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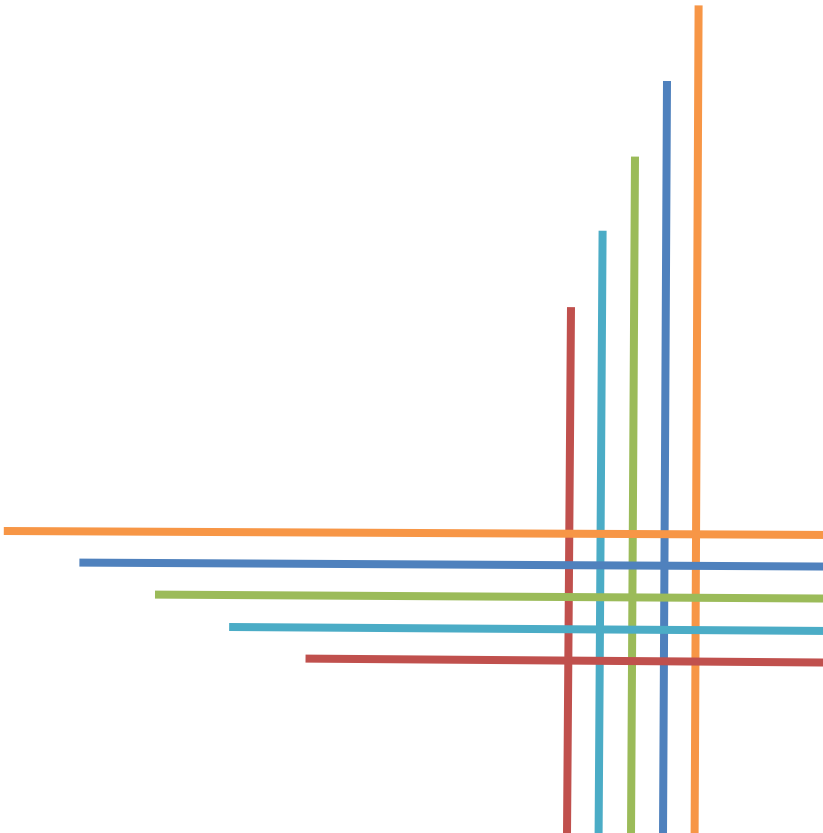

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University of British Columbia's Undergraduate Journal of Psychology (UBCUJP) is an annual, student-run, peer-reviewed journal. Our goal is to provide a platform for psychology undergraduates at UBC to showcase their research. We believe undergraduate research papers provide a fantastic opportunity for undergraduates to experience the peer-review process while also being a valuable resource for faculty and students to learn about the research happening next door.

Our focus is three-fold:

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

2) To our editorial board and reviewers, we offer the opportunity to develop reviewing, critical thinking 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, graduate students and other motivated undergraduates.

3) To graduate students and faculty, we offer the chance to engage and mentor undergraduate students.

We hope the journal itself will offer a unique peek into various developing projects around the research labs of UBC's psychology department.

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Editor's Note

David W.-L. Wu

I am honoured to present the very first volume of University of British Columbia's Undergraduate Journal of Psychology (UBCUJP). This inaugural issue contains a year's worth of dedicated work from undergraduates, graduate students, and faculty alike. It was a true delight being able to watch this journal transform from conception to reality.

The response and support from students and faculty exceeded my wildest expectations. In truth, we were underprepared for the sheer amount of quality submissions we received, and luckily the response from students wanting to help review papers was just as great. Rivalling the quality of submissions we received was the quality of reviews from our volunteer reviewers. It was astonishing to witness the transformation of each initial manuscript to the final published material. I want to thank all the reviewers and also the authors who chose to submit with us for making this journal such an immense success. I also want to thank the graduate student and faculty advisors for taking time out of their busy schedules to be involved.

To my editorial team, you truly are the heart of the journal and without your hard-work UBCUJP would be non-existent. A special thank-you to the people who believed in this project from the very beginning: Alan Kingstone, Ashley Whillans, and Michael Souza. With your continued support, I know this journal can reach the vast potential it has. In the coming years, I hope to see UBCUJP's reach expand to psychology undergraduates from other universities in the region.

In this issue, we review topics ranging from metaplasticity, to whether hypersexuality disorder belongs in the new DSM-5. We also look at a diverse range of studies ranging from examining the cognitive effects of doodling, to how religiosity influences altruism. We are also very pleased to publish the paper which received the 2011 Belkin Award for the best undergraduate psychology paper. I hope this inaugural volume of UBCUJP gives you, the reader, a glimpse of the immense degree of scholarship and psychological research from UBC undergraduates.

David W.-L. Wu
Editor-in-Chief, UBCUJP

BNS
Literature Review

Metaplasticity: A new frontier in the neural representation of memory

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Abstract

Synaptic plasticity, the modification of the strength of connections between neurons, is widely accepted to be essential for information storage in the brain and is thought to form the basis of learning and memory. However, in order for the richness of learning and memory to emerge from the long-term potentiation and depression of synapses, regulatory mechanisms must exist. Metaplasticity, the phenomenon of previous synaptic activity modulating the future synaptic plasticity of a neuron, might answer questions about how synaptic plasticity is regulated in order to create meaningful, coordinated changes in neural activity. There are many different proposed contributors to metaplasticity, including the NMDA and AMPA receptors, epigenetics, and neurotrophins. Although the way in which all these factors interact remains enigmatic, metaplasticity appears to play a role in learning, possibly by serving to control neuronal 'learning modes.'

Keywords: *metaplasticity, plasticity, memory, learning, long-term potentiation*

The seemingly simple question, “how is information stored in the nervous system?” has proven difficult to answer in the nearly five decades in which the biological basis of memory has been studied. Behavioural observation of learning and memory has been successful in characterizing many of the functional aspects of memory; short-term memory, long-term memory, and conditioning have all been well studied. However, due to technological constraints and the complexity of neural systems, knowledge of the neurobiological underpinnings behind learning and memory is severely lacking. Synaptic plasticity, the ability of neural connections to change by strengthening or weakening, is revolutionary in its potential to provide a physiological explanation for learning, but its mechanisms have yet to be fully understood. How the complexity of learning and memory can arise from such simple changes is one the most fascinating questions in neuroscience.

For the purposes of this review, synaptic plasticity is defined as long-term potentiation (LTP) and the complementary process of long-term depression (LTD) of connections between neurons. First discovered in rat hippocampal experiments in 1964, LTP is the process by which high

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frequency electrical stimulus delivered to a bundle of axons results in increased sensitivity or 'potentiation' of those neurons to stimulation. Between two synapsed cells, this means that if one neuron repeatedly stimulates another, the first neuron can more easily excite the second neuron. This results in the strengthening of synaptic transmission between these two communicating neurons. Because this potentiation was observed to last for days (up to an entire year in one study), it was believed to be the primary process through which memory traces were encoded in neural structures (Abraham, 2002). This effect, which was first discovered by Bliss and Lomo in 1964, caused great excitement because it supported an important idea that had been circulating—that persistent changes in the strength of connections between neurons form the basis of learning and memory.

LTD is the reverse of LTP; wherein synapses are depressed and exhibit reduced sensitivity following long-term, low-frequency stimulation. Less extensively studied, LTD is believed to be critical in the ability of neural systems to refine their circuits for efficiency.

Although the brain's ability to learn, remember, and adapt to stimuli cannot be explained entirely in terms of synaptic plasticity, most memory research today is based on the assumption that plasticity is the foundation from which all these abilities arise. For a comprehensive review on the role of LTP and LTD in learning and memory see Lynch (2004).

This review will address the basic mechanisms of synaptic plasticity and describe metaplasticity, a recently discovered and exciting phenomenon which regulates and integrates synaptic plasticity over time. Metaplasticity is the process in which high or low frequency stimulation affects the extent with which a neuron will undergo LTP or LTD in the future. Between two synapsed neurons, this could manifest as a greater frequency of stimulation required to induce LTP in a neuron that has already been potentiated. The specific mechanisms and functions of metaplasticity remain unclear, but it appears to be critical in maintaining synaptic memory traces and keeping synaptic plasticity occurring within a tight, dynamic range. If synaptic plasticity is the neural representation of firing history, then metaplasticity is the neural history of that plasticity.

Synaptic Plasticity: Potentiation and Depression

Neurons can form thousands of connections with neighbouring cells between specialized cell junctions called synapses. Neurons transmit information through action-potentials (APs), large waves of electrical activity that travel down the neuron's axon and stimulate the awaiting dendrites of that neuron's synaptic partners. Importantly, action potentials are all-or-none responses; once the threshold level of stimulation of the neuron is reached, the action potential will fire with the exact same intensity, regardless of the magnification of the triggering stimuli. This means that the frequency, not the intensity, of action potential firing becomes the primary way through which out-going signal strength is encoded in neural systems.

The synapse is the primary junction of information transfer. When an AP reaches the synapse of the transmitting or presynaptic neuron, neurotransmitters are released which stimulate much smaller electrical signals of variable strength in the receiving, or postsynaptic, neuron. Unlike APs, these postsynaptic potentials (PSPs) can

vary in strength depending on a number of factors, such as the number and sensitivity of postsynaptic neurotransmitter receptors. These PSPs then travel to the cell body and, much like how smaller waves in the ocean combine to form larger waves, summate into large membrane potentials which push the total membrane depolarization towards or away from the threshold at which an AP is created (Pinel, 2007). With hundreds of these incoming signals converging with different strengths and frequencies, there exists a staggering amount of computational power within each neuron.

Synaptic plasticity is simply the process by which the sensitivity of these synaptic connections alters according to their level of activity. “Those that fire together, wire together” is a common expression describing this process in which the synapses between neurons that often fire together are strengthened, such that it becomes easier for the presynaptic neuron to activate the postsynaptic neuron. This is accomplished by a change in synaptic efficacy, defined as the amplitude of the PSP generated upon activation by presynaptic firing. LTP strengthens PSPs and LTD weakens them. In this way, the brain is able to adapt to organize its firing and adapt to new patterns of stimulation.

How does LTP occur? When researchers first set out the answer this question, they hoped to pinpoint either presynaptic or postsynaptic changes as leading to changes in synaptic efficacy; however, it appears that both presynaptic and postsynaptic changes are involved. Because primarily postsynaptic changes appear to be involved in metaplasticity, only postsynaptic LTP mechanisms will be discussed here and readers interested in presynaptic mechanisms should consult Castillo (2012). In the synapse, the generation of PSPs primarily occurs through the rapid flow of ions through ion-permeable, ionotropic receptors. At glutamine-based synapses in the hippocampus, which are known to be critical in learning and memory, there are two important types of ionotropic receptors: NMDA (N-methyl-D-aspartate) and AMPA (α-amino-3-hydroxy-5-methyl-4-isoxazolepropionic acid). These receptors, though both responsive to glutamine, have several important functional differences. AMPA receptors (AMPARs), will always allow ion flow and cause local PSPS when glutamate binds to them, while NMDA receptors (NMDARs) possess a voltage-dependent magnesium gate and will only open when binding is coupled with a significant amount of postsynaptic depolarization (Pinel, 2007). The interplay of these two of receptors is crucial for many neuronal functions, including synaptic plasticity

During high-frequency stimulation, glutamate binding to AMPA receptors causes a large number of ions to enter the postsynaptic neuron, which initiates PSPs and opens NMDAR channels by depolarizing the postsynaptic environment. With their channels open, NMDARs are free to allow the influx of calcium ions into the synapse. Calcium (Ca^{2+}) influx leads to the phosphorylation of regulatory protein kinases, initiating both an early and a late-phase of LTP. First, in early-phase LTP, these protein kinases (e.g calcium-dependent protein kinase II (CaMKII)), increase the sensitivity of existing AMPARs and recruit new receptors to the synapse (Malenka & Bear, 2004). This almost immediate increase in both AMPAR density and sensitivity leads to a stronger postsynaptic response to the same presynaptic stimulus, effectively creating a memory trace within the neuron. In what is known as late-phase LTP, a

cascade of secondary messengers travel to the cell nucleus, initiating gene expression and protein synthesis, facilitating increased production of AMPAR proteins and other synaptic proteins (Lynch, 2004). Late-phase LTP often results in an increased postsynaptic surface area and a greater number of synaptic vesicles, which further amplifies the ability of the presynaptic neuron to excite the postsynaptic neuron (Desmond & Levy, 1988). Both early- and late-phase LTP are implicated in learning and memory by enhancing retention of a task for the first few minutes after it is learned while also making arrangements for the persistent retention of that learning.

Long-term depression, the weakening of synaptic efficacy following prolonged low-frequency stimulation, has not been studied as extensively as LTP, but its basic mechanics appear similar. During low-frequency stimulation, there is a relatively low degree of postsynaptic depolarization and thus a much smaller amount of NMDAR activation and Ca^{2+} influx. Interestingly, rather than simply leading to a reduced degree of LTP, low levels of Ca^{2+} appear to have the opposite effect entirely. While high levels of Ca^{2+} phosphorylate regulatory kinases, low Ca^{2+} levels promote their dephosphorylation. This leads to a decrease in synaptic efficacy via AMPAR

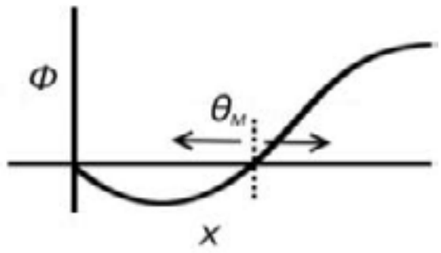

Figure 1. The BCM model function depicting postsynaptic activity (X), change in postsynaptic efficacy (Φ), and plasticity threshold (θ_M).

desensitization and removal (Malenka & Bear, 2004). The selective weakening of synapses through LTD is believed to be important for the constructive use of LTP. Indeed, if synapses continued to increase in strength, they would ultimately reach a ceiling level of synaptic efficacy which would prevent the encoding of new information It is important to note that the complete picture of these mechanisms, including the involvement of other supplementary mechanisms, is much more complex than described here and despite being an area of active research, is beyond the scope of this article. For further detail on LTD mechanisms, readers should consult Collingridge (2010).

The BCM Theory: Thresholds of Plasticity

In order to describe how metaplasticity affects the induction of synaptic plasticity, it is appropriate to first address the BCM theory of plasticity thresholds. During synaptic firing, increases in postsynaptic Ca^{2+} cause changes in synaptic efficacy: but if Ca^{2+} is the stimulus for both LTP and LTD, then what determines whether LTP or LTD will be induced? Because the effect of Ca^{2+} is concentration-dependent, there seems to be a threshold concentration that determines whether potentiation, depression, or no change in synaptic efficacy will occur. The Bienenstock-Cooper-Munro (BCM) model best characterizes this threshold.

The BCM model (see figure 1) describes a relationship between postsynaptic response (x-axis on figure) and change in postsynaptic strength (Φ) with two key features. First, a threshold exists (θ_M) above which the synapse will be strengthened (LTP), and below which it will be weakened (LTD). Second, this threshold is not static, but shifts in response to the average frequency of presynaptic stimulation

(Bienenstock, Cooper, & Munro, 1982). In this way, an increase in sensitivity following LTP induction will not cause even more LTP in a cycle of positive feedback and lead to excitotoxicity (cellular toxicity involving overactivation of glutamate receptors), and a loss of meaningful input from the synapse. A sliding threshold allows synaptic plasticity to function as a synaptic 'novelty detector', with the threshold being equal to the average level of activity so that LTP and LTD are only induced during significant bursts of in stimulation frequency.

The BCM model was constructed based on observation and mathematical analysis of synaptic plasticity with little explanation for physical mechanisms. However, following the discovery of metaplasticity, it has become clear that synaptic plasticity regulation is not as simple as the BCM model proposes.

Metaplasticity: Making Plasticity Make Sense

In an early experiment on LTP, researchers were surprised to find that increasing the permeability of NMDARs to Ca^{2+} paradoxically seemed to prevent LTP induction (Coan, Irving, & Collingridge, 1989). This conflicted with what was known about LTP at the time; NMDAR activation leads to LTP so it was expected that greater NMDAR permeability, and thus greater Ca^{2+} influx, would strengthen LTP. These researchers correctly concluded that NMDAR activation could somehow have an inhibitory effect on LTP despite its central role in LTP induction, but were unable to specify how. Research by Huang et al. in 1992 clarified this effect when they demonstrated that induction of LTP by a strong stimulus could be inhibited if a weak stimulus had been previously delivered to the same pathway (Huang, Colino, Selig, & Malenka, 1992). This effect lasted for upwards of thirty minutes, was dependent on NMDAR activation, and seemed to represent a shift in the BCM plasticity threshold since the inhibition could be overcome eventually by increasing the intensity of stimulation. These experiments were the first to demonstrate that 'priming' stimuli, whether it induces LTP or not, can cause covert changes in the synapse which will affect subsequent plasticity responses. This effect was dubbed “metaplasticity” because of its higher-order nature and was met with much excitement because of its implications for a mechanism of synaptic plasticity control similar to what had been proposed by the BCM theory.

Metaplasticity is often defined as “the plasticity of synaptic plasticity.” In other words, synaptic plasticity itself is plastic (capable of change), and metaplasticity is its modulation by a cell's prior history of activity. Metaplastic changes are subtle yet enduring, and allow synaptic events at a single point in time to regulate synaptic processing minutes, hours, or even days later. For example, if a synapse has just undergone LTP, the same stimulus delivered only minutes later will fail to elicit the same degree of potentiation, and may even cause depression. Importantly, metaplasticity can be monosynaptic, effective at one synapse only, or heterosynaptic, effecting neighbouring synapses as well (Abraham, 2008).

Functionally, metaplasticity allows neurons to integrate plasticity-relevant signals over time, encouraging gradual and meaningful neural change. Furthermore, metaplasticity maintains plasticity within a dynamic range and prevents destructive feedback cycles that may lead to either excessive or insufficient activation. The higher-order, 'meta', nature of this effect is exciting not only because of its importance to organized functioning of plasticity, but

also because it suggests that neurons retain a trace of their own activity.

Mechanisms of Metaplasticity

NMDAR: LTP Inhibition. Much like synaptic plasticity itself, metaplasticity can either have potentiating or depressing effects. As described by the BCM model, a decrease in successive LTP (a shift of the threshold θ_M to the right, Figure 1) appears to be based on NMDA activity, and lasts from 30-90 minutes (Huang et al., 1992). There have been two proposed mechanisms for how NMDAR activation may lead to an increase in the plasticity threshold. One theory was based on the observation that NMDARs themselves will occasionally become desensitized after stimulation due to nitric oxide feedback mechanisms (Sobczyk & Svoboda, 2007). It was proposed that this decrease in NMDAR sensitivity leads to a reduced postsynaptic Ca^{2+} response and thus inhibits LTP (Murphy & Bliss, 1999). As attractive as this hypothesis is, metaplastic LTP inhibition has been shown to occur independently of this NMDAR-specific desensitization (Moody, Carlisle, & O'Dell, 1999). Although it may be important in NMDAR function, this pathway cannot be directly mediating NMDAR-dependent metaplasticity.

The most promising explanation for NMDAR-dependent metaplasticity is the long-term alteration of the regulatory enzyme CaMKII by previous synaptic 'priming' (Bear, 1995). Manipulation of CaMKII phosphorylation sites has been shown to replicate the effect of NMDAR priming and increases the amount of postsynaptic activity needed to induce LTP without any prior high-frequency stimulation (Zhang et al., 2005). This is plausible since CaMKII is crucial in both early- and late-phase LTP; however, it is unclear whether the activation of CaMKII during metaplasticity is involved or conflicts with its transient phosphorylation during LTP induction. Recent electrostatic imaging studies have revealed that CaMKII is an impressively complex enzyme possessing two sets of six binding domains, so it is quite possible that it may be activated at multiple sites independently (Craddock, Tuszynski, & Hameroff, 2012). This is a fascinating area for further research, not only to clarify CaMKII's involvement in metaplasticity, but also because these multiple binding domains may be another site of information storage in the nervous system.

mGluR: LTP Facilitation. The idea that metaplasticity facilitates LTP is exciting. Might there be some way our neurons can direct themselves to learn faster and more efficiently?

Certain types of priming stimulation have indeed been shown to enhance LTP, though the mechanisms by which this occurs appear to be more mysterious and complex than LTP inhibition. The lowering of the LTP threshold, decreasing the amount of stimulation needed in order to elicit LTP response, appears not to be based on NMDARs but on an entirely different type of receptor, the metabotropic glutamine receptor.

In addition to fast-acting ionotropic receptors, there also exists a different class of receptors that are slower acting, with profoundly different structure and effects. These receptors, known as metabotropic or G-protein coupled receptors, do not open ion channels in response to neurotransmitter binding but instead activate secondary messenger proteins on the inside of the postsynaptic membrane. These secondary messengers can then effect long-term changes within the cell, such as

influencing gene expression and protein translation (Simon, 2007).

Metabotropic glutamate receptors (mGluRs) appear alongside NMDA and AMPA receptors in the postsynaptic membrane and are involved in LTP facilitation (Cohen & Abraham, 1996). The activation of mGluRs has been shown to both facilitate the induction of LTP and lengthen its persistence (Bortolotto, Bashir, Davies, & Collingridge, 1994; Bortolotto et al., 1995). This enhancing effect can last up to an hour and appears to be related to the down-regulating effect that mGluR activation has on the After-Hyperpolarization Period (AHP): the length of time neurons take to return to their resting potential after firing. A decrease in the AHP could lead to an increase in whole-cell neuronal excitability and an increase in postsynaptic depolarization due to back-propagation of action potentials from the cell body (Saar, Grossman, & Barkai, 1998). Additionally, mGluR activity may also enhance LTP by trafficking AMPARs to the synaptic membrane, preparing them for involvement in subsequent plasticity events (Oh, Derkach, Guire, & Soderling, 2006). Despite these promising findings, the involvement of mGLuRs in metaplastictic events has proven difficult to completely describe. For instance, mGluR activation appears to have an inhibitory effect on LTP in the dentate gyrus, and it is unknown how this effect could be reconciled with their usual role in enhancing LTP (Gisabella, Rowan, & Anwyl, 2003).

Epigenetics. In addition to synaptic receptor activity, there are a number of other factors that can effect long-term modulatory changes on synaptic plasticity. For instance, environmentally induced changes in gene expression (epigenetics) have been shown to be associated with increased LTP during learning tasks. Histone acetylation is an epigenetic process by which certain stretches of DNA are made more accessible to transcription proteins, leading to the increased production of the proteins encoded therein. High levels of histone acetylation have been found in relevant brain regions during learning tasks in rats, and experimental manipulation of this acetylation was shown to affect plasticity thresholds (Levenson et al., 2004). This not only implicates epigenetics as yet another possible mechanism of metaplasticity, but also suggests that a learning event in one synapse could promote LTP to other synapses throughout the neuron. By increasing the availability of proteins involved in late-phase LTP, epigenetics could provide a fertile environment for LTP to occur and thereby enhance learning.

BDNF. The protein known as Brain-Derived-Neurotrophic-Factor (BDNF) has recently been suggested to be involved in metaplasticity, although it is uncertain whether it can effect metaplastic changes its own, or whether it is simply a necessary factor in LTP induction. BDNF's primary role in the brain is developmental: it is involved in the promotion of neural cell survival, differentiation, and the establishment and maintenance of newly formed synapses (Huang & Reichardt, 2001). Because of its stimulatory effect on most neuronal processes, it is not surprising that artificial introduction of BDNF can induce LTP (Ying et al., 2002). However, research has revealed that BDNF may also alter the plasticity threshold in conjunction with PKMζ, another critical protein for LTP induction (Sajikumar & Korte, 2011). Furthermore, BDNF appears to be upregulated during certain learning tasks (Naimark et al., 2007). BDNF's role in

synaptic plasticity is far from being completely understood and the persistence of its effect on LTP induction has yet to be demonstrated. Metaplasticity entails a temporal component where synaptic events at one point in time affect later synaptic plasticity; this property has yet to be demonstrated with BDNF, though its presence does appears to amplify LTP. Nevertheless, it does provide a promising avenue of research and serves to illustrate just how many different factors are involved in regulating synaptic plasticity.

Metaplasticity and Learning

Metaplasticity is critical for maintaining synaptic plasticity within a dynamic range, but could it have a more direct role in learning? Research on the link between metaplasticity and learning is still in its infancy, yet what has been found is exciting and seems to implicate metaplasticity in both the facilitation and inhibition of learning. For example, it is well known that stress can impair learning, and now research has demonstrated that NMDAR-related metaplasticity triggered by stressful events may be the reason why (Sacchetti et al., 2002). Metaplasticity may also increase neural plasticity during learning periods, leading to more efficient learning. An exciting study demonstrated that during olfactory-discrimination training in mice, the AHP period of pyramidal neurons in the hippocampus was significantly decreased, suggesting the presence of mGluR-mediated metaplastic LTP facilitation. Importantly, this effect was present during the learning period but disappeared once the learning rule had been acquired, and was even correlated with enhanced ability to learn a different task in which the same neurons were involved. This suggests that mGluR-mediated metaplasticity may act as a 'learning switch', providing an improved cellular environment for learning to occur (Zelcer et al., 2006). Similar learning-related reductions in AHP have also been observed in reflexive eye-blink conditioning and water maze tasks (Lebel, Grossman, & Barkai, 2001; Moyer, Thompson, & Disterhoft, 1996).

