Miles et al. (2005) seem to suggest KC is most effective within a certain timeframe of infant development (i.e., at a certain age). Further research to investigate this may be worthwhile so that practitioners can maximize KC’s favorable effects.

The varying intermittent KC session lengths across the studies of Miles et al. (2005) (an intended 20 minutes daily over 4 weeks), Feldman et al. (2002) (at least 1 hour daily over 2 weeks) and Cho et al. (2016) suggests that there may be a minimum necessary session length for those practicing KC treatment to experience benefits in infant-caregiver relationships. Alternatively, it could be that the quality of the intermittent KC administered during the Miles et al. (2005) study was deficient in comparison to the intermittent KC administered during the Cho et al. (2016) and Feldman et al. (2002) studies. Further research might investigate covariation between intermittent KC session length and beneficial outcomes, as well as the qualities of intermittent KC that are necessary to elicit a beneficial effect.

Conclusion

The research reviewed in this paper suggests a trend that KC is beneficial to healthy attachment in infant-caregiver dyads where a caregiver is managing the difficulties of caring for a premature infant. KC’s beneficial quality has been observed in contexts of intermittent application as well as continuous application (Cho et al., 2016; Feldman et al. 2002; Tessier et al., 1998). Likewise, its benefits have been observed cross-culturally in Colombia, Israel, and Korea (Cho et al., 2016; Feldman et al. 2002; Tessier et al., 1998).

Maternal mood and attachment seem to improve when KC is implemented (Cho et al., 2016; Feldman et al. 2002; Tessier et al., 1998). Mothers who practice continuous KC have reported feeling more competent, less stressed, and experiencing fewer symptoms of depression than mothers who did not practice KC (Tessier et al., 1998). However, mothers who practice continuous KC have also reported increased feelings of isolation—an effect that might be diminished by the important consideration of good quality social support (Tessier et al., 1998). Additionally, the research shows that the home environment according to the developmental needs of the premature infant until at least six months of age also seems to benefit from KC (Feldman et al., 2002).

Here the transactional model of development may be insightful. The transactional model conceives of child development in terms of the bidirectional, interdependent effects of the child and their (Sameroff, 2009). It could be that improvements in maternal mood and attachment associated with KC comprise an aspect of the infant’s social environment that promotes the development of a mutually fulfilling relationship within the infant-mother dyad. Cho et al.’s (2016) finding that intermittent KC helps reduce maternal stress, Tessier et al.’s (1998) finding that continuous KC was related to improved maternal perceptions of their infant, and Feldman et al.’s (2002) observation of the association between KC and an improved home environment all correspond to this analysis. Research that investigates whether KC may positively mediate caregiver-infant relationships in transactional terms may be valuable.

In sum, Tessier et al. (1998) concluded continuous KC was related to a “subjective bonding effect” (p. 8) between mothers and infants, while Feldman et al. (2002) determined intermittent KC had a positive effect on mothering and fathering across the first six months of life. Similarly, Cho et al. (2016) observed improved maternal affection and attachment associated to intermittent KC. Although each study had limitations, these results indicate that both continuous and intermittent KC may result in beneficial outcomes in relationships and attachment between preterm infants and their caregivers. Notably, the results of Miles et al. (2005), in which intermittent KC had no significant effect on maternal confidence, maternal mental health, or maternal attachment, seem the exception rather than the rule. Miles et al.’s (2005) results may have occurred because KC sessions were not effectively administered or too brief. The literature would benefit from further investigation to develop these findings.
Declaration of Conflicting Interests
The author(s) declared they have no conflicts of interests with respect to their authorship or the publication of this article.

References


Differentiating Multiple Suicide Attempters from Single Suicide Attempters Using Personality Traits

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Abstract

Those who attempt suicide typically only attempt once; however, 10-50% of them still go on to attempt at least one more time. Among those who did, 4% completed suicide, compared to the 1% in single attempter populations. Looking at personality disorder as a determining factor to predict multiple attempters (MA) is a promising area of research. This study aims to determine whether a comprehensive set of empirically derived personality disorder traits measured on a dimensional scale would differentiate multiple attempters from single attempters. We classified participants as either single attempters (those who had only attempted once) and multiple attempters (those who had attempted more than once). We measured their personality traits using the Schedule for Non-Adaptive and Adaptive Personality and compared the group means for each trait to find if there was a significant difference between them. Our results found that there were personality profiles unique to each group that differentiated them. MAs presented significantly higher levels of detachment, self-harm, suicide proneness and lower self-esteem, with medium effect sizes. Single attempters (SAs) presented significantly higher positive temperaments and characteristics of exhibitionism with small to medium effect sizes. Overall, the results suggest that MA and SA may differ substantially enough to warrant future research and special intervention strategies. These results also highlight the pitfalls of conducting research in a classificatory way, whereby the nuances of potentially disparate diagnoses are overlooked when they are presented in diagnostically similar patients.

Keywords: multiple attempters, single attempters, suicide prevention, suicide

Suicide is a pandemic that warrants careful examination in psychological research. Almost 800,000 people die due to suicide every year, with many others attempting (World Health Organization, 2015). Suicide accounted for 1.4% of deaths worldwide in 2015, making it the 17th leading cause of death (World Health Organization, 2015), and the second leading cause of death in adolescents and young adults between the ages of 10-34 years in the United states (Center for Disease Control and Prevention, 2018).

There is significant empirical evidence indicating a wide range of suicide risk factors that predict future suicidality. Three of the most supported predisposing factors are current suicidal ideation, suicide attempt history (Stein, Apter, Ratzoni, Har-Even, & Avidan, 1998) and non-suicidal self-injury

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Multiple Attempters vs. Single Attempters

Asarnow et al., 2011; Klonsky, May, & Glenn, 2013. Other factors are the presence of personality disorders (Ansell et al., 2015; S. Yen et al., 2009), psychiatric illnesses (Nock, Hwang, Sampson, & Kessler, 2010), substance abuse (Crumley, 1990), stressful life events (Grover et al., 2009), hopelessness (Cox, Enns, & Clara, 2004), and low self-esteem (Hull-Blanks, Kerr, & Robinson Kurpius, 2004).

10-50% of those who attempt suicide go on to attempt at least one more time. Of those who do re-attempt, 4% end up completing suicide, which is a significantly higher rate than the 1% in single attempter populations. (Stein et al., 1998). This presents a significant problem considering that so many single attempters (SAs) go on to become multiple attempters (MAs), and the rate of lethality increases with multiple attempters (MAs) (Stein et al., 1998). In the same way that the “ideation-to-action” framework (May & Klonsky, 2016) advocates for a separate consideration of suicide ideators and attempters, there should be a consideration that MA may present a clinically different composition than SA. This may help in efforts to target treatment and predict suicide attempts in those who are prone to reattempting.

A promising area of research for determining factors that predict MA is personality disorders (PDs). One PD that has reliably shown to factor into suicidal behavior—even after controlling for comorbid Major Depressive Disorder—is Borderline Personality Disorder (BPD) (Bolton, Pagura, Enns, Grant, & Sareen, 2010; Shirley Yen et al., 2003, 2004). Patients with BPD account for 9-33% of all suicides (Links, Gould, & Ratnayake, 2003), and since suicide is such a pervasive characteristic of the disorder, BPD is the only PD in the DSM-V that has suicidal behaviour listed as a diagnostic criterion under ‘pathological personality traits’ in the depressivity domain. Gunderson (2009) found that 75% of a BPD inpatient sample had engaged in at least one suicidal behaviour in the past. Several studies have found supporting evidence that patients with BPD could be at increased risk for multiple attempts (Linehan, Armstrong, Suarez, Allmon, & Heard, 1991; Rudd, Rajab, et al., 1996; Rudd, Joiner, & Rajab, 1996). Patients with BPD have personality traits characterized by impulsivity and aggression, which have been found to be significant factors in predicting suicide (Brezo, Paris, & Turecki, 2006) and MAs (Corbitt, Malone, Haas, & Mann, 1996; Stein et al., 1998). However, one study found that the single trait of impulsivity alone may be associated with severity of suicidal behaviour, rather than the global severity of BPD itself (Bolton et al., 2010).

