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University of British Columbia's Undergraduate Journal of Psychology

Editor-in-Chief: Richard Alan Rigby
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Editors Note: A Message of Thanks

Richard Alan Rigby[1]
[1]Department of Psychology, University of British Columbia;
Editor-in-Chief of the UBC Undergraduate Journal of Psychology

Dear fellow students, researchers, and faculty,

In 2014 I was a young undergraduate psychology student, eager to develop my skills as a researcher. Having completed projects in Dr. Gorzalka's Sexual Psychophysiology and Psychoneuroendocrinology Laboratory I began searching for opportunities to disseminate my results to the scientific community. In the process I came across UBC's Undergraduate Journal of Psychology. I had not previously considered submitting a publication so early in my academic career, but the UBC UJP gave me the unique opportunity to showcase my work. I was honoured to be featured in a publication alongside so many talented undergraduate psychology researchers at UBC. I was later given the honour of continuing the legacy of the UBC UJP as its Editor-in-Chief.

Publishing this journal would not be possible without the hard work and dedication of the team of faculty and student volunteers. First of all I would like to thank Dr. Michael Souza, Dr. Sunaina Assanand, and Dr. Steven Barnes for your guidance as the Faculty Sponsors and for supporting undergraduate research within our department. Thank you to the Section Editors and their team of reviewers, who put so much effort to ensuring the manuscripts we published were of high quality. Thank you to our Graduate Student Advisors, who provided support for our editors and reviewers. A special thanks to my Promotion Officers, who helped spread the word about our call for submissions. And lastly, thank you, our readers, for taking the time to learn about the research that our undergraduates are conducting.

To our authors, I sincerely hope this has been a rewarding experience for you, and I hope this is just the beginning of your successful careers in research and psychology.

Thank you,

Richard Rigby

Contact the Editor:
Richard A. Rigby
rarigby@alumni.ubc.ca

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

Our focus is three-fold:
1) To undergraduate authors we offer a valuable and rare experience into the peer-review, editorial, and publication process.

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

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

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

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Contact: ubcujp@psych.ubc.ca; rarigby@alumni.ubc.ca

BNS
Research Paper

CB1 Receptor Agonist HU-210 and Antagonist AM-251 Exert Unique Effects on Male Rat Sexual Behaviour When Chronically Exposed in Adolescence

Amanda Lee[1]
[1]Department of Psychology, University of British Columbia

Edited by: Quentin Raffaelli, Department of Psychology, University of British Columbia. Received for review May 16, 2016, and accepted Nov 28, 2016.

Abstract

Marijuana affects perception, motivation and sexual functioning via the endocannabinoid system and its cannabinoid 1 (CB1) receptors. With steadily rising rates of cannabis consumption among youth, chronic adolescent exposure must be examined. Previous literature has determined that CB1 receptor agonists inhibit sexual function and CB1 receptor antagonists facilitate it. In adolescent male rats given prolonged exposure to CB1 receptor ligands, behavioural patterns in various domains undergo opposite trends from those seen in rats only exposed during adulthood. For example, normally anxiolytic doses of cannabinoids for adult mice display anxiogenic effects when juvenile mice are chronically exposed. The present study investigated the effect of chronic adolescent injections of the selective CB1 receptor agonist (-)11-hydroxy-Δ8-tetrahydrocannabinol (HU-210) and the selective CB1 receptor antagonist N-(Piperidin-1-yl)-5-(4-iodophenyl)-1-(2,4-dichlorophenyl)-4-methyl-1H-pyrazole-3-carboxamide (AM-251) on sexual behaviour in the male rat. Forty-seven Sprague–Dawley rats (PND 20) received daily injections of a vehicle (control), AM-251 or HU-210. After 10 days of injections, sexual activity was observed by measuring mount frequency, intromission frequency, ejaculation frequency, mount latency, intromission latency, ejaculation latency and post-ejaculatory interval. Consistent with predictions, longer latencies were observed in rats given AM-251, indicating less sexual activity than the HU-210 group while the vehicle group's sexual behaviour remained in between the treatment conditions. These findings imply that chronic AM-251 and HU-210 treatment cause long-term sexual effects that are significant and opposite in direction. Future research should focus on the neuroadaptive changes potentially responsible, such as changes in receptor density, as well as if these effects persist well into adulthood.

Keywords: sexual behaviour, endocannabinoid, HU-210, AM-251, adolescence

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Corresponding Author:
Amanda Lee
amandalee92@gmail.com

The recreational consumption of substances containing psychoactive constituents has been extensive worldwide: one such substance is Cannabis sativa, commonly used by humans in the form of marijuana (Deiana, 2013). Of particular note is the shift in usage and attitude (toward legalization and perception of harmful effects) among the adolescent population. In 2012, 44.1% of 18-year old respondents agreed with the statement that "great risk" was involved in regularly smoking marijuana, a considerable drop from the 57.4% of participants who responded "yes" in 2001 (Johnston, O'Malley, Bachamn, & Schulenberg, 2013). In the same national survey, 45.2% of US high school seniors reported having used cannabis, 36.4% of which had done so in the past 12 months (Johnston et al., 2013).

However, there is concern regarding the potential adverse effects of cannabis use on the adolescent brain. Longitudinal studies suggest that adolescent use of exogenous cannabinoids is associated with cognitive impairments and increased risk of neuropsychiatric disorders such as anxiety and schizophrenia (Rubino & Parlaro, 2008; Schneider, 2008). In adolescent rodents given chronic cannabinoid agonist exposure, negative behavioural effects persist into adulthood and include anxiety, deficits in social behaviour and impaired object recognition memory (Kohl, Heekeren, Klosterkotter, & Kuhn, 2013). Rodents exposed to cannabinoids during adulthood did not experience these consequences, implicating adolescents as being particularly susceptible to the long-term effects of cannabinoids (Schneider & Koch, 2003; O'Shea, Singh, McGregor, & Mallet, 2004; Quinn et al., 2008). This is unsurprising given the great degree of neuronal maturation and development during this time. As neurodevelopmental processes such as cell proliferation and migration are affected by the endocannabinoid system, the developing brain is particularly prone to neuroadaptive changes if cannabinoid exposure occurs at a young age (Fernández-Ruiz, Berrendero, Hernández, & Ramos, 2000; Schneider, 2008).

The endocannabinoid system also modulates gonadal hormones to influence sexual functioning via cannabinoid 1 (CB1) receptors throughout the central nervous system (Demuth & Molleman, 2006; Gorzalka & Dang, 2012). The chief active ingredient of cannabis is Δ9-tetrahydrocannabinol (THC) and activates CB1 receptors; as such researchers have become interested in the effects of cannabis use on sexual functioning (Ferrari, Ottani & Giuliani, 2000; Quinn et al., 2008; Riebe, Lee, Hill & Gorzalka, 2010). While cannabinoids also activate CB2 receptors, they are not implicated in sexual function due to being restricted to the periphery and immune cells (Demuth & Molleman, 2006).

It has previously been established that the onset of CB1 signalling inhibits adult male rat sexual behaviour: both acute and chronic administration of THC or its selective CB1 receptor agonist (-)11-hydroxy- Δ8-tetrahydrocannabinol (HU-210) impairs sexual functioning and results in decreased frequency of copulation behaviours (Riebe, Lee, Hill & Gorzalka, 2010). Ferrari, Ottani, and Giuliani (2000) found decreased sexual behaviour in male rats injected with doses of HU-210 between 25-100 μg/kg, as exhibited by fewer mounts and intromissions and longer ejaculatory latency periods. Furthermore, acute administration of the CB1 receptor antagonist AM-251 (N-(Piperidin-1-yl)-5-(4-iodophenyl)-1-(2,4-dichlorophenyl)-4-methyl-1H-pyrazole-3-carboxamide) facilitates sexual behaviour in the adult male rat (Gorzalka, Morris, & Hill, 2008). Castelli and colleagues (2007) observed that chronic daily administration of the selective CB1 receptor antagonist SR 141716A led to an increase in CB1 receptor density in the paraventricular nucleus (PVN), a hypothalamic structure responsible for central control of penile erection. An enhancement in pro-erectile effects after SR 141716A injection into the PVN was observed relative to the vehicle group, and persisted for 3 days (Castelli et al., 2007).

Given the well-established role of the endocannabinoid system on both sexual functioning and regulation of neural development, it is perhaps surprising that chronic juvenile use of cannabinoids has not been studied with respect to sexual behaviour in adulthood. The few studies comparing consequences of adolescent versus adult exposure to CB1 receptor ligands studied other motivational and affective domains, and rats given cannabinoids as adults displayed opposite behavioural trends to rats exposed in adolescence. For instance, receiving HU-210 after repeated injections in adolescence causes weight gain despite reduced food intake and subsequent weight loss in non-exposed adults. and CP

administration demonstrates an abrogation of its typical anxiolytic effects at low doses in mice chronically treated with AM-251 injected with AM-251 in order to induce up-regulation of CB1 receptors in select brain regions (Tambaro, Tomasi, & Bortolato, 2013). Low doses of CP (CP 55,940, a synthetic selective CB1 receptor agonist) were then administered based upon the premise that low doses of cannabinoids have an anxiolytic effect while high doses are anxiogenic. As predicted, after chronic AM-251 treatment there was anxiogenic shift upon CP administration: treated mice expressed more behaviours indicative of anxiety in tests such as the elevated plus maze and novel open field test wherein less locomotor activity and exploration was observed. However, the anxiolytic effects of CP remained when given to the group chronically injected with the vehicle.

When translated to other domains involving modulation by the CB1 receptor, the effective reversal in behavioural patterns upon chronic CB1 receptor ligand use may persist. Therefore, two novel realms must be further explored: the effects of chronic exposure to CB1 receptor ligands on sexual activity, and the outcomes that arise when subjects are adolescents. The need to ascertain long term effects on adult sexual functioning as a consequence of cannabinoid receptor perturbations in the periadolescent period provides the foundation for this study.

Presently, we aim to determine the effect on sexual behaviour of male rats chronically administered two different cannabinoid receptor ligands, HU-210 and AM-251. HU-210 has been established as an appropriate synthetic CB1 agonist with strong binding affinity to the CB1 receptor (Cohen, Solowig, & Carr, 2008). AM-251 is a high affinity, selective cannabinoid antagonist, binding 306 times more effectively at CB1 receptors than at the CB2 receptors (Seely et al., 2012). To observe the extent of the drug's influence on the level of sexual activity, we tabulated the frequency of certain actions and latency to enter certain stages of sexual intercourse which had been established in previous studies as indicative of overall sexual function.

We hypothesize that male rats given chronic injections of HU-210 will exhibit decreased sexual activity relative to baseline in a dose-dependent manner while AM-251-administered rats will lead to increased copulation relative to controls. More specifically, the treatment groups by ascending order of sexual activity level is predicted as follows: AM-251, vehicle, HU-210 low and finally the HU-210 high group.

Methods

Subjects

The subjects tested were thirty-six sexually naïve male Sprague–Dawley rats (postnatal day, PND 20) from Charles River (Saint Constant, Quebec, Canada). Adult female rats were also purchased for the purposes of sex testing from Charles River, where they were ovariectomized under 75 mg/kg ketamine hydrochloride and 7 mg/kg xylazine for anesthesia (I.P. injections). All animals were experimentally naïve and kept for a one-week habituation period. Prior to testing, male and female rats were kept in separate rooms at 21±1°C on a reverse 12:12-hour light/dark cycle with lights turned on at 09:00h and off at 21:00h. Pairs of rats were contained in polyurethane bins (28x17x21 inches) containing one polycarbonate tube (10cm in diameter x 15cm long) and lined with aspen chip bedding. Subjects were fed Purina rat chow and given ad libitum access to tap water. Throughout the experiments, guidelines of the Canadian Council on Animal Care were observed. International guidelines for ethical treatment of animals were approved by the Animal Care Centre at the University of British Columbia. To abide by these guidelines, the number of animals used per group and the suffering of animals were kept as minimum as possible during the experiment.

Equipment and Apparatus

The vehicle drug used in this experiment was a mixture of dimethyl sulfoxide (DMSO), Tween-80, and physiological (0.9%) saline in a ratio of 1:1:8, respectively. The control group of male rats received the vehicle (n = 8) and two treatment groups received HU-210 (Tocris Bioscience) at doses of 25 μg/kg (n = 10) and 75 μg/kg (n = 10) respectively, dissolved within the vehicle. The last treatment group (n = 8) received 5mg/kg of AM-251 (Tocris Bioscience) dissolved in the vehicle. All doses were based on values previously used in the literature and ascertained to be effective. Prior to each session of

sex exposure, the ovariectomized female rats received 10 μg per animal of estradiol benzoate (Sigma-Aldrich) and 500 μg per animal of progesterone (Sigma-Aldrich), both dissolved in peanut oil and injected at 0.1ml/animal prior to ensure a controlled level of sexual receptivity. The experiment was conducted in sex testing chambers, which were 30 x 30 x 45 cm clear Plexiglass bins lined with 2.5 cm aspen chip bedding. All sessions were timed with a stopwatch and recorded on video using camcorders to retrospectively score sexual activity. Experiments took place between 10:00h and 15:00h in a room (4 x 3 x 1.5 m) kept at 21±1°C under dim light conditions.

Procedure

Male rats were randomly assigned to either the vehicle-receiving control group or one of the three treatment groups. Male rats were injected starting at PND 35-45 at a volume of 1ml/kg via daily intraperitoneal (IP) injections between 10:00 am – 12:00 pm for ten days. Female rats were injected subcutaneously with 10μg of estradiol benzoate 48 hours before testing, and 500μg of progesterone three to six hours before testing.

Testing began when males were around PND 100. Before each 30-minute long testing session, each male rat was placed in a separate testing chamber and given a 5-minute habituation period, after which a female rat was placed in the chamber. To maintain sexual interest in response to the Coolidge effect (a decline in receptivity to the same sexual partner), each male was paired with a new female every 10 minutes, regardless of sexual activity level. Each camcorder recorded two testing chambers at a time. The videotapes were then scored by experimenters who measured the following behaviours that are well-established as indicators of sexual activity: mounting frequency and latency, frequency and latency of intromission (defined by penile-vaginal penetration), ejaculatory latency and post-ejaculatory interval (defined as time between ejaculation and the following intromission).

Results

On average, rats administered doses of the CB1 receptor agonist HU-210 exhibited increased levels of sexual behaviour relative to rats injected with the vehicle and the CB1 receptor antagonist AM-251. As HU-210 dosage increased, rats showed a lower intromission latency (IL), indicating more sexual activity.

All data are presented as means ± SEM (standard error of the mean) for each group condition (dosage level) over the test period. A one-way (between-subjects) ANOVA, followed by a Tukey HSD test, was conducted on the mean mount latency (ML), mount frequency (MF), intromission latency (IL), intromission frequency (IF), ejaculation latency (EL), ejaculation frequency (EF) and post-ejaculatory interval (PEI) between all group conditions/dosages.