Within the limited body of behavioural research on metaplasticity, an important observation has arisen which calls into question the accuracy of the BCM model and previous conceptions about synaptic plasticity regulation. The presence of multiple mechanism of metaplasticity (NMDARs, mGluRs), often leads to a failure of a single sliding threshold model to predict or explain changes in synaptic plasticity. For example, when decreases in the AHP are observed, there is almost always a simultaneous reduction in LTP as well. This suggests that NMDAR-mediated LTP inhibition may occur in dynamic balance with mGluR sensitization and illustrates an important point: these processes are by no means exclusive. With multiple metaplastic processes occurring simultaneously, it is challenging to develop a single model of metaplasticity that is accurate in all situations. At this point, there is no unifying explanation for how these different mechanisms work together. They may be cooperating, competing, or involved in some complex memory encoding process we have yet to discover. Explaining the interactions between discrete metaplastic mechanisms is a critical question — how do all these pieces of the puzzle fit together?

Conclusion

Metaplasticity, the modulation of synaptic plasticity based on previous firing history, is critical for the emergence of learning and memory. Like memory itself, metaplasticity appears to be composed of many different

complex processes working together. NMDAR-mediated metaplasticity inhibits future LTP through CaMKII phosphorylation while mGluR-mediated metaplasticity facilitates LTP via AHP downregulation. Histone acetylation enhances LTP by increasing transcription of synaptic proteins and BDNF may play a role in metaplasticity as well. Together, these processes allow neurons to maintain synaptic plasticity within a dynamic range. There is also mounting evidence that metaplasticity is involved directly in learning processes through up-regulation of neural plasticity in task-relevant neurons and that a dynamic balance between mechanisms may exist in order to regulate these 'learning modes'. Further research on metaplasticity could elaborate on this involvement in learning, leading to new discoveries about how we learn and providing knowledge to fill the considerable gap between psychological and neurobiological understanding of memory.

Although the stated goal of this review was to dissect metaplasticity into a simple, unified, understandable phenomenon, it is clear that metaplasticity cannot be reduced to a single process. NMDARs, mGluRs, neurotrophins, epigenetics – all these factors are involved and inter-related in ways we do not yet understand, forming a very complex phenomenon which is only superficially cohesive. These phenomena are not neat, orderly, or amenable to a unified label. Instead, they constitute a complex adaptation to endow organisms with the flexibility to adapt in a chaotic and unplanned world.

Declaration of Conflicting Interests

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

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CLINICAL
Commentary

Psychology: A closer look at what psychologists bring to the table

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Abstract

While it is clear that psychologists are an important component of the mental health field in Canada, there is often confusion as to what exactly makes the services provided by psychologists distinctive to those provided by other mental health care professionals. This paper aims to explore some of the contributing factors that make the field of clinical psychology unique and essential in the provision and treatment of mental health problems. This discussion will investigate differences between psychologists and psychiatrists, with particular emphasis on the exclusive benefits provided by clinical psychologists. Furthermore, the following discourse will outline the various advantages associated with psychotherapy and the ways in which clinical psychologists in particular utilize this tool in providing treatment and services to clients. This paper will also focus on the costs of mental health provision in the Canadian health care system and how one particular form of psychotherapy has proved to be extremely cost-effective in relation to other types of treatment. Additionally, this paper will challenge the current lack of financial coverage afforded to individuals seeking treatment from clinical psychologists in Canada and how this is problematic. Finally, this paper will identify the specific role psychologists maintain in providing preventative approaches to mental illness and the value of such approaches.

Keywords: *clinical psychology, advocacy, pyschotherapy*

The purpose of this discussion is to advocate for the profession of psychology and to identify the value of this profession in terms of the skill sets and roles that psychologists, specifically clinical psychologists, maintain in society. As the great Carl Rogers (1961) once said, “When I look at the world I am pessimistic, but when I look at people I am optimistic”; the essence of psychology is helping people. With psychology’s vast allegiances in areas such as hospitals, universities, courtrooms, clinics, prisons, and schools there is truly no other mental health profession with such a degree of career diversity. With a smorgasbord of career options, the face of psychology is never stagnant; ultimately this is one part of what makes psychologists unique, while at the same time contributes to the public confusion about the roles that psychologists

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uphold in our society. The following discourse will dive head first into the world as seen by psychologists, to uncover the unique and vital contributions that the field of psychology has to offer in the present day. Specifically, this paper will explore the unique role that clinical psychologists maintain in our society with a focus on what they have to offer that is exceptionally different from psychiatrists, such as extensive training in psychotherapy. This paper will examine the advantages that psychotherapy alone can offer, and in particular, the benefits that can be derived from cognitive behavioral therapy (CBT). There will also be a focus on the cost-effectiveness of psychotherapy in regard to its ability to treat mental illness and the cost-benefits this can have for the Canadian health care system. Furthermore, there will be an emphasis on the reasons why clinical psychology is an ideal candidate to be considered for Medicare coverage in Canada, comparing and contrasting the benefits resulting from psychiatric treatment vs. psychological treatment. Finally, this discussion will examine the significant role psychologists play in the promotion of the treatment and prevention of mental health issues. Each of these points serves to illuminate one general theme: the immense overall worth of psychology.

To begin this discussion, it is imperative to understand what psychology is and its importance. According to the British Columbia Psychological Association (BCPA; 2009) psychology is "the study of behavior, including the biological, cognitive, emotional, social and cultural determinants of behavior, that is, how we think, feel and behave in our social and physical environments". In an era in which the intricacies and overlap between mental health and physical health are continually being uncovered, psychology plays a fundamental role in advocating the importance of mental health issues. Clinical psychology in particular is concerned with human functioning and the assessment and treatment of mental health concerns (Canadian Psychological Association, n.d.). Not only do clinical psychologists deal with human psychological problems and their solutions, but they also are an intricate part of health promotion in terms of physical, mental, and social well-being (Canadian Psychological Association, n.d.). The problems and concerns treated by clinical psychologists include, but are not limited to, depression, learning disabilities, anxiety, stress, substance abuse, addiction issues, relationship problems, issues surrounding coping, problems related to physical or sexual abuse, developmental and behavioral issues, lifestyle management, criminal behavior and crime prevention, and facilitating adherence to health interventions (Canadian Psychological Association, n.d.). With such a diversity of responsibilities and roles, it is easy to see how the general public can maintain uncertainties about what the field of clinical psychology encompasses. Psychology in general remains one of the few disciplines with such a wide-ranging scope of scientific concerns, which ultimately adds to its uniqueness (British Columbia Psychological Association, 2009).

There is often public confusion regarding the field of mental health professionals, specifically on what the difference is between a psychologist and a psychiatrist. There is indeed much overlap between the two professions; however they are also both distinctive in their own right (Lea, 2011). In terms of education, psychiatrists attend medical school and receive an M.D. degree with a specialization in psychiatry. As noted by Hunsley and Lee

(2010), a "fundamental difference between training in clinical psychology and psychiatry is that psychiatric training generally emphasizes psychopharmacological treatment over psychological treatment". Typically, psychiatrists rely more heavily on the use of medication for the treatment of individuals suffering from mental health issues and generally incorporate less psychotherapy as a part of a treatment plan, as compared to clinical psychologists. In Canada, most registered psychologists have completed a Ph.D in psychology, which involves extensive coursework, research and practical clinical training (Canadian Psychological Association, n.d.). The intense research aspect of psychology is often considered one of the main distinguishing features between psychiatry and psychology. Research psychology is a branch of psychology devoted to conducting research studies and contributing to the growing body of psychological research, which is not a characteristic feature found in many other training programs for mental health professions. This inclusion of research is a large part of psychologists' role in academia, as well as a foundational part of clinical psychology training programs. Another important distinctive aspect of psychologists and of clinical psychologists in particular, is that they rely on different methods of treatment for mental illnesses than psychiatrists, such as psychotherapy rather than drug treatment. Though psychologists are certainly able to see a role for drugs in the treatment of mental illness, psychologists in Canada do not currently have prescription privileges to administer drugs to patients (Hunsley & Lee, 2010). There are currently psychologists who advocate for prescription rights in Canada, while other psychologists oppose the movement (Hunsley & Lee, 2010). As it stands currently, clinical psychologists in Canada use various forms of psychotherapy rather than drugs to treat mental illness.

As stated above, clinical psychologists do not depend on medication for treating their patients, but instead use various forms of psychotherapy. According to Nordqvist (2009), psychotherapy is the "treatment of emotional, behavioral, personality, and psychiatric disorders based primarily on verbal or nonverbal communication and interventions with the patient, in contrast to treatments using chemical and physical measures". Psychotherapy can take many forms including behavioral therapy, cognitive therapy, group therapy, interpersonal therapy, and psychodynamic therapy to name a few. One of the most widely used and most intensely researched form of psychotherapy is Cognitive Behavioural Therapy (CBT) (Butler, Chapman, Forman, & Beck, 2005). A core theoretical underpinning of CBT is the belief that the symptoms and dysfunctional behaviors that characterize mental illness are often cognitively mediated, suggesting that improvement can be created by modifying dysfunctional thoughts and beliefs (Dobson & Dozois, 2001). In a meta-analysis completed by Butler et al. (2005), it was found that CBT is extremely effective in the treatment of adult unipolar depression, adolescent unipolar depression, generalized anxiety disorder, panic disorder, social phobia, PTSD, and childhood depressive and anxiety disorders. Furthermore the meta-analysis strongly suggested that across many of these disorders, the effects of CBT are maintained for a considerable amount of time beyond the cessation of treatment (Butler et al., 2005). In some cases, psychotherapy has been found to result in greater alleviation of symptoms compared to the results of drug treatment. To further

illustrate this point, a study done by Gloaguen, Cottraux, Cucherat, and Blackburn (1998) found that CBT was significantly more successful in the treatment of depression than was medication. In other studies, it has been suggested that the combination of CBT and pharmacotherapy (medication) for depression can actually yield a slight advantage over CBT administered alone (Hollon, Thase, & Markowitz, 2002). On a separate note, CBT provided by clinical psychologists may also be preferable over medication because it is considered a less intrusive way of treating patients compared to drug administration (Associated Psychological Health Services, 2006). Indeed, the side effects of some drugs can be severe and the benefits can disappear when the medication is no longer being taken. Additionally, studies have found that pharmacotherapy has considerably larger drop-out rates than psychological intervention (Hunsley, 2003). And finally, psychotherapy is less costly than drug treatments in the long run (Associated Psychological Health Services, 2006). It is clear that, psychotherapy provided by clinical psychologists is vital in the treatment of mental illness and psychiatric disorders and is effective in its own right.

The unique advantages of psychotherapy are clearly evident in the discussion above, yet the question remains: why is treatment administered by psychiatrists, and not psychologists, covered under the Canadian health care system? In Canada, the direct and indirect cost of mental illness has been estimated to be $14.4 billion dollars and mental illness alone accounts for more than 50% of physician billing (Myhr & Payne, 2006). Because psychiatry and general practitioner services are covered under the Canadian health care system, the bulk of individuals suffering from mental illness receive treatment through these avenues. This is problematic because, although these mental health professionals are helpful in some areas and receive some training in psychotherapy, they are not as extensively trained in psychotherapy nor do they necessarily and consistently implement treatment with an emphasis on psychotherapy. It is suggested that this leads to a heavier reliance on and increased use of medication because it is considered the first-line, mainstay treatment for mental health disorders. Consequently it has been suggested that this over-medicalization of psychological concerns greatly contributes to the rising health care costs in Canada (Romanow & Marchildon, 2003). As Myhr and Payne (2006) point out, publicly funded CBT for mental disorders is scarce in Canada, regardless of its proven efficacy and the health guidelines endorsing its use. This is troubling, considering the plethora of studies that have demonstrated the positive effects that CBT can have on relieving many mental illnesses. Additionally, from a financial perspective, psychological interventions are thought to be very cost-effective. A recent meta-analysis of 92 research studies found that the average health care savings attributed to psychological interventions as opposed to drug treatments was between 20-30% (Chiles, Lambert, & Hatch, 2006). Of the studies included in this analysis, approximately 90% of them showed a medical cost offset, that is, the reductions in health care costs resulting from psychological interventions were large enough to completely cover the costs of the psychological interventions themselves (Hunsley, 2003). Hunsley (2003) stated that there has been considerable evidence of this phenomenon, as evidence in dozens of research studies. Additionally, the BCPA

(2009) suggests that “psychological services should be an integral component of the Canadian health care system”. The BCPA (2009) goes further to illustrate the need for psychological intervention by highlighting the fact that psychological intervention has been estimated to cost 10%-50% less than drug treatments. The BCPA (2009) claims that for every $1 spent on psychology services, $5 are saved on medical costs. Considering the plethora of potential societal benefits that can arise from the field of clinical psychology, the question is how can Canadians afford not to have these services covered?

Finally, the last area of psychological contributions that this paper will touch on deals with the role of psychologists in mental health promotion and mental illness prevention. As Kenkel, Deleon, Mantell, and Steep (2005) state, “as health professionals, psychologists have many opportunities to use mental health promotion and early detection skills in the health arena”. Since many of the visits to primary health practitioners concern mental health, a preventative approach would be optimal for decreasing health care costs and visits (Kenkel et al., 2005). This would be in the best interest of practitioners as well as the public. Furthermore, despite overwhelming evidence and education about the benefits that come from living a healthy lifestyle, many people are disinclined to make major lifestyle changes. Psychologists, who are extremely experienced in behavior change, can attempt to tackle these sorts of problems in society, with outcomes that could potentially benefit the overall health of the country’s population (Kenkel et al., 2005). The bigger picture is that psychologists play an important role in mental health promotion and mental illness prevention, which is something that should not be taken lightly.

This paper has outlined the contributions and benefits stemming from psychology as a field and has attempted to illustrate the essential services that many psychologists provide. Through the unique role maintained by clinical psychologists, the proven benefits of CBT and other forms of psychotherapy, the provision of different treatment approaches rather than pharmacotherapy, and the overall cost-effectiveness of psychological interventions and the role psychologists can play in health prevention and promotion, it is clear that the field of psychology adds tremendously to the overall mental health and well being of humanity. Though there is an array of mental health professionals, such as psychiatrists, social workers, and counselors that have similar goals to psychologists, the treatment approaches to dealing with mental health concerns are fundamentally different and should be recognized for their uniqueness and individual contributions. Psychology is clearly a constantly evolving field and it is suggested that the evidence-based services provided by psychologists will become even more valuable in the future (Hunsley & Lee, 2010). With the prevalence of many mental health issues and health care costs on the rise (Sheppard, 2011), it is likely that the services provided by psychologists will continue to increase in value. Furthermore, Hunsley and Lee (2010) suggest that the future face of clinical psychology will be active in providing psychological services to an assortment of health problems, and not focusing as strictly on mental health. For example, the future of clinical psychology will involve developing along with changing health care needs aimed at facilitating Canada’s aging population. Furthermore, clinical psychology

as a discipline will continue to ensure that treatments, psychological assessments, and programs geared at prevention are evidence-based and well suited for the wide range of people who are seeking these services. Psychology is certainly a multifaceted field, and the services it provides toward improving the overall status quo of mental health services in Canada are palpable and distinguishing.

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

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Craniopagus: Overview and the implications of sharing a brain

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Abstract

Craniopagus twins, who are conjoined at the head, are uncommon and often misunderstood. While craniopagus is rare in itself, Krista and Tatiana Hogan are unique even among craniopagus twins: their brains are connected. In this review, I will explore the history of craniopagus as well as our current understanding of the malformation. Furthermore, I will discuss surgical separation techniques, classification systems, and how these have led to higher survival rates in separated craniopagus twins. Surgical separation of craniopagus twins is perhaps the most formidable of all neurosurgery operations, particularly in the presence of shared neural tissue. Krista and Tatiana fall into this daunting category. The risk of neural damage, coupled with circulatory complications, led Krista and Tatiana's physicians to conclude a separation would be too dangerous. Consequently, Krista and Tatiana are left with a connection that is both novel to documented research and exquisitely mysterious. They possess what their pediatric neurosurgeon Dr. Doug Cochrane has called a "thalamic bridge" (Dominus, 2011a). Krista and Tatiana's thalamic bridge will provide significant insight into the study of cognition and behaviour, and may even have significant implications to the philosophy of mind. Furthermore, their connection will be accompanied by major social change, as we must redefine our definition of what it means to be an individual. For us to understand how being part of a pair is more important than being an individual to one's identity, we must shift our perspective and eliminate our preconceived notions of individuality.

Keywords: *craniopagus, conjoined twins, thalamus, brain, surgical separation*

Examples of human fascination with twins are evident through history. The Gemini constellation, known in Greek mythology as Castor and Pollux, is arguably the most well known set of twins. Castor and Pollux fought great battles alongside Herkales and others in what became known as the Argonauts (Hard, 2004). The Greeks held these twins in high standing: they were not only great warriors, but raised by gods. Conjoined twins, though less recognized, also appear in Greek and Roman mythology. Kteotos and Eurytos, known as the Molionides, were joined at the hip and adversaries of Herkales. The Molionides destroyed Herkales's armies and are responsible for

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one of the great warrior's rare losses in battle (Hard, 2004). Furthermore, Janus, the Roman god of beginnings and transitions, is depicted as having two faces. Initially Janus may not resemble conjoined twins; however, a recent interview with nineteen-year-old brothers Stefan and Tyler Delp, craniopagus twins facing opposite directions, shows just how similar Janus is to conjoined twins (Hochman, 2011). Greek and Roman mythology clearly glorify twins, and to this day, twins continue to captivate us.

Krista and Tatiana Hogan are craniopagus conjoined twins. Craniopagus twins, a term originally coined by August Förster to describe twins conjoined at the head (as cited in Browd et al., 2008), are a rare (i.e., 0.6 per million births; Bucholz, Yoon, & Shively, 1987) and misunderstood congenital disorder, representing only 6% of all conjoined twins. If born, the chances of craniopagus twins surviving past infancy are quite low (Stone & Goodrich, 2006): 40% are still-born (Browd, Goodrich, & Walker, 2008) and 33% die within twenty-four hours of birth. Despite these harrowing odds, Krista and Tatiana Hogan are already beyond their fourth birthday. They not only survived, but they are healthy and thriving.

While craniopagus is rare in itself, Krista and Tatiana are unique even among craniopagus twins: their brains are connected. Krista and Tatiana's neural bridge will provide significant insight into the study of cognition and behaviour, and might even have significant implications to the philosophy of mind. Their unique neural connection may forever change the meaning of individuality and perception. In this review, I will explore the history of craniopagus as well as our current understanding of the malformation. Through this we can begin to grasp what Krista and Tatiana's lives will entail. From them, we must gain an appreciation of how their brains are connected, and objectively contemplate what it means to be an individual.

Modern History of Craniopagus

Although there are cases of conjoined twins dating to the 10th century (as cited in Browd et al., 2008), it was not until 1491 that the first case of craniopagus was documented (Browd et al., 2008). Sebastian Münster's famous work *Cosmographia universalis* provides the first account of craniopagus twins (as cited in Walker & Browd, 2004). While discussing Bavarian history, Münster mentions a pair of unique twins, joined at the head, who lived for ten years. Münster follows with an account attributing the twins' malformation to a punishment for their mother's mistakes (as cited in Browd et al., 2008). Furthermore, Browd et al. (2008) discuss a chapter from "On Monsters and Marvels," a republished book, originally written by 16th Century French surgeon Ambroise Paré. In the chapter entitled "Monsters," Paré depicts various types of "supernatural" twinning, some of which, curiously enough, resemble craniopagus. Later, Paré asserts that "[i]t is certain that most often these monstrous and marvelous creatures proceed from the judgment of God…" (p 5). Fortunately, over time, this radical view towards conjoined twins began to change.

Chang and Eng, the original "Siamese twins," embraced their malformation. They traveled in road shows near the beginning of the 19th Century – eventually becoming not only rich, but a new type of art (as cited in Browd et al., 2008). Nevertheless, because of the rarity of craniopagus twins, even now many still share Paré's view of them as tragic or punished. The Delp family's fear of people's ignorance and discrimination led them to hide Stefen and Tyler from much of the world. It was not until June of 2011 that they gave their first interview – at the age of nineteen (Hochman, 2011). Stefen, Tyler, Krista, Tatiana, and all other craniopagus twins are so rare that the most recent review shows a total of only 64 documented cases (Stone & Goodrich, 2006). The discussed history of craniopagus extensively shows how craniopagus twins can be seen by some as "monsters." Therefore, combating ignorance through both knowledge and being mindful of existing prejudices are vital steps in removing ancient stereotypes associated with craniopagus twins, thus providing Krista and Tatiana with the social acceptance they deserve.

Classification Systems and Surgical Interventions

In addition to increasing social awareness, there must be a push to increase scientific understanding of separation techniques; and, if separation is not an option, how to improve quality of life for the twins. Over the past fifty years, craniopagus research has had two main focuses: surgical separation techniques and classification systems (Browd et al., 2008; Bucholz et al., 1987; O'Connell, 1976; Stone & Goodrich, 2006; Walker & Browd, 2004; Winston, 1976). Increasing our knowledge of surgical separation techniques and classification systems is of utmost importance to advance research on craniopagus twins; however, addressing the ongoing debate of classification systems should precede any consideration of separation techniques. A secondary research question, which is related to both areas of focus, is the question of how craniopagus twins form. While this is unknown, Spencer (2000a) argues that conjoined twins result from fusion of two embryonic disks. Specifically, Spencer (2000b) states that craniopagus twins may result from fusion of primitive neural folds. Nevertheless, without a concrete cause, prevention is not an option and the focus must be on treatment.

The precision of existent classification systems and their correct application are critical for those attempting to successfully separate craniopagus twins, since different junction sites present different complications (Browd et al., 2008). The first attempt at a craniopagus classification system was made by O'Connell (1976), who refuted the philosophy of classifying according to the site of cephalic junction. Instead, he stated that depth of junction was the most important aspect in determining survival after separation. O'Connell (1976) proposed a differentiation between partial and total craniopagus. Partial craniopagus, characterized by a small cephalic junction, has the possibility that each cranium is still intact. Conversely, total craniopagus would be characterized by a wide connection: two brains, one cranium. Additionally, O'Connell (1976) discusses three different subclassifications of total parietal craniopagus, or as he calls it, vertical craniopagus. Type I entails the twins facing the same direction; Type II entails the twins facing the opposite direction (inter-twin angle ≥ 140°); and Type III entails anything in between.

A decade later Bucholz et al. (1987) contested O'Connell's (1976) system, stating that the difference between partial and total craniopagus described was not precise. Instead, four different classifications were introduced: frontal, parietal, temporoparietal, and occipital. These classifications, unlike O'Connell (1976)'s system, are dependent on the specific location of the junction. Bucholz et al.'s

(1987) classifications are junctions of either the frontal bones, parietal bones, both the parietal and temporal bones, and occipital bones, respectively. Yet, literature on recent separation attempts does not support Bucholz et al.'s view; rather, it reinforces classification according to O'Connell's (1976) system by building on it (Browd et al., 2008; Parameswari, Vakamudi, Raghupathy, & Siddhartha, 2010). In addition to this new classification, Bucholz et al. (1987) also proposed a venous scale to classify the amount of venous drainage interrupted during surgery: (1) no venous drainage was interrupted; (2) only cortical veins were divided; (3) major dural sinuses were encountered and ligated in the course of separation (Bucholz et al., 1987). Venous drainage describes the extent of which a twin's blood may be drained from their brain, collected in a sinus, or reservoir, and then sent to the heart to be re-oxygenated. If this drainage is interrupted, blood may be prevented from leaving the brain, resulting in swelling which ultimately leads to neural damage. This venous drainage classification system, important to subclassify different cases of craniopagus, has the strongest correlation with survival and outcome of the separated twins. Classification of these systems has proven essential in separation attempts, as the presence of a shared venous system is now known to be the single largest risk factor for fatalities (Browd et al., 2008).

Recently, Stone and Goodrich (2006) added to O'Connell's (1976) system by further subclassifying total and partial craniopagus into vertical and angular. More specifically, they define total craniopagus as the twins sharing a significant venous sinus and partial as an absence of a shared venous sinus. They define angular as "an inter-twin longitudinal angle below 140°, regardless of axial rotation" (p 1084). Conversely, Stone & Goodrich (2006) define vertical as having a continuous cranium. Thus, their system is comprised of four major classifications: total vertical, total angular, partial vertical, and partial angular.

The most recent proposed classification scheme comes from Browd et al. (2008), who stress the importance of including important risk factors such as "connectivity between scalp, calvaria, dura mater, neural tissue, arterial and venous connections, deep venous drainage, and ventricular anatomy, as well as atrial and venous outflow" (p 5). They provide a score, between 10 and 28, with a higher value suggesting a more difficult separation.

Classification systems, coupled with significant advancements in imaging techniques, allow surgeons to better understand common and unique problems when presented with craniopagus twins (Browd et al., 2008). It has been shown that a surgeon's awareness of shared venous drainage is imperative for a successful separation of craniopagus twins (Bucholz et al., 1987), and Winston (1987) proposed that a classification system be developed based on the "deepest shared anatomical structure" (p 769). Despite huge advances in classification there are still significant areas missing. For example, there has yet to be a discussion of neural connections aside from their presence being correlated to higher incidence of neurological deficits following separation (Bucholz et al., 1987). Furthermore, Browd et al. (2008) are the first to document a classification system that takes complicated neural, vascular, and ventricular anatomy into account. However, there is still more research needed to understand how to classify shared neural tissue. The current classification systems led to Krista and Tatiana's shared circulatory

system being immediately recognized as a significant risk; nevertheless, classification failed to address their novel neural connection (Dominus, 2011a). Classification of neural connections may prove daunting, as variability in the connection is extreme; however, understanding the nature of neural connections may give surgeons the tool they need to remove the connection without causing neurological deficits. Surgical separation of craniopagus twins is a difficult task, perhaps the most formidable of all neurosurgery operations. Classification systems will help surgeons be aware of common problems, but surgeons must have a plan in place and be ready to tackle a host of obstacles once the twins are on the operating table.