Research on other PDs has also shown possible roles in distinguishing SA from MA. Several studies have found Narcissistic Personality Disorder correlates with suicide (Ansell et al., 2015; Heisel, Links, Conn, Van Reekum, & Flett, 2007), even in the absence of depression; and it is also found that only Cluster B personality disorder predicts the number of attempts (Ansell et al., 2015). Other personality disorder studies have found conflicting evidence regarding whether personality disorders are able to predict MA from SA. For example, Ansell et al. (2015)’s longitudinal study found that the only PDs to predict increasing number of attempts to be NPD and BPD. In contrast to this finding, some studies have found that other personality disorders such as psychopathy (Brezo et al., 2006), and obsessive-compulsive disorder (Fernández de la Cruz et al., 2016) relate to multiple attempts. Taken together, this body of research suggests the possibility of PDs differentiating SA from MA, which needs further exploration.

The current study examines the predictive relationship that personality traits have in distinguishing MA from SA. This study will advance knowledge in two key ways. First, while many studies have already linked personality disorders to suicidality broadly (Ansell et al., 2015; Corbitt et al., 1996; J. c. Overholser, Stockmeier, Dilley, & Freiheit, 2002), few have made the distinction between MA and SA (Ansell et al., 2015; Bolton et al., 2010; Corbitt et al., 1996). Second, previous research has focused on DSM personality disorders (Ansell et al., 2015; Brezo et al., 2006; Fernández de la Cruz et al., 2016), whereas this study will examine a comprehensive set of empirically derived personality disorder traits
measured on a dimensional scale. The personality traits being measured are taken from The Schedule for Non-adaptive and Adaptive Personality (SNAP) (Clark, 1993) and include mistrust, self-harm, eccentric perceptions, aggression, manipulativeness, entitlement, detachment, exhibitionism, dependency, impulsivity, workaholism, propriety, negative temperament, positive temperament, and disinhibition. The SNAP distinguishes itself from other personality scales in that it measures maladaptive and adaptive personality traits rather than only adaptive traits. Three temperament and 12 trait scales are used that reflect the current nosology of personality pathology (Ross, Bye, Wrobel, & Horton, 2008). These scales have been shown to have high correspondence with previous measures of pathological traits (Harkness, 1992; Livesley, 1986).

The sample was drawn from a population of 66 undergraduates and 53 outpatients who had attempted suicide during the previous 3 years and had a mean of 21.6 years and 38.3 years respectively. We hypothesize that we will find a distinct personality profile that will distinguish MA from SA among the personality traits that are being measured.

Methods

Participants

Two samples containing 152 participants were obtained from different populations, in order to increase generalizability. Sample 1 consisted of 66 undergraduate students who had attempted suicide in the past 3 years. 78.8% of the sample was female, with a mean age of 21.6 years (SD = 2.6). The ethnicities of the sample were composed of the following; 50% East Asian descent, 22.7% Indian-South Asian descent, 15.2% European descent, 9.1% mixed descent and 3% Middle Eastern descent. A quarter (26%) of the sample reported being of a minority sexual orientation (i.e. gay, lesbian, bisexual, unsure). Participants reported a mode of 3.16 lifetime suicide attempts (range = 1-15), with an onset of suicide ideation at a mean age of 14.5 years (SD = 3.6). Participants were recruited from the University of British Columbia via an online system designed by the psychology department to recruit psychology students for research studies, as well as posters distributed on campus.

Sample 2 was a sample of 53 outpatients with at least one suicide attempt in the past 3 years. Almost half of the participants were female (52.8%) with a mean age of 38.3 years (SD = 12.3). Regarding ethnicity of the participants, the sample was 48.1% European descent, 14.8% East Asian, 11.1% First Nations descent, 9.3% mixed descent, 5.6% Latin American descent, 3.7% Middle Eastern descent, 3.7% of other descent, and 1.9% Indian-South Asian descent and 1.9% declined to answer. One fifth (19%) reported a minority sexual orientation

The sample had a mode of two lifetime suicide attempts (range = 1-15), and onset of suicidal ideation was at a mean age of 17.1 years (SD = 9.3). Participants were recruited by using online advertisements, announcements made at a local mental health community, and via posters placed throughout public areas. To determine single attempters from multiple attempters, we coded all participants who had reported attempting suicide once as SA, and all participants who had reported attempting more than once as MA. In total we compared 49 single attempters to 103 multiple attempters.

Measure

For the purposes of this study, the data collected on the Schedule for Non-Adaptive and Adaptive Personality (SNAP) (Clark, 1993) was used. The SNAP is a self-report questionnaire with 375 true/false items derived from factor analysis that measures the extreme ends of traits that are associated with maladaptive functioning and are at the core of personality disorders. It consists of 34 scales: 12 trait scales, 3 temperament scales, 6 validity scales and 13 diagnostic scales based on DSM-IV personality disorders. The trait scales are grouped into the 3 temperament scales: Negative Temperament, comprised of manipulation, mistrust, aggression, self-
harm, eccentric perceptions, dependency, negative temperament and suicide proneness; Positive Temperament—comprised of exhibitionism, entitlement, detachment (reverse scored), and positive temperament, and Disinhibition, comprised of impulsivity, propriety (reverse scored), workaholism (reverse-scored) and disinhibition. Morey et al., (2003) examined the relationship between the trait scales of the SNAP and the symptomology of four personality disorders; borderline PD, schizotypal PD, avoidant PD and obsessive-compulsive PD. They found that different clusters of SNAP traits distinguished each of these personality disorders from a) each other, b) from patients with depression but no PD diagnosis, and c) from a non-clinical population. A further study building on Morey et al. (2003) tested the SNAP on a non-clinical sample under the dimensional prediction that individuals with elevated personality pathology, that do not meet PD cut-offs for diagnosis, should have similar personality traits to those who do meet the cut-off (Wilt, Schalet, & Emily Durbin, 2010). Their study confirmed this prediction by showing that the SNAP produced similar personality profiles in participants with elevated personality pathology as those who met diagnostic cut-offs.

The trait and temperament subscales of the SNAP have good validity and reliability in comparison to other questionnaires measuring PDs. A principal components analysis conducted by Ross et al., (2008) calculated the correlations between the SNAP scales and primary and secondary psychopathy measured using Levenson’s self-report psychopathy scale (Levenson, Kiehl, & Fitzpatrick, 1995). Their analysis showed significant, large correlations between the two measures.

Results

We compared single attempters to multiple attempters to determine whether a personality profile emerged that significantly differed between the two groups. The variable ‘number of suicide attempts’ was coded into two variables: single attempts—in which there was only one suicide attempt, and multiple attempts—in which there was more than one attempt. We received results consistent with our hypothesis and past research. MA’s differed on several different traits and two distinct personality profiles emerged. We conducted a mean differences analysis and a paired-samples t-test comparing SAs to MAs, which showed that MAs (N = 86) reported significantly higher levels of detachment (M = 51.33, SD = 10.18), t(133) = -2.49 p = 0.01, Cohen’s d = -.45, self-harm (M = 51.86, SD = 9.59), t(134) = -3.14, p = <.01, Cohen’s d = -.41, suicide
Table 1. Mean differences and Cohen’s d effect size for personality traits between MA and SA