As shown in Figure 1, ML was considerably

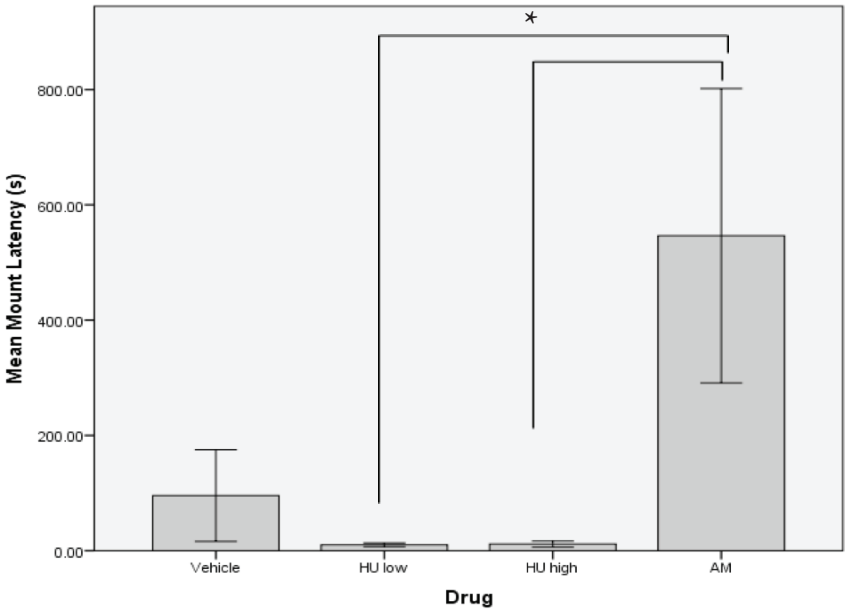

Figure 1. Mean mount latency, or time before female rats were initially mounted by adolescent male rats chronically injected with CB1 agonists or antagonists. Males were administered the vehicle (n = 8), a low dose of HU at 25μg/kg (n = 10), a higher dose of HU at 75μg/kg (n = 10) or AM: 5mg/kg of AM-251 (n = 8). Asterisks indicate significance differences between conditions ($p < 0.05$). Error bars represent standard errors of the mean.

higher for rats given AM than either of the HU-treated groups, which in turn had lower ML than the vehicle. A significant difference was found between AM and both HU-high and HU-low groups [$F(3,32) = 4.440$, $p = 0.010$]. A similar trend was found for IL, with a significant difference between AM and both HU-high and HU-low groups [$F(3,32) = 3.334$, $p = 0.032$]. The IL was also greater for HU-low rats than HU-high rats, although this difference was not statistically significant (Figure 2). Both HU groups displayed the same EF which was significantly higher than that of the AM group. A significant difference was found between AM and HU-low as well as AM and HU-high [$F(3,32) = 5.187$, $p = 0.005$], indicating a significant but non-dose-dependent effect of drug condition on sexual activity (Figure 3). No significant difference was found between groups in MF [$F(3,32) = 1.068$, $p = 0.377$] (Table 1). As seen in Table 1, the mean IF decreased with HU-210 dose and was even lower for both vehicle and AM-treated groups which also exhibited the same IF values, although none of these results were significant [$F(3,32) = 0.518$, $p = 0.673$]. No significant difference was found for the EL data [$F(3,32) = 0.518$, $p = 0.673$]; HU groups performed similarly to each other, but had lower EL values than the AM rats.

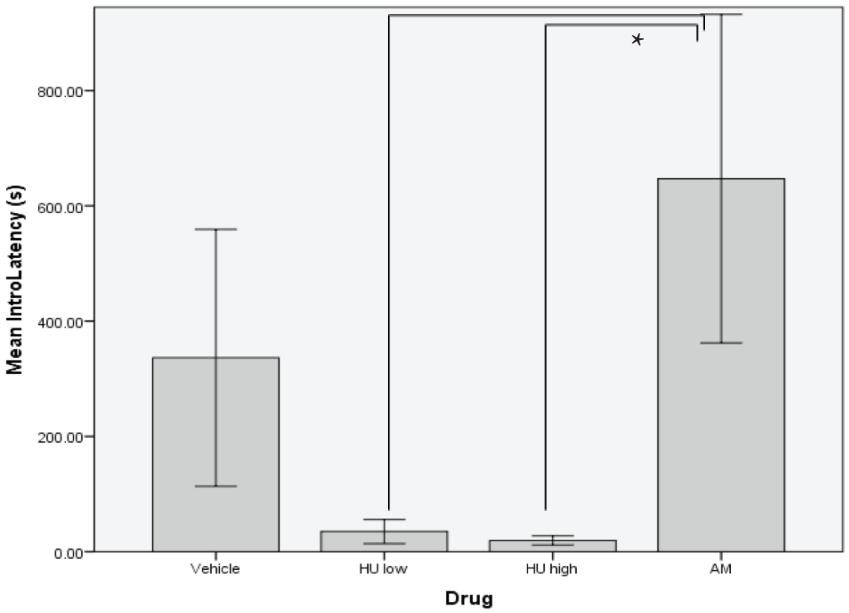

Figure 2. Mean intromission latency, or time before the first intromission by adolescent male rats chronically injected with CB1 agonists or antagonists. Males were administered the vehicle (n = 8), a low dose of HU at 25μg/kg (n = 10), a higher dose of HU at 75μg/kg (n = 10) or AM: 5mg/kg of AM-251 (n = 8). Asterisks indicate significance differences between conditions ($p < 0.05$). Error bars represent standard errors of the mean.

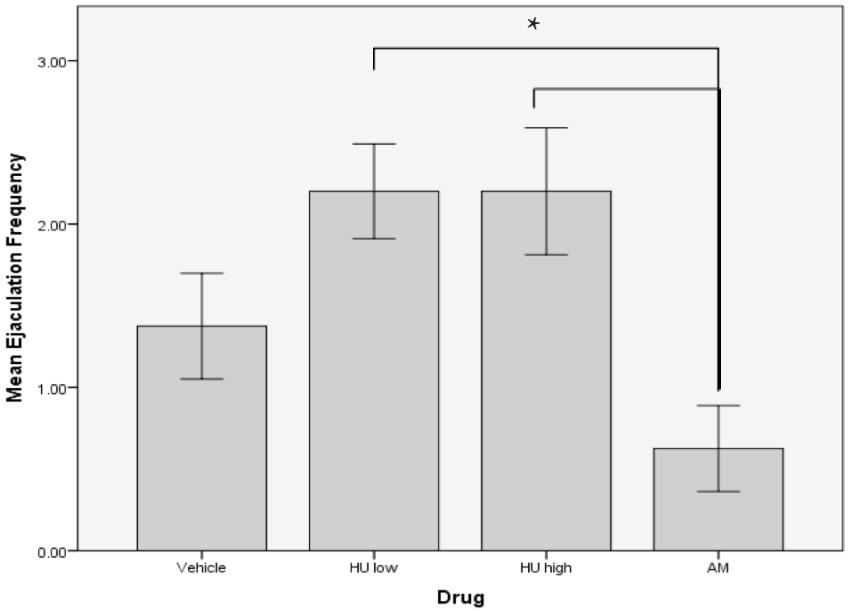

Figure 3. Mean ejaculation frequency by male rats chronically injected with CB1 agonists or antagonists. Males were administered the vehicle (n = 8), a low dose of HU at 25μg/kg (n = 10), a higher dose of HU at 75μg/kg (n = 10) or AM: 5mg/kg of AM-251 (n = 8). Asterisks indicate significance differences between conditions ($p < 0.05$). Error bars represent standard errors of the mean.

Table 1 also indicates the PEI values, for which no significant difference between groups was found [$F(3,23) = 0.885$, $p = 0.464$].

Discussion

In accordance with our hypothesis, the level of sexual activity in rats was lowest in the AM-treated rats and highest for the HU-210-treated rats, with the control group falling in between. This trend held true for all measures except MF which was highest for the AM group followed by the HU-low, vehicle and HU-high groups, respectively. However, the results on MF and IF were not statistically significant and moreover are not the sole indicators of sexual functioning or motivation. Rats that experienced facilitative effects on sexual performance may in fact have been more "efficient" by means of initiating more quickly (shorter latencies) and more ejaculations which are commonly regarded as the "endpoint" of sexual activity. This would logically be seen alongside fewer attempts at intromission (via lower MF) and is corroborated by the data: for measures that were significant (ML, IL and EF), AM-treated rats exhibited lower sexual activity than the vehicle group, and both HU-treated groups demonstrated aggrandized sexual behaviour compared to the control group.

The effects that each CB1 receptor ligand elicited on sexual activity was oppositional to that observed in adults administered the same drug: previous studies have determined that acute doses of AM-251 and chronic SR-141716A injections on average aggrandize sexual activity levels while the response to acute and prolonged treatment with HU-210 is decreased copulation in adult male rats (Ferrari, Ottani, & Giuliani, 2000; Castelli et al., 2007; Gorzalka et al., 2008; Riebe, Lee, Hill, & Gorzalka, 2010). In spite of this observation, the mechanism and specific trends remain unknown. The discrepancy between adolescent and adult response to chronic drug administration was unsurprising given the behavioural differences observed in previous studies testing other domains such as cognitive function, anxiety and eating behaviour. Differences in CB1 receptor densities between adults and adolescents are also drastic, in part due to the immense amount of developmental growth that the endocannabinoid system undergoes during adolescence. The number of cannabinoid receptors progressively grows until a maximal level is reached during postnatal days 30 or 40, after which postadolescent pruning decreases receptor density to adult values (de Fonseca, Ramos, Bonnin, & Fernandez-Ruiz, 1993; Belue, Howlett, Westlake, & Hutchings, 1995).

Indeed, adolescence is a critical phase of development during which synaptic connections are incredibly plastic and undergo a dramatic amount of modification (Viveros, Llorente, Suarez, Llorente-Berzal, Lopez-Gallardo, & de Fonseca, 2012). Receptors are

Table 1. Mean Measures of Sexual Behaviour in Rats Chronically Injected With CB1 Agonists and Antagonists

	Drug Condition			
	0.00 µg/kg (Vehicle)	**25.00 µg/kg HU-210 (HU-low)**	**75.00 µg/kg HU-210 (HU-high)**	**5.00 mg/kg AM-251**
Mount Frequency (± SEM)	10.00 ± 2.60	14.50 ± 3.98	8.50 ± 2.71	17.25 ± 5.71
Intromission Frequency (± SEM)	12.50 ± 2.31	17.10 ± 3.17	15.20 ± 2.71	12.50 ± 4.11
Ejaculatory Latency (seconds ± SEM)	867.55 ± 176.43	555.80 ± 1555.58	510.40 ± 153.57	1202.00 ± 234.23
Post-Ejaculatory Interval (seconds ± SEM)	314.20 ± 12.72	273.33 ± 24.67	297.22 ± 9.11	295.80 ± 8.95

particularly susceptible to up- or down-regulation induced by chronic cannabinoid administration such as THC, CP and WIN 55,212-2 (de Fonseca, Forriti, Fernandez-Ruiz, Palomo, & Ramos, 1994; Gonzalez, Cebeira, & Fernandez-Ruiz, 2005).

Chronic AM-251 (CB1 receptor antagonist) administration in our rats during adolescence may have induced a compensatory increase (upregulation) in CB1 receptors. In adulthood, a heightened concentration of the binding sites typically associated with sexual inhibition presented as declined levels of sexual activity compared to untreated rats. Conversely, long term injection of adolescent male rats with HU-210 may have produced tolerance or desensitization to the inhibitory effect of cannabinoid receptor signalling on sexual activity. In support of this contention, Gonzalez et al. (2005) concluded that chronic exposure to cannabinoid agonists leads to irreversible receptor internalization, which is the basis of receptor down-regulation. Chronic THC exposure in male Wistar rats had the same effect in the striatum and limbic forebrain; rats then displayed tolerance to the effects of THC such as motor impairment (de Fonseca et al., 1994).

Receptor perturbations that affect sexual behaviour are not exclusive to the cannabinoid system: dopaminergic reward pathways modulate sexual motivation/inhibition and genital reflexes via dopamine (DA) receptors (Hull, Muschamp, and Sato, 2004; Gardner, 2005). The D1 and D2 receptors are particularly involved in locomotion, reward/reinforcement and reproduction (Beaulieu & Gainetdinov, 2011). In fact, the dopaminergic and endocannabinoid systems are strongly associated rather than separate entities: upon cannabinoid administration in rats, DA neuron excitation occurs in regions important for DA-mediated reward and pleasure circuitry such as the substantia nigra, VTA and nucleus accumbens (French, Dillion, & Wu, 1997). DA receptor numbers are also at a maximum in adolescence and eventually decrease to adult values afterward in the same fashion that CB1 receptors do (Spear, 2000). Chronic CB1 receptor activation during adolescence may have caused upregulation of dopamine receptors implicated in sexual motivation and pleasure, leading to our findings of increased sexual activity in rats given chronic HU-210.

Dalton and Zavitsanou (2010b) inspected the changes in DA receptor density after cannabinoids were administered to adult and adolescent rats for sub-chronic and chronic periods of time (4 and 14 days, respectively). Although changes in D1 and D2 receptor density were not statistically significant, a dose-dependent increase in D1 receptor density was observed in adolescent brains. An overall increase in D2 receptors was found across all cerebral regions tested in adult rats after chronic HU-210 exposure. Another study found increased density in the D2 and D3 receptors after chronic THC administration in rodents: however, further research is needed, particularly among the different DA receptor subtypes. (Ginovart, Tournier, Moulin-Sallanon, Steimer, Ibanez, & Millet, 2012).

Although evidence was obtained for a relationship between drug condition and sexual activity, several shortcomings were present in this study such as small sample size. Narrow dosage resulted from only including two conditions of HU-210 and one dosage of AM-251. Future studies with a focus on dose-dependency would more effectively establish a trend by using multiple dosages. The ability to generalize the data to reach conclusions about both rodent and human sexual behaviour under the influence of cannabinoid exposure is also limited.

However, downregulation progresses over time and the magnitude of change varies between regions. For instance, Castelli et al. (2007) reported the greatest changes occurring in the hypothalamus and hippocampus; areas of least change included the globus pallidus and substantia nigra. Regions proving resistant to cannabinoid agonist-induced downregulation needed over three days of chronic administration before exhibiting changes in binding site density while other areas exhibited a considerable response within 24 hours. The magnitude of decrease in binding was also reported to vary from under 10% (globus pallidus) to 30% (hippocampus) (Romero et al., 1998). It is possible that our rats were tested before changes due to receptor perturbations were significant enough to be detected or that regions implicated in sexual behaviour did not experience a significant enough alteration in receptor density. However, any speculated mechanisms (ie. down- or up- regulation of receptors) could not be corroborated,

as no physiological data was collected. Improvements therefore include analyzing CB1 receptor density using well-established methods such as autoradiography and histological techniques.

As with most studies centering upon sexual behaviour, there is some ambiguity concerning what the measures of sexual activity indicate. ML may be interpreted as an indication of sexual motivation while intromission and ejaculatory measures are primarily associated with physiological functioning, such as the ability to maintain an erection. To consider both indicators, tests that separate those measures may be used to examine the endocannabinoid-mediated mechanisms of sexual behaviour.

Future tests could solely assess motivation-dependent sexual behaviours such as latency to mount or to initiate sexual activity. Lopez, Olster, and Ettenberg (1999) developed a novel method of measuring male sexual motivation using the straight-arm runaway test: sexually experienced male rats are separated by a straight bridge from female rats in estrous, and the time taken to run across the bridge and initiate copulatory behaviour with the female is measured. Prior to sex testing, researchers could also score the ability to sustain penile erection; this measurement is utilized by Sanna et al. (2013).

This study found that chronic adolescent exposure to HU-210 augments sexual activity in male rats relative to vehicle-treated groups and when exposed to AM-251, decreased sexual behaviour is observed – both effects being diametrically opposed to what is observed when adult rats are given acute or chronic treatments. AM-251 and HU-210 seem to cause opposite effects of significant magnitude. However, further research is still necessary to determine the mechanistic processes behind the CB1 receptor-modulated effects on sexual behaviour, particularly with respect to adult sexual functioning after cannabinoid use during adolescence. Translating preclinical results may contribute to development of medications for sexual disorders by operating on the endocannabinoid system: sexual dysfunction caused by aberrant upregulation may be treated with cannabinoid receptor antagonists while an underactive system may manifest as hypersexuality in humans requiring treatment with cannabinoid receptor agonists. Further practical applications include education (e.g. preventative measures) regarding the long term effects of cannabis use on various realms including sexual, cognitive and affective behaviours.