Classification systems and imaging techniques aside, enhanced surgical and anesthetic techniques may be the most important factors contributing to the decreasing mortality rates seen in separated craniopagus twins (Browd et al., 2008; Bucholz et al., 1987; Girshin et al., 2006). Browd et al. (2008) indicate the importance of classifying surgical risk factors in order to determine mortality and the extent of surgery required. They then point to enhancing surgical techniques, stating that in the presence of a shared venous sinus, a staged separation is of great importance. In this series of surgeries – often six to eight – the surgeon's goal is to remove one of the twins from the shared sinus. This is done by slowly cutting bridging veins from the twin that will be removed from the sinus; the surgeon must not rush this process. Cutting too many bridging veins in one surgery may result in fatal bleeding (Browd et al., 2008). After each surgery, the venous system of the twin being removed will show increased blood pressure, resulting in angiogenesis, which is the formation of a new path towards their own deep venous drainage system (Browd et al., 2008). The process is repeated until one twin's drainage system completely bypasses the shared sinus, at which point the twins can be physically separated. Bucholz et al. (1987) first showed that this method provided the lowest mortality rate and best post-operative neural function. Huang et al. (2004) discuss a case in which a staged separation was not used. Serious complications arose, such as extreme blood loss and shock as a result of severe decrease in blood volume. These complications can be fatal, and they posed extreme challenges to the surgeons and anesthesiologists. By performing a staged operation, the surgeon avoids the most common complication associated with separating craniopagus twins: disastrous bleeding due to a shared venous drainage system (Browd et al., 2008).

Although staged separation was a key breakthrough in the surgical separation of craniopagus twins, carefully planned anesthetic management is crucial if the twins are to survive. Girshin et al. (2006) discuss the substantial benefits of using a staged separation and the challenges it poses to anesthesiologists. Namely, craniopagus twins must be put under and woken back up multiple times – each time with significant risk of complication. This is particularly troublesome since craniopagus twins often have other pulmonary and cardiac complications (Girshin et al., 2006). Additionally, if a shared circulatory system is present, medicine provided to one twin will affect the other twin while under anesthesia (Parameswari et al., 2010). These problems are significant but can be partially addressed by a strong pre-operative plan, the use of two separate anesthesia teams, and strong communication (Browd et al., 2008).

Another major complication may arise in surgery that is often missed by current imaging techniques, and is not currently addressed in existent classification systems (Browd et al., 2008): shared neural tissue. Shared neural tissue significantly decreases the chances of optimal neural function after separation (Bucholz et al., 1987). Oddly, this risk factor has rarely been discussed in the literature. The enormous complexity of a neural connection is daunting; however, current research must begin to approach this issue and how it may be addressed in separation attempts. As craniopagus cases are rare in humans, this research may need to begin with animal models. In the case of Krista and Tatiana Hogan, separation posed too many risks. Not only do they share cerebral circulation (possibly a shared venous sinus) but also a complex neural connection, a bridge on which information can go from one girl to the other.

The Thalamic Bridge

Krista and Tatiana possess what their pediatric neurosurgeon Dr. Doug Cochrane has called a "thalamic bridge" (Dominus, 2011a). To appreciate the significance of this, a current understanding of the role of the thalamus is essential. Blumenfeld (2010) introduces the thalamus as "an important relay centre" (p 35). Pinel (2011) adds that "the most well understood thalamic nuclei are the sensory relay nuclei – nuclei that receive signals from sensory receptors, process them, and then transmit them to the appropriate areas of sensory cortex" (p 66). Dr. Cochrane describes the way in which Krista and Tatiana are unique: when sensory information travels to their thalamus it branches into two routes. Krista and Tatiana's thalami receive neural inputs, and process and relay them to the appropriate brain area. The inputs also cross the thalamic bridge to the other girl's thalamus (Dominus, 2011a). Krista and Tatiana share sensory information. To share every sensory modality passing through the thalamus allows them to not only feel what each feels but even see out of each other's eyes. A fine example of this emerges in an interview of the girls and their mother (Dominus, 2011b). Their mother covers Krista's eyes and holds a plush pony in front of Tatiana. She then asks Krista what she is holding and Krista replies, "pony." In the New York Times article, "Could Conjoined Twins Share a Mind?" Susan Dominus (2011a) describes an unpublished study performed by Dr. Cochrane when the girls were just two-years-old. While recording electroencephalography, or brain waves, from both girls, Dr. Cochrane covered Krista's eyes and flashed a light in front of Tatiana. Increased electrical activity from both girls' brain's visual areas was recorded. The test also worked when the girls switched roles (Dominus, 2011a). Surface electroencephalography is imprecise in its ability to localize where activity is happening but the fact that there is increased activity in both recordings is incredible.

Krista and Tatiana's ability to share sensory information is extraordinary; however, the thalamus does more than simply act as a relay centre. As stated by Pinel (2011), sensory relay nuclei are only a portion of the nuclei in the thalamus and describe merely one of its functions. Although the exact mechanisms are still unclear, the reciprocal connections from the thalamus to cerebral cortex are heavily involved in moderating consciousness. Blumenfeld (2010) poses a theoretical system, "the consciousness system," that regulates level of consciousness. He discusses three aspects of this system: alertness, attention, and awareness. These three aspects are all, in part, mediated by nuclei in the thalamus such as the thalamic reticular nucleus, thought to preserve attention by gating information (Blumenfeld, 2010). Accordingly, it could be that as Krista and Tatiana age, it will become apparent that their levels of consciousness, which may affect spiritual understanding, self-actualization, and perception, stay very similar. As the thalamus is crucial in consciousness and sensory information processing, damage to it would be detrimental to Krista and Tatiana. This risk of damage, coupled with circulatory complications, led their physicians to conclude a separation would be too dangerous. Consequently, Krista and Tatiana are left with a connection that is both novel to documented research and exquisitely mysterious.

Continued Observation and Social Issues

Krista and Tatiana's thalamic bridge seems to connect one or more of their sensory modalities. It might also connect their levels of consciousness and perceptions of the world. Scientific exploration of this connection holds the potential to change modern society's view of individualism. Specifically, by observing Krista and Tatiana as they age, their unique concept of identity will become more apparent. Due to their connection, Krista and Tatiana will spend their entire life, as a pair, being extremely different from most people. Thus, as a pair, they paradoxically exemplify individualism. However, these girls face a challenge in individuality that has never been addressed. Although Krista and Tatiana have separate brains and personalities, they may share a common perception of their surroundings, which makes them rare even amongst craniopagus twins. Consequently, they embody the expression "seeing the world through someone else's eyes." The emotional repercussions of this ability are, at this time, a mystery; however, through observation, Krista and Tatiana's relationship may serve as an example of how empathy is expressed in its truest form. They will feel each other's pain and may struggle to differentiate their own sensations from their sister's sensations. Krista and Tatiana will struggle to find individual identity – as we know it. Their version of individual identity will, perhaps, be as half of a pair. They are described as using the word "I" to refer to the other twin; however, they are aware they are two separate people (Dominus, 2011a). Krista and Tatiana's conception of "I" may be different from everyone else's.

The twins' inability to differentiate between the personal and their sister may be one behavioural consequence of their neural bridge; in that, their inability to distinguish between their own sensations and those of their sister may confuse their sense of identity. Continued observation of Krista and Tatiana may result in the finding of other behavioural consequences caused by their thalamic bridge, which could further our understanding of the thalamus and individuality. Furthermore, the sharing of identity, levels of consciousness, and perhaps thoughts, has implications for our understanding of the philosophy of mind. If Krista and Tatiana share these complex notions of identity and thought – commonly associated with "the mind" as opposed to "the body" – it implies the mind may be shared through a physical bridge. The mind may not be separate from the body, but housed within it. Although the notion that the mind and brain are one is not new, Krista and Tatiana's case may further strengthen our understanding of how and where the

mind is housed in the brain. Despite the endless scientific advances Krista and Tatiana may provide, one must remember: they are individual girls, but, more importantly, an individual pair of girls. For us to understand how being part of a pair is more important than being an individual to one's identity, we must shift our perspective and eliminate our preconceived notions of individuality. Also, it is crucial that researchers be aware of the ethical complications coupled with pursuing research on the girls. Apart from possible developmental consequences, it may enhance the social stigma they already face. Additionally, the question of their voluntary consent must also be taken into account. Krista and Tatiana will face challenges arising from the possession of an ability no one in the world can fully understand. They simultaneously epitomize individuality as a pair while facing individual struggles never before seen.

Declaration of Conflicting Interests

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

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CLINICAL
Literature Review

Pedophilia and brain function

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Abstract

Pedophilia is defined as a sexual deviation in which an adult is sexually attracted to a prepubescent child. With relatively high prevalence rates and growing public concern over this issue, there has been a need to empirically investigate the neuropsychological basis of pedophilic behaviour. This literature review examines the resulting research, starting with research identifying the differences displayed in pedophilic individuals in IQ scores as compared to the general population. The developmental onset of pedophilia may also be linked to abnormal brain morphology: neurological structures in both the frontal/dysexecutive hypothesis and the temporal/limbic hypothesis have been proposed to be associated with pedophilia. Morphological differences between pedophilic individuals and non-pedophilic individuals have been further substantiated by the link between left-handedness and a diagnosis of pedophilia. Developmental reports of childhood head injury further support this claim, as pedophiles are more likely to have experienced head trauma at an early age. Finally, modern brain imaging studies have enabled researchers to discover that those individuals diagnosed with pedophilia display altered brain activity when presented with sexual stimuli in comparison with those not diagnosed. It must be emphasized that all of the findings may contain an innate bias due to the social denigration that is attached to research conducted on known pedophiles.

Keywords: *pedophilia, brain function, neurobiology, neurology*

Pedophilia is considered a psychiatric disorder, which is characterized by statistically abnormal sexual urges and behaviours in adults directed towards prepubescent children (American Psychiatric Association, 1994). Typically, this sexual desire for prepubescent children surpasses the individual's sexual desire for physically mature adults and exists predominately in men (Freund, 1981). The media has heightened the public's awareness of deviant sexual behaviour, as evidenced by the popular reality television program *To Catch a Predator*, perpetuating a growing societal-level concern. The sexual exploitation of children has been documented in various cultures around the world (Bauserman, 1997; Ford & Beach, 1951), which has motivated the creation of international sex offender legislation (Newman et al., 2011). In the USA, the prevalence of child molestation is at an

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estimated 100,000 to 200,000 cases every year (Gorey & Leslie, 1997), underscoring the need to understand the underpinnings of this disorder, including the neurobiological aspects of this condition. This review will examine scientific evidence supporting hypotheses in the literature that brain function differs between pedophiles and non-pedophiles.

Early Work – IQ

It has been hypothesized that brain dysfunction contributes to sexual criminology since the 19th century (Krafft-Ebing, 1886/1965). Early studies into cognitive functioning assessed the general intelligence or Intelligence Quotient (IQ) of sexual offenders (Frank, 1931), and these assessment techniques were subsequently adopted into the common battery of tests administered to pedophiles by many researchers in the field. Subsequent research found that child sexual offenders score lower in intelligence than age- and socioeconomically-matched individuals (Langevin et al., 1985). Furthermore, when compared to convicted offenders of non-sexual crimes, child sexual offenders continue to score lower on measures of intelligence (Hambridge, 1994). In further support of this pattern of lowered intelligence test scoring, research suggests that child sex offenders have lower intelligence test scores than sex offenders who target adults (Blanchard et al., 1999). Results from a large meta-analysis done by Cantor et al. (2005) indicated that there is a specific relation between IQ and the age of the child victims targeted by sex offenders: the average IQs of males who molested children age 13 or younger were lower than the IQs of men who molested children between age 13 and 17. Based on the extensive research done in this area to date, it seems that the average IQ scores of pedophilic individuals are lower in comparison to various control groups, and that their intelligence scores decrease along with the age of their victims. Using other neurological assessments, Schiffer and Volaufen (2011) found that child molesters showed executive dysfunction concerning response inhibition. Such research provides convincing evidence that child sex offenders may have decreased cognitive neuropsychological functioning.

While these observations provide useful evidence, there is an alternate interpretation of the apparent relationship between intelligence and child molesting: less intelligent pedophiles may be more likely to be apprehended, and low socioeconomic status due to relatively low intelligence may render these offenders unable to afford the most effective legal representation. Perhaps the less intelligent pedophiles are more likely to be convicted due to the influence of these other variables. Unfortunately, researchers only have access to known (accused or convicted) child molesters. Because of legal implications and moral condemnation, pedophiles have little or no incentive to reveal their sexual attraction to children for the purposes of research studies. Not surprisingly, even those individuals who have documented sexual histories suggesting symptoms of the disorder will often outright deny sexual interest in children (Brown, Gray, & Snowden, 2009). In addition, since sexual offences against children committed by women are estimated to constitute only 0.4% - 4% of all convicted sexual offenders (Maletzky, 1993), research studies tend to focus on male subjects and the results may not be applicable to females for this reason. Thus, the pool of possible research participants may be limited to male sexual

child offenders who have been caught, accused, or convicted. This is a clear limitation to the research conducted in the area.

Hypothesis on the Development of Pedophilia

There are two main hypotheses concerning the development of pedophilia and sexual offending: the frontal/dysexecutive hypothesis and the temporal/limbic hypothesis (Blanchard et al., 2006). The frontal/dysexecutive hypothesis predicts that neurological deviations occur in the prefrontal cortex (which may be responsible for planning, decision making, and conforming to social norms), producing an inability to inhibit sexual urges (Yang & Raine, 2009). The temporal/limbic hypothesis suggests that pedophilia may be related to abnormalities within structures in the temporal lobe, which has been associated with hypersexuality. Hypersexuality is the tendency to seek out sexual activity with both appropriate and inappropriate partners or objects at appropriate or inappropriate times. This pattern of behaviour is one of many of the behavioural manifestations of Kluver-Bucy syndrome in which individuals have damaged or ineffective temporal lobes (Baird et al., 2002). Kluver-Bucy syndrome is a behavioural disorder caused by bilateral temporal lobe malfunction, and the disease is characterized by both cognitive and sexual disturbances including visual agnosia (the inability to associate meaning with visual stimuli), oral tendencies (examining objects or surroundings with the mouth), reduced sexual inhibition, and increased sex drive (Ozawa et al., 1997). Damage to the temporal lobe is also responsible for speech and language deficits, which may explain why pedophiles have difficulty relating to adults and therefore become attracted to children (Marshall et al., 2000).

Head Preference and Head Injuries

Another line of research investigating hand preference (handedness) has provided evidence relating brain dysfunction to pedophilia. Bogaert (2001) demonstrated that pedophiles have a higher incidence of left-handedness and these results remained significant after IQ and age were controlled for (Cantor et al., 2001). While it may be the case that pedophiles with lower IQ are more likely to be caught by the law, this argument does not hold true in the case of left-handed pedophiles. Therefore, the correlation between left-handedness and pedophilia indicates a unique characteristic of the disorder and handedness may suggest neurological differences as well. It has been well documented that disrupted perinatal neurodevelopment increases the likelihood of becoming left-handed (Coren & Halpern, 1991). For example, individuals who have experienced insults to neurodevelopment such as birth stress (Williams, Buss, &, Eskenazi, 1992), ultrasound (Kieler et al., 2001), neurotoxins (Biro & Stukovsky, 1995), and prematurity (Marlow, Roberts, & Cooke, 1989) have higher rates of left-handedness than controls. Therefore, disruptions in perinatal development of the brain may be related to the diagnosis of pedophilia.

Because of the possible differences in the neurological development of pedophiles compared to controls, researchers have studied whether childhood injuries to the head have associations with pedophilic tendencies. Indeed, an association seems to exist. For example, Blanchard et al. (2002) found that accidents in childhood leading to unconsciousness were associated with pedophilia, lower IQ, and lower levels of education. Later studies provided further

evidence that pedophiles reported more head injuries before the age of 13 than non-pedophilic controls (Blanchard et al., 2003). One possible interpretation of these results is that brain damage after birth increases the probability that a male will develop pedophilia, falling in line with the observation that pedophilic populations have a higher incidence of left-handedness.

Brain Imaging Studies

More recent studies using modern imaging techniques such as positron emission tomography (PET) and functional magnetic resonance imaging (fMRI) allow for the depiction of neural activity within individuals. These technologies are useful in identifying specific areas of the brain and their differential responses to identical stimuli. For example, studies in this area may be able to identify differing patterns of activity in pedophiles compared to non-pedophiles.

Using fMRI, Walter et al. (2007) found abnormal brain activity in the hypothalamus, periaqueductal gray, and dorsolateral prefrontal cortex (DLPFC) in response to adult visual-erotic stimulation in heterosexual pedophiles. Walter et al. (2007) suggested that because these regions are involved in the emotional components of sexual arousal (Ferretti et al., 2005), dysfunction within these areas may be involved in the lack of sexual interest towards adults. Through case study investigations and brain anatomy studies, morphological changes in the prefrontal cortex, ventral striatum (reward center), and regions of the temporal lobes have also been found (Mendez et al., 2000; Burns & Swerdlow, 2003; Schiffer et al., 2007). These studies provide support for the temporal/limbic hypothesis. Furthermore, Schiffer et al. (2008) found that when presented with erotic stimuli featuring children, structures corresponding to areas of the brain involved in sexual arousal and behaviour (the thalamus, globus pallidus, and striatum) were significantly more highly activated in pedophiles compared to controls.

While only a few studies are summarized here, the differential brain activation patterns described in the aforementioned studies lend strong support for the suggestion that pedophiles show differences in brain function in response to erotic and sexual stimuli compared to controls.

Conclusion

The cross-cultural and widespread prevalence of pedophilia have necessitated academic efforts to understand the neurobiological underpinnings of brain structure, function, and development in relation to altered sexual tendencies. While traditional methods in the form of IQ tests, retrospective head injury studies, and hand preference statistics have suggested neurological differences in pedophilic individuals, modern studies using advanced imaging technologies have provided a glimpse into the complexity of this psychiatric disorder, which may be influenced by the interplay of multiple neurological structures. The studies discussed in this paper have pointed to the reduced neurocognitive abilities and abnormalities in brain function among pedophiles; however, more research is needed to gain a complete understanding of the mechanisms underlying pedophilia.

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Too much sex, a mental disorder? Examining both sides of the debate on hypersexual disorder

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Abstract

In recent decades, the concept of pathological, excessive sexual behaviour has been a source of ongoing controversy. This controversy is centered on defining the characteristics of excessive sexual behaviours and the extent to which these behaviours should be considered pathological. This debate was intensified after Kafta (2010)'s proposed the inclusion of hypersexual disorder in the DSM-5. According to Kafta's proposal, for a person to be diagnosed with the disorder, he or she must have recurrent and intense sexual fantasies, urges, and behaviours which are not due to direct physiological effect of a drug-related substance and which cause significant personal distress or impairment (American Psychiatric Association, 2010). This literature review is intended to examine whether or not hypersexual disorder should be included in the DSM-5 based on current research literature in the field. Arguments for and against its inclusion in the DSM are reviewed. In sum, there is still a lack of consensus on the specific criteria for diagnosis, the theoretical approach to the disorder, and on how to measure hypersexual sexual behaviour; thus it is still too premature to include hypersexual disorder in the DSM.

Keywords: *hypersexuality, sexual addiction, sexual compulsive disorder, sexual disorder, DSM-5*

Excessive sexual behaviours have long been discussed and described in Western medicine. As early as the 1940s, terms such as nymphomania and Don Juan Syndrome were used to describe excessive sexual desire or behaviours (Rinehart & McCabe, 1997). In 1983, Carnes proposed the concept of sexual addiction as a diagnosable and treatable mental disorder in his controversial book, *Out of the Shadows: Understanding Sexual Addiction*. Carnes (1983) suggested that sexual addiction stems from an inability to effectively control one's sexual desires or behaviour. Over the recent decades, the concept of pathological, excessive sexual behaviour has been an ongoing source of controversy. This controversy is centered on defining the characteristics of excessive sexual behaviours and the extent to which these behaviours should be considered pathological. New labels for excessive sexual

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behaviours, such as "compulsive sexual behaviour" (Coleman, 1990), "hypersexual disorder" (Kafta, 2010) and "paraphilia-related disorders" (Kafka, 1997), have since been introduced.

This debate was intensified after Kafta (2010) proposed the inclusion of hypersexual disorder in the fifth edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-5). In his proposal, hypersexual disorder is conceptualized as a sexual desire disorder with an impulsivity component. For a person to be diagnosed with this disorder, he or she must have recurrent and intense sexual fantasies, urges, and behaviours which are not due to the direct physiological effects of a drug-related substance and which cause significant personal distress or impairment in social, occupational or other important areas of functioning (American Psychiatric Association, 2010). Examples of the sexual fantasies, urges and behaviours specified in the proposal include masturbation, cybersex, telephone sex, viewing pornography, and visiting strip clubs, and they are said to have the potential to become excessive (American Psychiatric Association, 2010). According to *U.S. News and World Report* (2010), if the proposal is passed by the DSM-5 Working Groups, hypersexual disorder may appear in the DSM by 2012. In this review, I will focus on the controversy surrounding hypersexual disorder by examining arguments for and against the inclusion of hypersexual disorder in the DSM-5.

There are three main arguments for the inclusion of hypersexual disorder in DSM. First, as stated by the DSM-5 Work Group, many mental health professionals have expressed the clinical need for such a diagnosis (American Psychiatric Association, 2010). There seems to be a distinct group of men and women who have been seeking clinical help for their "out of control" sexual desire and behaviour. The adverse consequences associated with this condition include significant marital dysfunction (Muench et al., 2007), a higher risk of sexually transmitted infections (Langstrom & Hanson, 2006; McBride, Reece & Sanders, 2008), unwanted pregnancies (Henshaw, 1998; McBride el al., 2008) and work and/or educational role impairment (Cooper, Golden, & Kent-Ferraro, 2002). Many health clinics offer treatments such as 12-step group support, individual psychotherapy and pharmacotherapy for these individuals (American Psychiatric Association, 2010). Currently, these people are diagnosed using the rather unsatisfying label, "Sexual Disorder Not Otherwise Specified" under DSM-IV-TR. An increase in clarity in the diagnostic criteria for such conditions could provide a starting point for testing and refining the proposed diagnostic criteria. It could also facilitate and stimulate more research in this area and consequently enhance the quality of treatments.

Secondly, this group of people that are seeking clinical help for their out-of-control sexual behaviours can be distinguished from non-clinical samples by their increased expressions of normative sexual desire (Kafta, 2010). Over the past decade, Kafka has conducted numerous studies examining clinical samples of men with paraphilia-related disorder, which is another term for hypersexual disorder used in the research literature (e.g., Kafta, 1997; Kafta & Hennen, 2003). He consistently found that this group of men was characterized by having seven or more orgasms per week (Kafta, 1997; Kafta & Hennen, 2003). This frequency of orgasms is two or three times greater than those observed in studies investigating average male undergraduate participants' sexual behaviour and experiences (Pinkerton,

Bogart, Cecil, & Abramson, 2002). In his research paper, Kafta (1997) expressed a genuine concern for the men in his clinical sample, citing that the majority were married men with a mean age of thirty-six, and masturbated more times per week on average than single men in their early twenties.

Several empirical studies based on non-clinical samples also found that a small proportion of men's and women's sexual experiences were characterized by excessive sexual desire and behaviour. For example, Kinsey, Pomeroy and Martin's (1948) famous study employing a large non-clinical sample of 5,300 American participants reported that only 8% of American men had weekly orgasm frequencies totalling seven or more. A subsequent investigation of high school and college men also found that only about 3% to 5% of American men masturbated on a daily basis, suggesting that they were experiencing at least seven orgasms per week (Atwood & Gagnon, 1987). In contrast to these relatively high frequencies of masturbation and orgasm, a 2010 research study indicated that the average male undergraduate student only masturbates three times per week (Pinkerton et al., 2002). Based on this empirical evidence, Kafta (2010) proposed that hypersexuality could be operationalized as a weekly average of seven or more orgasms over a period of at least six months.

Many researchers argue that hypersexual disorder stems from genuine psychological and behavioural dysfunction that can cause functional impairment and personal distress, and thus should be considered a mental disorder. For example, Stein (2008) stated that hypersexual disorder is caused by a dysfunction of the neural circuits of the reward system in the brain, particularly the amygdala and the ventral striatum, which is also associated with other addictive pathological disorders such as alcohol addiction and pathological gambling. Stein's hypothesis is derived from the addiction model that has been proposed to explain the etiology of hypersexual disorder (Carnes, 1984). According to the Carnes' (1984) addiction model, people who experience excessive sexual fantasies and behaviours often fail to control or reduce the frequency of their sexual activities and continue to engage in such activities despite a plethora of adverse consequences, such as the potential increased risk of contracting STIs and/or the instigation of marital and relationship dysfunction. This behaviour pattern is similar to that seen in drug addiction. Another analogue to drug or alcohol addiction is that these individuals may also experience withdrawal symptoms such as depression, anxiety and guilt. The popular 12-step recovery program for "sex addicts" is built upon this theoretical approach. Wines' (1997) study including 53 participants who identified themselves as sex addicts offered empirical support for the addiction model. More than 94% of the participants in this investigation reported failed attempts to stop or reduce their sexual desire or behaviours and 98% reported three or more withdrawal symptoms, such as depression, insomnia and fatigue.