<table>
<thead>
<tr>
<th>Trait</th>
<th>Mean SA</th>
<th>Mean MA</th>
<th>Difference</th>
<th>Cohen’s d</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Negative temperament</strong></td>
<td>N = 47</td>
<td>N = 86</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mistrust</td>
<td>47.97</td>
<td>51.06</td>
<td>-3.09</td>
<td>-0.30</td>
</tr>
<tr>
<td>(10.92)</td>
<td>(9.37)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manipulativeness</td>
<td>47.83</td>
<td>51.13</td>
<td>-3.30</td>
<td>-0.33</td>
</tr>
<tr>
<td>(9.77)</td>
<td>(9.99)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aggression</td>
<td>51.50</td>
<td>49.21</td>
<td>2.28</td>
<td>0.23</td>
</tr>
<tr>
<td>(49.21)</td>
<td>(9.90)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-harm</td>
<td>46.36</td>
<td>51.86</td>
<td>-5.51</td>
<td>-0.56*</td>
</tr>
<tr>
<td>(9.88)</td>
<td>(9.59)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eccentric perceptions</td>
<td>50.14</td>
<td>49.93</td>
<td>0.22</td>
<td>0.02</td>
</tr>
<tr>
<td>(9.44)</td>
<td>(10.33)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dependency</td>
<td>51.35</td>
<td>49.30</td>
<td>2.05</td>
<td>0.21</td>
</tr>
<tr>
<td>(8.99)</td>
<td>(10.47)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Positive temperament</strong></td>
<td>N = 47</td>
<td>N = 86</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exhibitionism</td>
<td>53.07</td>
<td>48.40</td>
<td>4.67</td>
<td>0.48*</td>
</tr>
<tr>
<td>(9.68)</td>
<td>(9.84)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Entitlement</td>
<td>52.44</td>
<td>48.71</td>
<td>3.73</td>
<td>0.37*</td>
</tr>
<tr>
<td>(10.31)</td>
<td>(9.65)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Detachment</td>
<td>51.45</td>
<td>49.24</td>
<td>2.21</td>
<td>0.22</td>
</tr>
<tr>
<td>(10.01)</td>
<td>(9.97)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disinhibition</td>
<td>50.63</td>
<td>49.66</td>
<td>0.97</td>
<td>0.10</td>
</tr>
<tr>
<td>(8.79)</td>
<td>(10.62)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Impulsivity</td>
<td>47.96</td>
<td>51.07</td>
<td>-3.11</td>
<td>-0.32</td>
</tr>
<tr>
<td>(8.75)</td>
<td>(10.48)</td>
<td></td>
<td></td>
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<tr>
<td>Propriety</td>
<td>51.92</td>
<td>48.97</td>
<td>2.95</td>
<td>0.30</td>
</tr>
<tr>
<td>(8.26)</td>
<td>(9.98)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Workaholism</td>
<td>48.98</td>
<td>50.54</td>
<td>-1.56</td>
<td>-0.16</td>
</tr>
<tr>
<td>(10.07)</td>
<td>(9.98)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Self-esteem</td>
<td>47.33</td>
<td>51.40</td>
<td>-4.07</td>
<td>-0.41*</td>
</tr>
<tr>
<td>(9.96)</td>
<td>(9.79)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Suicide Proneness</td>
<td>46.33</td>
<td>51.88</td>
<td>-5.55</td>
<td>-0.57*</td>
</tr>
<tr>
<td>(9.90)</td>
<td>(9.57)</td>
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</tbody>
</table>

*Note. Standard Deviations appear in parentheses below the means
*Indicates the results are significant based on ANOVA, T-Test and LSD analyses
proneness (M = 51.88, SD = 9.57), t(134) = -3.16, p = <.01, Cohen’s d = -.57 and low self-esteem (M = 51.40, SD = 9.79), t(135) = -2.30, p = .02, Cohen’s d = -.41, with medium effect sizes. SAs (N = 47) reported significantly more exhibitionism (M = 52.44, SD = 10.31), t(134) = 2.09, p = .04, Cohen’s d = .37, and positive temperament (M = 53.07, SD = 9.68), t(135) = 2.65, p = .01, Cohen’s d = .48, with small to medium effect sizes (see Table 1).

Discussion

Multiple attempters have often been investigated alongside single attempters, with researchers labelling them simply as ‘suicide attempters’. However, research indicates that MAs may have a clinically different profile to SA’s (Reynolds & Eaton, 1986; Stein et al., 1998; Stringer et al., 2013). Given the increased lethality of suicide attempts among MAs, there is merit to investigating the possibility of differentiating MAs’ clinical profile from SAs’. Personality disorder is a promising area of research on this topic, as BPD has proven to be characterized by recurring suicidal behaviour and the presence of personality disorders in relation to suicide behaviour is high (Ansell et al., 2015). Patients with BPD have been shown to be at higher risk for MA (Corbitt et al., 1996; Rudd, Joiner, et al., 1996), to the extent in which the DSM-V diagnosis criteria includes suicidal behaviour. Many of the personality traits characteristic of BPD taken on their own are also associated with a higher risk for suicidal behaviour. BPD combines impulsive aggression with affective instability, which can be an especially risky combination (Coccaro, Bergeman, Kavoussi, & Seroczynski, 1997) and has shown to be related with increased risk of suicidality and completed suicides (Paris, Brown, & Nowlis, 1987). This study aims to determine if there are personality profiles that differentiate between MAs and SAs.

Our results supported our hypothesis. We hypothesized that a distinct personality profile would emerge among the personality traits measured on the SNAP. We found that MAs reported significantly higher levels of detachment, self-harm, suicide proneness and lower self-esteem than that of SAs, whereas SAs had significantly higher levels of positive temperament and exhibitionism. Some of these results are consistent with previous research (Forman, Berk, Henriques, Brown, & Beck, 2004; Gispert, Davis, Marsh, & Wheeler, 1987).

The personality traits that we identified as differentiating MAs from SAs have been linked with suicidal severity in past literature. Detachment can lead to low levels of social support, connectedness, and belongingness. In both Joiner’s (2005) Interpersonal Theory and Klonsky & May’s (2015) Three-Step Theory, low feelings of belongingness play an essential role in the formation of suicide ideation and the transition from the conceptual level to real world implementation. Studies have found that poor interpersonal functioning and detachment from others may be singly linked to suicidal behaviour (Ledgerwood, 1999; Pace & Zappulla, 2010), even beyond differences explained by BPD (Forman et al., 2004). Past research also supports the predictive relationship of low self-esteem and MA.

Low self-esteem has been found to contribute to suicidal tendencies in adolescents (Overholser, Adams, Lehnert, & Brinkmann, 1995) and children (Kazdin, French, Unis, Esvedt-Dawson, & Sherick, 1983). In addition, low self-esteem has a high correlation with hopelessness, another important factor in Interpersonal (Joiner, 2015) and Three-Step theory (Klonsky & May, 2015). Suicide proneness and self-harm have proven to be reliable predictive risk factors in determining severity and recurrence of suicidality (Esposito, Spirito, Boergers, & Donaldson, 2003; Forman et al., 2004; Klonsky, Victor, & Saffer, 2014).

With regard to the higher levels of exhibitionism and positive temperament personality sub-types in SAs, several studies are in accordance with our findings. Exhibitionism is closely related to the concept of extraversion, which could be a protective factor for suicidality since it builds social connectedness and feelings of belongingness, which are another two protective factors against suicidality (Klonsky & May, 2015). Higher levels of positive temperament are suggestive of lower levels of
negative temperament (a temperament scale on the SNAP that subsumes the traits of detachment, low self-esteem, self-harm and suicide proneness). Negative temperament also encompasses depression, which is a reliable risk factor for suicidality (Berglund & Nilsson, 1987; Oquendo et al., 2002). We found that negative temperament was higher in MAs than in SAs, however, it was not a significant difference, which is somewhat contradictory to the significantly higher levels of positive temperament that we found in SA. However, it is worth noting that the two scales measuring negative and positive temperament are considered separately on the SNAP, which may explain this incongruency.

We also had some surprising results that were not in line with previous literature. In our sample, aggression was not significantly different between MA and SA, which contradicts past research that indicated that anger and rage were significant differentiators between the two groups (Esposito et al., 2003; Gispert et al., 1987; Stein et al., 1998). Gispert et al. (1987) found that of the four measured negative temperaments, patients with one suicide attempt differed from multiple attempts only in levels of aggression. Aggression and anger are also characteristic of BPD, which has been shown by many studies to have high occurrences in MA (Coccaro et al., 1997). Another characteristic of BPD that was not supported by our study is impulsivity. This is surprising given that impulsivity is often found to be a predictor of MA (Coccaro et al., 1997).