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

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CLINICAL
Literature Review

Complex Post-Traumatic Stress Disorder: A Differential Formulation of Post-Traumatic Impairment in Response to Prolonged, Recurrent, or Especially Noxious Trauma

Lukasz Felczak[1]
[1]Department of Psychology, University of British Columbia

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Abstract

In response to recent controversies, this article explores the improved clinical utility of the Complex Post-Traumatic Stress Disorder (CPTSD) construct as compared to the construct of traditional Post-Traumatic Stress Disorder (PTSD) when describing, explaining, and remediating the post-traumatic impairment observed in individuals who have experienced prolonged, repetitive, or especially catastrophic traumatization in childhood or adulthood. This article explores neurophysiological differences, differential biomarkers, and differential treatment modalities that underscore the empirical and clinical utility of the separate CPTSD construct. Also, as relevant to CPTSD, biopsychosocial variables of interest – including allostatic load (AL) and negative affectivity – as well as associated negative health outcomes are summarized. By including emotional dysregulation (including the somatization of distress), as well as interpersonal impairment, CPTSD captures both the etiological and maintenance factors associated with chronic traumatization more comprehensively than PTSD alone.

Keywords: stress disorders, neurophysiological differences, biomarkers, treatment, biopsychosocial variables, negative health outcomes

It is becoming increasingly clear that the diagnostic category of post-traumatic stress disorder (PTSD), first introduced in the third edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-III) (APA, 1980), and most recently revised in DSM-V (APA, 2013), does not adequately capture the full range of psychosocial impairment often associated with traumatic experience (Campbell, 2007, Hárdi & Kroó, 2011; Herman, 2012). Specifically, PTSD does not adequately account for the psychosocial impairment often associated with prolonged, repetitive, or especially catastrophic traumatization that may occur either in childhood or adulthood, and that may consist in child abuse, intimate partner violence, political violence, torture, or as a consequence of acute or chronic medical illness (Cloitre, Garvert, Brewin, Bryant, & Maercker, 2013; Resick et al., 2012). As such, Complex Post-Traumatic Stress Disorder (CPTSD), was formulated to better account for the broader constellation of impairment observed in this uniquely traumatized population (Herman, 1992).

UBC Ψ UJP

Corresponding Author:
Lukasz Felczak
lukaszfelczak@my.capilanou.ca

The CPTSD diagnostic category, however, continues to be a source of controversy in mental health community. A review of the literature would suggest that the PTSD diagnostic category is inadequate in addressing the broad biopsychsocial impairment observed in this population, and that recent research with respect to trauma biomarkers, differential treatment modalities, and broader mental and physical health risks associated with chronic traumatization have increasingly made the CPTSD category not only tenable but necessary.

Controversy

Chronically and severely traumatized individuals, including individuals who were repetitively victimized as children, in addition to experiencing the typical avoidance and re-experiencing symptoms associated with PTSD, also demonstrate significant impairment with respect to emotional regulation, self-perception, relations with others, and cognitive systems of meaning (Bryant, 2012; Cloitre et al, 2009; Resick et al., 2012). Although the most recent debate regarding the inclusion of CPTSD in the DSM focused, in part, on its construct validity, definition , and clinical measurement (Bryant, 2012; Goodman, 2012; Herman, 2012; Lindauer, 2012; Resick et al, 2012), the more significant aspects of this debate revolved around the differential neurophysiological basis of these two post-traumatic disorder constructs, the presence or absence of differential biomarkers and treatment options, and the differential conceptualization of post-traumatic impairment that either includes or excludes psychosocial factors in both the description, etiology, and treatment of post-traumatic stress impairment above and beyond the generally accepted neurophysiological basis of impairment.

Neurophysiological Differentiation

Resick et al. (2012), who did not recommend the inclusion of CPTSD in DSM-V, suggest that the disease process does not differ between PTSD and CPTSD. However, although the research is still in its infancy, it would seem that CPTSD has both a qualitatively and quantitatively different neurophysiological basis that PTSD. For example, in a recent albeit small sampled case-control study, it was found that individuals with CPTSD showed preferential recall for negative words, and that this preferential recall was associated with abnormal activation in the left hippocampus (Thomeas et al., 2009), suggesting, in part, a neurological correlate of the core emotional dysregulation often observed in individuals with CPTSD. Moreover, in a study exploring the neurobiology of children with CPTSD following child abuse, Thomaes et al. (2010) found that these children showed extensive reduction in orbitofrontal cortex (OFC) volumes in addition to the smaller hippocampus, amygdala, and anterior cingulate cortex volumes observed in individuals with classic PTSD. This is significant because OFC volume and function is associated with emotional regulation, impulsivity, and aggressivity (Dutton, 2002), and may therefore represent a differential neurobiological correlate associated with the core emotional and social impairment uniquely observed in CPTSD individuals. Despite these and other findings, including a recent review that has identified a core set of inter-related brain regions that may account for the social-cognitive and affective impairment observed in individuals with CPTSD (Lanius, Bluhm, & Frewen, 2011), more neurophysiological studies are needed that replicate these preliminary, and that explicitly match and compare differentially diagnosed individuals (those with either PTSD or CPTSD) using the same methodology.

Differential Biomarkers

Resick et al. (2012) state that a lack of valid and reliable biomarkers is an impediment to the diagnosis of post-traumatic impairment. However, this reality may be rapidly changing, as the application of various biomarkers employed in stress research may facilitate a differential diagnosis between PTSD and CPTSD, while also describing and explaining two related, if distinct, etiological pathways.

The core concept that may significantly contribute to the descriptive, diagnostic, and etiological differentiation between PTSD and CPTSD is that of allostatic load (AL) – an index used to describe the cumulative wear and tear on physiological, immunological, endochrinological, and neurological systems as a consequence of repeated efforts to adapt to stress over time (Glover, Stuber, & Poland, 2006; Taylor & Sirois, 2014). Although classic PTSD has been associated with a variety of biomarkers – including plasma norepinephrine

and 24-hour urinary norepinephrine(Bedi & Arora, 2007) – biomarkers that measure AL, and that reflect a history of chronic stress, such as hair cortisol (O'Brien, Tronick, & Moore, 2013), plasma cortisol, total cholesterol, high density lipoprotein cholesterol, glucose levels, and triglycerides (Juster et al., 2011), may be more appropriate in the assessment and diagnosis of CPTSD, especially when attempting to formulate a diagnosis based on the severity and/or chronicity of trauma experienced, and the severity of associated neurophysiological pathology.

This particular avenue appears to be promising, as the research seems to suggest that AL is positively correlated with a history of child maltreatment (Dyer, Dorahy, Shannon, & Corry, 2013; Katz, Sprang & Cooke, 2012) as well as with chronic stress (Glover, Stuber, & Poland, 2006). In an important study that explored the relationship between AL and chronically and recurrently stressed mothers (of pediatric cancer survivors), who themselves also met a diagnosis for PTSD, it was found that mothers highest in stress, and who met a PTSD diagnosis, had the highest levels of AL (Glover, Stuber, & Poland, 2006). AL differentiated these mothers from both high stress mothers without PTSD and low-stress controls. One could argue that these high stress mother's with a PTSD diagnosis were actually individuals with the more global impairment associated with CPTSD. But to confirm this assumption, and to determine if specific biomarkers appropriate to AL can reliably differentiate between control, PTSD and CPTSD groups, more research is required that directly compares carefully matched and differentially diagnosed individuals in terms of AL. Ultimately, AL may not only justify the clinical use of the above mentioned biomarkers to differentiate individuals with PTSD from those with CPTSD, but may also explain the unique self-regulatory impairment (especially physiological reactivity to stress and emotional dysregulation) observed in individuals who have been severely and/or recurrently traumatized (Taylor & Sirois, 2014).

Differential Treatment

Following a review of the literature, Resick et al. (2012) concluded that there was no evidence that treatments specifically designed for CPTSD were effective, and that there was, in general, a dearth of research into the differential treatment of CPTSD. As such, the authors concluded that the inclusion of CPTSD in the DSM system had no clinical or practical utility. Perhaps in response to these valid empirical deficits, a number of studies relevant to the debate have since been published. A review of these studies, as well as the related literature, suggests that evidence-based treatment indicates cognitive behavioral therapy (CBT) as the treatment of choice for PTSD (Bryant, 2010; Levi, 2013). The research, however, also suggests that there is a high dropout rate for CBT in the treatment of individuals with CPTSD (Levi, 2013), and that this may be significantly accounted for by the concomitant negative emotional arousal associated with CBT therapy for trauma, and the fear of relationships (Dorahy et al., 2013), emotional dysregulation, and social-cognitive impairment associated with CPTSD (Cloitre et al., 2009; Cloitre, Miranda, Stovall-McClough, & Han, 2005; Lonergan, 2014). In an effort to remedy the inadequacy of CBT as a treatment of choice for individuals with CPTSD, several studies have explored alternate forms of therapy in treating this uniquely traumatized population. A promising treatment for children with CPTSD is Real Life Heroes (RLH) (Kagan & Spinazzola, 2013), which, in consonance with CPTSD specific impairment, focuses, amongst other things, on developing emotionally supportive relationships, self-regulation, and a positive self-concept. Moreover, in a particularly well-designed randomized controlled study, with a moderately large sample (N=104), "augmented" exposure therapy, which included a primary phase of skills training in affect and interpersonal regulation, produced the greatest PTSD remission and the lowest dropout rate compared to two alternate conditions: social counselling followed by exposure therapy, and skills training followed by social counselling (Cloitre et al., 2010). This again highlights the core features of emotional dysregulation and social-cognitive impairment associated with chronically traumatized individuals, and similarly reflects their unique treatment needs. However, as Resick et al. (2012), correctly point out, although the adult individuals in this study were victims of chronic traumatization (childhood sexual abuse), they were not diagnosed and categorized as individuals with CPTSD prior to the study. As such, one should gen-

eralize these differential treatment findings to individuals with confirmed CPTSD with caution, or until similar findings can be replicated with randomized controlled studies that compare purported CPTSD specific treatment modalities between, for example, non-trauma, confirmed PTSD, and confirmed CPTSD sub-groups.

More generally, however, unlike the CPTSD construct, which includes more broadly biopsychosocial aspects of post-traumatic impairment – including altered self-perception, altered relationships with others, and altered systems of meaning (Resick et al., 2012) – the PTSD construct, which focuses more narrowly on re-experiencing and avoidance symptomatology (APA, 2013), and whose criteria are also included in the CPTSD construct (Bryant, 2012), is arguably too limited and too reductionist to account for traumatic impairment following chronic, repetitive, and relatively severe traumatization. Although there have been important neurobiological findings into the differential biological correlates of PTSD and CPTSD, and although there are proposed differential biomarkers and treatment modalities for each respectively, one should not underestimate the role of chronic stress, and other psychological and social factors, that contribute to the etiology, maintenance, and negative psychological and physical health outcomes observed in these highly traumatized individuals.

CPTSD, Biopsychosocial Variables, and Negative Health Outcomes

Individuals with CPTSD, as indicated by a greater risk for higher levels of AL (Pat-Horenczyk, Ziv, Asulin-Peretz, Achituv, MCohen, & Brom, 2013), may be at a heightened risk for not only impaired physical health and premature death in very young children (Katz, Sprang, & Cooke, 2011), for immunosuppression, obesity, atherosclerosis, and hypertension in adulthood (Katz, Sprang, & Cooke, 2012), and for geriatric depression (Juster et al., 2011) in later life, but may also be at a heightened risk for a plethora of other acute or chronic physical or psychological illness throughout the lifespan (Katz, Sprang, & Cooke, 2011; Katz, Sprang, & Cooke, 2012; Juster et al., 2011; Juster, McEwen, & Lupien, 2010).

Moreover, negative affectivity – which is a persistent negative mood marked by anxiety, depression, and hostility – and which may be etiologically rooted in the endochrinological dysregulation associated with both AL and CPTSD, has compounding negative health consequences. Individuals who display negative affectivity, as a consequence of either personality disposition or in the context of post-traumatic impairment, are more likely to somaticize their distress (Taylor & Sirois, 2014), abuse alcohol (Litt, 2013; Rosenkranz, Muller & Henderson, 2014; Taylor & Sirois, 2014), self-harm (Dyer et al., 2009; Dyer, Dorahy, Shannon & Corry, 2013), commit suicide (Taylor & Sirois, 2014), develop a severe mental illness (Mauritz, Goossens, Draijer, & van Achterberg, 2013), as well as develop a variety of physical health problems, including diabetes, kidney or liver disease, and stomach or gall-bladder problems (Taylor & Sirois, 2014). Furthermore, as a consequence of the deficits in emotional regulation associated with CPTSD, these individuals are less likely to engage in emotional-approach coping, and are more likely to employ an avoidant coping style, which together may contribute to greater persistent post-traumatic autonomic arousal (Saporta & van Der Kolk, 1992), and subsequently higher levels of AL and AL-associated negative health outcomes.

From a social perspective, individuals with a particular subtype of CPTSD, characterized by aggression, disinhibition, and social alienation (Dorrepaal et al., 2012), may not only fear mutual relativeness (Dorahy et al., 2013), or experience emotional disconnection from family and friends (Dorahy et al, 2009), but are also at a heightened risk for externalizing their hostility onto those around them (Dyer, Dorahy, Shannon & Corry, 2013). These feelings of social alienation and the social consequences of externalizing behavior may subsequently impair social functioning, may contribute to decreased social support for the trauma survivor, fewer healthy social bonds, and to fewer opportunities, through disclosure (Saporta & van Der Kolk, 1992; Taylor & Sirois, 2014) to make sense of one's traumatic experiences. Taken together, these factors may contribute to the persistent autonomic arousal frequently associated with chronic traumatization (Saporta & van Der Kolk, 1992), and subsequently to higher levels of AL and AL-associated negative health outcomes. In this regard, biophysiological factors (AL, orbitofrontal cortex abnormality) psychological factors (learned helplessness, traumatic bonding (Saporta & van Der Kolk, 1992)) and social fac-

tors (interpersonal traumatization) contribute not only to the etiology of CPTSD in the chronically traumatized individual, but as well, in terms of biophysiological factors (persistent AL), psychological factors (negative affectivity, avoidant coping style) and social factors (social disconnection, externalizing behaviour) to the maintenance of post-traumatic CPTSD-related impairment.

From a clinical perspective, the negative physical and psychological health outcomes associated with chronic traumatization are more accurately described by the CPTSD construct. By including emotional dysregulation (including the somatization of distress), as well as interpersonal impairment, CPTSD captures both the etiological and maintenance factors associated with chronic traumatization more comprehensively than PTSD alone. Furthermore, in recognition of the more broadly biopsychosocial effects of extreme trauma, a resolution to this controversy may be in sight for the DSM community. This may consist in the reformulation of traumatic stress impairment along a single spectrum, or dimension (and no longer in terms of distinct categories) (Herman, 2012). In this case, CPTSD would occupy the extreme end of this post-traumatic spectrum, and would represent the often broad and multi-faceted impairment observed in this population.

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

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CLINICAL
Literature Review

The Brain-Machine Interface: Evaluating the Reality of Neural Interfaces Systems (NIS) And Their Possible Applications in Rehabilitation And Therapy For Spinal Cord Injuries

Jacob Hutton[1]

[1]Department of Psychology, University of British Columbia

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Abstract

Advancements made in computer science, engineering, robotics, and neuroscience have allowed for the creation of a new area of study that has combined these disciplines to research how the brain can be linked to machines for several different applications. This linkage of brain and computer is known by several names in the scientific literature but is aptly described by the term neural interface systems (NIS). The goal of NIS research is to develop a connection between the brain and a machine, whether for the purposes of imaging thoughts occurring in the brain or for prosthetics and rehabilitation, connecting the nervous system to an external device is always the goal. Although the academic interest of this research is compelling, this field of study also has very real and useful applications for medicine and rehabilitation of patients with conditions such as tetraplegia and loss-of-function physical afflictions, particularly those affecting the spinal cord. This paper will evaluate the feasibility of neural interface systems as a rehabilitating and assistive technology for spinal cord injuries, highlighting the advantages and disadvantages of these technologies and discussing the state of contemporary research in the field. A discussion of the future of this research will also take place, evaluating the trajectory of progress for neural interface systems and the possibility of ever using techniques from this research to restore function in a patient.