Other researchers such as Coleman (1990) suggest that hypersexuality is associated with compulsivity. Unlike the addiction model that focuses on the failure to control one's sexual behaviour, the compulsivity model of hypersexual behaviour emphasizes the intrusive sexual fantasies and irresistible urges associated with hypersexual disorder. According to this model, some individuals have compulsive urges to engage in repetitive sexual

behaviour in order to reduce anxiety and other dysphoric effects such as shame and depression (Coleman, 1990). Based on this model, Kalichman and Rompa (1995) developed the Sexual Compulsivity Scale (SCS). Several studies have demonstrated the reliability and validity of SCS (Dodge et al., 2004; McBride et al., 2008). Higher scores on the SCS are correlated with an increase in frequency of masturbation and an increased number of risky sexual behaviours, such as engaging in sexual behaviour with large number of partners or the constant failure to use condoms when engaging in casual sexual intercourse (Dodge et al., 2004; McBride et al., 2008). This scale's high reliability and validity indicate that sexual compulsivity may indeed be a valid psychological construct.

Based on the addiction and compulsivity models of hypersexuality, hypersexual disorder shares common etiologies with alcohol addiction and obsessive-compulsive disorders, which are highly co-morbid with other mood disorders and developmental disorders (disorders that hinder children's motor or cognitive development). Therefore, it is reasonable to suspect a high co-morbidity rate between hypersexual disorder and other psychiatric disorders, such as depression, general anxiety disorder and attention deficit hyperactive disorder. Indeed, many research studies have found that excessive or compulsive sexual behaviour is often co-morbid with many other disorders in Axis I of the DSM such as those mentioned above. For example, Black et al. (1997) interviewed 36 participants who exhibited compulsive sexual behaviour. The researchers reported that 37% of the sample had a history of major depression and 42% had a history of phobia disorder. In a recent study, Raymond, Coleman and Miner (2003) reported similar findings. They interviewed 25 participants who reported sexually compulsive behaviour and found that 88% of the participants also met diagnostic criteria for an Axis I disorder, the most common disorders being anxiety and mood disorders.

However, Kafta (2010) argues that because not all people exhibiting hypersexual behaviour meet the criteria for a co-existing mood or anxiety disorder, hypersexual disorder may reflect a distinct underlying psychopathology. Based on the high co-morbidity rate and the current theoretical approaches to hypersexuality, Kafta (2010) concludes in his proposal that hypersexual disorder is a genuine psychopathology, which is associated with a loss of control over sexual behaviour and the maladaptive use of sexual behaviour in response to negative emotions or other life stressors.

In contrast, opponents have put forth four major arguments against the inclusion of the hypersexual disorder in the DSM. First, many researchers have questioned the validity of the diagnostic criteria proposed by Kafta (2010). Some researchers have raised doubt about the validity of Kafta's operationalization of hypersexual behaviour as a weekly average of seven or more orgasms (Kingston & Firestone, 2008; Winters, 2010). Recent data has failed to support Kafta's proposal that a weekly average of at least seven orgasms will only capture a small proportion of the population that could potentially be diagnosed with hypersexual disorder. For example, Winters, Christoff and Gorzalka (2010) conducted a study using a large community-based convenience sample and found that 44% of men and 22% of women reported a total weekly orgasm count of seven or more. Because of lack of support for the Kafta's original operationalization of hypersexual

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behaviour, Kafta has removed this controversial criterion from his most recent proposal for hypersexual disorder (Kafta, 2010). Without empirical support for criteria to identify hypersexual disorder, it becomes a challenge for clinicians to make accurate diagnoses and to include hypersexual behaviour as a disorder in the DSM-5.

Many researchers have also questioned the utility of pathologizing individuals' pursuit of sexual behaviours to enhance mood or as a strategy aimed to reduce stress (Moser, 2010; Winters, 2010). Many people engage in other rewarding activities, such as hobbies and work, to alleviate negative mood or to relieve stress, even if it may impair other aspects of their lives such as their marital relationship. Additionally, Kafta's interpretation of the high co-morbidity rate of hypersexuality with other DSM disorders has also been criticized. Both Moser (2010) and Winters (2010) have questioned the directionality of the correlation between hypersexual behaviours and other mental disorders. They argue that this high co-morbidity simply reflects the fact that hypersexuality may be a symptom of other disorders. Some people may use sexual fantasies and behaviours to alleviate the negative emotions that stem from their underlying mood and anxiety disorders (Winters, 2010). Therefore, if the underlying disorder(s) are treated, the maladaptive sexual fantasies and behaviours should also be ameliorated (Winters, 2010). In short, opponents argue that there is insufficient data in support of the diagnostic criteria proposed by Kafta (2010).

The second major argument against the inclusion of the hypersexual disorder in the DSM points to a myriad of methodological flaws in hypersexuality research. The majority of research studies in this area are based on self-report measures from small clinical samples without valid comparison groups. For example, most of Kafta's research studies on paraphilia-related disorders were based on clinical samples who sought help for their hypersexuality (e.g. Kafta, 1997; Kafta & Hennen, 2003). These clinical samples may vary systematically from those who did not seek treatment for excessive sexual behaviours. In Winters et al.'s (2010) study comparing a treatment sample with a non-treatment sample, it was found that men who sought treatment for their excessive sexual behaviours were more likely to belong to an organized religion and to feel that that religion was essential to their lives. This difference could impact the results of studies in this area, as previous studies have found that increased religiosity is correlated with negative sexual attitudes (De Visser et al, 2007). Therefore, it may be especially distressing for individuals high in religiosity to have high sexual desire and this may make them more likely to seek treatment.

In addition, the majority of studies in this area rely on retrospective reports of symptoms. For example, Wines' (1997) study (cited in Kafta's proposal) was a retrospective study based on participants who identified themselves as sex addicts and who participated in the Twelve-Step Alcoholics Anonymous-type program. Kaplan and Krueger (2010) have noted the limitations of these retrospective designs, including inaccurate and exaggerated reports of the frequency and severity of symptoms. It is possible that the men seeking treatment are highly motivated to change their sexual behaviours; thus they are more likely to over-estimate the severity of their symptoms before treatment.

The third main argument against the inclusion of hypersexual disorder in the DSM centers on the lack of consensus around the theoretical approach behind the disorder and the lack of solid empirical evidence for each proposed theoretical approach. The addiction model and the sexual compulsivity model mentioned in Kafta's (2010) proposal remain controversial. The aforementioned methodological flaw present in retrospective data has made Wines' (1997) findings very difficult to interpret and thus limits their ability to lend solid support for the addiction model. Upon reviewing the literature on the addiction model, Kafta (2010) also concluded in his proposal that there is a lack of empirical evidence for a specific withdrawal state and tolerance symptoms in hypersexual disorder, which are parallel with those in other addiction disorders. Thus, further studies are needed to support the utility of this model.

Although the sexual compulsivity model has received more support than the addiction model, several studies have failed to support this model. For example, Quadland's (1985) study, comparing results from participants seeking help for their compulsive sexual behaviour to those of matched controls seeking clinical help for non-sexual problems, found no group differences in mood or anxiety disorders. In his comprehensive review of 30 patients who volunteered themselves for clinical interventions for excessive sexual behaviour, Levine (2010) concluded that half of the sample was inadequately described using addiction and compulsivity models. In the majority of cases, participants sought treatment because their spouses criticized them as being "sex addicts", reflecting a sexual desire incompatibility between partners, not a sexual disorder (Levine, 2010).

Another theoretical approach has been introduced to overcome the limitations of previous models, namely, the dual control model (Bancroft & Vukadinovic, 2004). This model suggests that sexual arousal is determined by a balance between the sexual activation system and the sexual inhibition system in the brain (Bancroft & Vukadinovic, 2004). According to this model, people with a particularly high propensity for excitation or low propensity for inhibition are more likely to engage in problematic or excessive sexual behaviour. This new approach has received increasing research interest and has been tested against other models. If this model receives sufficient empirical evidence in the future, it would become necessary to incorporate it into the diagnostic criteria for hypersexual disorder.

In order to fulfill the DSM's criteria for a mental disorder, hypersexual disorder must manifest as a genuine psychological or behaviour dysfunction (American Psychiatric Association, 2009). Therefore, it is important for researchers in this area to arrive at some consensus on the explanation of hypersexual disorder (Winters, 2010). Until such consensus has been reached, it may be premature to include this disorder in the DSM-5.

The fourth argument against the inclusion of the hypersexual disorder in the DSM is focused on criticisms concerning the concept of "hypersexuality" itself. Gagnon and Simon (1973) introduced the term "sexual scripts" to refer to a set of social norms and values that govern the sexual behaviour of a specific cultural group. Different cultures vary widely in their sexual scripts and this may account for the large variations in what cultures regard as normative sexual expression (Levine & Troiden, 1988). For example, some cultures hold "sex-positive" scripts, in which high

level and wide variety of sexual activities are considered be normal; other cultures hold "sex-negative" scripts in which low sexual activities are deemed to be more appropriate. In criticizing the concept of sexual compulsivity, Levine and Troiden (1988) contrast a "sex-positive" Mangaia culture and a "sex-negative" Irish culture:

> *Among the sex-positive people of Mangaia, casual sex with different partners, and frequent intercourse with multiple orgasms are perceived as sexually normal….[In contrast], the sex-negative Irish…. consider abstinence and monogamy as normative and typically report low levels of sexual desire and low frequency of sexual intercourse (p.351-352).*

Moser (2001) suggests that in pathologizing mental disorders, innate therapist and cultural biases should be avoided. However, as shown by the examples above, hypersexuality is by no means free of cultural biases. Many researchers caution that the pathologizing of hypersexuality may cause clinicians with conservative or negative attitudes towards sex to impose a pathological label on normal sexual behaviour (Kaplan & Krueger, 2010; Moser, 2001). Halpern (2011) also addresses the possible legal consequences of misusing the concept of hypersexuality. If hypersexual disorder is included in the DSM without solid empirical evidence supporting the validity of such a disorder, arrestees charged with violations of laws prohibiting child pornography or with other sex offences may be able to claim that they were afflicted with hypersexual disorder, and be absolved of their charges or be allowed more lenient sentencing (Halpern, 2011).

Having considered both sides of the argument, I feel that there is not enough empirical evidence to show that hypersexual disorder represents a genuine psychological or behavioural dysfunction, thus it is still too premature to include it in the DSM. Although DSM-5 Work Group argues that the inclusion of the disorder in the DSM stimulates research, this argument in itself cannot be grounds for its inclusion (American Psychiatric Association, 2010). The lack of a diagnostic label has not hindered research in this area, as evidenced by the large number of research studies done on this topic in recent decades. Proponents also argue that hypersexual disorder is a genuine mental disorder and individuals afflicted with this disorder can be identified by meeting the criterion of having a weekly average of at least seven orgasms (e.g. Kinsey et al., 1948; Kafta, 2010). However, the lack of consensus on the specific criteria of the diagnosis, the theoretical approach of the disorder, and the measurement of hypersexuality demonstrate that there is still insufficient evidence to support hypersexual disorder as a genuine psychological disorder. Furthermore, many of the research studies supporting the models for the disorder have foundational limitations in methodology, such as small sample sizes, the use of clinical samples, and retrospective designs. These methodological limitations severely compromise the analysis and generalizability of research findings.

Considering opponents' concern about the possible misuse of the concept of hypersexuality, a more solid research foundation needs to be established in order to suggest that hypersexuality is a genuine psychological or behavioural dysfunction. This needs to be established before it can be included in the DSM. Further research should continue to test long-standing and

current theoretical models as they apply to hypersexual disorder, and should use more community-based samples and employ a variety of methodologies. Specifically, more rigorous research is needed to establish the links between human neurobiology and different models of hypersexual disorder in order to rule out models that are less valid. To address opponents' criticism that hypersexuality is a value laden and culturally biased disorder, more cross-cultural research is also needed to examine both normative and excessive sexual behaviours in different cultural contexts. As with many studies examining complex human social behaviours, research on hypersexuality should not be limited to convenience samples of North American undergraduate students and should include adult participants of all ages from a wide variety of cultural and religious backgrounds.

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

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CLINICAL
Research Report

Startle reflex as a physiological measure of emotion regulation

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Abstract

In the present study, the startle blink reflex is used as a measure of emotion regulation to affective picture stimuli. Based on the biphasic theory of emotion, it is hypothesized that the startle response will be largest in magnitude in the presence of negative emotional stimuli (Vrana, Spence, & Lang, 1988). It is also hypothesized that when attempting to decrease emotion, participants will show smaller blink magnitudes to negative images, and larger blink magnitudes when attempting to decrease emotion to positive images due to the aversive nature of the startle reflex. The present study highlights the difficulty of finding emotion regulation to positive images with the startle blink paradigm. Participants were 6 female undergraduate students who viewed negative, positive and neutral affective picture stimuli, and attempted to either maintain or suppress their emotional responses to the images. Emotion modulation of the startle response was recorded before regulation instruction onset. Significant differences were found in blink magnitude for emotion modulation between positive and negative images, but neutral images were not significantly different from either. For negative images, blink magnitudes during emotion suppression were significantly smaller than when maintaining emotion. No significant regulation differences were found for the positive images.

Keywords: *psychophysiology, emotion regulation, emotion modulation, startle blink*

Emotion regulation can be thought of as consciously or unconsciously altering one's behavioural, cognitive, and/or physiological emotional response tendencies towards a goal (Gross, 1998). The ability to regulate emotions is important for both mental and physical well-being, and social interaction (Kim & Hamann, 2007). Dysfunction in emotion regulatory abilities has been thought to play a role in many forms of psychopathology, such as anxiety, depression (Davidson, 2000; Jackson, Larson, & Davidson, 2000), and eating disorders (Clyne, Latner, Gleaves, & Blampied, 2010; Harrison, Sullivan, Tchanturia, & Treasure, 2010; Whiteside, Chen, Neighbors, Hunter, Lo, & Larimer, 2007). Understanding possible mechanisms associated with emotion regulation difficulties are essential to addressing these problems in clinical populations. Although emotion regulation deficits are a core feature of many forms of

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psychopathology, physiological evidence of these emotion regulatory deficits is severely lacking. A large body of research that has been used to correlate psychopathology and emotion regulation has been self-report, (Aldao & Nolen-Hoeksema, 2010; Whiteside et al., 2007) and the ability of individuals to accurately assess their own emotion regulatory abilities has not been confirmed. Little research exists that overtly examines emotion regulation and its possible deficits in an experimental setting using psychophysiological measures of emotion regulation.

The startle blink paradigm is an advantageous physiological tool as it has the ability to differentiate between positive and negative emotional states. This paradigm involves administering a loud blast of white noise, which acts to startle the participant causing their eyes to twitch reflexively. This startle reflex is measured using electromyographic (EMG) sensors placed on the *obicularis oculi* muscle below the left eye. The startle reflex triggers the defensive aversive response of the biphasic appetitive-aversive dimension of emotion; this automatic response is enhanced when the emotional context matches the reflex (Vrana et al., 1988). Funayama, Grillon, Davis, & Phelps (2001) found that the startle response is mediated by the right medial temporal lobe, specifically the amygdala, which plays a key role in aversive or negative emotional states, supporting the theory that the startle response is an aversive reflex. Therefore, the startle response is expected to be potentiated, or larger in magnitude, when it occurs in the presence of aversive emotional states (Lang, Bradley, & Cuthbert, 1990; Vrana et al., 1988). Along the same reasoning, one would expect that in the presence of appetitive or positive emotional states the startle reflex would be attenuated, or smaller in magnitude, due to a mismatch between the reflex and the emotional context (Lang et al., 1990; Vrana et al., 1988). Indeed, research has shown that the startle blink reflex is an effective measure of emotion modulation, with the startle reflex being potentiated in the presence of negative emotions, attenuated in the presence of positive emotions, and moderate in size when there is a lack of emotion (Bradley, Cuthbert, & Lang, 1991; Vrana et al., 1988). An increase in startle magnitude from positive, neutral, to negative emotional contexts has been found when emotions are elicited using visual stimuli (Bradley et al., 1991; Vrana et al., 1988), olfactory stimuli (Miltner, Matjak, Braun, Diekmann, & Brody, 1994), narrative stimuli, such as remembering events (Cook, Hawk, Davis, & Stevenson, 1991), and threat of shock paradigms (Greenwald, Bradley, Cuthbert, & Lang, 1998; Lissek et al., 2007).

Research showing that the startle blink response is an effective measure of emotion regulation to affective stimuli is less conclusive. The conditions common to emotion regulation research are: “maintain”, which instructs participants to focus on their emotional response to the stimuli without changing it, “suppress”, which involves decreasing emotional response, and “enhance”, which involves increasing emotional response to a stimuli (Eippert et al., 2007; Jackson et al., 2000; Lissek et al., 2007; Ray, McRae, Ochsner, & Gross, 2010). Jackson et al. (2000) found both emotion modulation and subsequent regulation to negative pictures compared to neutral. Replication studies by Lissek et al. (2007), which included a threat of shock paradigm, and Lee, Shackman, Jackson, & Davidson (2009) had similar findings of modulation and regulation to aversive contexts compared to neutral.

In concordance with previous research, Eippert et al. (2007) and Ray et al. (2010) found larger blink magnitudes for the negative images from the enhance condition compared to maintain and suppress conditions. However, both studies failed to find significant startle blink differences for the suppress condition compared to the maintain condition. One possible reason for this finding is that the timing of the probes may have been too early to accurately detect suppression, occurring 2 s after the regulation cue compared to the common 3 s delay (Eippert et al., 2007). In further support of this argument, fMRI results showed suppressed amygdala activity during the suppress condition compared to the maintain and enhance conditions, but the suppressed activation occurred after the startle probe measured regulation. Another possible explanation for both studies failing to detect significant regulation of the startle response for the suppress compared to the maintain cue is that both focused only on reappraisal as an emotion regulation technique, as opposed to subjects choosing their own regulation strategies. Perhaps cognitive reappraisal, a cognitive strategy that involves re-evaluating the meaning of an emotional stimulus (Gross, 1998), is not the most effective negative emotion suppression strategy for all individuals.

For all of the emotion regulation studies mentioned thus far, positive picture stimuli was not included. Jackson et al. (2000) contends that the failure to include positive images was due to a difficultly finding attenuation of the startle response to positive emotion compared to neutral during a pilot study. Difficulty finding the expected modulation to positive affective stimuli compared to neutral stimuli is not uncommon (Dillon & La Bar, 2005; Driscoll, Tranel, & Anderson, 2008). Studies that have included positive emotion regulation have hypothesized that arousal, and not valence, influences the startle response (Dillon & La Bar, 2005; Driscoll et al., 2008). Dillon & La Bar (2005) compared regulation to positive, neutral, and negative stimuli and found that the enhance cue during positive and negative picture presentation elicited larger blink magnitudes than the maintain and suppress cues, this finding runs counter to what would be expected from the aversive matching hypothesis, where enhancing positive emotion should elicit the smallest blink magnitudes (Bradley et al., 1993; Lang et al., 1990; Vrana et al., 1988). The authors contended that this finding suggests that the startle blink response is arousal dependent, meaning that the level of arousal will alter the startle magnitude, regardless of emotional valence. Therefore, increasing arousal will always result in larger startle responses, whether the emotion is positive or negative in valence (Dillon & La Bar, 2005). However, significant differences in blink magnitude for positive compared to neutral stimuli was not found, even though the positive images were rated as significantly more arousing then the neutral images. Therefore these findings are not sufficient to conclude that the startle response is solely impacted by arousal, clearly valence plays some role. Also, unlike Jackson et al. (2000) and others (Lee et al., 2009; Lissek et al., 2007) no significant difference was found between suppress and maintain conditions. Possible explanations for these contradictory findings may be that Dillon & La Bar (2005) did not utilize a within-groups design, which is common to these studies, because of large individual differences in blink magnitudes, combined with the problems associated with using a small sample size.

Driscoll et al. (2008) also looked at the regulation of positive and negative emotion,

and found that during the enhance condition, regardless of valence, there were larger blink magnitudes than during the suppress condition. The authors concluded that these findings suggest that arousal is the main factor that controls the startle response. However, across regulation conditions the startle response for negative images was significantly larger than for positive images, even though both were matched on arousal. Being matched on arousal and maintaining differences in startle blink magnitude suggests that the startle response is also influenced by valence. It should also be noted that Driscoll et al. (2008) used a small sample size in their analysis, and consequently their findings should be interpreted with caution.

Clearly, previous research utilizing physiological measures to assess emotion regulation yields inconsistent and confusing findings, and the exact relationship between the startle response and positive emotional cues is not agreed upon or well understood. Possible reasons for a failure to find startle response differences between neutral and positive stimuli may be due to a difficulty eliciting positive emotion in a lab setting (Jackson et al., 2000), and subjective differences in interpreting stimuli as positive. Research shows that arousal also influences the startle response (Dillon & La Bar, 2005; Driscoll et al., 2008; Lang et al., 1990). To effectively measure emotional valence, arousal must be balanced for positive and negative stimuli; however, some research studies fail to take into account the participant's subjective ratings of arousal or valence to the stimuli (Larson et al., 2000; Lee et al., 2009). Problems with current emotion regulation research using the startle blink paradigm are that a majority of the research fails to include positive affective stimuli (Jackson et al., 2000; Lee et al., 2009; Lissek et al, 2007), while others employ different methodologies or have very few participants (Dillon & La Bar, 2005; Driscoll et al., 2009).

The purpose of this study is to replicate and extend the findings of previous research on emotion regulation using the startle blink paradigm (Jackson et al., 2000), with the inclusion of positive affective stimuli. To overcome the limitations of previous research a balanced design will be used, matching the frequency of picture type and regulation cues. Probe and trial times that are consistent with previous research of emotion modulation and regulation will also be used (Eippert et al., 2007; Jackson et al., 2000).

Emotion modulation is of high importance in this study as it is an established finding in startle paradigm research (Bradley et al., 1991; Sanchez-Navarro et al., 2008; Vrana et al., 1988); failing to obtain the expected linear relationship of valence may suggest problems in the paradigm that limit the ability to interpret the emotion regulation findings. Subjective ratings of valence and arousal to the images will also be measured in conjunction with normative ratings in order to assure that arousal between positive and negative images are matched, and therefore not responsible for differences in regulation.

In this study the independent variable is the combined picture types and regulation cues, which result in 6 distinct conditions. The dependent variable is the blink magnitude elicited by the startle paradigm. Based on this information two main hypotheses were generated. The first hypothesis is that the startle response will show attenuation during the suppress negative condition compared to the maintain negative condition. The second hypothesis is that the startle response will show potentiation during the suppress positive condition compared to the maintain positive condition. These hypotheses are based on the concept that the startle response is a defensive response to threat, activating the aversive domain of the appetitive-aversive dimension of emotion (Vrana et al., 1988). Therefore, when a negative emotional state is suppressed, the magnitude of the startle reflex will be decreased, and when a positive emotional state is suppressed the startle reflex will increase in magnitude.

Method

Participants

All procedures were approved by the University of British Columbia Behavioural Research Ethics Board, and all participants provided informed consent before participation. Participants were eight female undergraduate students from the University of British Columbia. This study included only females as it was part of a pilot test for a larger study involving emotion regulation and disordered eating behaviours. As disordered eating is much more common among females, males were excluded. Three participants were recruited through the University's Human Subject Pool for 1.5 course credits; the remaining five participants were volunteers from the University's Clinical and Cognitive Neuroscience Lab. Participants ranged in age from 20 to 23 years (M = 22, SD = 1.06), and all participants had a minimum of 10 years of English fluency. Two participants were excluded from analysis due to a failure to stay awake and alert during picture presentation.

Stimuli

All images were selected from the IAPS based on normative female arousal and valence ratings. Pictures were selected to create three discrete picture types: negative (low valence, high arousal), positive (high valence, high arousal), and neutral (medium valence, low arousal). Thirty-two of each picture type (positive, negative and neutral) were included in the picture set, 16 per block. The overall normative female ratings for valence were negative M = 2.16, SD = 0.61, positive M = 7.56, SD = 0.61, and neutral M = 5.0, SD = 0.23. Paired t-tests revealed significant differences for valence between negative and positive images $t(62) = -35.16$, $p < 0.001$, negative and neutral images $t(62) = -24.5$, $p < 0.001$, and positive and neutral images $t(62) = -22.06$, $p < 0.001$. The overall female normative arousal ratings were negative M = 6.47, SD = 0.74, positive M = 6.02, SD = 0.76, and neutral M = 2.94, SD = 0.5. Paired t-tests revealed significant differences for arousal between negative and neutral images $t(62) = 22.51$, $p < 0.001$, positive and neutral images $t(62) = -19.12$, $p < 0.001$, and positive and negative images $t(62) = 2.42$, $p < 0.05$. However, follow-up t-tests between negative and positive images for all probed conditions revealed no significant differences in arousal between the positive and negative conditions. Each block was organized in quasi-random order, ensuring that the pictures were counterbalanced for regulation instruction, order of presentation, and time of startle probe. No more than three picture types (same valence, regulation cue, or probe time) occurred in a row.