The results of this study support our hypothesis that SA and MA differ substantially enough to suggest that future research and special intervention strategies need to be taken into more serious consideration. Although multiple attempters account for only a small percentage of total psychiatric populations, these patients often burden certain areas of health care more, such as hospital visits. In a Toronto study, 17% of repeat attempters were frequently hospitalized in the city’s hospitals and used 58% of emergency room contacts. Emergency room staff often reported feeling ill-equipped to respond to repeat attempters (Barnes, Braseliten, Lippman, & Siegel, 1979). Forman et al. (2004) suggest that repeated non-lethal suicide attempts should be taken seriously as a sign of severe psychopathology and high risk for future suicidal behaviours. In terms of clinical implications, MAs may present a unique case that should be treated differently from SAs. This may warrant a potentially different treatment regime that would focus specifically on decreasing detachment, low self-esteem, self-harm behaviours, and suicidal ideation. As found in this study and several others, suicide-proneness (ideation and suicide history) is a risk factor for MAs. More attempts are made as repeat attempters go untreated, this increases the level of suicide proneness. It is important that in the future we are able to tailor more effective treatments for this clinical population, in order to interrupt this cycle. As more indicators of MA are delineated in future research, interventions can be further tailored to meet the unique profiles of MAs. The theoretical implications of these results are important for understanding the underlying motivations of the behaviour, as well as allowing researchers and clinicians to behave more predictively when applying interventions. These results highlight the pitfalls of conducting research in a nosologic, classificatory way, whereby the nuances of potentially disparate diagnoses are overlooked when presented by diagnostically similar patients.

To be stated, the current study has several strengths, including the use of the SNAP questionnaire which was designed as a dimensional measurement of empirically derived personality traits associated with PDs, allowing for a more nuanced investigation than other personality scales which had been used in some previous studies. Past literature tends to take a classificatory approach by using DSM-IV personality disorders; this study instead took a closer look at the individual personality traits that derive PDs with its use of the SNAP's trait scales. We used samples from both undergraduate students and outpatients which makes our results more generalizable to a real-world context. We also sampled a relatively significant population with a minority sexual orientation.
There are some limitations that should be considered when interpreting our findings. When using cross-sectional methods to study suicidal behaviour, it is possible that an individual who at the time reports only one attempt may go on to become a multiple attempter later on. This would lead us to incorrectly classifying them as SAs. Furthermore, we gathered data from retrospective self-reports, which could be considered an inferior method in comparison to a prospective study. Retrospective studies run the risk that participants inaccurately respond due to the time that has passed between the event and the retrospective self-report. Furthermore, because of the ethical nature of the subject (suicidal behaviour), we are unable to use an experimental design consequently our data is only correlational, and thus causation cannot be inferred. Our relatively small sample size is a limitation to the validity of our results, and the uneven representation of ethnicities may have affected our data. Future studies would be advised to try and reach a more diverse age group, as our mean age in both the university student group and the outpatient group was relatively young (21.6 and 38.3 respectively). Finally, our measure was only limited to individuals who had made non-fatal suicide attempts. It may be the case that participants who complete suicide present a different picture, and our findings are limited in their ability to generalize to fatal suicide attempts.

An important future direction would be to test this analysis with a prospective study design. This would help reduce some of the limitations of this study by restricting the number of participants misclassified as SAs, and data could be collected on fatal suicide attempts. It would also give us a better clinical image of suicidal behaviour over time in MAs. In terms of developing new theories, studies should begin to focus on the effect of personality traits and disorders on multiple attempt status. Based on this current study we are unable to say whether high levels of negative personality traits cause repeated attempts, whether the reverse is true, or whether the relationship is transactional. Clinical research could begin to explore effective treatment practices for multiple attempters with the knowledge that has already been found in this study and others in a similar vein.

Declaration of Conflicting Interests
The author(s) declared they have no conflicts of interests with respect to their authorship or the publication of this article.

References


Mean Girls: Investigating the Effects of Sexism Perpetrated by Other Women

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As overt and hostile sexism has become increasingly denounced in modern society, researchers argue that women are now confronted with subtler, but more insidious forms of sexism. Existing literature demonstrates how women suffer negative consequences when exposed to sexism perpetrated by men, but little research has directly examined how women identify and react to sexist remarks when they come from other women. In the present study, women were exposed to a subtle sexist comment made by either a male or female perpetrator. We investigated a) how the perpetrator’s gender affected the identification of sexism, b) how the perpetrator’s gender influenced women’s feelings of self-efficacy, and c) if a woman’s own egalitarian attitudes mitigated the effects of sexism. Results showed that women reported sexism as more invalid and inappropriate when the source was a man. While perpetrator gender did not affect feelings of self-efficacy directly, exploratory moderation analyses found that acute awareness of gender stereotypes and personally rejecting gender stereotypes protected women’s self-efficacy against the negative effects of sexism when the sexist perpetrator was male, but not female. These findings suggest that sexism perpetrated by other women may potentially be more dangerous than sexism perpetrated by men.

Keywords: gender, sexism, prejudice, stereotyping, self-efficacy

Negative Effects of Exposure to Sexism

Strong evidence suggests that sexism is detrimental to women’s psychological and physical health. Women’s self-esteem is markedly reduced when they are confronted with gender discrimination (Swim et al., 2001), and they also experience increased levels of anxiety, depression, and anger (Klonoff et al., 2000). Exposure to sexism has also been found to be associated with distressing physiological symptoms, as well as negative health behaviours like binge-drinking and smoking (Zucker & Landry, 2007).

Existing literature provides ample evidence of consequences to women’s feelings of self-efficacy. Encounters with sexism have been shown to dramatically reduce women’s feelings of competence (Kuchynka et al., 2018), especially when it appears to be innocuous (Dardenne, Dumont, & Bollier, 2007; Dumont, Sarlet, & Dardenne, 2010; Vescio, Gervais, Snyder, & Hoover, 2005), or when it occurs in domains in which women are already negatively stereotyped, such as in science, technology, engineering, and mathematics (STEM) fields (Logel et al., 2009). Gender stereotypes in these fields perpetuate the assumption that women are
incompetent in these subjects (Nosek, Banaji, & Greenwald, 2002). Exposure to such attitudes activates women’s feelings of inadequacy (Dardenne et al., 2007; Dumont et al., 2010), which has been shown to negatively impact women’s sense of belonging in these domains (Smith, Lewis, Hawthorne, & Hodges, 2013).

Despite these negative effects, some women may adopt sexist attitudes themselves. There is evidence to suggest that being raised within a system in which the status quo encourages sexism influences whether women themselves will also have these attitudes (Hammond, Sibley, & Overall, 2014; Lau, Kay, & Spencer, 2008). Benevolent sexist attitudes, in contrast to hostile ones, are characterized as being seemingly positive towards women, but still incites the maintenance of traditional gender roles. Such attitudes may be particularly appealing to women if they appear to hold benefits for women who endorse them. For example, some men may find women who take on traditionally feminine roles as more physically attractive, as they adhere to stereotypes that fit the the status quo (Lau et al., 2008), and some women may feel as though they are being given special attention and treatment from men who endorse benevolent sexism (Hammond et al., 2014).

Possible Effects of Perpetrator Gender

While we know that women can be sexist, very little is known about the consequences that may occur when women are sexist towards other women. There are theoretical reasons to expect that sexism is easier to detect when the source is male and easier to agree with when the source is female, but the evidence is mixed. Emerging themes seem to highlight how our expectations and biases influence our perception towards instances of sexism. As men are seen as prototypical sexists, sexism is more easily identified when the perpetrator is male. By contrast, it is believed women do not match this prototype, and are therefore evaluated more positively than men even when they express the same sexist attitudes that men do (Inman & Baron, 1996). However, there is some research to suggest that source gender may not affect the perception of benevolent sexism specifically, because this type of sexism is evaluated more positively regardless of the gender of the perpetrator. These findings suggest that sexist perpetrators are judged unfavourably only if the type of sexism they express matches prototypical hostile sexism, which is evaluated independently from gender (Baretto & Ellemers, 2005). It is important to note that this research did not expose participants to sexism directly, warranting further investigation.