Keywords: neural interface systems, rehabilitation, artificial feedback, medical applications

The rapid progress that has been made in the neurosciences in the past century has allowed for many applications of research to a diverse number of fields. These fields range the scientific spectrum with research in the neurosciences contributing to the advancement of imaging techniques such as fMRI and protein microscopy, the medicinal and pharmacological treatment of disorders related to the psychology and physiology of the mind, and the rehabilitation of patients with conditions related to the nervous system and the brain. A key driving force for this wide array of applications of brain based inquiry to science as a whole is a confluence of research and knowledge attained in many different fields combining to allow for multidisciplinary projects to produce many of the key discoveries that have increased our knowledge of the brain and how to apply this knowledge.

UBC Ψ UJP

Corresponding Author:
Jacob Hutton
jacob_519@hotmail.com

New research in the fields of engineering, computer science, and neuroscience has developed into an expanding field that uses this confluence of knowledge to develop systems that translate neural signals into commands for electrical devices, commonly known as neural interface systems (NIS). These systems have been shown to have applications in a wide spectrum of uses, from imaging brain function to prosthetics and rehabilitation. One of the most compelling areas of inquiry in the field is the applications that this technology has to treating and rehabilitating loss-of-function injuries and disease resulting in impaired motor function for the patient. The goal of NIS research is to deal with these conditions, attempting to restore mobility in the patient by translating neural signals into commands that can be received by devices integrated into the patient's environment, such as a robotic arm or power wheelchair.

The scope of NIS research encompasses many fields of inquiry and applications. This paper will deal with a more specific subset of NIS research and consider the possibilities available for treatment and rehabilitation of motor disorders only, particularly those resulting in tetraplegia and paraplegia. Many studies have shown a definitive ability for this technology to be used in restoring volitional control to individuals through the manipulation of assistive devices controlled by a neural interface system, allowing patients to gain back a degree of autonomy that was lost at the onset of their disorders (Donoghue et al., 2007; Hochberg et al., 2006 & 2012). Furthermore, the potential for this technology to highlight new techniques for restoring function for affected individuals will be explored, along with the feasibility of a future technology that combines these techniques with bioengineering to restore function within the body, physically integrating the patient and device to a degree of seamlessness that is not yet possible with the current level of knowledge.

History of NISs

The advancements that have taken place in NIS research have propelled a once small field of study into a rapidly developing branch of biomedical research in a matter of a few decades. Research in this field began in the 1960's when using monkeys as a non-human model to investigate the potential for signals from single cortical neurons to control a meter needle provided a proof-of-concept for using neural signals to control external devices (Fetz, 1969 in Daly, 2012). Human clinical trials began soon after in the 1970's and in the 1980's Elbert et al. (1980) was able to demonstrate that patients were able to control a rocket image in a vertical dimension as displayed on a television screen using only slow cortical potentials in EEG activity and biofeedback training (Daly, 2012). Researchers throughout the late utilized a specific event related potential (P300) to allow normal volunteers to spell words on a computer screen (Farwell and Donchin, 1988 in Daly, 2012). Research progressed quickly through the start of the new millennium and by 2006, an invasive NIS was successfully tested when the implantation of a microelectrode array in the primary motor cortex of a young man with C3-C4 tetraplegia (full limb paralysis) allowed the patient to utilize an external brain-controlled interface (BCI) to open emails, open and close a prosthetic hand, and perform simple actions with a robotic arm (Hochberg et al., 2006 in Daly, 2012).

Limitations of Current NISs

While the scope of this research has advanced tremendously over the past decades, there still exist major caveats to the widespread development and use of NISs as a clinical practice and treatment option. The propagation of NISs in a clinical setting in the future of medicine depends on improvements needed in three areas: signal acquisition hardware, long-term validation, and day to day reliability and performance (Daly, 2012). Many NISs used in clinical and scientific research use bulky, non-portable equipment to detect a neural signal that is then translated into action in an electrical or mechanical pathway. For NISs that are non-invasive (usually EEG based), the device components must be streamlined to be as portable and compact as possible to ensure high performance in all environments that a patient would encounter in a normal day (Daly, 2012). For invasive NISs that require the use of implanted electrodes (such as ECoG systems) the same issues apply, along with a need to solve issues related to electrode sterilization and functionality, allowing a system to function reliably for many years with a maintenance level conducive to living life outside the clinic (Daly, 2012). This is an avenue requiring much more research and testing to begin ap-

proaching a level of practicality for everyday patient use.

Although the science of NISs still requires a high volume of research in signal acquisition and communication with devices, researchers must also keep in mind the intended use of these systems for the impaired individual. In order to approach validation as a practical and feasible option for rehabilitation of motor disorders, NISs need further exploration into function in individuals afflicted with physical and motor deficits in a real life setting removed from the lab. While most of the current studies in NIS research have focused on the ability of NISs to perform certain actions or movements in a variety of situations, much of this research is focused on an acute representation of a motor deficit. For further validation of these measures, models for widespread implementation must be utilized in long term studies of real world use by people with severe disabilities (Daly, 2012).

The issue of reliability is also a key limiting factor in the dissemination of NIS technology. In attempting to take over for CNS control in affected patients, NISs must approach the functionality and reliability of a natural CNS-muscle integration relationship. To address related to reliability, Daly (2012), identifies 3 key issues requiring attention: the central role of adaptive interactions in NIS operation; the desirability of designing NISs that imitate the distributed functioning of the normal CNS; and the importance of incorporating additional brain signals and providing additional sensory feedback. All 3 of these factors are in need of more directed research if NISs are to occupy a greater role moving forward in medicine.

State of Research

A hallmark of natural, muscle based function in normal humans is the confluence of information from different sensory modalities to mediate movement in a responsive and adaptive manner. Most NISs rely on feedback via the visual modality of perception, excluding many of the integral modes of sensation that are required for the regulation of movement (Daly, 2012; Hatsopoulos & Donoghue, 2009). The cutaneous, auditory, and proprioceptive sensations that are hallmarks of coordinated movement are absent from most technologies in the NIS spectrum, constituting a significant deviation from the species-typical method of evaluating muscular control (Daly, 2012). One way that this issue is being addressed in the scope of NIS research is the use of functional electrical stimulation (FES), which has provided hope for developing a method of reconnecting the CNS to muscles (Hatsopoulos & Donoghue, 2009). Artificial feedback has also been used with some success, with both methods providing avenues for possible feedback integration from NIS devices into the CNS (Hatsopoulos & Donoghue, 2009).

The use of artificial feedback in the control of prostheses has been present in the literature dating back to the late 1970's (Hatsopoulos & Donoghue, 2009). The feedback used has historically manifested either in the form of mechanical stimulation of peripheral tissue or in the form of electrical stimulation of residual nerves (Hatsopoulos & Donoghue, 2009). These stimulation methods are referred to as examples of associative artificial feedback, highlighting the fact that the features of the stimulation and the prostheses involved must be associated through learning by the user, the immediate sensory effects of the stimulation are not innately programmed into the sensory system of the patient (Hatsopoulos & Donoghue, 2009). The ability of patients to successfully integrate new methods of nervous stimulation is reflective of the plastic remapping processes that occur in the somatosensory and motor cortex during the learning period required for the use of these methods.

FES technology has the potential to provide feedback to implanted cortical communication devices, simulating more closely the two-way relationship between afferent and efferent neural activity in a limb (Hatsopoulos & Donoghue, 2009). The residual proprioceptive abilities of amputees has been harnessed by using FES stimulation to allow for amputees to sense the motion and position of their prostheses (Hatsopoulos & Donoghue, 2009). The FES technique has been also used to emulate natural extended physiological proprioception by providing feedback directly to muscles attached to a prosthetic limb (Hatsopoulos & Donoghue, 2009). FES can also be used to link joints of a certain prosthetic device to the parts of the limb that still possess sensory abilities in the proprioceptive and tactile domains (Hatsopoulos & Donoghue, 2009).

Direct stimulation of the nervous system has also been explored in NIS research as sensory replacement. As an alternative to the normal methods of sensory

substitution, such as artificial feedback, Somatosensory Neural Interfaces (SSNIs) have been used to engage the normal neural pathways involved in the perception and processing of peripheral somatosensory information (Wang et al., 2011). These SSNIs are utilized by stimulating the nervous system of an amputee and directly providing information directly to the user's pre-existing neural networks that mediate the control of an affected limb (Wang et al., 2011). This stimulation can take place at many different levels in the sensory hierarchy, ranging from stimulation of peripheral nerves close to the injury site, or by stimulation of the somatosensory cortex via the use of an invasive NIS with implanted electrodes (Wang et al., 2011). Research conducted by Dhillon & Horch (2005) has shown ability for this technology to provide feedback in terms of grip force and position of a prosthetic joint to patients with upper limb amputation while controlling a robotic arm (Wang et al., 2011). The efficacy of SSNIs in stimulation of CNS components has also been displayed in cats, Weber et al. (2007) showed that stimulation of the dorsal root ganglion via an inserted electrode can produce responses in the cortex similar to those observed in conjunction with actual motor activity, suggesting that this region is an excellent candidate for NIS applications (Wang et al., 2011).

Rehabilitation

NIS research provides a profound opportunity for the treatment and rehabilitation of spinal cord injuries. Spinal cord injuries (SCI) resulting in tetraplegia or paraplegia affect between 250 000 and 500 000 people a year worldwide and are difficult to rehabilitate, those with spinal cord injury being 2 to 5 times more likely to die early when compared to those without a spinal cord injury (World Health Organization, 2013). NIS research has displayed an ability to deal with the symptoms of these injuries in a manner that increases patient autonomy (Donoghue et al., 2007; Hochberg et al., 2006; Hochberg et al., 2012; Jackson & Zimmerman, 2012; Kennedy & Bakay, 1998). Neural control of robotic devices, prostheses, and software interfaces has displayed an ability to allow patients to regain control over certain aspects of their routine, enabling patients a greater degree of influence in their environment than their deficits would normally allow (Donoghue, 2008; Daly & Wolfpaw, 2008). However, the application of NIS research in this spectrum is mostly focused on allowing patients to cope with their deficits through controlling external devices to function in a different way than before their injury. A different avenue of research in NIS technology is focused on using the knowledge and techniques learned in NIS development and applying it to rehabilitation of motor deficits resulting in motor paralysis, usually with a pathophysiological root in traumatic SCI but also possibly as the result of amyotrophic lateral sclerosis or stroke (Jackson & Zimmerman, 2012; Kennedy & Bakay, 1998; Wang et al., 2011).

The methods for rehabilitating neural activity in the scope of NIS technology are divided into invasive methods and non-invasive methods (Wang et al., 2011). Both of these types of methods are largely focused on promoting neuroplasticity as a recovery tool through the use of cortical stimulation in different ways (Wang et al., 2011). Invasive cortical stimulation is usually accomplished through the use of intracortical electrode implantation, similar to the deep brain stimulation technology used for the treatment of symptoms associated with Parkinson`s disease (Wang et al., 2011; Donoghue et al., 2009). Clinical trials of cortical surface electrical stimulation devices implanted above the primary motor cortex have yielded mixed results and require more controlled investigation that focus on the localization of cortical stimulation sites and the viability of descending motor pathways as discussed by Plow et al. (2009) (Wang et al., 2011). In contrast, cortical stimulation by non-invasive methods uses repetitive trans-cranial magnetic stimulation (rTMS) to manipulate neural activity levels in the ipsilateral and contralateral hemispheres to the site of injury. In the rTMS framework, ipsilateral motor cortical excitability is enhanced by stimulation to the stroke affected hemisphere (Wang et al., 2011). Inhibition from the unaffected hemisphere is also reduced by rTMS stimulation of the hemisphere contralateral to the site of injury (Wang et al., 2011). When coupled with a motor training regiment, these methods have been shown to result in improved motor performance in stroke affected patients, highlighting the efficacy of NIS treatments focused on directing neuroplasticity for recovery (Wang et al., 2011).

Direct connection to the central nervous sys-

tem (CNS) has also been used in the treatment of patients with amytrophic lateral sclerosis (ALS). In a case study of a "locked-in" patient with ALS, Kennedy and Bakay (1998) were able to establish a link for communication by using an implanted neurotrophic cortical microelectrode that recorded action potentials which allowed for induced levels of neuroregeneration that endured until the implantation was removed months later. This research provided a theoretical basis for the idea of linking muscle stimulators with original CNS neural signals, a technique the authors claim may offer a greater degree of control for neural prosthetic devices than available at the time of publication (Kennedy and Bakay, 1998). Jackson and Zimmerman (2012) engaged in a similar scope of research, analysing the role electrical stimulation of muscles and the spinal cord has to play in the retraining of motor circuits in patients with SCI. The results theorized that several plasticity methods were at work as the underlying causal mechanisms for recovery, and that electrical stimulation promoted these mechanisms (Jackson & Zimmerman, 2012). Research focused on the role of induced neuroregeneration in rehabilitating muscular control in paraplegics and those with ALS represents a direction for future research in this field, with preliminary results such as these representing a positive foundation for exploration.

Future Research

NISs have a large potential for applications in medicine and rehabilitation of motor disorders. The current state of NIS research is largely focused on making NIS technology more accessible to patients with actual deficits by improving the technology so that it is safer, more portable, and more convenient in everyday life (Daly, 2012). In order to accomplish this, many researchers have focused on improving these systems with a goal in mind of more closely approximating function that emulates the movement and feedback capabilities of normal muscular coordination. A key technique that is being described as the future of NIS technology is an integration between neural prostheses in the form of robotics and artificial feedback mechanisms. Artificial feedback has been displayed to successfully accompany traditional mechanisms for neurally controlled devices by providing two-way control between the device and user in the form of somatosensory feedback. In the future, NISs used in conjunction with an implanted FES system could provide the stimulation necessary to bridge the gap between the CNS and peripheral nervous system (PNS), reconnecting the brain to the muscles affected by injury (Donoghue, 2008). The use of both of these technologies in the future will be the foundation for seamless integration of the human nervous and muscular system with machine interfaces for rehabilitation and treatment of motor disorders.

NISs also have potential for the prediction of seizure onset in epileptics (Donoghue et al., 2007; Donoghue et al., 2008). Intracortical installation of an implanted electrode sensor near a region responsible for the genesis of epileptic events could theoretically provide a means for measuring and detecting the change in brain activity that accompanies the onset of an epileptic seizure, providing a warning to the user of an oncoming event (Donoghue et al., 2007). Along with the clinical dissemination of techniques for seizure prediction, NIS technology also has potential for use in the treatment of epilepsy in the scope of brain stimulation techniques; similar to those discussed earlier that used rTMS for hemispheric stimulation of ipsilateral and contralateral stroke sites in rehabbing motor deficits (Morrel, 2006; Wang et al., 2011). These techniques have been shown to be effective and safe in a clinical setting, but will require more streamlining and development of user interface to make the technology more accessible and convenient.

Conclusion

Advancements in NIS technology are occurring at a rapid rate. Many of the recent findings in NIS literature are focused on methods that treat motor deficits resulting from a wide variety of injuries and attempt to restore function to a level close to normal function. As neural prostheses and interfaces progress, the disconnect between human and machine will continue to shrink, eventually leading to a seamless integration of human with machine that mirrors normal function. This seamless integration will be the result of the application of biofeedback methods into current NIS systems, allowing the user to control devices with instantaneous feedback simulating real proprioceptive, cutaneous, and somatosensory communication. The widespread dissemination

of these technologies will have profound implications for medicine and clinical treatment of these disorders, allowing afflicted patients to overcome severe motor deficits and function almost normally via neural assistive technology. As these systems become more widespread in the treatment of deficits, they may expand to include use in other non-medical settings, highlighting the incentive for continued research and development of these systems in conjunction with continued clinical use.