Procedure

Each participant came in for a testing session that lasted approximately 1.5 hrs. Details were then provided about the nature of the

task, and each participant provided informed consent. EMG sensors were then applied to the *obicularis oculi* muscle of the left eye. EMG sensors at the *obicularis oculi* site are used to measure the size of the startle response, as this muscle is an important component of the startle reflex. Electroencephalographic (EEG) sensors were also applied at this time as part of another study; the EEG data will not be included in the analysis.

After receiving both visual and verbal instructions and engaging in a practice session, participants viewed digitized colour images from the International Affective Picture Set (IAPS; Lang et al., 1999). Each picture was presented for 8 s. A total of 96 pictures were presented in 2 blocks of 48 pictures each. At 4 s post-stimulus onset the regulation cue, either a white equal sign or a red minus sign, appeared on the screen briefly. A white equal sign instructed participants to maintain their emotional response to the picture. A red minus sign instructed participants to decrease the intensity of the emotion they were experiencing in response to the picture. Both regulation instructions were presented for all picture types (positive, negative, and neutral) an equal number of times to maintain consistency across trials. After 8 s a black screen replaced the picture for 5 s. The word "RELAX" then appeared on the screen for 5 s, at this time participants were instructed to stop decreasing or maintaining their emotional response to the previous picture and to get ready for the next picture. During picture presentation an acoustic startle probe (a 95 dB, 50 ms burst of white noise generated by the Audacity 1.3 Beta Unicode Software) was presented to both ears at either 3 s (probe A) or 7 s (probe B) after picture onset. Inter-trial probes were presented 4 times during the trial to decrease the predictability of the probes. There were 6 conditions in total, combining each picture type and regulation cue, which each occurred 8 times during the course of the experiment. No probe was presented for 24 of the trials. After the task was completed the EEG and EMG sensors were removed and the participants filled out an image rating for each picture on arousal and valence using the Self Assessment Manikin (SAM) valence and arousal scales, with 9 rating high (arousal or valence) and 1 rating low, this is the same scale that was used to measure the normative ratings of the IAPS (Bradley & Lang, 1994). Pictures were presented in the same order that they had originally appeared and picture-viewing time was recorded to assess interest. Participants were also asked to fill-out a strategy questionnaire in which they described the strategies they used to regulate their emotions for each picture type (decrease and maintain for positive, negative and neutral images). After the strategy questionnaire was complete all participants were debriefed on the nature of the study.

Emotion regulation instructions

Participants were left free to decide on how to regulate their emotions effectively. No strategies were provided on how to regulate emotions. However, to separate emotion regulation from inattention, participants were instructed to focus on the picture, and told not to produce thoughts or images that were unrelated to the picture or emotion they were experiencing. For example, in the sample trial participants are shown a picture of a striking snake. Participants are then told that if they are presented with a red minus sign and are required to decrease their emotion, fear is the example given, they should accomplish this by decreasing the intensity of the fear they are experiencing,

and not by thinking of something unrelated to the picture or by trying to produce a different emotion. A similar example is provided for a positive picture in the maintain regulation instruction. All participants are also given a 9 trial, 3 of each picture type, practice session and question period before the actual experiment begins to ensure that they understood the regulation instructions.

EMG data collection and analysis

To measure the startle reflex two Ag-AgCl 4 mm electrodes were placed on the *obicularis oculi* muscle below the left eyelid. The ground electrode was placed at the AFz site. Preparation of the sensors involved briskly brushing the skin with medical gauze, cleaning the area with rubbing alcohol, gently exfoliating with saline gel, and brushing the skin once more with gauze. EMG sensors were filled with Quickgel. Impedance levels of the electrodes below 20 kΩ were accepted (Larson et al., 2000). EMG data was obtained with a Brain Products Inc, QuickAmp 72 System. Brain Vision Recorder was used to record the data and Brain Vision Analyzer was used to process and score the startle responses. Data was sampled at 1000 Hz. Signals were digitally filtered offline with high and low pass frequency filters at 30 Hz and 500 Hz (48 dB/octave roll-off) with a 60 Hz Notch filter. Startle EMG was rectified and smoothed with a 20 ms moving window average. The data was baseline corrected, subtracting the average value of the 50 ms baseline period (before the probe onset) from all time points in the segment. The peak startle magnitude was determined within a window of time extending from the time of probe onset to 120 ms. Trials were excluded if the blink began prior to 15 ms following the probe, if there was excess noise in the baseline period (>10 μV), if there was a visible artifact in the segment, or if the magnitude was greater than 3 standard deviations above the subject's individual mean amplitude. Trials with no discernable startle response were given a magnitude of zero and included in the analysis (Larson et al., 2005). Startle responses were standardized using within subject z-score conversions to normalize data, and to reduce the influence of between subjects variability unrelated to psychological processes (Blumenthal, Cuthbert, Filion, Hackley, Lipp, & Van Boxtel, 2005).

Test-retest reliability of the emotion modulated startle response may not be stable over time; a study by Larson et al. (2000) found low reliability at a second assessment. However, replication of this study that includes subjective ratings of arousal and valence to stimuli are needed to help understand why the reliability of the emotion modulated startle appears to be low. A study by Lee et al. (2009) found low test-retest reliability of the emotion regulated startle response, with decreased sensitivity to regulation, compared to a corrugator measure. The startle paradigm measures emotion over a span of milliseconds, which may account for its variability across assessments, whereas corrugator activity is measured over a larger span of time and is therefore likely to be more consistent. To be confident in the ability of the startle paradigm to measure emotion modulation and regulation over time more research needs to be done testing reliability, and the factors that may influence it.

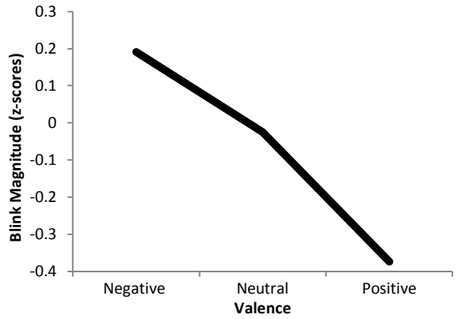

Figure 1. Differences in blink magnitude by affective picture type. Measured 3 s after picture onset.

Results

Image Ratings

A one-way repeated measures ANOVA was conducted to evaluate the participant's subjective ratings of picture valence. A significant effect for valence was revealed, $F(2,10) = 52.28$, $p < 0.001$. Follow-up paired t-tests revealed a significant difference of valence between negative and positive, $t(5) = -7.41$, $p = 0.001$, neutral and negative, $t(5) = 8.48$, $p < 0.001$, and neutral and positive, $t(5) = -5.42$, $p < 0.05$. Therefore, participants rated each picture type as significantly different from each other on emotional valence. A one-way repeated measures ANOVA was conducted to evaluate the participant's subjective ratings of arousal. A significant effect for arousal was revealed, $F(2,10) = 34.37$, $p < 0.001$. Follow-up paired t-tests revealed a significant difference for arousal between neutral and negative $t(5) = -9.44$, $p < 0.001$, and neutral-positive $t(5) = -6.08$, $p < .005$, while the difference between negative and positive, $t(5) = 2.14$, *ns* were non-significant. In other words, participants rated the positive and negative pictures as high in emotional arousal, while the neutral images were rated as low in emotional arousal. Accordingly, the participant's subjective ratings of valence and arousal for the images matched the normative ratings.

Emotion Modulation

A one-way repeated measures ANOVA was conducted to examine the predicted emotion modulation effects on the startle response to probe A, which was presented 3 s after picture onset, before the regulation cue. The effect of valence was non-significant, $F(2,8) = 3.05$, *ns*, startle blink magnitudes for each picture type were not significantly different. The hypothesized linear trend of negative>neutral>positive was examined using a linear trend contrast on valence and revealed a significant linear trend, $F(1,4) = 8.39$, $p < 0.05$, blink magnitudes did follow the expected pattern of largest in magnitude to negative images and smallest in magnitude to positive images, supporting the argument that the startle response is an aversive reflex. Follow-up paired t-tests revealed a significant difference between negative and positive, $t(4) = 2.90$, $p < 0.05$ while the difference between negative and neutral, $t(4) = 0.83$, *ns* and neutral and positive, $t(4) = 1.48$, *ns* were non-significant (see Figure 1). Therefore, blink magnitudes to negative pictures were significantly larger than to positive pictures. However, no significant differences in blink magnitudes were found between neutral and positive or neutral and negative images.

Emotion Regulation

A 3 (image valence) x 2 (regulation condition) repeated measures ANOVA was conducted for the startle response to probe B, presented at 7 s following picture onset. This revealed a significant main effect for valence, $F(2,8) = 7.08$, $p < 0.05$, blink magnitudes were significantly different across picture types. A main effect for regulation approached significance, $F(1,4) = 5.08$, $p = 0.087$,

meaning that differences in blink magnitude between the regulation conditions showed a trend, but were not substantial enough to show significant differences. The interaction between valence and regulation was non-significant, $F(2,8)=2.74$, *ns*. Therefore, blink magnitudes were not significantly affected by the relationship between picture type and regulation cue. The linear contrast for valence was significant with negative>positive>neutral, $F(1,4) = -8.69$, $p < 0.05$. Concretely, a consistent linear trend was found for blink magnitudes and picture type at both probe times, before and after the regulation cue, highlighting the stability of this effect. Paired t-tests were conducted to test the hypothesized regulation effects for the negative and positive images (see Figure 2). A significant difference was found between negative maintain and negative decrease, $t(4) = 5.01$, $p < 0.05$, with blink magnitudes being significantly smaller in the decrease condition than the maintain condition. The difference between positive maintain and positive decrease were non-significant, $t(4) = 1.06$, *ns*. Blink magnitudes were not significantly different in size between the decrease and maintain conditions. As expected there was no significant difference in blink magnitudes between neutral maintain and neutral suppress conditions. Therefore, significant differences in blink magnitude were found only during regulation to the negative images.

Discussion

The initial emotional response to the pictures, before any regulation cues were given, as measured by probe A, was an important characteristic of this study. To help assess that the paradigm was working

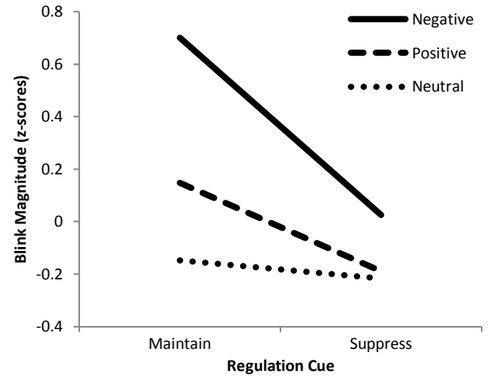

Figure 2. Changes in blink magnitude relative to the affective picture type and regulation cue condition. Measured 7 s after picture onset.

successfully, and that the pictures were eliciting the expected response, we expected to replicate the findings of other emotion modulation research (Bradley et al., 1991; Sanchez-Navarro, Martinez-Selva, Torrente, & Roman, 2008; Vrana et al., 1988). The startle magnitude was significantly larger for negative compared to positive images. However, responses to the neutral images were not significantly different from either the positive or negative images. Failing to find differences in response magnitude for neutral and positive images has been a problem in other emotion regulation studies (Dillon & La Bar, 2005; Driscoll et al., 2008). This finding may indicate that the positive images were not interpreted as positively as expected by the participants.

The lack of significant differences between negative pictures to neutral pictures could be due to a lack of habituation to the startle probe at the beginning of the paradigm. The first probed images in both trials were neutral, and responses to these images were typically much larger than for the rest of the neutral pictures in the task. Therefore, a few large startle responses in the neutral condition

could be responsible for driving the mean up. Leaving out the first trial in the paradigm has been used in previous research as it has been found to be larger than all other responses, and may be useful in future research to avoid habituation effects (Larson et al., 2000). Another possible reason significant differences were not found for positive and negative images to neutral is because of the small sample size in this study. Due to the small sample size, the power to detect smaller significant differences was low.

Emotion regulation to the picture stimuli was also measured by the startle response. The first hypothesis stated that in the suppress negative condition the startle response would be attenuated compared to the maintain negative condition. This hypothesis was supported, during the suppress negative condition the startle response was significantly smaller than during the maintain negative condition. The startle blink paradigm successfully measured voluntary changes in emotional response to a regulation cue for the negative images. The second hypothesis stated that for the positive images, startle blink magnitude would be potentiated during the suppress positive condition compared to the maintain positive condition. As others have found, this hypothesis was not confirmed; the startle response was smaller during the suppress condition than the maintain condition for positive images, however, this difference was not significant (Dillon & La Bar, 2005; Driscoll et al., 2008). In this study the startle blink paradigm was not a sensitive measure of emotion regulation to positive affective stimuli. No significant differences were expected for startle blink magnitudes between the suppress neutral and the maintain neutral conditions, and indeed no differences were found.

Current research has not found the expected emotion regulated startle response to positive images (Dillon & La Bar, 2005; Driscoll et al., 2008). Jackson et al. (2000) has proposed that this may be due to a difficulty in eliciting positive emotion in a laboratory setting. Genuine positive emotion may be harder to elicit in participants than negative emotion, as the participants are sitting in a dark room, unaware of what they will see next, with loud noises occasionally startling them. Also, to ensure that arousal is matched in both negative and positive images, erotic images are often used because other positive images are often rated low on arousal. Although the startle response is supposed to be smallest when viewing erotic images (Lang et al., 1990), it is possible that individuals may vary on their responses to the erotic images in the lab setting, depending on their comfort level.

Another explanation for the failure to find the expected regulation to positive images comes from Dillon and La Bar (2005) who suggested that the emotion regulated startle response is arousal-dependent. Therefore, stimuli that are arousing, regardless of valence, should show an attenuated startle response when suppressed compared to maintained, in opposition to the aversive matching hypothesis. However, both the positive and negative stimuli in the task were matched on arousal for normative and subjective ratings, but positive images failed to show any significant differences between the suppress and maintain conditions, while the negative images did show significant differences between condition. Therefore, arousal does not appear to fully explain why positive emotion regulation has not followed the pattern expected by the biphasic (appetitive-aversive) theory of emotion.

An important limitation of this study, and others, that have attempted to measure positive and negative emotion regulated startle is the small size of the sample (Dillon & La Bar, 2005; Driscoll et al., 2008). The magnitude of the emotion modulated and regulated startle varies widely across individuals (Lang et al., 1990), therefore, a larger sample size is needed before making any strong conclusions about the results. The small sample size reported in this and other research may play a large role in the failure to gather significant or consistent findings of emotion regulation to positive stimuli.

This study only used female undergraduate subjects, as have others (Eippert et al., 2007; Ray et al., 2010), which limits the generalizability of the results. Females were used exclusively in this study as they were participants in part of a larger study involving behaviours most common to women. Although previous research that has included both sexes has found no significant differences of gender (Jackson et al., 2000) it would be beneficial to include both sexes in a study of the emotion regulated startle response with positive and negative stimuli, to be able to further generalize the findings and to test for any possible differences in emotion regulation between gender. How these results relate to other populations, for example, non-educated individuals, older adults or clinical populations is unclear. It would be beneficial if these findings could be replicated with more varied samples.

In the introduction it was suggested that the emotion regulated startle response could potentially be a useful measure of emotion regulation abilities/deficits in clinical samples. Emotion dysregulation, or the inability to regulate one's emotions in a healthy or adaptive way has been linked to destructive behaviours such as binge eating and drinking, gambling, and self-injury (Klonsky, 2008). As most research regarding emotion regulation is self-report it is critical to address if these emotion regulation deficits are also present at the physiological level, in order to better develop and assess treatment strategies that improve emotion regulation cognitively, behaviourally, and physically. However, due to inconsistencies in the research and insufficient data to support the expected hypotheses, more research needs to be done using the startle paradigm on positive and negative emotion regulation, with large sample sizes, to properly understand the mechanisms at work that influence the startle response before it can be used to provide reliable information about clinical samples.

Future studies on the emotion regulated startle response should utilize a larger sample size, balanced paradigms for picture valence, and matched subjective and normative arousal for positive and negative stimuli in order to successfully extend upon current knowledge on the nature of the startle response to emotion regulation. It may also be beneficial to look for more effective ways to elicit positive emotion in the lab setting, beyond the IAPS picture set. Moreover, fear conditioning has been shown to modulate the startle response in the lab (Greenwald et al., 2007; Lissek et al., 2007); perhaps associating a stimulus with a positive experience or reward could also be used to modulate the startle response, eliciting a more genuine positive emotion in the lab. In conclusion, the startle blink paradigm is a promising physiological measure of emotion regulation, however more research needs to be conducted with larger samples before it can be used to assess dysregulation in clinical populations.

Declaration of Conflicting Interests

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

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COGNITION
Research Report

The negative effect of doodling on visual recall task performance

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Abstract

Doodling consists of drawings that are often made to pass the time while an individual's primary attention is elsewhere. Therefore, it is often seen as a sign of lack of attention. Studies have shown that doodling can actually be beneficial to recall performance on auditory tasks since it does not require many executive resources and may serve to stop mind wandering without affecting attention on the main task (Andrade, 2009). To date, there have been no studies investigating whether recall performance is affected when the primary task requires the same modality as doodling; the present study aimed to determine whether doodling would affect performance on a visual recall task. Participants (N = 14) were randomly assigned to either 'doodling' or 'non-doodling' conditions. Both groups observed a collection of images that they were then instructed to recall from a second list presented directly afterwards, with the 'doodling' group instructed to doodle while observing the first set of images. As hypothesized, the mean number of recalled images by the doodlers was found to be significantly lower than that of the non-doodlers. This was likely due to the fact that doodlers' visual processing resources were divided between the two tasks. An implication of this finding is that multitasking in activities which require the same primary modality as that of the main task can have a negative effect on the amount of information processed and retained.

Keywords: *doodling, modality, visual processing, recall, multitasking*

A doodle is a drawing that is made while a person's primary attention is elsewhere. It can consist of cartoons, landscapes, geometric shapes and/or lettering. Doodling is often done to pass the time when one is bored or while daydreaming. An example of doodling can be seen in schools on students' lecture notes. Whether doodling impairs performance by detracting resources from the primary task or whether it can improve performance by maintaining concentration is currently being questioned.

While doodling has long been associated with a lack of attention on the task at hand, such as an ongoing lecture, some studies have shown that doodling actually improves recall performance. In one such study, forty participants listened to a monotonous mock telephone message containing the names of people coming to a

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party. The researchers randomly assigned half of the group to a doodling condition in which they shaded printed shapes while listening to the message. Unexpectedly, the doodling group performed better on the task and recalled 29% more information on a surprise memory test than the non-doodling group (Andrade, 2009).

Unlike many dual task situations, doodling while working may be beneficial because it is thought to improve attention to the primary task by reducing mind wandering such as daydreaming, which requires more executive functioning than doodling (Andrade, 2009). A simple task such as doodling requires very few executive resources and may be sufficient to stop daydreaming without affecting attention and processing of information – therefore performance – on the main task (Andrade, 2009). Another study proposed that doodling is beneficial for attention to a primary task by being a way for students to address their need to be active when they are forced to be inactive in a confined space such as a classroom setting. By acting as an outlet for this tension, doodling allows the student to focus on the class lecture (Aellig, Cassady, Francis, & Toops, 2009).

However, doodling may only be beneficial in dual task situations where the two tasks do not compete for the same information processing resources. After being viewed, images must travel from the eyes through the optic nerve to the lateral geniculate nucleus of the thalamus. From there, this signal is sent to the visual cortex, where it is further processed. For example, the ventral stream of the visual association cortex, or the "what" stream, plays a role in recognition and identification of visual stimuli. The dorsal stream, or the "where" stream, helps to guide visual attention. When a person engages in tasks that demand the use of both of these pathways, information may not be processed to the same degree as when there is solely one visual task because the capacity of the visual system is limited (e.g., Broadbent, 1958; Kastner & Ungerleider, 2000).

To the author's knowledge, no previous studies have investigated the effects of doodling on recall on a primary task which requires the use of the same primary modality, such as the recall of objects. Therefore, as doodling and viewing objects both require visual processing, this study will investigate whether or not doodling affects recall on a visual task. Participants will be randomly assigned to the 'doodling' and 'non-doodling' conditions and instructed to memorize a slideshow of images, with those in the 'doodling' condition instructed to doodle. They will then be presented with a second slideshow and asked to identify the images that were in the first slideshow. Since doodling will compete for the visual processing resources necessary for the primary recall task, it is hypothesized that doodlers will do worse than non-doodlers on the visual recall task by recalling fewer images than the non-doodlers.

Method

Participants

Fourteen undergraduate students from the University of British Columbia participated in this study. There were ten females and four males, with an average age of 19.79 years (SD = 1.19). Participants were enrolled in the PSYC 260 course and recruited as volunteers.[1]

[1] As this experiment was conducted as part of a course project, ethics approval was not needed.

Materials

Microsoft Office PowerPoint 2007 was used to present the two slideshows of images for the visual recall task. The two lists of images and the order they were presented in are shown in Supplementary Table 1. The images were found on the internet. The slideshows of images were all presented in colour on the full screen setting of a 15.4" Toshiba laptop. For the duration of the study, each participant was seated at a table with the laptop directly in front of them, with sufficient table space on which to use the paper and pen provided.

Procedure

At the beginning of the experimental task, half of the participants were randomly assigned to the 'doodling' condition based on the order in which they took part in the study. All participants were instructed to view the first slideshow (List 1) and to try to memorize all of the images that would be presented. Participants in the 'doodling' condition were given the additional instruction to draw flowers (an arbitrary, relatively simple image) on the piece of paper provided at the same time as they were viewing the slideshow. They were told that they could look at their doodling as they wished, and not to stop drawing until the slideshow was over. Directly afterwards, all participants were told to view the second slideshow (List 2) and, as they watched, to indicate on the paper provided which images in List 2 also appeared in List 1. There were twenty images in each slideshow, and ten of the original twenty images from List 1 were in List 2 along with ten new images (Table 1). However, participants were not told how many of the images from List 1 would be in List 2. Each image in both slideshows was presented once and shown for three seconds.

The experiment was conducted between-groups, and each participant was individually tested. The independent variable was doodling, and the dependent variable was the number of images correctly identified in List 2 as being from List 1. Participants were scored on correctly indicating whether or not each image in List 2 was present in List 1 for a total maximum score of 20 (i.e., participants were given a point for correctly identifying when an image in List 2 was or was not presented in List 1).

Results

A between-groups, independent samples t-test was conducted to test for a difference in the average number of images recalled in the visual task between the 'doodling' group and the 'non-doodling' group. As shown in Figure 1, the mean number of recalled images by the doodlers (M = 15.86, SD = 1.07) was significantly lower than that of the non-doodlers (M = 19.29, SD = 1.11), t (12) = 5.88, $p < .001$.

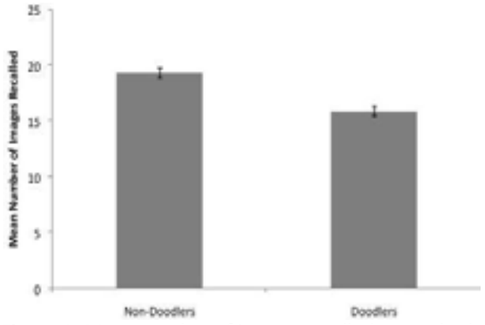

Figure 1. Mean number of images recalled ± standard error of participants (n=14) in the 'doodling' and 'non-doodling' conditions. Non-doodlers (M = 19.29, SE = 0.42) had a significantly higher mean number of images recalled in the visual task than doodlers (M = 15.86, SE = 0.40).

Discussion

As hypothesized, there was a significantly higher mean number of images recalled by the non-doodlers than by the doodlers, which suggests that doodling negatively affects performance on the visual recall task. This is likely a result of the fact that as both doodling and the main visual recall task required visual processing by the brain, performance on the recall of images was impaired. In a similar fashion, Andrade (2009) noted that tests of memory or attention often use a second task to selectively block a particular mental process, and if that process happened to be important for the main cognitive task, it would result in performance being impaired due to this competition for cognitive resources. As well, all doodlers were observed to glance at their doodles from time to time throughout the slideshow, which detracted from the time that could have been spent looking at and memorizing the pictures. Therefore, it is possible that doodlers viewed the images for a shorter duration of time than non-doodlers.

A further explanation for these results could be that the 'doodling' condition evoked the effects of multitasking on performance since doodlers had to doodle at the same time as memorizing the images in the slideshow that was presented. Multitasking requires attention to be divided between simultaneously occurring tasks, and after much research (e.g., Broadbent, 1971; Hembrooke & Gay, 2003), it has been shown almost without exception that performance on one or both tasks suffers as a direct result of having to perform two tasks simultaneously (Hembrooke & Gay, 2003). This effect may be explained by Broadbent's theory of selective attention which proposed that after sensory processing, information is filtered through a limited processing channel that can become overloaded (Broadbent, 1971). When this happens, some of the incoming information is filtered out, while other information is selected for further processing (Broadbent, 1971). If this is indeed the case, some of the information from the visual recall task could have been filtered out and not processed by the brain into short term or working memory as a result of engaging in doodling. It is assumed that performance on a recall task, measured in terms of accuracy in recall, reflects the depth of processing of the monitored material (Andrade, 2009).

A potential confound for this experiment arises in how participants were told prior to the task that they would be tested on recall. As a result of this, participants had incentive to focus on the images and devote their attention to the task, thereby resisting from any mind wandering, such as daydreaming, that may occur in a natural setting. Another potential confound lies in how the images in the slideshows were not strictly neutral and could have generated some emotion or memory in the participants, which could have affected recall. In the future, the images could be selected from a list of pre-determined neutral images.