By contrast, some evidence has found that women come to accept and agree with sexist attitudes, even if they are hostile, when they are expressed by other women. It appears that sexism seems to be more convincing and justified when perpetrated by the in-group because we do not typically expect in-group members to be critical towards their own (Davidson, Czopp, & Mark, 2015). Sexism perpetrated from in-group members may even be perceived as attempts to be helpful, as members of the in-group are appraised as being more valid sources of information (DeMarco & Newheiser, 2017). We predict that sexism from women towards other women will be harder to discount, as these attitudes will appear to be more positive and their female sources will be perceived as more qualified in their opinions.

If sexism is detected, however, we expect that women may feel alienated from other women as a group. We expect this to be especially true for women who are acutely aware of gender stereotypes and personally reject them, such as those high in feminist values. Possessing congruent attitudes within a group signals belongingness, and so experiencing sexism from other women may signal that their attitudes are indeed different from other women, therefore indicating a lack of solidarity.

Overview

The current research was a large exploratory study that examined how women identify and react to subtle sexism perpetrated by other women, in comparison to subtle sexism perpetrated by men. We predicted that women would be less likely to identify comments as sexist when they were made by a
woman as opposed to a man. Consequently, they would feel less efficacious in the domain in question and feel less solidarity with women as a group. We also tested whether individual differences in women’s own attitudes would moderate effects of condition (male or female perpetrator of sexist comment) on self-efficacy. We predicted that women who held egalitarian attitudes, such as high stigma consciousness (acute awareness of gender stereotypes), and low benevolent sexism (personally rejecting gender stereotypes), would be more likely to be protected from the negative effects of sexism. We note that while we predicted that feminist identity (women challenging gender norms) and female identity centrality (women who feel that their gender is a core tenant of their identity) would moderate effects, especially on women’s feelings of belonging with other women, results were not significant and will not be included further in our analyses.

**Methods**

**Participants** A total of 225 female undergraduate students at a large Canadian University were recruited for what they thought was a study to pilot a “peer-reviewed, course-rating website”. Data from seven women were excluded because they failed our attention checks (e.g. “If you are reading this, please select option four”), guessed our hypothesis, or had an academic standing above third year, as our manipulation relied on participants being unfamiliar with with upper-level courses. Our final sample had a mean age of 19.6 years (SD = 1.8), and most identified as heterosexual (94%). A majority self-reported their ethnicity as East Asian (39%), Caucasian (23%), and South/Southeast Asian (20%). Students received 1 unit of course credit in exchange for their participation.

**Procedure** This present study used novel experimental methodology. Experimental sessions were held in-lab and were led by one of two female research assistants who ran between 1 and 4 participants at a time. Participants were placed in separate cubicles at a computer station, where they were given instructions over the speaker by the research assistant. Participants were told we would be testing the peer-reviewing component of the university’s new course-rating website, in which they were to evaluate comments made by other students for appropriate and helpful content.

All participants were presented with three course reviews for fourth-year psychology courses. The first two course reviews acted as control/filler reviews. To indicate who the course reviews were written by, we created digital avatars (portrait-style) of fictitious people and assigned first names to them to accompany the reviews. Participants evaluated one filler review by a male and one by a female, the orders of which were counterbalanced. The reviews contained details about the subject matter of the class, lecture and exam style, as well as tips for success in the class.

**Manipulation** After evaluating the two control reviews, participants were randomly assigned to read a third comment that differed by condition: male perpetrator sexism vs. female perpetrator sexism. This final review was similar in content and style to the controls, except it also contained a subtle sexist comment. The comment stated that the class was a “less girl-y” psychology course in that it was “science heavy”, and concluded that other women tended not to like this course but preferred a different one that studied children. Participants were randomly assigned to one of two conditions: whether the sexist remark was made by a man (n = 117), or a woman (n = 108). Avatars for both the man (Figure 1, see supplementary data) and woman (Figure 2, see supplementary data) for this third comment were matched on ethnically ambiguous facial features that could be interpreted as Caucasian or East Asian to match our student population, as well as facial expression, clothing colour, and level of attractiveness. ethnically ambiguous facial features that could be interpreted as Caucasian or East Asian to match our student population, as well as facial expression, clothing colour, and level of attractiveness.

**Dependent measures** To maintain consistency and believability, participants rated our dependent measures after each of the filler reviews as well as...
after the critical review that contained our manipulation. Unless otherwise specified, all self-reported items were measured on a 1 (strongly disagree) to 7 (strongly agree) scale. Item scores were then totaled and averaged across each measure, well as facial expression, clothing colour, and level of attractiveness.

Attitudes towards class Participants evaluated their attitudes regarding the domain/course by responding to six items that measured their self-efficacy (e.g. “I would receive a good grade in this class”) on a 0% (not at all certain) to 100% (extremely certain) sliding scale. Additionally, one item evaluated participants’ feelings of belonging (“In this class, I would feel like I belong”), and another item on their likelihood of taking the class (“How likely are you to take this class in the future?”). Higher scores on each measure indicated higher levels of self-efficacy, belonging, and likelihood of taking the class respectively facial expression, clothing colour, and level of attractiveness.

Labelling of sexism To examine whether the inappropriate comment would be explicitly labeled as sexist, participants were presented with a text box to leave additional feedback about the course review. We then coded and scored these responses for labels of sexism (e.g. gender discrimination, chauvinism, misogyny, etc.), as a dichotomous variable of 0 (no mention) and 1 (explicitly mentioned sexism). The greater the number of participants that explicitly mentioned gender discrimination in their feedback served to indicate a greater detection of sexism. Not be included further in our analyses.

Exploratory Measures and Demographics

In-group belonging To assess participants’ levels of in-group belonging, we measured participants’ feelings of fit/belonging with other women as a group (e.g. “Among other women, I feel like I fit in”), solidarity with other women (e.g. “I feel like I can count on other women to be on my side”) and feelings of similarity with each other (using pictorial scales). Additionally, we measured self-ascribed femininity vs. masculinity (“Compared to other women of your age, how masculine (or feminine) do you see yourself?”). No significant results were found for these analyses and they will not be discussed further.

Moderators As part of our exploratory analysis we also measured potential moderators at the end of our survey. These included stigma consciousness (e.g. “When interacting with a member of the opposite sex, I feel like they interpret all my behaviors in terms of my gender”) and endorsement of benevolent sexism (e.g. “Many women have a quality of purity that few men possess”).

Demographics Participants also provided demographic information regarding gender, age, ethnic background, and major.

Results

Condition Differences in Key Variables

Correlations as well as means and standard deviations by condition for key variables can be found in Table 1. We first tested condition differences in key variables through a series of independent sample t-tests. As predicted, we found some evidence that women’s attitudes towards the sexist comment and commenter were more positive when the source was female rather than male. Specifically, participants rated the sexist comment as significantly more valid, $t(222.26) = 2.17, p = .031$, and the source of the comment to be marginally more valid, $t(222.7) = 1.96, p = .051$, when the source was female rather than male. A chi-square test of independence tested whether participants were more likely to explicitly label the comments as sexist when the commenter was male as opposed to female. While only a small percentage of participants left any comments in this section ($M = 17\%$), results from this test revealed the male comment was marginally more likely to be explicitly labeled as sexist than the female comment, $X^2(1, N = 225) = 3.48, p = .062$. 
Contrary to what we had predicted, no substantial condition differences were found in women’s attitudes towards the class. Self-efficacy did not differ significantly by condition, \( t(219.96) = -1.11, p = .912 \), nor did women’s feelings of belonging in the class, \( t(222.82) = 0.03, p = .976 \), or their likelihood of taking the class, \( t(222.47) = 0.69, p = .492 \).