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

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CLINICAL
Literature Review

Research Behind the 12-Step Program: How Effective is it for Alcoholism?

Tasha Johal[1]
[1]University of British Columbia

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Abstract

The 12-step program has been a classic approach for the treatment of alcoholism for many years, since the original program was created in 1935. While many continue to overcome their addiction with the help of this method, it is important to examine just how effective the program really is. This literature review discusses the research that has been conducted on the efficacy of the 12-step program, specifically for alcoholism. It is demonstrated that distinct factors play a role in the effectiveness of the program for each individual: religiosity, familial history, levels of anger, and social network. Limitations of existing research as well as suggestions for future research are also discussed.

Keywords: 12-step, addiction, recovery, alcoholism

1.4 million: the number of individual memberships with Alcoholics Anonymous (A.A.) in Canada and the United States since its creation in 1935 (General Service Office, 2014). 2,138,421: the number of individual memberships with A.A. in the entire world, since its creation in 1935 (General Service Office, 2014). What's more, these numbers are based off of reports provided by A.A. groups who are listed with the General Service Office- excluding those groups that are not listed, and potentially many more individuals who identify as A.A. members (General Service Office, 2014). These numbers clearly demonstrate that Alcoholics Anonymous, a popular 12-step program, has a large following.

In 1935, two men who had struggled with alcohol sobriety came together to form Alcoholics Anonymous. Bill W. and Dr. Bob Smith took notice of the fact that talking to one another was helpful in becoming and staying sober; from this partnership, grew the 12-step approach that is now used across the world (Detar, 2011). Today, A.A. gains more popularity, with its original 12-step approach getting more recognition as membership grows (Fiorentine, 1999). Alcoholics Anonymous is just one of many programs across the globe that employs a 12-step approach to battling addiction. Being aware of the large influence that this program has on the world with respect to treatment options (Detar, 2011), it is important to examine rates of success. Through analysis of the research in the field of addiction, this paper will evaluate the success of 12-step programs, with specific emphasis on the effectiveness of these programs for individuals with alcohol addiction. Finally, factors contributing to success in 12-step programs will be analyzed.

Discussion of the effectiveness of 12-step programs for alcohol addiction typically draws on data from two studies, Fiorentine (1999) and Moos & Moos (2005). These studies' findings have led to the concept that 12-step programs are in fact successful. In Fiorentine (1999), it was concluded that 12-step programs were effective in keeping individuals sober. The statistics reported were astounding- less than four percent of individuals tested positive for alcohol consumption at

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Corresponding Author:
Tasha Johal
johal_02@hotmail.com

their 24-month follow-up. However, upon a scrutinous examination, it has been realized that the conclusions of success were slightly skewed and hugely generalized. The participants were 356 individuals from various treatment centers across Los Angeles, who volunteered to participate, and were assessed by interview at three times (six months prior to ending treatment, six months after treatment, and twenty-four months after treatment). This study placed emphasis on examining the rates of success amongst those participants who attended 12-step programs during and after their treatment (Fiorentine, 1999). However, the lack of simple randomization to control and experimental groups made it so that Fiorentine (1999) was only examining one type of participant- those who had received treatment. Moreover, having voluntary participation likely affected the results, as there are typically certain personality characteristics associated with sharing information and volunteering one's time to research. Out of the original 356 individuals, a much a much lower sample size of 262 participants were assessed during all three periods of time (Fiorentine, 1999). Furthermore, out of these 262 individuals, only forty-nine percent actually attended a 12-step program (Fiorentine, 1999). Fiorentine's (1999) conclusions (i.e., 12-step programs are effective) were based on statistics from these 262 participants (more than half of which did not even attend a 12-step program), which is a large generalization. Additionally, the wide acceptance of this study fails to acknowledge that these results came after investigating participants who did not only attend 12-step programs; rather, they attended 12-step meetings in addition to an ongoing addiction treatment and recovery program. This implies that the other treatments, rather than the 12-step programs could have caused the positive results of the study.

In a more recent study, Moos and Moos (2005) also revealed that A.A. was an effective treatment option. This study quickly became a cornerstone for the advocating of Alcoholics Anonymous' effectiveness (Dodes & Dodes, 2014). By longitudinal assessment of 628 A.A. members, it was found that participation in treatment or A.A., or both in combination, led to a higher likelihood of staying sober (Moos & Moos, 2005). This study, however, came with its limitations as well. Participants were assessed for sobriety at one-year, three-year, eight-year, and sixteen-year follow-ups; by the end of the study, the number of individuals assessed had shrunk to 362. Many participants (121) had passed away over the course of this study- and their data was eliminated. Also, 99 of the original 628 participants were simply excluded from the data because they had not taken part in treatment or A.A. by the time of the one-year follow-up. Results were based only on individuals who consistently and actively stayed with treatment or A.A, an obvious bias due to the fact that the number of individuals who withdrew from A.A. was a number that was large enough to affect the statistics of the study. Lastly, it is important to point out that the study's data demonstrated that individuals were unsuccessful in the Alcoholics Anonymous setting when they were present for less than six months.

The above studies may be the most popular ones when advocating for 12-step programs (Dodes & Dodes, 2014). There is another, carried out more recently, that points to the same conclusions as Fiorentine (1999), and Moos and Moos (2005), with similar limitations. In Witbrodt (2012), results from a longitudinal study indicated A.A. members remain sober years after taking their last drink (as cited in Dodes & Dodes, 2014). Similar to the 1999 and 2005 studies, a large number of participants had left the study or been excluded. Twenty-five percent of the remaining participants were identified as 'high attenders,' the group associated with the best outcomes; counterintuitively, however, twenty-two percent of this group was still drinking. Hence, the conclusion that was reached in this study (i.e., excellent success rates in A.A. members) was essentially a generalization that was made from the small number of participants who remained sober.

The presented studies (i.e., Fiorentine, 1999, Moos and Moos, 2005, and Witbrodt, 2012) are plagued with limitations. Historically, there has also been research that has addressed negativities of 12-step approaches (Brandsma, 1980, as cited in Dodes & Dodes, 2014; Emrick, 1989, as cited in Dodes & Dodes, 2014). In Brandsma (1980), after random assignment of participants into groups which used a 12-step approach or a behavioral therapy approach, it was found that those who had been in the 12-step approach group reported higher rates of binge drinking at the three-month fol-

low-up. In contrast, those participants who had been a part of the behavioral therapy approach group were found to have reported less binge drinking. Nine years after this study, a review of the effectiveness of Alcoholics Anonymous was conducted using data reports from the years of 1976 to 1989 (Emrick, 1989, as cited in Dodes & Dodes, 2014). This review stated that there was not yet any substantial evidence demonstrating A.A. to be effective and successful in helping individuals maintain sobriety. It was after this review that the population was cautioned against immediately referring all individuals with alcohol-related issues to A.A. (Dodes & Dodes, 2014).

It has been noted that larger-scale studies (i.e., Fiorentine, 1999; Moos & Moos, 2005) seem to indicate success of 12-step programs, while smaller-scale studies (i.e., Brandsma,1980 and Emrick, 1989) seem to indicate no success of 12-step programs (Dodes & Dodes, 2014). Dodes and Dodes (2014) suggest this is because individuals within a 12-step program will undoubtedly remain in them if they feel it is working for them; however, they will leave as soon as they feel it is not. Therefore, when researchers are measuring individuals who are currently within a 12-step program for a limited amount of time, they may be missing out on data that suggests these programs may not be as successful as they are made out to be (Dodes & Dodes, 2014).

Numerous other studies have been done to investigate efficacy of 12-step programs in alcohol addiction and, due to their more accurate and unbiased research methods, have been able to identify specific types of individuals who benefit the most from this types of treatment approach. Key indicators of 12-step program success have been reported to be: religiosity (Craig, Krishna, & Poniarski, 1996; Detar, 2011), familial history (Craig et al., 1996), levels of anger (Project MATCH Research Group, 1998), and social network (Longabaugh, Stout, Wirtz, & Zweben, 1998).

Research has found that religious beliefs are strong predictors of success in a 12-step program (Craig et al., 1996). Most 12-step programs have some sort of religious foundation- typically being associated with Christianity (Detar, 2011). Alcoholics Anonymous specifically focuses on Christian faith and places emphasis on spirituality and the belief in a god (Craig et al., 1996; Detar, 2011). Figure 1 outlines the 12 steps of A.A. In this figure, steps three, five, six, seven, eleven, and twelve are explicit in their focus on a god or spirituality; hence, half of the 12-steps focus on religiosity (Detar, 2011). Out of 101 participants, all seventy individuals in Craig et al. (1996) identified themselves as Catholic or Protestant had successful outcomes in the 12-step program. Out of the remaining individuals, who had identified themselves as having no religion or being associated with another religion (e.g., Jehovah's witness), only three had successful outcomes (Craig et al., 1996). While this study did rely on self-report methods of data collection, which can be seen as an inaccurate method of data collection, its findings are not unique. It has been found that doctors who make patient referrals to A.A.

THE 12 STEPS OF ALCOHOLICS ANONYMOUS

1) We admitted we were powerless over alcohol—that our lives had become unmanageable.

2) Came to believe that a Power greater than ourselves could restore us to sanity.

3) Made a decision to turn our will and our lives over to the care of God as we understood Him.

4) Made a searching and fearless moral inventory of ourselves.

5) Admitted to God, to ourselves, and to another human being the exact nature of our wrongs.

6) Were entirely ready to have God remove all these defects of character.

7) Humbly asked Him to remove our shortcomings.

8) Made a list of all persons we had harmed, and became willing to make amends to them all.

9) Made direct amends to such people wherever possible, except when to do so would injure them or others.

10) Continued to take personal inventory and when we were wrong promptly admitted it.

11) Sought through prayer and meditation to improve our conscious contact with God as we understood Him, praying only for knowledge of His will for us and the power to carry that out.

12) Having had a spiritual awakening as the result of these steps, we tried to carry this message to alcoholics and to practice these principles in all our affairs.

Figure 1. The 12 steps of Alcoholics Anonymous Reprinted from "Alcoholics Anonymous and other twelve-step programs in recovery," by T.D. Detar, 2011, Primary care: Clinics in office (38), p. 144.

are often met with resistance from individuals who are not Christian or Protestant (Detar, 2011). These findings (Craig et al., 1996; Detar, 2011) suggest that it may be useful to consider one's religion, or even general sense of religiosity (i.e., does one believe in a god?) when thinking about the likelihood of success in a 12-step program.

Family history has also been found to influence rates of success, after research conducted with Army veterans (Craig et al., 1996). That is, individuals who have a family history of alcohol abuse tend to be less successful in 12-step programs (Craig et al., 1996). This is believed to be due to a genetic basis for these individuals' alcoholism. As a result, the individual is naturally less sensitive to effects of alcohol (Craig et al., 1996). Based on this finding, considering one's family history prior to referring them to a 12-step program may be important. However, there are likely members of 12-step groups who are successful in their efforts to become and stay sober, despite their genetic inheritance. What's more, this research (Craig et al., 1996) was conducted with Army veterans which could very well have affected the results. For example, the combat veterans in the study were found to have higher rates of success, and it was suggested that this could be because the act of combat could cause a predisposition to being successful.

In addition to religiosity and family history, levels of anger were shown to be predictive of success in 12-step programs (Project MATCH Research Group, 1998). Project MATCH (1998), a study done to measure efficacy of matching the individual to a treatment on the basis of certain characteristics, was conducted over three years with over 900 individuals. Clients were matched to one of five alcoholism treatments (one of which was a 12-step program) and then examined for rates of success. It was found that clients who had high levels of anger did not fare well in 12-step programs; they seemed to be more successful in a treatment called Motivational Enhancement Therapy, whereby their active resistance was met with by specific strategies created to counter it. Clients who reportedly did best in 12-step programs were those individuals who had low levels of anger. The Project MATCH Research Group (1998) did not disclose exactly what 'high levels of anger' were operationalized as during this study. This is unfortunate because how Project MATCH defined and measured this specific variable is therefore unclear.

The last reported indicator of success in 12-step programs is one's social network (Longabaugh et al., 1998). Specifically, individuals who have social networks that are supportive of drinking (i.e., drinking is okay) are most successful in 12-step programs. This was found through research with 806 participants who completed detailed questionnaires about their social networks and relationships, and then attended 12-step programs. Following their time in the 12-step program, they were followed up for a period of three years to examine success (Longabaugh et al., 1998). However, since the participants were not followed-up with after more than three years, it is difficult to know exactly how successful they were. For this reason, the researchers discuss the need for studies that are of a longer duration (Longabaugh et al., 1998).

Based on the findings discussed in the above studies, individuals that should attend or be referred to 12-step programs are ones who: are high in religiosity, have a family history of alcoholism, possess high levels of anger, and have a social network supportive of drinking. Unfortunately, not many individuals will meet these requirements, making it difficult to refer someone who will be successful. This being said, 12-step programs can be successful. However, to whom and to what extent depends on every individual. Nonetheless, the findings provided by these studies should be continually viewed critically, as they are dated. The existence of a research-based list that details factors contributing to success is ideal, as the current factors are very few and it would be excellent if they could be replicated.

Whether or not 12-step programs are effective for alcohol addiction is a very controversial topic, and there is little research that has been done on it (Kaskutas, 2009). Amongst the research that is frequently cited in support of 12-step programs (i.e., Fiorentine, 1999, and Moos & Moos, 2005) there is bias and frequent generalizations are made. There is hope that future research will focus on more sound research methods that allow for more consistent and specific findings.

Further studies need to have participants from varying background (e.g., not all Army veterans) and need to be of longer duration to allow a more coherent and conclusive argument. Most importantly, studies

need to operationalize the term success, as all the studies discussed here refer to this term, but the definition of success may vary.

It is also important to have studies that examine treatments in combination and not simply in isolation. Additionally, participants that are selected for this type of research should be individuals who have not already progressed through treatment, but those who are just beginning to contemplate it. For now, however, support for the effectiveness of 12-step programs should be taken with a grain of salt. The efficacy of 12-step programs has yet to be fully supported, and therefore it can be said that perhaps it is important to examine other recovery programs that may be more beneficial. One such example is SMART, Self-Management and Recovery Training, a non-religious organization (Atkins, n. d.). This international organization draws techniques from rational emotive behavioral therapy, with the belief that individuals struggling with addiction can change their maladaptive behaviors by adapting to a new lifestyle and learning how to problem solve (Atkins, n.d.). Unlike A.A. where attendees are referred to as members, this organization calls its attendees participants (Atkins, n.d.). While the classic 12-step approach may be more popular, it is important to note that other programs such as SMART be indeed be more effective.

Declaration of Conflicting Interests

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

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CLINICAL
Research Paper

Clinical Characteristics of Disruptive Behaviour in Childhood Obsessive-Compulsive Disorder

Rachel Wong[1] and S. Evelyn Stewart[2]
[1]Department of Psychology, University of British Columbia
[2] Department of Psychiatry, University of British Columbia

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Abstract

As research has been conducted on various pediatric psychiatric disorders such as obsessive-compulsive disorder (OCD), one area that has been largely overlooked is the role of coercive and disruptive behaviours. This study seeks to focus on the data captured by the Coercive and Disruptive Behaviour Scale – Pediatric OCD (CD-POC) in a pre and post design to determine whether changes are observed in disruptive behaviour following group cognitive behavioural therapy (group CBT) among children with OCD. The relationship between CD-POC items and other clinical measures was also examined. In this study, 29 pediatric OCD patients undergoing group CBT were administered questionnaires to capture clinical outcome measures of OCD at four points during the treatment. The results demonstrated that CD-POC scores decreased when comparing before and after group CBT treatment. A positive relationship was found between CD-POC scores and increased OCD-related impairment, although none was found between CD-POC and either OCD severity or OCD-related family impairment. These preliminary findings imply that group CBT is an effective treatment method for decreasing disruptive behaviour in pediatric OCD patients. They also suggest that the functioning of a child is better when there is less coercive and disruptive behaviour. The results can be used as a reference point to predict the course of coercive behaviour in the future and to help prevent misdiagnosis of disruptive behaviour disorders in untreated OCD-affected children.