In the present study, although all participants assigned to the 'doodling' group were instructed to draw pictures of flowers as a way of standardizing doodling, every participant had their own interpretation of these instructions, and hence, all the doodled images of flowers were different. In order to better standardize the doodling condition, a sample image of a flower could be given to participants to copy or the doodling task should be even more simplified (i.e., participants instructed to draw a simple shape such as a square). This

would also make the task of doodling more "mindless" and allow more cognitive resources to be devoted to the primary recall task. Furthermore, participants were allowed to look at their doodling as they wished and the viewing time of each participant to the slideshow images was therefore inconsistent and uncontrolled. More precise instructions in future studies would help to minimize confounds. However, in the interest of standardizing the experiment, a limitation to the implications of the findings exists in how participants' doodling is unnatural since they are not allowed to draw as they please; doodling is typically done at one's own discretion.

Important implications of this study focus around methods of aiding attention and memory. In previous research, such as that of Andrade (2009), auditory tasks were chosen to be the main cognitive tasks in order for doodling to compete minimally for modality-specific resources, and resulted in doodling being found to improve recall. The findings of the present study further develop this idea by showing that doodling does not remain beneficial for performance on a primary task when it competes for the same cognitive resources. Therefore, it could be generalized that in order to improve information processing and memory, one should not multitask in activities which require the same primary modality as that of the task. This has practical applications for real-life activities, such as studying, and for behaviour in class lectures and during meetings in the workplace. It is plausible that multitasking could be beneficial if the secondary task serves to reduce mind-wandering while not detracting from the cognitive resources necessary for the primary task (Smallwood, O'Connor, Sudbery, & Obonsawin, 2007). A future study could explore whether an auditory secondary task that uses minimal executive resources and does not compete for visual resources, such as listening to music without lyrics, would be beneficial for performance on a visual recall task. To further specify findings, future studies using larger sample sizes could also investigate whether sex differences play a role in the effect of a secondary task on main recall task performance (i.e., doodling on audio recall task performance) as it has been shown that there may be sex differences in the ability to multitask (Ren, Zhou, & Fu, 2009). Continued research on the effects of a secondary task on a primary recall task will allow students and professionals alike to adopt work habits that can help to maximize information processing and recall, thus increasing time efficiency and productivity in their everyday lives.

Declaration of Conflicting Interests

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

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Supplementary Material

Table 1. Images presented in List 1 and List 2.

Order of images	List 1	List 2
1	Tropical island	City (List 1)
2	City	Beach
3	Pink flower	Pink flower (List 1)
4	Airplane	Piles of wood (List 1)
5	Wooden loom	Colourful water droplet
6	Tree trunk	Oak tree in sunset
7	Kite	Snail (List 1)
8	Fighter jet	Purple flower
9	Purple flower petal	Rocks
10	Snail	Kite (List 1)
11	Bed	Pile of marbles
12	Brick wall	Butterfly
13	Various slate patterns	Tree trunk (List 1)
14	Water droplet	Snow-covered landscape
15	Palm tree in sunset	Bookcase (List 1)
16	Piles of wood	Purple flower petal (List 1)
17	Multicoloured swirl	Toy wagon
18	Wagon	Fighter jet (List 1)
19	Pile of beads	Window
20	Bookcase	Multicoloured swirl (List 1)

Did he really earn it? An examination of anabolic-androgenic steroid use in sports

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Abstract

Performance-enhancing drug scandals have tarnished the reputation of many professional athletes in a wide variety of sports, from baseball to swimming to cycling. This paper will examine the literature in order to determine the effects of anabolic-androgenic steroids (AAS) on performance and both physical as well as psychological health; the prevalence in both professional and amateur sports; how steroids are used; how they produce their intended effects; and a brief history of doping in sport and relevant organizations created to deal with doping in sport. The literature will be reviewed and used to conclude that anabolic-androgenic steroid use should not be allowed a place in the professional sporting environment. Analysis of this question proves to be increasingly relevant as more players are indicted for illegal use of performance-enhancing drugs, and as the ethics of "cheating" by using PEDs are cited as a reason to keep great athletes from the Hall of Fame.

Keywords: *anabolic steroids, sports, performance-enhancing drugs, doping*

Roger Clemens played for a total of four teams over his 23-year career as a pitcher; accruing 4,672 strikeouts and 354 wins and making him arguably the most dominant pitcher the game of baseball has ever seen (Fantasy Sports Ventures, 2011). At the end of his hall-of-fame-worthy career, Clemens was indicted in the Mitchell Report, a 400+ page report highlighting the rampant use of performance-enhancing drugs (PED) in the game of baseball, which cast his illustrious record in the nasty light of anabolic-androgenic steroid (AAS) use. Abuse of AAS plagued baseball and many of its players at the end of the 20th century, and even today anabolic steroids are one of the most commonly abused PEDs in many sports. Considering the difficulty of banning these substances, more and more authorities are considering allowing anabolic-androgenic steroid use in sport. This paper will now discuss the reasons why athletes abuse PEDs, what exactly an anabolic-androgenic steroid is, its effects and side effects, an historical account of drug abuse in sport and the prevalence of doping today, and conclude

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with the reasons why anabolic steroids do not have a place in the sporting environment.

Colloquially, anabolic-androgenic steroids are known as “anabolic steroids” or even just “steroids”, and their use is often referred to as “doping”. PEDs are used for various purposes and for different reasons depending on the sport. Baseball players use AAS to hit balls farther and to throw balls faster in order to gain a competitive advantage over other players, whereas a bodybuilder might use them for the simple reason of being able to lift heavier weights. Although this paper is concerned with AAS use in sports, AAS abuse is problematic even outside of the sports environment. Some researchers assert that although the media focuses on AAS abuse in sports, the great majority of users are not athletes at all, but rather individuals desiring to become more muscular and more attractive (Kanayama, Hudson, & Pope, 2008).

The World Anti-Doping Agency (WADA) outlaws a number of substances in the sporting environment, most notably stimulants and hormones. Stimulants are often used in cycling, and have led to several deaths in the sport (Catlin, Fitch, & Ljungqvist, 2008). Strychnine, ephedrine, amphetamines and methylphenidate are several examples of stimulants that have historically been abused in sport (for a more complete list of banned stimulants and their effects, see Deventer, Roels, Delbeke, & Van Eenoo, 2011). Steroids are the most abused class of substances that are outlawed by the WADA. Synthetic testosterone, a type of steriod, is detected in the blood through an immunoassay (or urine test), which is administered to every athlete on a regular basis as a requirement to play professional sports (Catlin, Fitch, & Ljungqvist, 2008).

Anabolic-androgenic steroids are a synthesized type of testosterone, a hormone chiefly responsible for muscle development, and are consumed to mimic its effects in the body. They accelerate muscle growth, often to unhealthy extremes. This commonly occurs in conjunction with weight training to speed up tissue repair after damage caused by a workout (National Institute of Drug Abuse, 2011). AAS is often prescribed for therapeutic purposes, and is often used to treat HIV-related muscle wasting and hypogonadal men; however, use without a prescription is against the law and is recognized as cheating in most competitive sporting events (Evans, 2004; National Institute of Drug Abuse, 2011). Men with testosterone blood plasma levels that are below the normal range of 300 to 1000 ng/dl are those who would typically be treated with anabolic steroids (Evans, 2004).

Side effects of steroid abuse include extreme acne, increases in low-density lipoprotein (LDL, or “bad” cholesterol), which leads to elevated blood pressure and related heart problems, and shrinking of the testes in males along with a decreased sperm count and possibly even infertility (National Institute of Drug Abuse, 2011; Grace, Sculthorpe, Baker, & Davies, 2003). Additionally, injuries associated with rapid muscle gain and slow bone growth are often reported, such as muscle tears and bone fractures (see Stannard & Bucknell, 1993). In fact, after reviewing the relevant literature on steroid use and infertility, de Souza and Hallak (2010) strongly recommend that AAS use be avoided based on the fact that the negative effects on fertility are so severe. Lumia and McGinnis (2010) found similar effects of testosterone on rats, along with an increase in aggressive behaviour as well. It is well known that use of AAS is also associated with mood swings, often referred to as “’roid rage.” It is interesting to note that environmental

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influences seem to play a disproportionately large role in how “’roid rage” is expressed. It is well documented that hormones alter our perceptions of social cues and others’ intentions, and as a result it is not simply high levels of androgens that cause increased aggression, but rather the environment in which they are in effect (Lumia & McGinnis, 2010). This is important to consider in the aggressive environment of sports, and compounds the problems of injury and aggression during games when AAS drugs are abused. Additionally, it is important when considering the place that PEDs have in the sporting environment at the end of this paper.

In addition to these relatively short-term side effects of steroid use, steroid use by younger athletes has developmental consequences, leading to stunted growth, an increased tendency towards aggression and altered serotonin levels in the brain (National Institute of Drug Abuse, 2011; Lumia & McGinnis, 2010). Additionally, cardial problems associated with use of these drugs often continue to persist well into adulthood (Kanayama, Hudson, & Pope, 2008). Furthermore, long-term health consequences such as renal disorders and prolonged changes in brain chemistry leading to psychiatric disorders are associated with extrended use of AAS (Deshmukh, Petroczi, Barker, Szekely, Hussain, & Naughton, 2010; Kailanto, Kankaapaa, & Seppala, 2011).

It is worth noting that although AAS abuse is highly dangerous, there are other PEDs that may have a legitimate place in sport. Some types of PEDs, such as Human Growth Hormone (HGH), are often used to speed up recovery after a sports injury. Although HGH is not the focus of this article, it should be noted that the WADA still outlaws HGH in most sporting environments, and the effects of HGH in the sporting environment are a hotly contested issue and are far from conclusive (see USA Today, 2009). Many advocate for controlled use of this substance to speed up recovery from injury, although its potential for abuse still needs to be explored (for more information on HGH and sport, see Saugy, Robinson, Saudan, Baume, Avois, & Mangin, 2006).

Historically, substance use and abuse in sport goes back as far as the first Olympic Games in Athens, when athletes would use alcohol, bull’s blood and mushrooms to enhance athletic ability (Kamber, 2011). Even in these times, use of substances such as these was banned, even though it would not become a major concern until anabolic substances were produced in large quantities after World War II (Kamber, 2011). As far back as the 1960s, athletes in Germany were facing governmental pressure into taking extremely high doses of anabolic steroids (Savulescu, Foddy, & Clayton, 2004). A doping scandal at the 1988 Seoul Olympics produced the 1990 Dubin Report, investigating steroid and other PED use in Canadian sports (Kamber, 2011). Anabolic steroid use by baseball players in North America during the 1990s and early 2000s was revealed by the Mitchell Report, an investigation of the practice of doping in the MLB (Major League of Baseball). This report drew considerable media attention to the problem of doping in baseball, and indeed sports in general. Unfortunately, this scandal tarnished the reputation of several legendary players like Clemens. After this scandal, more reports on doping practices emerged in other countries, and eventually another major scandal of PED abuse in the 1998 Tour de France triggered the International Olympic Committee (IOC) to form the WADA, one of the first international-level anti-doping

agencies. The formation of the WADA made fighting PED abuse in sport an international initiative for the first time, and was a huge step towards promoting fairness in the sports environment. The WADA still exists today, and is still fighting against the use of PEDs in sport.

How effective is the fight against doping in the sports environment? Gradidge, Coopoo and Constantinou (2011) found the prevalence of AAS use among high school athletes to be 4%, most of them citing that they used it because they felt it gave them a performance advantage. Sports at the high school level can be a stressful and highly competitive environment. Many students depend on sporting scholarships to finance post-secondary education, creating immense pressure to excel in students who are already under plenty of stress. In turn, this stress can foster a desire to use anabolic steroids, and use of AAS creates problems in normal developmental processes (See Lumia & McGinnis, 2010 for complete information on developmental problems associated with anabolic steroid use and puberty). Lorang et al. (2011) revealed a smaller proportion of high school students in the United States (1.4%) used anabolic steroids, but nevertheless found that some athletes practiced doping at a young age. Additionally, between 1 and 3 million people in the United States are thought to have misused AAS at some point in their life (Sjoqvist, Garle, & Rane, 2008; de Souza & Hallak, 2010). These numbers are certainly striking, and highlight the fact that doping is indeed an issue. Unfortunately, it is difficult to determine the prevalence of doping in the current professional sports environment, as athletes who are still active in the sport and using AAS are doing so illegally and thus will not disclose such information. Athletes may try many methods to avoid detection of their steroid abuse, such as urine switching or the use of diuretics. It should be noted, however, that diuretics are also on the list of WADA banned substances, in part for this very reason (Cadwallader, de la Torre, Tieri, & Botre, 2010).

Why is it so important that doping in sport be eradicated? This is a question that many athletes and spectators ask in an effort to understand just how PED use in sport is damaging. Firstly, AAS use is physiologically damaging. As discussed earlier, the high levels of anabolic steroids that are often used by those abusing the substance (oftentimes 10 to 100 times higher than that which would be used for therapeutic purposes) cause many adverse side effects, most notably increased aggression and decreased fertility along with many cosmetic changes (National Institute of Drug Abuse, 2011). Secondly, the issue of fair play in sport is important to consider, as those who "cheat" by taking PEDs without putting in as much work as those who are "clean" is considered by most to be unfair. In relation to this, Solberg and Ringer (2011) note that that baseball culture is a unique case in that the culture promotes unfairness. Cheating is more accepted in baseball than in other sports, made evident by the fact that stealing signs, corking bats, and throwing "spitballs," have historically been part of the game. It may be this attitude that contributed to the steroid abuse scandal of the 1990's, and the higher proportion of baseball players that abuse AAS compared to other sports (Solberg & Ringer, 2011). This attitude continues to pose problems for those trying to eradicate abuse of AAS in baseball.

From a psychological point of view, AAS use has compounding effects within a sport. For instance, when it is learned by one athlete that another player competing for

either wins or their spot on the team is using PEDs, it becomes a perceived necessity to abuse substances as well. A survey conducted by Dr. Bob Goldman highlights the power of competition in relation to doping behavior. In this survey, respondents were asked if they would take a substance that would cause them to remain unbeaten for five years, but would subsequently be the cause of their death. Over 50% of respondents said they would take the substance (Bird & Wagner, 1997). The intense effects of competition on drug abuse becomes an especially important point to consider when this paper discusses the effect that a perceived disadvantage can have on a player (Stirin, Ganzach, Pazy and Eden, 2012). The powerfully compelling psychology behind competition probably fueled the baseball PED scandal of the late 20th century even further, and continues to make implementing successful anti-doping measure difficult.

It has long been suggested that AAS use should simply be given a place in sport. Anti-doping measures cost national anti-doping agencies millions of dollars each year, and some believe them to be a waste of resources (World Anti-Doping Agency, 2006). The argument for legalizing any PED stems from eliminating these costs, and from the fact that if they were legal, everyone would use them and there would no longer by any unfair advantage. However, looking at the damaging effects that long-term use of AAS has on the athlete, it is ethically difficult to give substances like AAS a place in sport, especially when the high levels of aggression that are already present in competitive sporting environments are considered. Even though much time and money could be saved by not having to test for the presence of anabolic steroids, it is hard to imagine children growing up and idolizing a competitor for their athletic prowess knowing that they did not earn it through hard work.

Research conducted by Stirin et al. (2012) underscores the psychological effects of a few athletes doping versus standardized doping. Their experiment examined how perceived disadvantage in a competitive situation effects performance, and revealed evidence that a perceived advantage (for instance, by taking steroids) in itself can give a performance enhancement, while a perceived disadvantage decreases performance. Therefore, it seems that if all athletes are taking steroids these effects might disappear. In fact, it is possible that as performance becomes attributed to a highly externalized source (the drug), the widespread use of these drugs may operate to wash out any natural ability differences that each athlete might perceive (i.e., they would assume that because each competitor is on the same drug, they will perform roughly the same), which might diminish incentives to prepare for competition. This research suggests that when AAS use is standardized among all players, there are diminishing returns on performance for identical risks to health.

Some researchers believe that PED use should be standardized across specific sports, or at least monitored in a different way. In one article, Savulescu, Foddy and Clayton (2004) explain why legalizing most hormonal PEDs and instead monitoring the hormone levels in the body would level the playing field, save time and money on detection, and still ensure a safe, competitive environment for all athletes. Levels of both natural and synthetic hormones in the body (for example, HGH) could be measured and as long as they do not breach a certain threshold the athlete will be allowed to compete. This allows for athletes to use

therapeutic hormones while still competing, or to correct for natural deficiencies in these hormones that would otherwise make performing at a competitive level impossible. Although the authors raise some very good points, it is still important to note that they do not recommend that anabolic steroids specifically become legalized, as anabolic steroids are in themselves harmful, whereas many PEDs (like HGH) are not (Savulescu et al., 2004).

Competitive sport has been plagued since its origin by a history of drug abuse in order to obtain an unfair advantage. Anabolic-androgenic steroid use is perhaps the most problematic, and historically it has been a huge problem in the world of professional baseball, where a "cheating positive" atmosphere and the need for larger muscles create a great incentive to abuse the drug. Although some argue that AAS use in sport should be legalized to save money and remove the problem of fair play, this conclusion would be ignorant of the damaging effects that anabolic-androgenic steroids have on the body and of the psychological effects surrounding competitive advantage and drug abuse. Additionally, sport has a responsibility to set an example for those spectators who draw inspiration from their favourite pitcher or quarterback. Sport needs to send the message that hard work and determination - and not a drug - are the most important tools for success. Although some performance-enhancing drugs may be legalized in the near future, the effects, history, and prevalence of anabolic steroids reviewed in this article clearly suggest that the standardized use of AAS should still be vehemently protested. New detection techniques are constantly in development to try and stop AAS use, and future research should focus on new technology in this area as well as investigating how often athletes turn to other, legal competitive advantages like psychological skills training. Awareness of these skills could deter athletes from abusing PEDs. Anabolic-androgenic steroid use in sports today pulls dominant records held by legends like Roger Clemens into question, and makes us ask ourselves: "Did he really earn it?"

Declaration of Conflicting Interests

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

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Exploring religiosity's effects on altruistic behaviour

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Abstract

Previous research has found that a person's altruism is related to religiosity. This study attempted to tease apart whether this finding is due to religion itself or other factors related to religiosity. This study asked participants to donate money towards a friend and charity using a cold pressor task. This task involved asking participants to put their hand in ice cold water, once for the friend and once for the charity. The longer a participant could hold their hand in the water, the more money they earned for the recipient. Because the task was painful, it was an altruistic act for participants to hold their hand in the water. We then used the Moral Foundations Questionnaire (Graham, Haidt, & Nosek, 2009) to study the four different moral foundations people use to make moral judgements. The study found that the relationship between religiosity and altruism was actually related to the moral foundation of concern about purity and highly correlated with religiosity. Furthermore, the relationship between purity/sanctity and altruism was mediated by in-group/loyalty and authority/respect. Therefore, this study suggests that it is not religiosity that influences altruistic behaviour, but rather the moral foundations that religious people score highly on.

Keywords: *religiosity, altruism, moral foundations, beliefs*

A person walking on any street in Canada will inevitably see panhandlers, who she will then try to brush past. This same person may willingly give money to one of her friends. Why would she refuse to donate money to someone who probably desperately needs money, but would gladly give the donation to a friend, who is probably a lot less desperate? Because the friend has a much closer social distance with her than the panhandler and social distance can affect altruistic action.

Social Distance and Altruism

Altruism is defined as the willingness to help another at a cost to oneself. There are many factors that affect one's altruistic level including social distance, which is one of the most ubiquitous influences on altruism. Regardless of a person's level of religiosity, people will be more willing to help someone who is socially closer to them than someone who is more socially distant. The relationship between social distance and altruism is known as the altruism curve, which states

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that there is an inverse correlation with altruism and social distance (Rachlin & Jones, 2008). Therefore, according to this curve, both religious and non-religious people will be more willing to perform an altruistic act for their friends than for charities, even though objectively speaking; the charity may need the help more.

Religiosity and Altruism

Historical Background. One of the major factors that influence the altruism slope is religiosity, the level of religious belief that a person possesses. All major religious texts explicitly encourage altruism, therefore, the stronger a person's religious belief, the more the person should be altruistic (Batson, Schoenrade, & Ventis, 1993). In fact, Pichon, Boccato, and Saroglou's study (2007) shows that the link between religion and altruism is so firmly entrenched in people's belief system that even when individuals are primed with a positive concept of religion, they become more altruistic. In the last couple of decades, psychology has begun to test whether the belief in the positive effects of religion is warranted (e.g. Ahmed, 2009; Batson et al. 1989). Does scientific research agree with this idea that religious belief promotes altruism? Results have been decidedly mixed (e.g., Ahmed, 2009; Pichon et al., 2007).

Studies that found a correlation between religiosity and altruism.

Studies using self-report measures, have found a weak positive link between religiosity and altruism (e.g., Piazza & Glock, 1979). Researchers have also found a reliable, positive link between religious service attendance and frequent praying and altruistic behaviour such as charitable donations and volunteerism (Brooks, 2003). These differences in altruism between religious and non-religious people remain even after controlling for possible, alternative factors such as marriage status, age, and income. On the surface then, it seems that the idea that religious belief promotes altruistic behaviour is correct; however, there is a small complication in this interpretation.

Studies that found religiosity sometimes positively affect altruism. Other research has found a positive correlation between religiosity and social desirability – the tendency for people to project an overly favourable self-image in evaluative contexts (Trimble, 1997). Religiosity predicts greater altruism when reputation-related egoistical motivation has been activated in the believer and in within-group situations (Batson et al., 1989). This egoistical motivation relates back to the positive correlation between religiosity and social desirability discussed earlier. If performing or appearing to perform the altruistic behaviour would promote a good self-image in the eyes' of the participant or observers, than religiosity predicts a greater level of altruism. This means that it is possible that religiosity does *not* predict greater altruistic behaviour, just greater *reported* altruistic behaviour, which may or may not be a true reflection of the believer's behaviour. Together, these studies suggest that it is the desire to *appear* altruistic that explains the relationship between religiosity and altruism, not an actual desire to *be* altruistic.

However, it is *not* always about appearances, as religiosity *does* predict altruistic behaviour in within-group contexts. Religious people behave more altruistically to in-group members than non-religious people. One reason is that religious belief enhances within-group interpersonal trust. With greater trust, the chances of altruistic

behaviour within the group increases (Norenzaya & Shariff, 2008; Berg, Dickhaut, & McCabe, 1995). This type of altruism is known as "parochial altruism" (Choi & Bowles, 2007). Yet, it also has a dark side: increased parochial altruism is correlated with discriminatory and unhelpful behaviour towards out-group members (Hunsberger & Jackson, 2005).

Moral Foundations Theory and Religiosity

The research above has shown that religiosity has a complicated relationship with altruism. One factor that affects religiosity's effects on altruism is who is being helped. Another factor is the moral foundations that people use to make moral judgements. These foundations can be defined using the Moral Foundations Theory created by Graham, Haidt, and Nosek (2009). According to the theory, there are five functions of these moral foundations: harm/care, fairness/reciprocity, in-group/loyalty, authority/respect, and purity/sanctity. Religious people are more likely to use three of these foundations, known as the "bonding foundations": in-group/loyalty, authority/respect, and purity/sanctity. In-group/loyalty and authority/respect have been found in other literature to influence altruistic behaviour, while purity/sanctity has been found to influence in-group/loyalty and authority/respect.

"Help your friends." In-group/loyalty is defined as concerns related to obligations of group membership such as self-sacrifice for the group and preference towards the group, in other words, in-group bias (Haidt, Graham, & Joseph, 2009). Religious people tend to score higher on in-group bias. This leads them to be more helpful towards in-group members and possess stronger loyalty to the group. This loyalty can be observed in areas such as scoring higher on nationalism (Eislinga, Felling, & Peters, 1990). The flip side of this is that when faced with groups that are different from them, religious people tend to be discriminatory. Previous studies done by Allport and Ross (1967) have found religion to be positively correlated with most or all types of prejudice. This leads religious people to be less altruistic towards out-group members. Studies have found that when faced with people who are different from them, such as people who are homosexual, religious people were much less willing to help (Pichon & Saroglou, 2009). This difference in attitudes towards in-group and out-group members can be summed up in studies that show that religious people highly value benevolence, a pro-social trait in relation to interpersonal interactions, universalism, which includes a broader openness to all people, is not so highly endorsed by religious people (Schwartz & Huismans, 1995). Therefore, people who score higher on the in-group/loyalty score should be more altruistic towards their friends than charity.

"Give help to the needy." This in-group bias is complicated by the fact that religious people also tend to score higher on the authority/respect scale. Authority/respect is defined by Haidt and his colleagues (2009) as concerns related to social order and hierarchical relationships such as obedience and respect as moral imperatives. Therefore, someone who scores higher on this scale, all other things being equal, may more strongly believe that that obedience to authority is a moral imperative. Religious people tend to score higher on this scale. One of the reasons they score higher is that religion socializes people to conform to rules and the orders of authorities (Donahue & Benson,

1995). Thus, they are more likely to obey those they consider authorities, such as religious commandments, which encourage charitable behaviour (Batson et al., 1993). This would suggest that religious people should be more altruistic towards charities than non-religious people. However, previous research on political stances, conservatives versus liberals, found that individuals who score high on conservativism, which is highly correlated with religiosity (Jonathan, 2008) also score higher on the authority/respect scale, and are less altruistic overall (e.g., Carey & Paulhus, 2010). Therefore, non-religious people should be more likely donate to people than religious people.