**Moderated Condition Effects**

We also examined several possible interactions between condition (gender of sexist commenter) and individual differences in attitudes about sexism in predicting women’s attitudes towards the class they had just heard a sexist comment about. Specifically, we focused on possible interactions between gender of commenter and individual differences in women’s levels of stigma consciousness and their endorsement of benevolent sexism in predicting feelings of self-efficacy, belonging, and likelihood of taking the class.

### Stigma consciousness as a moderator

First, participants’ self-efficacy was regressed on condition (Male = 0, Female = 1) and stigma consciousness (z-scored), followed by their interaction. Results revealed a marginal interaction between condition and stigma consciousness in predicting self-efficacy, \( \beta = -0.25, t(204) = -1.72, p = .088 \). Simple slope analyses revealed that among participants with high stigma consciousness, self-efficacy was descriptively lower after a sexist comment when the comment came from a woman rather than a man, \( \beta = -0.22, t(204) = -1.08, p = .28 \), whereas those with low stigma consciousness reported descriptively less self-efficacy when the comment came from a man rather than a woman, \( \beta = 0.28, t(204) = 1.35, p = .179 \). We also found that for those who were exposed to the sexist comment from a male, stigma consciousness appeared to be correlated with marginally higher efficacy, \( \beta = 0.19, t(204) = 1.91, p = .058 \). For those who were exposed to sexism by a female, we find no such protective effect.
EFFECTS OF SEXISM PERPETRATED BY OTHER WOMEN

of stigma consciousness, $\beta = -.03$, $t(204) = -1.19$, $p = .852$.

We repeated these analyses with feelings of belonging in the class as our outcome variable. Results again revealed a marginal interaction between condition and stigma consciousness, $\beta = -.32$, $t(204) = -1.68$, $p = .095$. Simple slope analysis revealed that among those with high stigma consciousness, participants reported descriptively more belonging in the class when the source of sexism was male, $\beta = -.27$, $t(204) = 1.01$, $p = .315$, whereas those with low stigma consciousness reported descriptively less belonging in the class when the source was male rather than female, $\beta = .37$, $t(204) = -1.37$, $p = .174$. We also found that for those who were exposed to sexist a comment from a male, stigma consciousness appeared to be related to marginally higher class belonging, $\beta = .18$, $t(204) = 1.35$, $p = .18$ [3]. For those who were exposed to sexism by a female, stigma consciousness was related to descriptively less class belonging, $\beta = -.05$, $t(204) = -2.25$, $p = .801$.

Participants’ likelihood of taking the class was also regressed on source gender (Male = 0, Female = 1) and stigma consciousness, but results showed no significant interaction effect, $\beta = .23$, $t(204) = 1.26$, $p = .209$.

Benevolent sexism as a moderator

We then tested whether participants’ own endorsements of benevolent sexist attitudes would moderate effect of condition. We predicted that those who strongly disagree with sexism would be particularly protected from sexist comments from a male but were unsure whether this would be the case if the sexist comment came from a female. To explore this, we regressed self-efficacy on condition (Male = 0, Female = 1) and endorsement of benevolent sexism, followed by their interaction. Results revealed a significant interaction between condition and benevolent sexism, $\beta = -.33$, $t(219) = -2.39$, $p = .018$. Simple slope analysis demonstrated that source gender marginally predicted lower self-efficacy when the source was male (but not female) among participants with high levels of benevolent sexism, but not with low levels of benevolent sexism. Participants with high level of benevolent sexism reported marginally more self-efficacy in the class when the source of sexism was female, $\beta = .34$, $t(219) = 1.76$, $p = .08$, whereas those with low benevolent sexism reported descriptively more self-efficacy when the commenter was male rather than female, $\beta = -.31$, $t(219) = -1.63$, $p = .104$. We also found that for those who were exposed to sexist comment from a male, endorsing benevolent sexism was related to significantly less self-efficacy, $\beta = -.28$, $t(219) = -3.04$, $p = .003$. For those who were exposed to sexism by a female, however, we found that personally disagreeing with benevolent sexism showed no such protective effect, $\beta = -.01$, $t(219) = -1.10$, $p = .924$.

Similarly, we repeated these analyses with feelings of belonging in the class as our outcome variable, but no significant effect was found, $\beta = -.22$, $t(219) = -1.18$, $p = .238$. Regression of participants’ likelihood of taking the class on source gender was also non-significant, $\beta = .23$, $t(204) = 1.26$, $p = .209$.

Discussion

Sexism is shown to negatively affect women, with an especially strong impact when its subtlety allows it to go unnoticed (Dardenne et al., 2007; Dumont et al., 2010; Vescio et al., 2005). We predicted that subtle sexism perpetrated by women would be especially difficult to detect, and so our exploratory study aimed to test this directly. Results showed that women perceived sexist comments as more valid and they were less likely to perceive the comments as discriminatory when the source was female. By contrast, sexist comments were more readily labeled as sexist when the source was male. These findings are consistent with prior research that demonstrates how in-group members are more likely to be evaluated as valid sources of information about their group, making their attitudes seem justified and fostering agreement (Davidson et al., 2015).

Although our results showed that source gender did not affect self-efficacy directly, as we expected, more exploratory moderation analyses
suggest that awareness of gender stereotypes and personally rejecting them might protect women’s confidence in a domain against sexism when the perpetrator is male, but not when the perpetrator is female. Specifically, women with high stigma consciousness and low benevolent sexism suffered smaller losses in self-efficacy, but only when the commenter was male. Research indicates that women are often confronted with sexism (Swim et al., 2010), and thus they are more accustomed to having to discount sexism, especially if they are acutely aware of gender stereotypes and personally reject them. We therefore propose that not only is discrimination from the out-group easier to detect, but women with egalitarian attitudes may also be better prepared to handle sexism from men.

Limitations

Although the current study is the first to our knowledge that directly examines how women identify and react to sexism from other women in comparison to sexism from men, our design was largely exploratory and has some clear limitations. While results of interaction analyses are in line with our predictions and are consistent moderators, both are marginal and not significant. Additionally, our sample size may not have been large enough to draw clear conclusions from them. For example, when measuring the detection of sexism, there were very few participants left comments; therefore, the sample of people from which we drew conclusions from was small and should be increased in the future. Lastly, participants’ responses to measurements of moderators such as stigma consciousness after the manipulation may have been influenced by the salience of gender-related content throughout the duration of the study, which may explain in part the observed interaction effects.

Implications & Future Directions

Our findings suggest that sexism perpetrated by other women may potentially be more dangerous than sexism from men, but a larger study is needed to better understand the costs associated with not being protected from sexism. We predict sexist comments from a woman will be less likely to be identified, and that not being able to protect oneself against sexism will be a key operator in reducing women’s feelings of self-efficacy.

Future research could build on our findings to explore how young girls’ feelings of self-efficacy in typically male domains (e.g. STEM) might be more negatively influenced by central female figures in their lives (e.g. teachers, mothers), which could predict their interest in pursuing academic interests in STEM. Future research could also examine how egalitarian attitudes develop in young girls and function to protect against sexism from men while still concurrently allowing the acceptance of sexist attitudes from women.

Declaration of Conflicting Interests

The author(s) declared they have no conflicts of interests with respect to their authorship or the publication of this article.

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The Effects of Nonverbal Behaviours on Perceptions of Dominance and Prestige

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Abstract
Converging lines of evidence suggest that two signs of social rank: dominance and prestige, are communicated via visually distinct nonverbal behaviours. Prestige and dominance are both highly agentic strategies of obtaining power, but they differ in communion, which is the level of warmth and agreeableness a person expresses in their interpersonal relationships. Prestige individuals display warmth and kindness towards their subordinates. In contrast, dominant individuals convey fear and aggression. We tested the ecological validity of previous studies that had shown that smiling and degree of head tilt affected perceptions of dominance and prestige. To do so, we created 6 conditions in which the researcher greeted randomly selected people on the street; their heads were either tilted up, neutral, or down, and they were either smiling or not smiling. If the person agreed to participate, the greeter had them complete a questionnaire in which they rated how dominant and prestigious they perceived the researcher who greeted them and whether they wanted to work with them on a task or not. We found that a greeter displaying a neutral head position without a smile was rated as significantly more agentic than when they displayed a downwards head tilt without a smile. All other measurement scales including communion ratings, dominance scores, and prestige scores were unaffected by head tilt and smiling/not smiling. Therefore, these results showed that specific nonverbal behaviours (i.e. head tilt and smiling) can alter perceptions of dominance and prestige.