Keywords: disruptive behaviour, childhood OCD, cognitive behavioural therapy, CD-POC

Imagine constantly having distracting thoughts on your mind that cause you to engage in the same repetitive behavior until you get feeling of being "right" again, regardless of how much time this takes up or how distracting it is to your normal daily functioning. Obsessive-compulsive disorder (OCD), a disorder characterized by intrusive thoughts known as obsessions and repetitive behaviours or rituals known as compulsions, was once thought to be rare among children (Stewart et al., 2007). However, a significant portion of OCD cases in adults were discovered to have started during childhood and research has shown that the structure of OCD symptoms appear to be consistent throughout life (Mataix-Cols, Nakatani, Micali, & Heyman, 2008; Stewart et al., 2007). Due to the possible onset of the disorder early on in life – as suggested by the aforementioned studies – it

UBC Ψ UJP

Corresponding Author:
Rachel Wong
rachel.wong@telus.net

is important to address OCD in youth, thereby correctly diagnosing and treating the disorder in its early stages. This current study seeks to specifically address the concepts of disruptive behaviours that may be present in relation to pediatric OCD and its treatment.

Research conducted to better understand the components of OCD have revealed that OCD is a multidimensional disorder that is highly variable in its clinical expression (Stewart et al., 2007). A potential aspect of the disorder's presentation for consideration relates to rage and aggression or disruptive behaviours. Rage attacks in relation to OCD were defined as "explosive anger outburst that were grossly excessive or inappropriate to the situation and beyond the child's control" (Stewart, 2012). Storch et al. (2012) found that rage was positively associated with OCD severity, in addition to other OCD related variables such as parent-related functional impairment. This study was important as the first to identify a relationship. Rage in children has been studied in relation to other psychiatric disorders and disruptive behaviour disorders, but very few conclusions have been drawn on the correlation between rage and pediatric OCD (Storch et al., 2012). Even with the research that has already been conducted, small sample sizes and the absence of observational data limit the contexts to which the results can be applied (Storch et al., 2012). Therefore this area of OCD and rage has been thoroughly unaddressed overall until this point.

In relation to rage and aggression is the disruptive or coercive behaviour in children with OCD. A study by Lebowitz, Vitulano, & Omer (2011b) indicated that children with OCD used aggression and intimidation to include the whole family in their ordeal by having the parents give in to the OCD-related demands that the child experienced. This act of involving the family in the compulsive rituals that are associated with OCD suffering is known as family accommodation (Lebowitz et al., 2011b). Lebowitz et al. (2011b) also suggested that children with OCD may use violence and aggression in an attempt to help lessen the feelings of fear or disgust that they experience from their obsessions. In order to further study this violence in pediatric OCD cases, an 18-item questionnaire known as the Coercive and Disruptive Behavior Scale – Pediatric OCD (CD-POC) was developed (Lebowitz, Omer, & Leckman, 2011a). This questionnaire was created to examine some of the features of disruptive behaviour disorders such as aggression and rage that might be present in pediatric OCD (Lebowitz et al., 2011a).

The research on disruptive behaviour and pediatric OCD is important given its potential to help the scientific and medical community gain a better understanding of how the disruptive behaviours affect or are affected by OCD. As previously noted, the results from this research contribute fundamental information to the field of pediatric OCD given that relatively little attention has been given to the possible relationship between aggression and OCD (Storch et al., 2012). The knowledge that can be gained from studying this relationship will contribute to the growing knowledge of what OCD encompasses and therefore help to prevent misdiagnosis of the disorder from an early age (Stewart, 2012). For example, children newly diagnosed with OCD who also experience behavioural outbursts may be misdiagnosed with bipolar disorder (Stewart 2012). By learning more about the relationship between disruptive behaviour and OCD, clinicians will be better equipped to correctly identify the disorder and find the appropriate form of treatment. Furthermore, recognizing that aggression is related to OCD can have implications on the treatment approach, such that shifting the focus towards treating OCD itself and limiting family accommodation may help to alleviate the severity of aggression and rage in children (Stewart, 2012).

The current preliminary study examines the characteristics and relationship between disruptive behaviour within pediatric OCD. More specifically, it aims to determine whether group and family cognitive behavioural therapy (CBT) – a form of treatment for OCD – has an effect on the disruptive behaviour demonstrated by children with OCD. Based on previous research that indicates the success of family CBT in reducing OCD impairment, we expect to see similar results of decreased severity in OCD symptoms with our study (Piacentini et al., 2011). In addition, based on the previous cross-sectional research by Storch et al. (2012) indicating the link between rage and OCD, it is expected that there will be a decrease in the scores for the CD-POC following group CBT. If this is the case, then that would indicate that a relationship between

disruptive behaviour and childhood OCD may exist and that group CBT is useful in this context. However, if the results counter our predictions such that the CD-POC scores do not decrease compared to the first day of CBT, then this could suggest that coercive and disruptive behaviour among OCD-affected children requires separate treatment from that focused on OCD alone.

Method

Participants

Twenty-nine participants (mean age = 13.0 years, SD = 2.50), eleven of whom were male, participated in this study. These individuals were patients of the Pediatric OCD Program at BC Children's Hospital who had participated in group, family-based cognitive behavioural therapy (group CBT) and consented to research. All participants were diagnosed with Obsessive-Compulsive Disorder (OCD) according to the DSM-V (Diagnostic and Statistical Manual of Mental Disorder, Fifth Edition), and as assessed via the Anxiety Disorders Interview Schedule. Participants were originally referred to the program from various locations across British Columbia by family doctors, pediatricians, psychiatrists, and other mental health providers.

Treatment Intervention

Group CBT sessions occurred at three points during the year; in the winter starting around January, in the fall starting around September, and in the summer months of July and August. The fall, winter, and spring groups were 12 sessions long and ran on a weekly basis. The summer groups were also 12 sessions long but ran three times a week for a total of four weeks. The group CBT was separated into two age groups: a child group and a teen group. Each child and teen group included approximately 5-7 patients. Child and adolescent groups were led by a clinical child psychologist with assistance from graduate and post-graduate level trainees in psychiatry, psychology, or social work. Parent groups were led by a social worker and psychiatrist, in addition to trainees. All group CBT sessions were held at the BC Children's Hospital Mental Health Outpatient Department in Vancouver, BC.

Study Measures

There were a variety of clinician-rated and self-report measures administered to the patients and their families throughout the group CBT process. These included the Children's Yale-Brown Obsessive Compulsive Scale (CY-BOCS) of OCD severity, the Coercive Disruptive Behaviour Scale for Pediatric OCD (CD-POC), the Family Accommodation Scale (FAS) of OCD-related accommodation, the Child Obsessive Compulsive Impact Scale – Revised (COIS-R), the OCD Family Functioning Scale (OFF), the Clinical Global Impression – Severity (CGI-S), and the Clinical Global Impression – Improvement (CGI-I) (Lewbowitz et al., 2011a; Stewart et al., 2007; Stewart et al., 2012; Storch et al., 2012). The 18 item CD-POC questionnaire was of particular interest in this study to examine the potential relationships between pediatric OCD and disruptive behaviour. Behaviour frequencies were reported by parents using the following scale: "0 = never", "1 = rarely", "2 = sometimes", "3 = often", and "4 = almost all the time".

Measures were administered at four points during the group CBT process: at the start, midpoint, end and one month follow up. Measures were completed either via REDCap, an online application for data capture, or in hard copy. These questionnaires are a standard part of the BC Children's Hospital clinic assessment and they serve as a guide for clinical management.

Procedure and Analyses

Following diagnostic assessment at the BC Children's Hospital Pediatric OCD Program by a team of clinical child and adolescent psychologists and psychiatrists, those deemed appropriate were offered the option to participate in group CBT. Each session was 90 minutes in length and focused on psychoeduation about OCD, the development of individualized exposure hierarchies, teaching cognitive restructuring and anxiety management strategies, and exposure and response prevention activities. Parents of the patients participated in a concurrent parent group led by social workers and psychiatrists focusing on learning specific treatment strategies and decreasing family accommodation of OCD. The remaining 15 minutes of each session was reserved for parents to join patients in discussing what was accomplished in that particular session and in assigning home-

work. All questionnaire data from the questionnaires was recorded into REDCap at the end of the program for future extraction and statistical analysis. Only those providing informed consent and assent were included for the study.

After consolidating data from the final subject pool consenting to research, item-level frequency analyses were conducted for the CD-POC and final scores were calculated for each questionnaire at baseline. Correlation analyses were conducted between the measures of interest, using the Pearson r correlation coefficient and a p-value threshold for significance of less than 0.05. Finally, mean CD-POC scores were compared across time points of CBT treatment. Subjects with missing item level data were excluded from analyses involving the related measure.

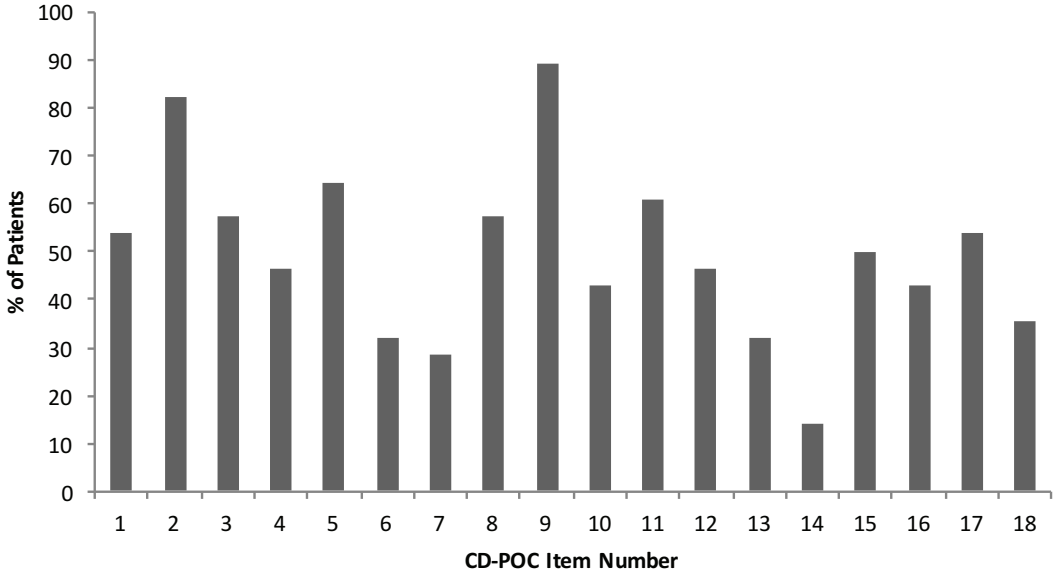
Results

Considering the data from each item of the CD-POC questionnaire at week one individually yielded frequencies of different reported coercive and disruptive behaviours in the sample (see Figure 1 and 2). The most prevalent coercive behaviour, reported to be experienced at least "rarely" by 89.3% of the sample was Item 9: "Force others to make decisions for him/her or demand endless reassurance to their own decisions". The second most prevalent coercive behaviour was Item 2: "Impose physical closeness or exaggerated clinginess (eg. won't keep a normal distance, asks never-ending

Figure 1. CD-POC items that are each rated on a scale of "not at all", "rarely", "sometimes", "often", and "almost all the time".

Items	
1	Forbid certain actions because of feelings of extreme disgust (e.g. forbids coughing at the table)?
2	Impose physical closeness or exaggerated clinginess (e.g. won't keep a normal distance, asks never-ending questions)?
3	Impose strict rules of cleanliness or order on other household members (e.g. demands repetitive cleaning or a special laundry schedule)?
4	Neglect his/her personal hygiene in a manner that is offensive to others (Leaves personal items in public spaces, refuses to shower and smells bad)?
5	Force you to behave in certain ways or forbid you to do certain things because of extreme pickiness (e.g. forbids certain foods in the home, demands specific clothes always be ready)?
6	Forbid the use of objects in his/her vicinity because of feelings of fear or disgust (e.g. knives, scissors, creams)?
7	Forbid making changes in the household or react with rage or violence to changes made (e.g. moving furniture, new car)?
8	Forbid the performance of certain normal actions and activities or react with violence or rage if they are performed (e.g. forbids opening windows or watching TV)?
9	Force others to make decisions for him/her or demand endless reassurance to their own decisions?
10	Perform rituals that cause damage to the surroundings (e.g. ruins items by repetitive cleaning, splashes water over the floors cleaning)?
11	Force others to perform actions on his/her behalf due to feelings of fear or disgust and react to refusal with rage and violence (e.g. to open doors for him because of a fear of touching the handle)?
12	Demand special "cuddling" or ritualized contact without regard for the will of others?
13	Forbid the entrance of strangers to the home or limit others in their social activity in the home?
14	Impose intimacy or act provocatively around others (e.g. walks around naked)?
15	Repeat actions or words many times and demands that others listen or attend to them/her until he/she feels it's enough?
16	Impose physical contact or proximity in a way that is unpleasant to others (e.g. approaches and hugs for a long time, shouts into other's cars)?
17	Deprive parents or others of sleep (e.g. demands that they be with him all night, turns on and off lights)?
18	Impose rules or behaviours on others due to tactile or other sensitivity and react to disobedience with rage or violence (e.g. forbids certain sounds, demands specific temperature settings)?

Figure 2. The frequencies of different coercive behaviours experienced by the patients. Each bar represents the percentage of patients that have ever experienced a particular behaviour as indicated by each of 18-items on the CD-POC questionnaire. This represents responses ranging from behaviours having occurred between "rarely" to "almost all the time".



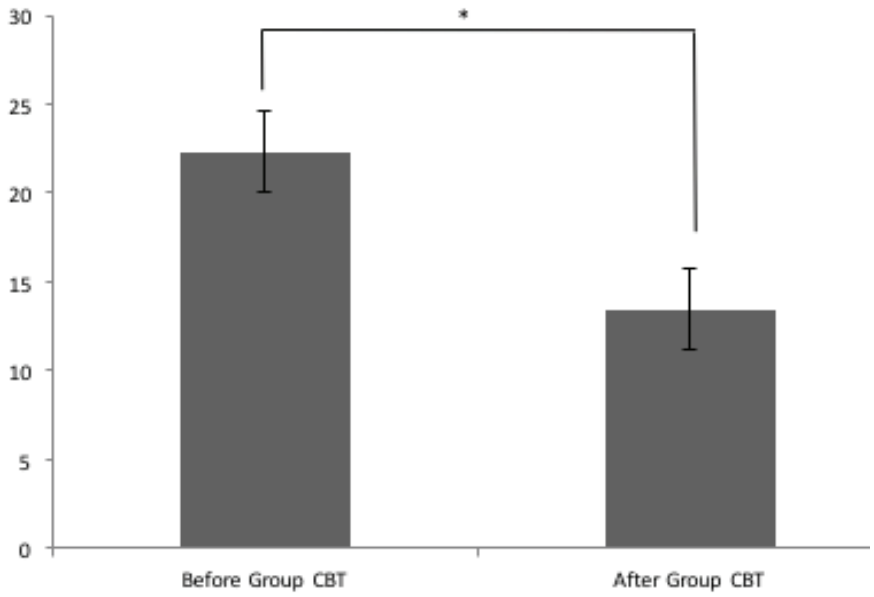


Figure 3. The mean CD-POC scores before and after group cognitive behavioural therapy (CBT) where N = 15 and $\alpha = 0.05$ 2 tail. The asterisk indicates a significant difference between the two conditions. The error bars represent the standard error of the mean.

questions)", which was reported to be experienced by 82.1% of the patients. The least common behaviour was Item 14: "Impose intimacy or act provocatively around others (eg. walks around naked)" which was reported to have been experienced at least once by 14.3% of the sample.