"They tell me that they're disgusting." In-group/loyalty and authority/respect are influenced by the purity/sanctity foundation. Purity/sanctity relates to concerns about the purity of the body and spirit. In relation to religious doctrine, this would express itself in areas such as concern for chastity, temperance, control of one's desires (Haidt et al., 2009). A person who behaves or possesses a trait that is not considered "pure" evokes disgust from others. This type of disgust is called sociomoral disgust (Beck, 2006) and it is in response to the person who possesses the undesirable action or trait. Which behaviours and traits are considered undesirable are defined by cultural factors, such as religious authorities (Beck, 2006). The people who invoke this type of disgust are generally categorized as members of an out-group, and, in turn, not worthy of charitable help (Nussbaum, 2001). Consequently, those who are considered not pure, as defined by authorities, are considered to be less worthy of help because they become more distant out-group members. People who score higher on the purity/sanctity scale, who tend to be religious people because they tend to use more purity metaphors (Beck, 2006), should score higher on in-group/loyalty and authority/respect.

Hypothesis

Hypothesis #1. Based on the literature cited above, we predict that religiosity will predict a greater difference in donations towards friends compared to charity. Specifically, we predict that the more religious someone is, the more they will donate to friends, as opposed to charity.

Hypothesis #2. Furthermore, we predict that the relationship between religiosity and altruism will be mediated by the three bonding moral foundations: in-group/loyalty, authority/respect, and purity/sanctity. We predict that the relationship between religiosity and altruism is actually the relationship between religiosity and purity/sancity, which is mediated by in-group/loyalty and authority/respect.

Hypothesis #3. Finally, we predict that the effects of in-group/loyalty and authority/respect on altruism will be opposite of each other, whereby in-group loyalty will lead to more altruism and authority/respect will lead to less altruistic behaviours.

Method

Participants

The 39, participants (77% females; East Asian 54%, 13% European, 8% South Asian, and 26% “other”) were all undergraduate students at the University of British Columbia who were taking at least one psychology course. Among the participants, 64% were religious. They participated in

exchange for half a credit that they could then apply to their grade in a psychology course.

Independent Variables

Moral foundations questionnaire (MFQ). Created by Graham and colleagues (2009), the MFQ had 32 statements divided into two sections and was designed to measure five scales: harm/care, fairness/reciprocity, in-group/loyalty, authority/respect, and purity/sanctity. Each scale measured a possible purpose for moral judgment. The five foundations were correlated with different explicit and implicit political ideology $|\beta| = .16$ to $.52$, $p < .001$). In-group/loyalty, authority/respect, and purity/sanctity were positively correlated with conservatism ($|\beta| = .17$ to $.34$, $p < .001$). The Cronbach's alphas for these foundations are .71 (in-group), .64 (authority), and .76 (purity).

The first section of the MFQ asked, "When you decide whether something is right or wrong, to what extent are the following considerations relevant to your thinking?" and listed 16 statements to which participants indicated their relevance on a six-point scale. Statements included "whether or onto someone suffered emotionally" and "whether or not someone acted unfairly" (1 = *Not at all relevant,* 6 = *Extremely relevant).* The second section asked participants to indicate their agreement on a six-point scale to 16 statements. Items included "compassion for those who are suffering is the most crucial virtue" and "it is better to do good than to do bad" (1 = *Strongly disagree,* 6 = *Strongly agree).*

Right wing Authoritarian scale (RWA scale). We then used the five-point RWA scale that was shortened by Zakrisson (2005) to 15-items. The new scale lost a small amount of reliability (Cronbach's alpha) compared to the original 30 item RWA scale, (.86 vs. .72). However, the new scale still reliably measured all the items that the original RWA scale measured: conventionalism, authoritarian aggression, and authoritarian submission. Seven items on the scale were reverse-scored. Items included "our country needs a powerful leader, in order to destroy the radical and immoral currents prevailing in society today" and counter-balanced items such as "our country needs free thinkers, who will have the courage to stand up against traditional ways, even if this upsets many people" (1 = *Strongly disagrees,* 6 = *Strongly agree).* Larger overall scores indicated more conservative and less liberal orientations, whereas smaller scores indicate more liberal and less conservative orientations.

Ten item personal inventory (TIPI). A ten-item scale created by Gosling, Rentfew, and Swann Jr. (2003) was used to measure the Big Five personality dimensions (i.e., extraversion, agreeableness, conscientiousness, emotional stability, and openness to expression). The TIPI asked participants to rate their agreement to statements about their own personality on a five-point scale. Half of the statements were reverse-scored. Statements included "I see myself as: extraverted, enthusiastic" and "I see myself as: dependable, self-disciplined" (1 = *Strongly disagree,* 5 = *Strongly agree).* This scale was highly correlated with the original Big-Five Inventory *(r* = .65 to *.87, p* < .01). The Cronbach's alphas ranged from .45 to .73.

Belief in a just world (BJW). Created by Lerner (1980), the BJW contains 15 items which test belief in a just world. Scoring

highly on the BJW indicates that people believe that those who have unfortunate event happen to them deserved it, thus, high scores identify individuals who participate in victim blaming. Participants were asked how much they agreed with each item on a five-point scale. Items included "I feel that a person's efforts are noticed and rewarded" and "I feel that the world treats people fairly" (1 = *Strongly disagree,* 5 = *Strongly agree).*

Demographics. On the last page of the questionnaire package, we asked participants to indicate their age, years they have spoken English, gender, number of family members, primary ethnic heritage, political orientation, and level of religious belief. Both the political orientation and religiosity questions were on a five-point scale. The political orientation ranged from 1 = *very liberal* to 5 = *very conservative* and religiosity ranged from 1 = *not at all religious* to 5 = *very religious.*

Dependent Variable

Level of altruism. The level of altruism was measured by the amount of money participants earned for their friend and charity. They earned the money with the cold pressor task. The cold "pressor" was a cooler filled with water, which was cooled by ice packs. Participants were asked to put their hands in the cold pressor twice, once for friend using one hand and once for charity using the other hand. The longer they kept their hand in the water, the more money they earned. The total amount they earned was dependent on how long they held their hand in the water on either round. If the longest they held their hand in the water was under a minute, then the total amount they earned was $10, and if they longest was at the maximum of five minutes, they earned a total of $20. The amount increased by $5 per minute. The money was split between the conditions depending on the difference between the times in the two conditions. For every 60 seconds difference, the longer lasting condition earned $5 more. For example, if a person held on for one minute in the charity condition and three and a half minutes for the friend condition, then they earned $20 in total with $5 to charity and $15 to the friend.

Procedure

Participants were placed in front of a computer where they entered a unique identification code. The computer randomly determined if they started with the personality questionnaires or the cold pressor task. During the personality questionnaires component, participants filled out the questionnaires listed above, including demographics, on the computer and went on to the cold pressor task. When the participant got to the cold pressor task, the research assistant explained to the participants that they would earn money for their friend and charity. The research assistant showed participants the Canadahelps.com website to convince participants that the charities were real and that they were really earning money for charity. The computer randomly decided whether the participants earned money for the friend or for charity first. If it was the friend condition, participants were asked to write the name of a close friend, who was not a relative or significant other, onto a white envelope. Participants then performed the cold pressor task, once for the friend and once for charity. At the end of the study, the amount of money they earned for the friend was placed in the envelope for them to give to their friend. The money they earned for charity was given to them in the form of an electronic gift certificate for Canadahelps.com that was emailed to them at the end of the day.

Table 1. Regression of religiosity, RWA total score, and politics on time difference

	B	Std. Error	β	t	*p*
Constant	-51.236	81.655		-.627	.534
Religiosity	32.064	15.602	.403	2.055	.047
RWA Total	-.876	34.305	-.005	-.026	.980
Politics	-5.820	15.925	-.060	-.365	.717

Results

We first calculated altruism preferences for the friend condition by finding the time difference between the friend and charity. Then we did a regression with political stance, Right Wing Authoritarianism (RWA) score, and religiosity with the time difference between the friend and charity cold pressor task as the dependent variable. We used political stance, RWA score, and religiosity because previous research has found a relationship between them (e.g., Graham, Haidt, & Nosek, 2008). We wished to confirm that religiosity was driving the relationship between these three factors and altruism. The regression found only religion to be significant, β = .40, p = .047 (see Table 1).

Hypothesis #1: Religiosity will predict a greater difference in donations towards friends compared to charity

We did a repeated measures ANOVA and controlled for the order of the tasks, cold pressor or questionnaire first and friend or charity first. The ANOVA looked at the religiosity, friend time, and charity time. There was a significant relationship between religiosity and time according to Wilk's Lambda, F = 14.10, p = .001 (see Figure 1). Therefore, religiosity was correlated with how much time participants were willing to keep their hand in the cold pressor for the two recipients.

Hypothesis #2: The relationship between religiosity and altruism is mediated by the three bonding moral foundations.

We did a regression with religiosity, time difference, and the Moral Foundations Questionnaire to see if any of the moral foundations had a significant relationship with religiosity and time difference in keeping the hand in the cold pressor task for friend vs. charity. We found that in-group/loyalty had a significant relationship

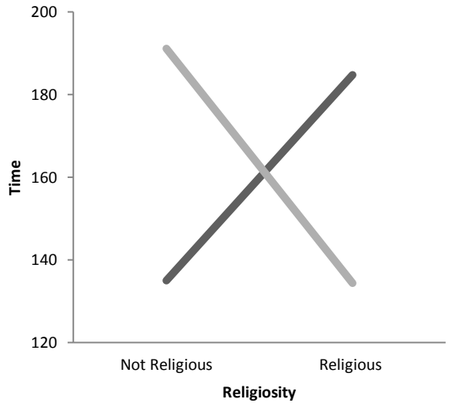

Figure 1. Interaction between religiosity and time spent on friend and charity.

between religiosity and time difference, β = *.61, p* = .027. Also, authority/respect had a significant relationship between religiosity and time difference, β = -.64, *p* = .039. Mediation analysis was performed to test whether in-group/loyalty and authority/respect mediated the relationship between religiosity and time difference. They were not significant. For authority/respect, *b* = -11.11, *z* = *-1.43, p* = .15, bootstrapping $CI_{.95}$[-32.12,-.29], or for in-group/loyalty, *b* = 18.10, *z* = *1.83,p* = .067, bootstrapping $CI_{.95}$[.90, 61.32].

But, religiosity was strongly correlated with purity, *r* = .50, *p* = .002. Therefore, mediation was again performed to test whether in-group/loyalty and authority/respect mediated the relationship between purity and time difference. It did, for the authority/respect path, *b* = -33.81, *z* = *-2.03, p* = .042, bootstrapping $CI_{.95}$[-87.44, -4.62], and for in-group/loyalty, *b* = 34.24, *z* = *2.31,p* = .021, bootstrapping $CI_{.95}$[4.09, 104.43] (see Figure 2).This suggests that the factor that was driving the correlation between religiosity and altruism was purity/sanctity.

This relationship was mediated by in-group/loyalty and authority/respect. In-group/loyalty mediated a positive correlation between purity/sanctity and altruism and authority/respect mediated a negative correlation. This explains why the original test to see if they mediated the relationship religiosity and altruism were not significant. These opposing effects are about the size and opposite of each other, therefore, they cancel and when looking at their effects together, so it appears that they have no effect. However, when the two factors are separated, it becomes clear that both do affect the relationship between religiosity and altruism.

Hypothesis #3: The effects of in-group/loyalty and authority/respect on altruism will be opposite of each other

Simple effects for both in-group/loyalty and authority/respect were calculated to see their effects on the time for friends and charities. None of the correlations were significant; however, most show a significant trend. Friend times were not affected by in-group/loyalty, p = .89, and decreased as authority/respect increased, *r* = *-.21, p* = .24. Charity times decreased as in-group/ loyalty increased, *r* = *-.22, p* = .20, and as authority/respect increased, *r* = *-.21, p* = .23.

The length of time participants kept their hand in the cold pressor for a friend was not affected by how high participants scored on the in-group/loyalty scale. However, there was a negative correlation between the time and authority/respect. The higher participants scored on the authority/respect scale, the less time they kept their hand in the water. The length of time participants kept their hand in the cold pressor for charity was correlated with both factors. As participant scores for both scales increased, the time they kept their hand in the water decreased.

Discussion

We discovered a very interesting relationship between levels of religious belief and altruistic behaviour. These findings suggest that it is not religious belief that influences altruism, but rather the

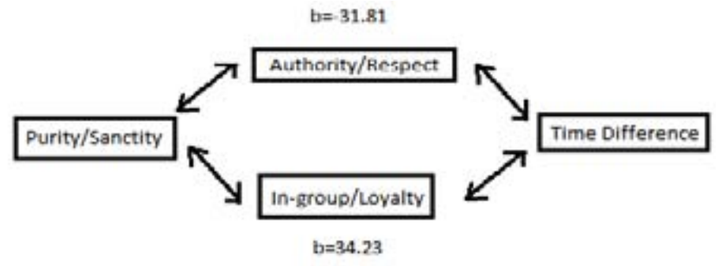

Figure 2. Mediation between purity/sanctity and time difference.

functions of moral judgment that religious people share. Religious people score highly on purity/sanctity, which this study found to correlate with altruism. Higher scores on this purity/sancity scale signify that individuals put more moral weight on the purity of a person or group.

As Beck (2006) suggests this could be due to many religions using purity metaphors. Or, it could be that people who are more easily disgusted are more conservative (Inbar, Pizarro, & Bloom, 2009), which would predict that they would also be more religious. Purity/sanctity was positively correlated with in-group/loyalty and authority/respect. Therefore, people who put more moral weight on purity, also have greater in-group bias due to the fact that they view their own group as being pure and out-group members as being impure. Widening the gap between in-group and out-group members, out-group members become not just strangers, but *disgusting* strangers. Seeing strangers as disgusting tends to cause people to view others as less human and less worthy of help. Also, people who are highly concerned with purity will look to authorities, including religious authorities, to tell them what is pure and what is not. Religious authorities, since they use a lot of purity metaphors, probably also increase the people's concerns about the morality of purity (Beck, 2006). It should be pointed out that the relationships between purity with in-group/loyalty and authority/respect were found using mediation, consequently, they can only be seen as correlations, not causations.

Both in-group/loyalty and authority/respect effected how much time was spent on friends and charity in the cold pressor task. In-group/loyalty stretched out the distance between friends and charity as it did not affect friend time and decreased charity time. However, there was no correlation between stronger in-group bias and more altruistic behaviour towards friends. In-group bias *was* correlated with behaving less altruistically towards charities, which are considered out-groups. The reason in-group bias does not increase altruism towards friends is probably explained by the effects of authority/respect. Authority/respect decreased the time spent on friends and charity because it caused the altruism slope to become steeper. Hence, even if the social distance between the helper and helped was the same for a religious and non-religious helper, the helped would gain less altruistic behaviour from the religious helper than the non-religious helper. This agrees with previous

research done by Carey and Paulhus (2010) that conservatism, which is correlated with obedience to authority, and decreased altruism. As indicated by the results, people who score higher on in-group/loyalty and authority/respect provide less help towards charities than toward friends.

Implications

There are several important implications of this study. Importantly, this study suggests that it is not religiosity itself that influences altruism, but rather the moral functions of moral judgments related to religion. Therefore, if society wishes to encourage more altruistic behaviour in group contexts, it would probably not be most helpful to encourage different moral functions of moral judgment. Also, these findings suggest that if a charity is looking for donations from a religious person or group, it should emphasize the similarities between the charity and people they are close to.

Considering the moral foundations that are driving the relationship between religiosity and altruism, people might be tempted to suggest that society should encourage religious belief because it encourages altruism. However, religious driven altruism does have costs. Religious people are more altruistic toward in-group members because of in-group bias than non-religious people, but in-group bias is linked with parochial altruism (Choi & Bowles, 2007). This means that believers are less helpful and more discriminatory towards outgroup members (e.g., Hunsberger & Jackson, 2005). This might not have been a problem in earlier societies, which were more homogeneous, but it does pose a big problem in modern societies such as Canada, where most people in society will be out-group members to the believer, non in-group members. Furthermore, religious people's altruistic behaviour towards out-group members is influenced by who their authorities tell them is worthy of help. Considering that this study has provided evidence that religiosity does not promote altruism and may in fact create prejudice and division between groups, nations might wish to be careful when encouraging religion in case it has negative, rather than positive effects. We would also like to clearly state that we are not suggesting that religion is a negative influence or that it should be discouraged. We would only like to point out that research, including our study, suggests that some people might benefit from religious based altruism, but most are victims of it.

The effect of religious salience also suggests that should society wish to use religious belief to increase altruism, it needs to ensure that religion is always salient. When it is, studies have found that the religious people are more helpful than non-religious people (e.g., Sosis & Ruffle, 2003). However, an alternative explanation could be that it is not the religious salience, but the public ritual participation which encourages altruistic behaviour (Norenzaya & Shariff, 2008). Given the uncertainty of what is driving the increased altruism, religious salience or public ritual participation, more research in this area should be conducted.

Our study found that it was the moral foundations, not religiosity itself, that influenced altruistic behaviour. In large, modem secular societies, such as Canada, it is possible for secular moral authorities to replace religious influence on altruism because secular authorities can promote the same moral foundations as religiosity (Norenzaya & Shariff, 2008). Future research should aim to understand what types of moral judgments predict greater altruism to help secular moral authorities influence a more universal altruism in society and avoid the negative consequences of religious driven altruism.

Limitations

There are several limitations to the study. The main limitation is that there was only one question relating to religiosity that participants completed, which did not allow for much differentiation of religious belief. Also, there were very few participants, 21 of whom were East Asians and all who were undergraduates. As religious belief *does* change with age (Kenrick, in press) *and* interacts with ethnicity (Chatters, Taylor, Bullard, & Jackson, 2009), our results are less generalizable to the general population. Also, the operational definition for altruism in this study was one-time donation behaviour. Thus, the relationships found in this study might not generalize to other types of altruistic behaviour. For example, studies have found that sustained altruistic behaviour, such as volunteering, has a greater positive relationship with religion than spontaneous altruistic behaviour, such as donation (Benson et al., 1980).

Furthermore, this study evaluated the donation behaviour using the cold pressor task where ethics bound the participants from keeping their hand in the water for more than five minutes. We found ceiling effects among some participants, suggesting that we might have found more variance if we had permitted participants to participate in the task for longer than five minutes. There were also participants who kept their hand in the water for a very short time (less than 30 seconds). The difference in time for those who experienced the ceiling effect and for those who could barely keep their hand in the water suggests that there might be an individual difference in pain tolerance. Pain tolerance might have confounded the time differences between friend and charity. In future studies, pain tolerance should be pre-tested to ensure that all participants have similar levels of tolerance. Furthermore, the maximum time for the task should be increased or the water made colder to eliminate ceiling effects.

Future Directions

As stated above, future studies should try to tease apart various aspects of religious belief to isolate which aspects are relevant to which type of moral functioning. Also, studies may want to compare other groups that share the same moral foundations, such as minority ethnic groups, and see if they share similar altruism patterns as religious people. Previous studies have shown that minority ethnic groups who score highly on in-group/loyalty and authority/respect show similar altruism patterns for donations (e.g., Amponsah-Afuwape, Myers, & Newman, 2002), but I am not aware of any studies that directly compare minority ethnic groups and religious groups to study how similar the groups are. Also, it would be interesting to tease apart the differences among the different groups of non-religious people. Are atheists different from agonistics and spiritual people? Some studies have suggested atheists follow similar altruistic patterns as spiritual people (e.g., Dillon, Wink, & Fay, 2003). These future studies could build and expand the intriguing results found in the current study.

Declaration of Conflicting Interests

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

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Communal Male Role Models: How they influence identification with domestic roles and anticipation of future involvement with the family

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Abstract

The division between work and family is still gendered in our society. While today's women heavily participate in the workforce, men have not begun to participate in household tasks and child care to the same extent, leading to continuing gender imbalances. This seems to have an influence on individuals' self-concepts, their association with work and family, and how they predict their future work-family balance. Furthermore, previous research has shown the influence of career-oriented female role models but has neglected the possible influence of male role models. In this study we investigated whether exposing female and male participants to three different conditions of male exemplars, differing on their work-family balance in lifestyle, from family orientation over a balanced lifestyle to extreme career orientation, would influence their implicit associations with work and family as well as their predictions of their future life. Consistent with our predictions, a preliminary data analysis focusing on female participants showed different anticipations of their future work-family balance when exposed to family oriented male models rather than balanced or career- oriented males.

Keywords: *modelling, gender roles, male, division of labour*

Gender-typing of activities is very salient in our society, with children as young as three years of age showing knowledge of which activities are stereotypically masculine and which activities are stereotypically more feminine (Boston & Levy, 1991). Since the 1970s we have experienced considerable changes in gender norms and gender equality in North America and Europe. The women's rights movement and the entry of women into the workforce have paved the way for the different gender norms we experience today. Although young women today are increasingly more career oriented and obtain a larger percentage of undergraduate degrees than men (Statistics Canada, 2008), expectations for men and women's life course continue to differ.

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Remainders of archaic gender hierarchies can still be seen in today's society. For example, female leaders are still perceived as role-incongruent, meaning not typically feminine (Eagly & Karau, 2002), and less than 7% of males are househusbands (Smith, 2007). Although society has come a long way, there is still the need to work towards equality between men and women. True gender equality could enable each individual to make choices and realize their potential independent of any gender specific expectations. Research in psychology can give us important insight into which methods could be used to achieve more equal thinking and actions in individuals. In this study we are interested in the influence of counter-stereotypical primes on participants' adherence to traditional gender roles.

Generally, men still tend to associate themselves with traditional gender roles and norms (Spence & Buckner, 2000). Changing men's adherence to these traditional gender roles, which prevent them from taking part in nurturing and family activities, can be seen as a benefit to women as well as men. Compliance to traditional gender roles might actually deprive males from experiencing alternative roles, such as being a stay-at-home dad, which could be rewarding. Researchers have indeed suggested that fatherhood and fathering activities are beneficial for males' well-being (Dykstra & Keizer, 2009). In this current line of research, we are investigating whether men and women predict that their own life will take a less counter-stereotypical path and whether they will change their own association with family and career when primed with male exemplars that display an alternative, family-oriented lifestyle.

Most research on how men and women relate to family and career matters and how they manage the division of labour, comes from the fields of the sociology, gender or family studies, and concentrates on describing phenomena. The research from these fields shows that traditional conceptions of husbands being the bread-winners and women taking care of the household are still relevant (Blair and Lichter, 1991). Women and men's attitudes are in line with these stereotypes, with women holding more favourable attitudes towards housework than men do (Blair and Lichter, 1991). These attitudes also seem to be reflected by the actual division of labour in families, with women doing more childcare and housework (Blair and Lichter, 1991). It is worth noting that men's attitudes are more important in determining how the couple actually handles the division of household work (Poortman & Van der Lippe, 2009). This finding suggests that it is extremely important to find ways to change men's associations with the domestic sphere in order to promote gender equality. This makes the possibility of a simple intervention, such as exposure to role models, especially interesting for shaping male attitudes.

We have already noted the persistent underlying conservative attitudes toward the division of labour within marriages. These attitudes and their consequences have a markedly negative effect on women. One study showed that having a husband who works long hours made wives more likely to quit their jobs, especially when children were present, but this effect wasn't seen the other way around, when the wife worked long hours (Chaa, 2010). Women have also been shown to have less leisure time today compared to 1975, which is not the case for men (Mattingly & Sayer, 2006). This supports the notion that the increasing participation of women in the work force

does not necessarily mean they will do less housework. Instead women often take on a "second shift," being responsible for the majority of the housework in addition to their paid job (Hochschild, 1989).

This research exemplifies the one-sided trend towards more egalitarian attitudes and actions. We have witnessed a considerable amount of change in women's attitudes and lives but men have failed to show changes to the same extent. Men are still shown to be less family oriented than women in how they situate themselves in relation to career and family. These differences have been demonstrated when young males and females are asked to imagine their "possible selves," a concept introduced by Markus and Nurius (1986). An important gender distinction in these forecasts has been found by Diekman and Brown (2010), where young men predicted themselves to be less involved with family in the distant future than young women did.

This gender difference is also evident on a conceptual level. Conceptualizations of femininity and masculinity are still closely connected to agentic (i.e., expressive) and communal (i.e., instrumental) traits, with women stereotyped as more communal and men as more agentic (Lippa & Conelly, 1990). Interestingly, some researchers have argued in favour of renaming these traits "Dominance and Nurturance" (eg. Spence, 1983) which clarifies the role segregation that underlies these dimensions. Since women are connected to nurturance it may seem evident that this accounts for their traditional adherence to household and family matters, in contrast to the dominant male, who is concerned with work and achievement. Fortunately, masculinity and femininity are now conceptualized as a two-dimensional model, meaning that men and women can possess both feminine and masculine traits, a concept termed "androgyny" (Bem, 1974; Spence, Helmreich & Stapp, 1974, Spence 1983, Lubinski, Tellegen & Butcher, 1983).