Keywords: nonverbal behaviours, dominance, prestige, agency, communion

Across the animal kingdom, nonverbal behaviours are used to communicate signals of high social rank, which has been documented in many species such as cuttlefish, crickets, swamp sparrows, and chimpanzees (Schnell et al., 2016; Gray et al., 2014; Ballentine, Searcy, & Nowicki, 2008; Waal, 2007; Goodall, 1986). The ability to communicate high social rank is important because organisms that can do so have greater social influence and attention, as well as access to more resources (Foulsham et al., 2010; Brown & Maurer, 1986). In addition, the ability to recognize high social rank allows organisms to avoid harmful encounters with other organisms, be more selective about their mates, and work their way up in the social hierarchy (Martens, Tracy, & Shariff, 2012). Thus, the ability to effectively communicate and recognize signals of high social rank has many genetic and evolutionary benefits. In humans, past research has shown that people attain high social rank, or leadership, through two strategies: prestige and dominance (Cheng et al., 2013). Prestige is defined as obtaining leadership through respect and
expertise in a given area so that followers willingly defer to their leader (Maner & Mead, 2010). Conversely, dominance is defined as obtaining leadership through aggression and intimidation to induce fear in others (Brown & Maurer, 1986). Another way to differentiate prestige and dominance is through the interpersonal circumplex of agency and communion (Wiggins, 1979). On the circumplex, prestigious and dominant individuals both score high in agency, which is defined as obtaining power through using proactive behaviours (Wiggins, 1979). However, they differ in the level of communion, which is defined as the level of warmth and agreeableness a person expresses in their interpersonal relationships. Prestigious individuals display these prosocial traits, and, as a result, score high in communion on the circumplex. In contrast, dominant individuals receive low communion scores on the circumplex because they convey fear and aggression (Wiggins, 1979). Thus, prestige and dominance are differentiated based on the strategies that individuals choose to increase their social rank.

Past research has shown that smiling and an upwards head tilt are the nonverbal behaviours most commonly associated with prestige and happiness (Krumhuber et al., 2007, Mignault & Chaudhuri, 2003). For example, Krumhuber et al. (2007) found that in a laboratory setting, participants were more likely to cooperate with a confederate if the confederate displayed an authentic smile compared to a neutral expression. Moreover, faces displaying no smile and a downwards head tilt evoke feelings of intimidation in participants (Hehman, Leitner, & Gaertner, 2013). Hehman et al. (2013) conducted a study where they presented participants with a series of 20 photos of different people displaying either an upwards, downwards or neutral head tilt. The researchers found that faces displaying a downwards head tilt were rated as more intimidating than faces with an upwards head tilt. The photos displaying a neutral head tilt were rated as the least intimidating. Thus, the results of both of these studies added further evidence to the theory that certain nonverbal behaviours are associated with dominance and prestige (Cheng et al., 2013).

However, most nonverbal behavioural studies have been conducted in strictly controlled laboratory settings, making it unclear as to whether these results can be replicated in a real world-setting. By investigating whether dominance and prestige can be nonverbally communicated through a brief handshake in the real world, the study not only tests the ecological validity of previous findings, but also adds to the existing literature in the field. We hypothesized that participants would be less likely to work with the greeter when approached with a downwards head tilt without a smile and would also rate it as the most dominant, while participants would be more likely to work with the greeter when approached with an upwards head tilt with a smile and would rate it as the most prestigious. This would provide ecological validity to the findings of Hehman et al. (2013) and Krumhuber et al. (2007). The independent variable conditionsof this experiment were 4 sets of nonverbal behaviours the greeter displayed to each participant: head tilt up with smile, head neutral with smile, head tilt down with no smile, head neutral with no smile. The dependent variable was how dominant and prestigious the participant perceived the greeter to be, as well as whether they wanted to work with the greeter on a task. The dependent variable was how dominant and prestigious the participant perceived the greeter to be, as well as whether they wanted to work with the greeter on a task.

**Methods**

**Participants**

110 people took part in the study (56% male, 44% female; Mean age = 23.3 years; SD = 6.41 years). Participants ranged from 17 years to 50 years old, and described themselves as Caucasian (34.5%), East Asian (44.5%), Hispanic/Latino (4.5%), Middle Eastern (5.4%), African American (0.9%) and Other Ethnicity (11.8%). Participants were recruited on UBC campus in front of the Beaty Biodiversity Museum and in front of the Tim Hortons on Main Mall. They were approached on the basis of whether they were walking alone regardless of their age, occupation, or ethnicity. This was to minimize the amount of the
distractions during the procedure to ensure that the participant was paying attention to the greeter. All participants gave their written informed consent, were debriefed, and were compensated with a granola bar.

**Materials**

Consent forms, questionnaire sheets, and debriefing forms were printed out prior to running the study and were filled out on a clipboard by participants. The questionnaire sheet consisted of 24 items. The first 17 items were statements taken from a study by Cheng et al. (2010) designed to assess the dominance and prestige of the greeter. In this study, Cheng et al. (2010) developed a set of scales containing eight dominance statements and nine prestige statements, an example of a statement measuring prestige being, “People respect and admire him/her”. The full statements can be found in the Supplementary Materials under Appendix B. Participants completed these statements by rating each of their teammates, or peers, on a 7-point Likert scale ranging from 1 (Not at all) to 7 (Very much). For peer-rated prestige and dominance, internal consistency αs were .85 and .88, respectively, and inter-rater consistency αs were .78 and .84, respectively. The inter-rater consistency values suggested that participants were able to reach a general consensus of the dominance and prestige displayed by their peers.

The next seven items assessed agency and communion and were taken from a list of trait descriptive adjectives created by Wiggins (1979), who chose and organized the terms according to their locations on the interpersonal circumplex. As a result, the interpersonal circumplex has become a common way of assessing agency and communion. To assess agency, participants indicated how "Self-Assured", "Assertive", and "Self-confident" they perceived the greeter to be. To assess communion, participants indicated how "Tender", "Accommodating", "Gentlehearted", and "Kind" they perceived the greeter to be. All items were also rated on a 7-point Likert scale ranging from 1 (Not at all) to 7 (Very much). Lastly, Microsoft Excel and JASP were used for data input and analyses. See Appendix B: Supplementary Materials for the questionnaire given to participants.

**Procedure**

Two research assistants (RAs) worked together to conduct the experiment. The RAs, one male and one female, took turns acting as the greeter and facilitator and switched roles every three participants. The greeter’s job was to approach one person of the same sex for a handshake. This was done to minimize any effects that sex may have had regarding perceptions of dominance and prestige, as previous studies had found sex differences when it came to perceiving emotions and the masculinity/femininity of an individual (Biele & Grabowska, 2006; Penton-Voak & Perrett, 2000; Huddy & Terkildsen, 1993). If the person agreed to participate, the facilitator’s job was to ask the participant to sign the consent form, oversee the completion of the questionnaire, and debrief them when the study was over.