The CD-POC total score was significantly and positively correlated with COIS measure of OCD-related functional impact [r = 0.42, p (two tailed) = 0.03] (see Table 1). The CD-POC total was not significantly correlated with either the CY-BOCS [r = 0.06, p (two-tailed) = 0.76] severity score or the OFF [r = -0.27, p (two- tailed) = 0.22] measure of OCD-related family impact.

There was a significant decrease in mean CD-POC scores following CBT treatment for OCD ($t(14) = 3.80$, $p = 0.002$) (Figure 3).

Table 1. Pearson r correlation between CD-POC and other pediatric OCD measures at baseline. * indicates $p < 0.05$

	Pediatric OCD Measures (2 tailed p-value)		
	CY-BOCS (mean = 22.71; SD = 6.65)	COIS (mean = 32.74; SD = 17.50)	OFF (mean = 46.36; SD = 15.03)
CD-POC (mean = 19.89; SD = 10.94)	0.06	0.42*	- 0.27

Discussion

As reported by this sample, and contrary to traditional descriptions of pediatric OCD, coercive and disruptive behaviours were commonly present in this disorder. Results indicate that certain behaviours were more prevalent than others, and that those dealing with forced physical closeness and decision-making were the most common (see Figure 2). The latter finding is consistent with research in the field of OCD, identifying decision-making deficits (Detorre & O'Connor, 2012). The report of forced physical closeness may relate to the child's desire for easy access to family accommodation, or enabling of the OCD symptoms. This is consistent with research suggesting that rage severity predicts family accommodation (Storch et al., 2012).

However our results contrast with another study on the coercive behaviours in pediatric OCD that also utilized the CD-POC and found that item 1 on feelings of disgust and item 18 on enforcing rules and preventing disobedience were the two items that would most effectively distinguish the presence of OCD from other disorders such as disruptive behaviour disorders (Lebowitz et al., 2011a). These two items focus on different aspects than the two items that were most prevalent in our study. One possibility for these differences is that the limitations of a small sample size led to results that were not representative of the greater population. In the study by Lebowitz et al. (2011a), the results were concluded from a sample of 60 subjects whereas the current study includes less than 30 subjects.

The relationship between the CD-POC measure was also compared to other pediatric OCD measures such as the CY-BOCS, COIS, and OFF. The goal was to determine whether the CD-POC scores – which reflect disruptive behaviours in OCD – were correlated with OCD severity (CY-BOCS), with how well a child functions overall (COIS), and with how well the family functions (OFF). Analyses demonstrated no significant correlations between the CD-POC and either CY-BOCS or OFF (see Table 1). This indicates that OCD severity may increase without concurrent emergence or worsening of coercive and aggressive behaviours. Moreover, improved family functioning does not indicate less disruptive behaviour. Of note, OCD-related family functioning is not equivalent to the family accommodation, which was previous found to be associated with OCD severity (Storch et al., 2012). In addition, the results are not consistent with existing research literature that found a significant correlation between CD-POC and CY-BOCS (Lebowitz et al., 2011a). However, since qualitative or quantitative research on the CD-POC remains limited, it is difficult to determine the causes of the discrepancy (Stewart, 2012).

A positive correlation identified in this sample was that between CD-POC and COIS. The higher the value in the CD-POC means the more that the patient experiences a coercive behaviour, while the higher the value on COIS means the more than the OCD negatively impacts different areas of daily life. Therefore this correlation suggests that children with OCD will function better when they experience less aggressive and disruptive behaviour.

In line with our hypothesis and initial predictions, there were significant decreases in both the CD-POC scores and in CY-BOCS severity scores following completion of CBT (see Figure 3). The findings would suggest that group CBT is not only for treating OCD symptoms in pediatric patients, but it is also for dealing with the coercive behaviours that might exist in the presentation of this condition.

Before assuming that a causal relationship exists

between CBT completion and CD-POC score decreases, further examination is required with higher powered samples. In addition to examining total score changes, subsequent studies may examine changes of specific coercive and aggressive behaviours.

In conclusion, preliminary findings indicate that coercive and disruptive behaviours are common in pediatric OCD, that these are correlated with overall functioning, and that these appear to decrease following CBT treatment focused on OCD. Given that research on rage and aggression in pediatric OCD is still early in evolution, our findings should be replicated in larger and independent samples.

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

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COGNITIVE
Research Paper

Visual Search for Single Italic Letters Is Aided by Word Recognizability but May Be Hindered by Word Processing

Rachel Coe[1], Angela Martinovic[2], and Marika Constant[3]
[1]Department of Psychology, University of British Columbia
[2]Department of Psychology, University of British Columbia
[3]Department of Psychology, University of British Columbia

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Abstract

The serial versus holistic mechanisms that may be involved in reading written words remain unclear and further investigation is required in order to understand how our visual system matures and specializes for processing written language. The automaticity of reading, demonstrated through paradigms such as the Stroop effect, can be linked to the holistic processing of words in experienced readers. Alternatively, research using visual search paradigms have demonstrated that feature discrimination is not dependent on grouping, indicating serial processing. However, this work has failed to consider grouping into words, which may be uniquely processed, automatically and holistically. This study aims to merge these two approaches in investigating whether the presence of lexical content in groupings of letters significantly affects feature discrimination search for single letter targets. 22 UBC students complete two visual search tasks, one in each condition, English and jumbled, for a within-subjects experimental design comparing search efficiency between conditions. The lexical content is found to significantly increase efficiency of visual search for single italicized letters, suggesting a different mechanism of visually processing words than other perceptual groups. This novel investigation of reading automaticity and visual search in one paradigm reveals new information about the subtleties of our visual processing of language. Understanding how the mechanisms of our visual system develop in learning to process language may help us to better form strategies for language learning, in particular for those learning English as a second language, or with language related disabilities such as dyslexia.

Keywords: visual search, reading automaticity, holistic word processing, language

Investigating the way in which we visually parse, group and process written language is crucial to understanding the specialized visual mechanisms we develop for reading. Reading involves a complex visual process, including the allocation of visual attention, serial processing of component parts such as letters, and higher level processing involving grouping into words. Although visual attention, search efficiency and reading automa-

UBC Ψ UJP

Corresponding Author:
Rachel Coe
rachel.r.coe@gmail.com

ticity have been studied extensively, the mechanisms by which they interact for processing written language remains unclear. Uncovering these interactions could help improve language learning by guiding focus on to the mechanisms most important at various stages of learning, for example by stressing components such as letters and strict letter order, or by underlining holistic word recognition and contextual cases. Further research in this area may also reveal differences in the way these mechanisms develop in those with native languages other than English, or those with language disabilities such as dyslexia, in which case we may be able to better target education for ESL (English as a second language) or dyslexic individuals.

Previous research has shown that search efficiency decreases when targets are placed within visual distractors, when targets become more similar to distractors, or when distractors become less similar to each other (Duncan & Humphreys, 1989; Duncan & Humphreys, 1992; Treisman, 1982). Early research in this field shows that feature searches—where only one visual variable differs between the targets and distractors (e.g. colour or shape)—should not be hindered by grouping of objects since participants can focus on the single differentiating variable in their search (Treisman, 1982). However, groupings that are innately processed as a whole, such as the grouping of letters into words, were not studied.

Though it has yet to be studied in the context of visual search, some aspects about the way we process groupings of letters into words have been investigated extensively. In particular, studies have repeatedly shown that humans read words automatically (LaBerge & Samuels, 1974; Samuels, 1994/2013). This is perhaps most famously demonstrated in the Stroop effect (1935) where colour names are written in opposing colour hues, slowing down participants' processing and identification of the hues they perceive. For example, the word 'green' may be written in red ink, hindering the participant's ability to name the ink colour, 'red'. The Stroop effect also extends to non-colour words (MacLeod, 1991), suggesting that the automatic reading of the words likely conflicts with the hue identification, rather than just the conflicting concepts of colour names and hues. Stroop interference is more prominent for words compared to pseudo-words, which are pronounceable, word-like strings, and pseudo-homophones, which sound identical to a given word but are not a meaningful written word, such as 'bloo'. Because pseudo-words and pseudo-homophones are pronounceable and share many lower level features of words such as letters, this suggests that the Stroop effect stems from automatic processing of lexicons rather than just the effort of processing of lower level features (Besner, Stolz, & Boutilier, 1997; Sharma & McKenna, 1998).

This work using the Stroop paradigm reveals some conflict between lower level processing and the automaticity of reading. However, *how* the more holistic, automatic processing involved in reading interferes with perception of lower level component parts has yet to be thoroughly investigated. Visual search paradigms have been used to study similar holistic versus serial mechanisms of the visual system in looking at how we process groupings of individual targets; however, this work has looked primarily at spatial groupings, and not more meaningful groupings such as words (Treisman, 1982). The holistic, automatic processing associated with reading has not yet been studied in the context of visual search. In the present study, we aim to further previous research and look at whether directed perception of lower level features, such as in a visual search task, is interrupted by the automatic processing of lexical content. This brings together previous research done on visual search and work on reading automaticity in order to gain new insight into how we process written language, in particular, how our processing of individual features interacts with our processing of the word as a whole. Understanding these processes will help us gain a more complete understanding of how we learn to read written language, which may have implications for education, as well as for helping those with English as a second language, or with various reading impairments such as dyslexia. This study will investigate, using an experimental design, whether manipulating the language content of the groupings in an excerpt, namely whether the content contains real words or pseudo-words, affects visual search efficiency for single letters. We hypothesize that automatic, holistic word recognition and processing will affect visual search efficiency for single italic letter targets within a paragraph of grouped, non-italicized

distractor letters. If automatic, holistic processing of the words hinders processing of other features, as is seen in previous work using the Stroop paradigm, it would be expected to affect identification of lower level feature targets in a visual search paradigm.

Methods

Participants

Twenty-two undergraduate and graduate students from the University of British Columbia (UBC) participated in the study during a lab session for the course Psychology 260. Fourteen subjects identified as female, eight as male, with a mean age of 19.95 (SD = 2.42). Thirteen participants were native English speakers, and the nine non-native speakers had 6 to 15 years of experience speaking English (M = 11.67, SD = 3.43 years). Participants met the UBC required level of English proficiency (University of British Columbia, 2015).

Materials

The English prose excerpt was a page from "The Emperor's New Clothes" by Hans Christian Andersen (1837/1872). The text was divided into segments of 100 letters, and a random number generator determined one letter to italicize within each segment; this ensured targets were not bunched close together or spaced very far apart. To create the non-word gibberish excerpt, the non-italicized distractor letters from the English excerpt were jumbled, swapping consonants for consonants and vowels for vowels. Between conditions, this preserved the exact appearance and location of target letters, as well as the formal structure of the paragraph and to some degree, the pronunciation of the pseudo-words, since they contained appropriately placed vowels. Excerpts used 1.15-line spacing and Arial 12-point font, which is not fixed width, avoiding exactly the same spatial placement of targets on the page between the two conditions.

Participants completed the experiment on paper printouts and were timed using the iPhone Clock app's stopwatch function.

Procedure

All subjects completed both the English and non-word visual search in a within-subjects experimental design. To control for order effects, each participant was randomly assigned using a random number generator to complete a certain excerpt first. Up to three participants completed the experiment simultaneously. Participants filled out a brief demographics questionnaire prior to beginning the task. They were then shown an example of an italic letter within a word and received oral instructions to find and circle as many italic letters as they can in 40 seconds. After finishing the first excerpt, participants then completed the other excerpt. Finally, they were asked to write down the central character in the excerpt. This was to try and gage the level of semantic processing occurring in the English condition, to check whether this higher-level semantic understanding also interfered with the search efficiency. This analysis helped researchers isolate effects caused by just the presence of the lexical content, compared to other aspects of reading such as higher level semantic processing. If they asked for clarification about which excerpt we meant, the researcher responded, "Either." Responses of either "emperor" or "king" were considered correct since "emperor" appeared in the excerpt six times and "king" appeared once. In our analyses, the dependent variable was the participant's visual search efficiency score—the number of italics circled—for each excerpt, in which the higher scores indicated higher efficiency.

Results

We hypothesized that the automatic processing associated with the presence of lexical content in a passage would affect the visual search efficiency for a single letter target. A two-tailed paired-samples t-test compared differences in participants' visual search efficiency scores between the English and gibberish conditions. A two-tailed independent-samples t-test compared the English visual search efficiency scores of those participants who could identify the excerpt's central character to the scores of those who could not. Alpha level was set to $p = .05$, and analyses were performed using JASP.

Data were analyzed to assess the effect of processing English lexical content on visual search efficiency. The maximum possible visual search efficiency score

in both conditions was 26. Participants had a mean English visual search efficiency score of 7.18 ± 2.50, which was significantly higher than their mean gibberish score of 5.32 ± 2.30, $t(21) = 4.70$, $d = 1.00$, $p < .001$ (see Figure 1).

Data were then analyzed to determine if any higher level semantic processing that may occur while reading the English excerpt—as measured by participants' ability to identify the central character—affected visual search efficiency. The 16 participants who could identify the excerpt's central character had an English visual search efficiency score of 6.44 ± 2.07. This was significantly lower participants who could not identify the central character, with a mean score of 9.17 ± 2.64, $t(20) = 2.57$, $d = 1.23$, $p = .02$ (see Figure 2). A paired-samples t-test analyzing only the participants who could identify the central character still showed that their mean English score was significantly higher than their mean gibberish score (English score = 6.44 ± 2.07; gibberish score = 4.50 ± 1.75; $t(15) = 4.48$, $d = 1.12$, $p < .001$).

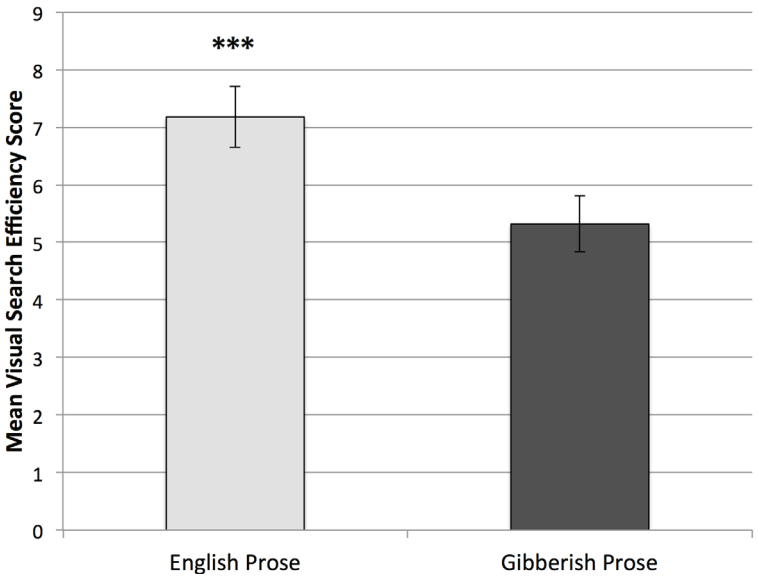

Figure 1. Mean visual search efficiency scores for finding single italic letters in English prose and gibberish prose. Participants (n = 22) completed the task for both excerpts and had a significantly higher mean visual search efficiency score when searching for single italic letters in an excerpt of English prose than in an excerpt of gibberish. Visual search efficiency scores represent the number of single italic letters found in an excerpt within 40 seconds, out of a maximum possible score of 26. A two tailed, paired samples t-test was used. Error bars represent standard error of the mean. *** $p < .001$.