This, however, does not mean that Western society has arrived at a point where men and women equally display and associate themselves with communal and agentic characteristics. In line with the finding that men are still less likely to associate themselves with domestic matters, which are closely connected to femininity (Diekman & Brown, 2010), research has failed to find a strong change in men's femininity and masculinity scores over past decades. In a recent examination of gender typing, Spence and Buckner (2000) found that women have developed a stronger identification with agentic traits but men have stayed relatively constant in their identification with agentic and communal traits –meaning that they do not identify strongly with communal traits. This illustrates the one-sided male maintenance and retention of traditional gender roles. We think that this lopsided advancement creates a mismatch between women wanting to participate in the working world and men who are not willing to be more involved in family life. As long as more egalitarian attitudes fail to exist for men, gender equality cannot be achieved – so ultimately we are interested in what could create a change in this imbalance.

One reason for the rigidity of men's roles may be that masculinity is still seen as more positive and desirable in our society. Masculinity is connected with competence, whereas femininity is perceived to be linked to warmth and expressiveness (Broverman, 1972). A man who engages in feminine, nurturing activities may then be seen as showing weakness. This idea is best reflected by the idea of "precarious

manhood" which describes the finding that manhood, in contrast to womanhood, is a less stable concept. Research shows that there is an underlying belief that manhood, but not womanhood, is a trait that can be lost and is therefore something that has to be proven. It is partly because of this instability of manhood that men still feel threatened when they are associated with femininity or activities deemed feminine (Vandello et al, 2008).

The importance of role models is emphasized by a number of social learning theories that attempt to explain how we acquire gender stereotypical knowledge, attitudes and behaviours (e.g., Bandura, Ross & Ross, 1961). Different models in the social learning perspective are used to explain how society teaches individuals to behave according to a gender standard. For example, social cognitive theory describes how children first learn behaviours through observing models in their environment (Bandura, Ross & Ross, 1961; Perry & Bussey, 1979). Male and female children learn to behave differently because they learn behaviour appropriate for their gender from models in their environment. Moreover, socialization theory (operant conditioning), applied to the learning of gendered behaviour, holds that men and women differ because they are reinforced by peers and superiors when they display gender-congruent behaviour and punished when they display gender incongruent behaviours (Fagot, 1977). Furthermore, social role theory maintains that females and males develop different characteristics because of the diverging social roles they are assigned to (e.g., domestic roles vs. career roles). These roles require distinct attributes that the individual develops to fit into the role (Eagly & Diekman, 2000).

There is a large body of evidence giving support to all of these pathways, many of which emphasize the role of models in gender development. These findings help explain why the male gender role appears to be more rigid. Research indicates that various role models encourage males not to show feminine characteristics. These role models come from a variety of sources, including characters within children's books, actors, teachers or their own parents (Diekman & Murnen, 2004; Coltrane and Adams, 1997; Raag & Rackliff, 1998; Lamb Easterbrooks, & Holden, 1980). All of these findings suggest that boys may be under special pressure to conform to the models of masculinity and provides an explanation as to why gender-incongruent males may elicit more negative reactions in participants than gender incongruent females.

As I will describe here, there has been a vast amount of research into women's issues in gender equality. This work has examined how exposure to successful female role models can usher women to adopt more agentic traits and roles and promote women to move into the workforce. One study showed that exposing female participants to exemplars of successful women in a lab setting leads them more easily associate females with leadership attributes on an IAT, marking less stereotypical cognitions (Dasgupta & Asgari 2004). Another study showed that young college women were more likely to believe that they would have a successful career when they had a higher amount and better quality of contact with female professors (Asgari, Dasgupta & Gilbert Cote, 2010). Most recently, a series of studies focusing on the fields of Science, Technology, Engineering and Mathematics (STEM) has shown that women in these fields exhibit stronger implicit association of self with STEM subjects as well as higher

association of women with these fields after exposure to female experts or after being taught by female math professors (Stout, Dasgupta, Hunsinger & McManus, 2011).

The value of role model primes also connects to findings that suggest that decisions about the division of labour are often made on an implicit level, but serve to perpetuate gender roles (Wiesman et al, 2008). This may mean that attitudes about what is appropriate for each gender are so deeply internalized that they influence cognition without awareness. This suggests that participants may not consciously recognize the influence a counter stereotypical male role model can have on their thoughts and behavior. Overall, the previous findings connected to modelling and gender roles leads us to believe that role models may be a promising way to change traditional gender role adherence. A notable point, however, is that previous investigations concentrated on how women benefit from female role models. The male side of this issue has, unfortunately, been largely ignored. We, on the other hand, want to utilize these past research findings to see how communal male role models can influence not only men, but also women.

Hypothesis 1

In this study, we wanted to assess how heterosexual male and female students were influenced by reading about family-oriented males (condition 1) , males with an equal balance between work and family (condition 2) or males with a clear career oriented lifestyle (condition 3). We expect effects on the way students implicitly associate themselves with work and family on a Go-No-Go Association Task of implicit associations (GNAT; Nosek & Banaji, 2001), as well as on how students imagine a day in the life of their future self. We think that these profiles could model a counter-stereotypical but positive version of males and therefore be successful in changing attitudes about what lifestyles are appropriate for males as well as females. Hence, our prediction is that male students will be faster to associate themselves with family related words when primed with profiles of family-oriented men than participants who are primed with traditional, career oriented males. Male participants in this condition should also predict more involvement in the family compared to male participants in the other conditions.

Because of the findings related to precarious manhood, which require males to constantly "prove their maleness," we expect that some men may have a threat-like reaction when confronted with examples of communally oriented men and may rate them as less favourable and less like themselves than career oriented men. This presumably serves to distance their self from the counter stereotypical males. Women, in contrast, would likely not show an adverse reaction to examples of communal men and may even rate them more favourable than men who have little association with family. We believe that it is vital to search for ways that might be able to curtail men's strong adherence to masculine gender-typing, and past research has shown that role models may be an extremely valuable tool for attempting to do so.

Hypothesis 2

For women, we envision a different picture. We believe that being primed with family oriented men might free up women to pursue career opportunities. Hence, we predict that women will show the opposite pattern of men when primed with the family-fathers. Specifically, we predict that women will be more likely to associate

themselves with career words (implicitly) and to indicate high work involvement when primed with male profiles that are family oriented or keep a work-family balance compared to the career focused primes. The strong evidence for social learning perspectives of gender differences makes us confident that our manipulation of role models differing in career vs. family orientation should have an effect on participant's implicit association with career and family, as well as influence how they picture themselves in the distant future and how they predict work-family balance to turn out in their own lives.

Method

Participants

Participants were 81 UBC students (28 males and 53 women) who participated for either course credit or monetary compensation. Fifty nine percent of our participants were East Asian, 22 % Caucasian, 12 % Hispanic, 3% south Asian and 2% Southeast Asian. We are still in the process of collecting data and because our current number of male participants lacks the power to detect any meaningful differences between conditions, this paper will concentrate on reporting the results of the female participants. After excluding participants that indicated homosexuality in the post-study questionnaire (n = 9) and participants with evident language barriers (n =1) we were left with a sample of 70 participants (48 women and 23 men). Following the exclusions our female data consisted of 17 women in the career condition, 16 women in the balance condition and 15 women in the family condition.

Procedure

Upon entering the lab, participants read and signed a standard consent form discussing the general study procedures, participant's rights and contact information. Next, participants were given the cover story that we were investigating people's life narratives and the activities they typically engage in. We told them that we were pilot testing some sample narratives to obtain baseline information needed for an upcoming study. Next, we explained that they would do a computer-sorting task to give us a baseline measure of how fast people are generally able to sort stimuli. Finally, they were told that after evaluating the sample narratives, that they would be given the chance to compose their own, future-life narrative.

Our independent variable was a role model prime with three conditions (career, balance and family). Participants were randomly assigned to one of these conditions and asked to read the profiles of five men (the exemplars) and rate them. The five profiles (see Supplementary Material) included the same pictures, education, profession, and number of children in all three conditions, but differed in the amount of career-family balance expressed in the biographical statements. In the career condition the men worked full time and made minimal reference to their family lives, in the balance condition the men had a thriving career but flexible schedules which allowed them to spend more time with their families, and in the family condition the men were extremely family oriented, taking time off of work to be there for their family and raise small children.

After reading each profile, participants were asked to make ratings of each of the exemplars, presumably to help us pilot test stimuli for another project. Following this task, participants completed the Go/No-Go Association Test (GNAT; Nosek & Banaji, 2001) designed to measure their implicit associations between themselves and career or family. During the final portion of the study, we invited participants to compose a future life narrative for themselves in which we asked them to thoroughly imagine and visualize their future-life 15 years from now. This task was divided into two parts: predicting demographic information and reconstructing a typical day in their future lives.

Measures

Profile Ratings. After reading each of the individual profiles we asked participants to make ratings of how they perceived the person they just read about. First participants rated the exemplar on the 16 item Personal Attributes Questionnaire (PAQ; Spence, Helmreich & Stapp, 1974), which assesses masculine traits (e.g. independent) and feminine traits (e.g. kind) on a five-point scale. To determine whether or not participants were aware of our primary manipulation, we asked them to rate each role model's family-career balance on a scale of 1 to 7, with 1 indicating family orientation, 4 indicating balance and 7 indicating career orientation (α = .84). Furthermore, participants were asked to indicate how physically attractive (α = .83), how attractive as a possible mate (α = .88), how similar to themselves (α = .86) and how representative (α = .74) they perceived the exemplar. These ratings were made on a scale of 1 to 7, with 1 indicating "*not at all*" and 7 indicating "*very much*".

Implicit Measures. The GNAT (Nosek & Banaji, 2001) we used was modelled after Park, Smith and Corell (2010). In this task, participants had to decide whether stimuli fit into one of two categories presented on top of the screen. We used four (Self, Other; Career, Family) different categories to gauge participants' implicit associations between career and family. Target stimuli included either pictures (see Supplementary Figure 2 for example pictures) related to family or career or words representing self (e.g., me, mine, my) or other (e.g., they, them, theirs). Participants completed four separate pairing blocks (self-career, self-family, other-career and other family) of categorizations with 96 randomly ordered trials each. The categories "Self" or "Other" were each paired with either "Family" or "Career" in a counterbalanced order between participants. The stimuli were presented with a 500-ms response window and an inter-stimulus interval of 150-ms (as in Park et al., 2010). Categorizations were made by either pressing the spacebar if the item did not fit in to one of the two target categories ("Go") or not acting ("No-Go") if the item did not fit into either category. We then measured the speed and the accuracy that participants made these categorizations. The GNAT task works off the assumption that participants will be slower or make more errors when the two categories presented together contradict their own implicit associations (Park, Smith & Corell, 2010). In principle, someone who, for example, has a strong association of self to career should then be better able to categorize stimuli when the categories self and career are presented together than when the categories self and family are presented together. The dependent variable for the GNAT (d-prime) is calculated for each block (i.e. associative pairing) by subtracting a participant's probability of showing false alarm responses (pressing the space bar if the stimuli does not fit) from their probability of getting a correct hit (pressing the spacebar when the

stimuli does fit in one of the categories). In turn, a more negative value indicates more error and, therefore, a weaker association between the two concepts.

Future Self Predictions. The measure of future self-predictions consisted of two parts. First, participants filled out a questionnaire that asked them to predict the demographic characteristics of their future life. These questions were largely associated with anticipated career-family balance such as martial status, occupation, number of children and time spent with family. A number of questions pertained to the likelihood of certain life events and lifestyle in the future. Questions included the likelihood of having a spouse, having children, being the primary economic provider and being the primary caregiver for their family. We also asked participants how satisfied and successful they anticipated to be in terms of their family, career and overall life. These questions were answered on a scale of 1 to 7, with 1 indicating "*not at all*" and seven indicating "*very much*". Additionally, participants had to predict which activities would take up what percentage of time in their day as well as their spouse's day.

To aid participants in predicting a day in their future life we used a modified version of the day reconstruction method (Kahneman, Krueger, Schkade, Schwarz & Stone, 2004). This method provided participants with a framework that divided their day in three large blocks (waking to noon; noon to 6 pm; and 6pm to bedtime) with a number of sub-episodes. For each sub-episode participants were asked to provide a topical name and then a more detailed description of what they did durin this period of time. The predictions participants made were coded by two coders focusing on how much time participants anticipated working, taking part in personal activities or family activities, or other activities such as commuting. Time spent on family activities was furthermore split up into time spent with kids, doing housework, being with the whole family or spending exclusive time with a spouse.

Results

Analytic Strategy

To analyze our data we used one-way Analyses of Variance (ANOVAs) to test the significance of the effects of condition (Family, Balance and Career) on our primary dependent variables. Subsequently, we used the Fisher's Least Significant Difference (LSD) to examine pairwise comparisons between the different conditions. Because we are not yet done collecting data for this study and we are aiming for a larger sample size, especially for males, but female participants as well, I will present some promising trends in the data in addition to significant results. Furthermore, as stated above, the extremely limited power due to the low number of male participants has led us to concentrate on reporting female participants' data in this paper.

Manipulation Check

A one way ANOVA run on our manipulation check ($F(2,67) = 104.54$, $p < .001$) and a subsequent pairwise comparison indicated that participants yielded significantly different ratings for Family ($M = 3.13$), Balance ($M = 4.07$) and Career ($M = 5.23$) condition (all p's $< .001$). These significant mean differences indicate that participants, as expected, perceived our family-oriented exemplars as family oriented, our balanced exemplars as balanced and our career-oriented exemplars as career oriented.

Notably, however, we can see that the ratings for family and career condition were not at the far end of the family-career spectrum.

Profile Ratings

First, we tested how female participants rated the profiles of the role-model primes they saw at the beginning of the experiment. As predicted, there was a significant effect of condition on perceived masculinity of the exemplars, $F(2, 45) = 11.15$, $p < .001$. Pairwise comparisons showed that masculinity ratings for the career condition ($M = 32.41$) were significantly higher than ratings for the family condition ($M = 26.51$) and the balance condition ($M = 26.90$; $p < .001$), whereas masculinity ratings in the balance and family condition were extremely similar to each other ($p = .77$, *ns*).

Furthermore, there was a significant effect of condition on perceived femininity, $F(2, 45) = 5.59$, $p = .001$. Pairwise comparison revealed that femininity ratings in the career condition ($M = 25.14$) were significantly lower than femininity ratings in the family ($M = 29.14$), $p = .01$ and balance condition ($M = 31.88$), $p < .001$. We see here that males in the career condition were perceived as less feminine compared to the other two conditions.

Interestingly, participants reported no significant differences between conditions in perceived similarity of the exemplars to themselves ($p = .50$). There was, however, an effect of condition on average representativeness of the exemplars, $F(2, 45) = 4.58$, $p = .02$. Participants perceived the exemplars in the balance condition ($M = 4.31$) to be significantly more representative than the family oriented exemplars ($M = 3.64$), $p < .01$ and marginally more representative than the exemplars from the career condition ($M = 3.91$), $p = .09$. This suggests that participants felt, on average, that the males trying to keep a work-family balance were most representative of the males they encountered in everyday life.

Although participants rated the males differently on several dimensions, e.g., not perceiving them as equally masculine and feminine in the three conditions, these differences were not reflected in how physically attractive participants perceived the exemplars, as we found no difference between conditions ($p = .31$). Instead, we found that participants responded differently to the exemplars as possible mates, $F(2, 45) = 3.63$, $p = .04$. Pairwise comparisons indicated that female participants who were exposed to the career oriented males ($M = 4.31$) judged them to be significantly less attractive potential mates than the male exemplars in the family ($M = 5.31$), $p = .02$, and the balance condition ($M = 5.29$), $p = .03$.

Implicit Associations

When we conducted the same one-way ANOVA on participants' implicit associations of self vs. other and family vs. career, the only effect of condition we observed was a marginal effect on self and family associations, $F(2, 45) = 2.41$, $p = .10$. A follow up pairwise comparison analyses showed that women in the family condition were actually significantly faster at associating self with family stimuli ($M = -0.02$) compared to women in the balance condition ($M = -0.186$), $p = .03$. Recall that a mean d-prime value closer to zero indicated faster association of the two concepts than a value further away from zero. These results may suggest that it took women longer to associate themselves with family when they were exposed to the balanced male role models than when exposed to the career oriented role models.

Future Life Predictions

Next, we examined whether participants' predictions of future demographic characteristics differed between conditions. In line with our predictions, we found a significant effect of condition on how likely female participants expect that they will be the primary economic caregiver 15 years in the future, F (2,45) = 4.86, p = .01, see Figure 1. Pairwise comparisons showed that there was a significant difference in likelihood that female participants will be the breadwinner between the Balanced (M = 2.81) and the Family (M = 4.47) condition, p < .001. Furthermore there was a near marginal difference between the Balance and the Career condition (M = 3.65), p = .11 as well as between the Career and the Family condition, p = .12. This data suggests that females might be more likely to want to engage in a career when confronted with the family-oriented males as opposed to the career-oriented males. Women exposed to the balanced condition, however, showed lower career anticipation than women exposed to the other two conditions.

Moreover, although the initial ANOVA was not significant (p = .20), the data indicated that females in the balance condition predict a marginally lower mean percentage of their spouse's time spent with family matters (M = 22.36 %) compared to females in the family condition (M = 28.87 %), p < .10. This means that females in the balance condition actually predict lower spousal family involvement.

In addition, despite a none-significant overall ANOVA (p = .21) we observed a marginal difference between career (M = 6.29) and balance (M = 5.81) condition of participants anticipation of satisfaction with their job in the future, p = .09. This suggests that women may anticipate more job satisfaction when they are exposed to examples of career oriented men as opposed to being opposed to more family oriented male exemplars.

The only difference between conditions that appeared in the predictions of a typical future day was in how many hours on average female participants anticipated spending at work. As the overall ANOVA yielded non-significant results, p = .21, pairwise comparisons showed that females may anticipate having more time when they were confronted with career males (M = 7.59 hours) than when they were confronted with the exemplars in the balance (M = 6.54), p = .09, and the family condition (M = 6.45), p = .06.

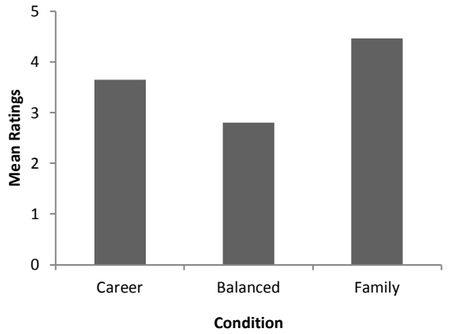

Figure 1. Female participants' reported likelihood of being the primary economic provider.

Discussion

Although preliminary, these data suggest that our manipulation had the hypothesized effect with participants perceiving the exemplars' career-family balance in the different conditions as we had planned. Secondly, women's perceptions of the exemplars seemed to be shaped by the exemplars' orientation towards career or family. In particular, masculinity and femininity ratings, which showed higher masculinity and lower femininity in the career condition, are consistent with social

role theory that predicts that females and males are perceived feminine when they are assigned female roles and as masculine when they are assigned male typical roles (Eagly, Wood & Diekman, 2000). This also supports the notion of precarious manhood, as we saw that females assigned males more masculine quality when they proved themselves through living traditionally masculine career-oriented lifestyles (Vandello et al, 2008). Participants furthermore perceived the role models from the balance condition as the most representative of the average male population, while they indicated preferring the family-oriented males as potential mates.

The finding that was most supportive of our predictions was the finding that exposing female participants to male role models had an effect on how they viewed their future life related to family and career. Interestingly, females reported a significantly higher likelihood of being the primary economic provider when they were confronted with family oriented males as opposed to males that were trying to keep a work-family balance. This finding is in line with our prediction that females should be more likely to anticipate a thriving work-life when they come in contact with family oriented male models. It is however, somewhat surprising that there was no significant difference between female participants' anticipated career involvement in the career condition and the other conditions. In fact, women in the balance condition appeared to predict the lowest likelihood of becoming the primary economic provider for their family. This somewhat unexpected reaction of women was also reflected by the marginally higher anticipated time spent with career and satisfaction with career that females reported in the career condition as opposed to the balance condition.

Furthermore, the finding that females had higher anticipated time spent in the career condition connects to the idea that women perceive family oriented males as more attractive potential mates than the career oriented males, which may suggest that there is, today, a general desire among females to have a successful career. This is easily explained by the higher status our society reserves for work outside the home (e.g., Furgeson, 1991). A tendency to discard males who are not willing to participate in family duties from the pool of potential mates may also explain why females confronted with career oriented males do not anticipate a significantly lower probability of the being the breadwinner. Females that read about career oriented males may actually have had a defiance-like reaction and dissociate from these males as models of potential partners. This may explain why these women actually show the desire for more career involvement. Overall, our data would suggest that young female university students already show a significant affinity towards focusing on career matters. This is amplified by being exposed to the possibility of a house-husband but not necessarily reversed by being exposed to career-focused men – as these men are perceived as unattractive partners.

The finding that females presented with the exemplars of men who strive for a work-family tradeoff anticipate lower probability of being the breadwinner of their future-family than females in the other condition is somewhat counterintuitive. One speculation to explain women's unexpected reaction to being presented with the balanced exemplars might be that these exemplars may have represented a realistic tradeoff for

women, which may have lead them to actually anticipate shared duties, which would require them to still be involved with their families. These balanced males may very well be seen as the embodiment of modern conceptualizations of equal partnership. The exemplars might have, therefore, made a compromise between career and family, and seem like an attractive and realistic option. In such a partnership, none of the partners would actually be the primary breadwinner, which is reflected by our participants' answers.

Moreover, our data show marginal effects that point to lower anticipated job satisfaction and lower anticipated percentage of the spousal day spent with family for females in the balance condition. This could suggest that our participants fear higher work-family strain and stressful experiences resulting from the vision of a dual-earner couple. Females might be especially aware of the notion of the "second shift" (Hochschild, 1989). Research shows that working mothers as well as fathers are at risk of feeling strain from this situation (Bakker, Demerouti & Dollard, 2008). In fact, trying to be highly involved with both work and family can create interference of work with family life and vice versa (Byron, 2005). This is especially true for employed mothers of young children, who can experience guilt with regard to their employment (Elvin-Novak, 1999). Our participants' unexpected response to the balance condition could then represent a concern about the hardships of combining work and family duties in their future.

Although these findings are intriguing, there are some limitations of this study that should be noted. Specifically concerns about external validity and cross-cultural validity are applicable. Our study aims to approximate the effect of role models through a simple lab procedure. It is questionable, however, whether the brief exposure to profiles in a sterile laboratory setting can substitute for real world contacts. If anything, one would expect the effects of real-life role models to be stronger on the basis of authenticity and length of contact. In addition, although our sample contains a considerable percentage of Caucasians and East Asian participants, the population is still limited to undergraduate students at a North American university and therefore cannot adequately address cultural variability in the influence of gender role modeling.

The most important next step in this research would be the continuation of data collection on this project in order to obtain greater power to make statistically significant conclusion about the effects of our role model prime on females *and* males. As participant's reactions to the balance condition seem somewhat unexpected, establishing a fourth condition could be a way to gain a better control measure. Such condition would likely consist of giving participants a short reading about a non-relevant topic instead of the role-model prime, to find out what people's associations and future life predictions look like at baseline.

As our research shows some promising trends pertaining to the influence male models can have on females' future life expectations, we believe that these findings should be further pursued. Research could explore the impact of family-oriented male models on males and female in other settings. As our data suggest that work or family-orientation of male role models have an effect on females anticipation of a breadwinner role in their future, it might be interesting to see whether such role model effect are present in non-lab settings. For

example, we could explore how parents' gender stereotypical beliefs affect their children's gender related cognition, especially on an implicit level. In connection to the data I presented in this paper, it would be intriguing to see would be whether family-oriented or even stay-at home fathers influence their daughters to be more eager to have a career and associate themselves with more with work.

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Supplementary Material

Figure 1. Profile picture for profile 1.

Profile 1 – Career condition

Christopher Berry went to The University of Alberta and received a Bachelor's of Science degree in Chemical Engineering. He started out in engineering design at Dow Chemical, a large chemical company where he designed equipment and processes that were used to make chemicals such as plastics and chlorine. In his work he focused on creating a better and more biodegradable form of packaging for food products. Christopher has found this very fulfilling, and despite the amount he has to put into his research, Chris knows he is making a valuable contribution to the environment. He never loses interest in what he is doing, as he feels that all of his hard work will eventually pay off. It is this persistence that makes him such a good chemical engineer. Chris is also married and has a young son.

Profile 1- Balance condition

Christopher Berry went to The University of Alberta and received a Bachelor's of Science degree in Chemical Engineering. Chris works as an engineer at Dow Chemical, a large chemical company where he designs equipment and processes that are used to make chemicals such as plastics and chlorine. In addition to his success at work Chris maintains a healthy home life and enjoys spending his time off work with his son and wife. Chris says: “since my son Nathan was born, I try to stick to a regular schedule and go home early to spend time with my family.” Although Chris loves being an Engineer and is happy at his workplace he is equally eager to spend time with his family.

Profile 1 – Family condition

Christopher Berry went to The University of Alberta and received a Bachelor's of Science degree in Chemical Engineering. He started out in engineering design at Dow Chemical, a large chemical company where he designed equipment and processes that were used to make chemicals such as plastics and chlorine. He was very successful within his field, and well liked by his colleagues. However, Chris’s priorities changed when his first son, Nathan, was born. Since then, he has decided to take paternity leave to care for Nathan, while his wife goes back to work to advance her career and support their family. Chris really loves taking care of his son and he is planning to return to work once Nathan is ready to attend kindergarten.

A.

B.

Figure 2. A. Example of a family-related stimulus. **B.** Example of a work-related stimulus.

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