To begin, the greeter walked up to a person and asked if they would like to participate in a four-minute psychology study in exchange for a free granola bar while extending their right hand for a handshake. As this occurred, the greeter displayed one of four predetermined conditions of non-verbal behaviours similar to the ones in the study by Hehman et al. (2013). In condition one, the greeter displayed an upwards head tilt and a smile. In condition two, they kept a neutral head position while smiling. In condition three, they displayed a downwards head tilt with no smile. In condition four they kept a neutral head position head with no smile. Conditions two and four served as control conditions for conditions one and three respectively. We chose not to create a standardized degree of head tilt because past studies had already shown that small degrees of head tilt significantly affect perceptions of dominance in laboratory settings (Witkower, 2017), so we wanted to see if we could get these same effects in a less controlled environment.
If the person agreed to participate, the greeter directed them to the facilitator standing several feet away. The facilitator explained to the participant that they would be working on a task in which they would be tested on their knowledge of several topics. Then they asked if the participant would like to work on the task together with the greeter or if they would prefer to work independently. After recording the participant's answer, the facilitator gave the participant a one-page questionnaire consisting of 24 questions. For all questions, they were required to give a rating from 1 (strongly disagree) to 7 (strongly agree) on statements and personality traits relating to dominance or prestige. After completing the questionnaire, they filled out their basic demographic information. To conclude the study, the facilitator debriefed and gave them a granola bar as compensation.

**Data and Analysis**

We wanted to see if participants gave higher agency ratings to conditions one (prestige display) and three (dominance display) compared to the control conditions. We also wanted to see if participants gave higher communion ratings to condition one compared to condition three. Lastly, we wanted to see if conditions one and three had the highest prestige and dominance scores respectively, compared to each other and the control conditions. To answer our questions, we calculated the average agency rating and average communion rating for all four conditions. To find the agency score for each condition, we found the mean of items “self-assured”, “assertive”, and “self-confident”, and for the communion score, we found the mean of items “tender”, “accommodating”, “gentlehearted”. The dominance score for each condition was averaged over items: 3, 5, 7, 9, 10 (reversed), 11, 12 (reversed), and 16. The prestige score was found by averaging items: 1, 2 (reversed), 4, 6 (reversed), 8, 13, 14, 15, 17 (reversed). A one-way ANOVAs with an alpha level of 0.05 was performed to examine the relationship between each condition and their agency and communion ratings, as well as the relationship between each condition and the corresponding dominance or prestige score. A Bonferroni post hoc test was carried out for significant results.
Results

There was a statistically significant difference between groups as determined by a one-way ANOVA (Condition x Agency: $F(3, 108) = 6.83, p < 0.001$). As shown in Figure 1, a Bonferroni post hoc test revealed that the agency ratings were significantly higher in condition four compared to condition three ($M_{Diff} = -1.39$, $SEM = \pm 0.3$, $p < .001$). In other words, a neutral head position without a smile was rated as more agentic than a downwards head tilt without a smile. There was no significant difference between the conditions and communion ratings (Condition x Communion: $F(3, 108) = 0.469$, $p = 0.705$). There was no significant difference between the conditions and willingness to work together on a task (Condition x Task: $F(3, 108) = 0.906$, $p = 0.441$). There were no significant differences between condition and dominance score (Condition x Dominance: $F(3, 109) = 1.86$, $p = 0.14$) and no significant differences between condition and prestige score (Condition x Prestige: $F(3, 109) = 1.41$, $p = 0.24$).

Discussion

The purpose of our study was to test the ecological validity of whether dominance and prestige can be nonverbally communicated in the real world during a brief handshake interaction. We hypothesized that participants would be less likely to work with the greeter when approached with a downwards head tilt without a smile and would also rate it as the most dominant, while participants would be more likely to work with the greeter when approached with an upwards head tilt with a smile and would rate it as the most prestigious. Our results do not support the original hypothesis, since we found that greeters who displayed a neutral head position without a smile were rated as more agentic than when they displayed a downwards head tilt without a smile. An upwards head tilt did not have any significant effects on agency and communion ratings. None of the conditions had a significant effect on the participant’s willingness to work with the greeter on a task. There were also no significant differences between each of the four conditions and their corresponding dominance or prestige scores.

One limitation of our study was that we did not create standardized nonverbal behaviours for the greeter to display. That is, the greeter did not display a consistent degree of head tilt and/or smiling when greeting participants. Since past studies had found that smiling and head tilt angles of less than 10 degrees compared to neutral head positions had significant effects on perceptions of dominance and prestige (Krumhuber et al., 2007; Witkower, 2017), we wanted to see if these effects, which were observed under rigorously controlled laboratory settings, could also be observed in real world interactions where behaviours are less rigid. As a result, we lost some experimental control because we were unable to keep the degree of head tilts consistent throughout the experiment. Future studies may control for this by creating a standardized head tilt that a greeter can consistently recreate.

One confound of our study was that the appearance of the greeters was not consistent throughout the experiment since our data was collected over a period of four months. This may have affected our results since we do not know if factors like clothing and hairstyle influenced the participants’ perception of the greeter and thus their questionnaire responses. To control for this in the future, we could have the greeters wear the same clothing and maintain the same appearance for the entirety of data collection.

Our results differed from previous research such as Krumhuber et al. (2007), who found that smiling increased perceptions of warmth and willingness to work with the greeter. This may have occurred because Krumhuber et al. (2007) had participants look at pictures of smiling faces on a computer, compared to our study where participants were greeted by a smiling research assistant. Perhaps people noticed the smiling more in the photos than in the greeter interaction. This could be due to having fewer external distractions (background noise, people walking by etc.), and as a result, the people in the Krumhuber et al. (2007) study reacted more favourably by indicating higher perceptions of warmth and willingness to work on a task. Our results
also differed from the findings of Hehman et al. (2013) because they found that photos displaying a neutral head position were rated as the least intimidating compared to the upwards and downwards head tilts, whereas we found that a neutral head position without smiling was the most agentic compared to our other conditions. This may be because we conducted our study in a real-world context, where past research has found that people who smile are perceived as more interpersonally attractive than those who did not smile (McGiley, McGinley, & Nicholas, 1978).

As stated previously, prestigious and dominant individuals both score high in agency, but they differ in communion with prestigious individuals scoring high and dominant individuals scoring low. An alternate explanation of our findings may be that participants perceived the downward head tilt as an indicator of shyness rather than dominance which would have lowered the dominance score. Another alternate explanation may be that the appropriate behaviours were just not displayed long enough. The time it took for the greeter to display the nonverbal behaviours, which were neither measured nor standardized, may have been too short for the participant to distinguish and thus would have affected the responses on the questionnaire.

Our study could be improved in several ways. First, specifying the degree of head tilt and smiling would ensure that the greeter’s behaviour is consistent between participants, allowing us to investigate the magnitude of degree required for participants to notice. We could also make sure that the greeters’ appearance (clothing, hairstyle, etc.) are constant throughout the experiment to control for factors other than behaviour which may affect the perception of the greeter.

Future studies could apply our findings to group settings and examine the nonverbal behaviours that are associated with how rapidly people arrange themselves in a social hierarchy when given a task to complete. For example, Cheng et al. (2013) examined the formation of social hierarchies in groups of previously unacquainted university students and found that individuals who exhibited dominant or prestigious behaviours were rated as having higher social influence by their group members.

The present research supports the theory that distinct nonverbal behaviours affect perceptions of dominance and prestige (Cheng et al., 2013). Our findings also have implications for our understanding of prestige and dominance as two forms of high social rank when it comes to a leader’s followers. These strategies involve different sets of nonverbal behaviours, which suggests why subordinates react differently to each style of leadership (Cheng et al., 2013). Thus, future studies may expand on ours by further examining the leader-follower relationship in both laboratory and real-world settings.

In conclusion, the present research provides evidence that dominance and prestige are communicated using distinct nonverbal behaviors in a real-world setting. This is important because, as explained by Martens et al. (2012), the ability to communicate high social rank has many adaptive benefits when it comes to group dynamics and social learning. Although our results were not in line with past findings, our study had several limitations that could be improved upon. Some were unavoidable due to the fact that we were conducting our research in the real-world where we had less experimental control. To expand on our study, future research could examine leader-follower relationships in group settings and the associated nonverbal behaviours. Thus, the current findings support the idea that humans can send and receive signals of dominance and prestige through readily interpreted nonverbal displays of behaviour.

Declaration of Conflicting Interests
The author(s) declared they have no conflicts of interests with respect to their authorship or the publication of this article.
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