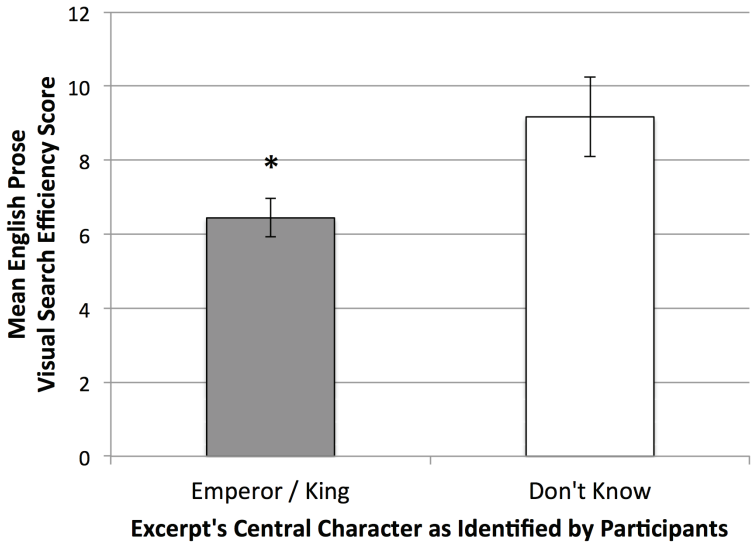

Figure 2. Mean English visual search efficiency scores for participants who could and could not identify the excerpt's central character. Participants who could identify the excerpt's central character (n = 16) had a significantly lower mean English visual search efficiency score compared to the mean score of those who could not identify the central character. Visual search efficiency scores represent the number of single italic letters found in an excerpt within 40 seconds, out of a maximum possible score of 26. A two tailed, independent samples t-test was used. Error bars represent standard error of the mean. * $p < .05$.

Discussion

This study aimed to investigate the relationship between our automatic, holistic reading processes and directed visual search by testing whether visual search efficiency for single letter targets is affected by the presence of lexical content in the grouping. We hypothesized that there would be an effect of the English word grouping on visual search efficiency compared to grouping without lexical content. Our findings indicate that grouping distractor letters into English words rather than into gibberish words increases visual search efficiency for single italic letters. While this supports our hypothesis that English would affect search efficiency, we had initially anticipated that the English condition would have decreased search efficiency based on the idea that reading automaticity would slow the serial search process. Our study design does not allow us to conclusively determine why visual search for single letters in English words was not impaired by reading automaticity, but previous research provides several possible explanations.

Humans process words holistically (Grainger & Whitney, 2004; Wong et al., 2011), but their perception of individual letters may actually be enhanced when letters are presented in words, compared to in isolation or in non-word contexts (Rumelhard & McClelland, 1982). This would suggest that holistic word processing may be occurring, but also may actually assist both the holistic and serial processing involved in reading, aiding visual search. Additionally, people with extensive English reading experience would be very familiar with the appearance of common words. Research into recognition has found that familiarity with a class of objects increases the ability to distinguish subtle differences within those objects (Gauthier & Tarr, 1997). This research was specific to facial recognition, but it could be that, similarly, participants are better at recognizing single letter disturbances if the word is highly recognizable to them in English. It also seems possible that reading automaticity becomes problematic in the context of gibberish words because the brain is attempting to read words that it cannot understand, distracting it from and slowing down the visual search task at hand, however more research would be needed to investigate this possibility.

It is very interesting that participants who could identify the excerpt's central character had decreased visual search efficiency in the English excerpt. This may indicate that the processing of semantic meaning in the English excerpt slows serial search for a single letter. It could be that the higher level semantic processing involved in retaining meaning slows scanning of text in general, leading to reduced efficiency on a visual search task. It may also be possible that retaining meaning encourages the automatic reading of words, hindering serial search as hypothesized, and that those who failed to answer were somehow minimizing normal processes of automatic reading. However, this is not a perfect measure of holistic word processing. We cannot conclusively determine if the participants who could not identify the central character failed to process words at all or just failed to encode the specific words needed to answer our question. Since participants who identified the central character also had lower efficiency in the gibberish excerpt compared to those who could not, it could be that they start with lower efficiency, and the decreased search speed allowed more words to encode into memory. Alternatively, it's also possible that their efficiency was still impaired in the gibberish excerpt because of attempts to read. Further research that includes non-letter visual searches could try to determine if search speed is affecting processing or vice-versa. It would also be especially interesting to conduct similar tasks using brain-imaging techniques to see if activated regions correlate with pathways important in word recognition, as uncovered by previous imaging studies (Cohen, Dehaene, Vinckier, Jobert, & Montavont, 2007; Fiebach, Friederici, Müller & von Cramon, 2002). It has been shown that the holistic processing of words correlates to a more ventral pathway, while more serial processing of pseudo-words involves a more dorsal pathway (Cohen et al., 2007). Repeating the tasks of this study using fMRI may reveal new information about how these two pathways work or interact in a situation involving both word processing and serial search for a single letter target.

Though our study was able to support the hypothesis that lexical content affects visual search efficiency, there are limitations that should be considered when interpreting the findings. Although results showed that the English words improved search for the single letter targets, we cannot necessarily claim that holistic reading

processes therefore aid in serial search. This study was unable to account for reading speed between conditions so it is possible that the presence of English words simply allowed the participants to scan the text more quickly and in turn reach more of the targets in the allotted time. A follow up study using eye tracking technology could help analyze this further. Our experimental design is also limited in that it does not isolate higher level semantic content from merely the presence of lexical content so it is possible that in the English condition, participants were aided by some sort of semantic contextual priming instead of the mere holistic processing of individual lexicons. While we tried to account for this somewhat using a semantic probe question, it is unclear whether this was a good measure of semantic processing. Further research comparing visual search in lexicons with and without the presence of semantic context would be useful to support our findings.

This study adds new knowledge to the fields of visual search and visual word processing. However, our findings are just a preliminary step toward determining the relationship between reading automaticity and visual search. Expanding on these findings will help us better understand the interplay of automatic, holistic word processing and the more serial processing of component parts such as letters. This knowledge of the mechanisms involved in reading and how they develop will allow us to refine our language education system, and to better target the needs of individuals who may process written language in different ways, such as those learning English as a second language, or those with language related disabilities such as dyslexia.

Declaration of Conflicting Interests

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

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COGNITIVE
Literature Review

Production, Testing and Expanded Retrieval Practice Improve Short-Answer Performance

Minzhi (Menchi) Liu[1]

[1]Department of Psychology, University of British Columbia

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Abstract

This literature review discusses three strategies to improve studying for an exam, how to implement each strategy, and how each strategy has been demonstrated to improve long-term performance on short answer (SA) questions. The biggest difficulty in answering SA questions is missing detailed information in the students' answers. This can be attributed to the use of inappropriate encoding strategies while studying or retrieval failure during examinations. The finding of the paper is that reading aloud produces more production effect than mouthing or silent reading; testing promotes greater retention of materials and performance in SA task, compared to rereading and no testing during studies; expanded retrieval practice combines the positive effect of spacing and testing, and the effect is most optimal when it is integrated with delayed initial test. The implication of the paper is that different study strategies have positive effects on different levels, while expanded retrieval practice has the greatest effect on long-term retention.

Keywords: learning, memory, performance, strategies, long-term retention

This paper is devoted to describing three study strategies for short-answer questions on the upcoming final exam, including evidence and implementation approaches for them. Since recall tasks (e.g., short-answer questions) in general require greater deliberate learning than recognition tasks (e.g., multiple-choice questions) (Baddeley, Eysenck & Anderson, 2015), students' performance on short answer (SA) questions in general is poorer than on multiple-choice (MC) questions (Smith & Karpicke, 2014). One of the reasons for losing marks is missing detailed information in answers. This could be that detailed information is encoded inefficiently while studying or due to retrieval failure during exams. It is difficult to find the causes of retrieval failure, either it is the lack of accessibility (e.g., information cannot be retrieved at the moment) or availability (e.g., information is not stored) in the brain (Baddeley, Eysenck & Anderson, 2015). Therefore, it is more realistic to look at efficient study strategies for encoding information. In this paper, three effective strategies are discussed to improve free recall in SA questions: production, testing, and expanded retrieval practice. The first strategy for improved performance is to encode acoustic information while reading: memory benefits from information that has been read aloud, relative to information that has been read silently. Considering that SA questions require students to recall and produce answers, a more efficient and effortful encoding strategy is necessary for re-studying, such as testing (e.g., SA and MC questions). However, the effect of a test is only limited to short-term retention; a long-term retention study strategy is essential for SA question on the final exam, which covers a half term's

UBC Ψ UJP

Corresponding Author:
Minzhi (Menchi) Liu
menchi905@gmail.com

worth of materials. As a result, the third strategy is expanded retrieval practice—a strategy with a positive effect on long-term retention by combining the benefit of spacing and testing.

Strategy 1—Production

Description

The first strategy to improve performance on SA questions is called production. A principle finding is that retention of information that has been read aloud is enhanced, relative to materials that are mouthed or read silently during an encoding episode. This enhanced memory effect is called production effect.

Evidence

A few studies have provided evidence that reading information aloud can induce better recall. Empirical evidence is found in Conway and Gathercole's experiment 3 (1987) demonstrating that memory performance is poorest in silent reading and is best when words are read aloud, with memory for mouthed materials being located between the two. In this experiment, however, reading silently is compared with two input response conditions—mouthing and vocalizing in which cases participants are required to perform explicit motor actions with visually represented words. It is unclear whether the benefits result from the effect of active vocalizing (mouthed words) or hearing (read aloud). In experiment 4 (1987), Conway and Gathercole further illustrate how production effect results in better memory through spoken words due to the presence of acoustic information (i.e., hearing), compared to silently reading words. Experiment 4 includes three input conditions—silent reading, listening, and both reading and listening. A clear pattern of acoustic advantage emerges from this analysis. There is no difference between the two input modes (i.e., listening only and both reading and listening), and both of them have greater advantages than reading only. It, therefore, appears that learning through listening reflects a greater retention of acoustic information, rather than silent reading and active presentation procedures such as mouthing and reading aloud. Experiment 4, therefore, reveals that the critical mechanism underlying the production effect is the presence of acoustic information. Ozubko, Hourihan and MacLeod's research (2012) further suggests the idea of production effect in showing that materials that are read aloud not only help the learning of pair words and sentences stimuli but also educational text materials compared to silent reading. Based on these findings, it is evident that production is an effective strategy for greater SA performance in exams.

Implementation

The most direct way to apply production is to read the information from a textbook and lecture notes aloud in a quiet study place so that the learners are able to hear the acoustic information. However, reading aloud can only be used in the first-time study when looking for important points in the textbook and it is also far from sufficient for most university-level courses. In order to succeed in short-answer questions, a more effortful study strategy is essential—testing.

Strategy 2—Testing

Description

MC and SA questions are the primary formats employed in educational settings as a means of measuring a state of knowledge on exams; however, a number of studies have shown that testing can enhance learning as well. A phenomenon known as a "testing effect" explains that taking a memory test improves retention of materials, relative to repeatedly studying the material (Butler & Roedifer, 2007). The testing effect has been observed in both MC and SA questions, but is greater in the SA format.

Evidence

Empirical evidence for the effectiveness of testing as a studying strategy is found in the McDaniel, Roediger and McDermott experiments (2007). Both SA and MC tests help retain more information than rereading and non-testing condition. In particular, SA test formats result in superior memory performance when compared to MC. Similar results are also observed in Smith and Karpicke's study (2014), where practicing retrieval in SA

format produced better performance than MC form on final assessments later. SA questions examine whether students can recall and provide the answers, whereas MC questions only require students to recognize the correct answers among alternatives (Smith & Karpicke, 2014). Since retrieval practice with SA questions require more effort than tests involving multiple choice or true/false, SA questions should, in principle, lead to greater retention of materials. Furthermore, to obtain the most benefits from an SA test, it is important to provide corrective feedback, especially if performance on the test is relatively low (Kang, McDermott & Roediger, 2007). Feedback undoubtedly serves as the supporter of testing effects thereby enhancing final retention to a greater extent.

Implementation

The results of the experiment provide an evidence-based recommendation for usage of testing to improve retention in order to succeed in SA tests. The easiest way to apply testing is to self-generate questions and test oneself, followed by corrective feedback. However, students with higher abilities are often more experienced in selecting important information that has a higher likelihood of being tested, compared to students with lower abilities (Weinstein, McDermott & Poediger, 2010). One way to address this weakness for the low-ability students is to form a study group where group members can generate questions for each other. This will allow for feedback from other group members, including what valuable information the student missed while studying. Although testing is useful, further research is needed to identify how testing can be further optimized to produce even greater gains in long-term retention of information, so that a student can perform well in the cumulative final exams.

Strategy 3—Expanded Retrieval Practice

Description

The third strategy to promote long-term retention for SA performance is to combine spacing (i.e., to study fewer times over a long period of time) and testing. Testing and spacing have been shown to enhance the long-term retention of to-be-learned information. However, it is not clear how these two manipulations can be most effectively combined. There are two ways to combine testing and spacing—one is expanded retrieval practice, and the other is equally spaced retrieval practice. Expanded retrieval procedure is to ensure a high level of retrieval success on the first immediate test with increasingly spaced retrieval attempts (Karpicke & Roediger, 2007). An example of expanded retrieval conditions could be an increasingly spaced schedule of practice — Test 1 occurred one trial after the study trial; Test 2 occurred after three more trials, and Test 3 occurred after eight more trials and so on. Thus, the number of intervening trials between study or test trials in this condition would be 1-3-8. In contrast, equally spaced retrieval practice is when the numbers of intervening trials occur at equal intervals between study and subsequent test trials (Karpicke & Roediger, 2007). An example of equal retrieval conditions would be four intervening trials occurred between each study trial and the subsequent test trials, which are denoted as 4-4-4. The following studies show that expanded retrieval is better than equally spaced retrieval practice if to-be-learned information is vulnerable to being forgotten.

Evidence

Both spacing and testing can be used to succeed on final SA exams. Students who employ spacing without testing, such as repeated studying, forget significantly more than those who repeatedly test the materials (Larsen Butler & Roediger, 2009). On the other hand, students employing testing without spacing, such as single tests, also perform worse than those using repeated testing (Karpicke & Roediger, 2007). The difficult question is how to space in order to maximize the testing effect?

Expanding retrieval usually involves an immediate first test (e.g., test 1 day later after studying), whereas equally spaced practice involves a delayed first test (e.g., test 4 days later after studying) (Karpicke and Roediger, 2007). Karpicke and Roediger have suggested that equally spaced practice leads to better long-term retention than expanded retrieval practice (2007). However, the key factor is not the equal spacing effect (4-4-4), but the delayed initial testing (test 4 days later after initial studying) in the equally-spaced procedure.

In other words, delaying the initial retrieval attempt promotes long-term retention, regardless of whether repeated tests were expanding or equally spaced. Overall, expanded retrieval practice is the most optimal way to combine testing and spacing if the initial test is a delayed test and interference such as longer spacing are involved.

In addition, Storm, Bjork & Storm illustrated that expanded retrieval practice leads to greater long-term retention if the to-be-learned information is vulnerable to being forgotten (2010). They suggested that forgetting is linked more strongly to the nature of intervening or interpolated changes in contextual cues than to the passage of time between studying and testing (Storm, Bjork & Storm, 2010). Specifically, greater forgetting happened when several to-be-learned information was associated with the same retrieval cue in the brain, so the recall of a particular item can suffer competition from other information in memory—either proactive or retroactive interference (Storm, Bjork & Storm, 2010). So it necessitates a more efficient study strategy to overcome the interferences. The reason why expanding schedule of tests leads to better performance than equally spaced schedule is that to-be-learned information gains greater strength in memory as the interval between consecutive tests is systematically increased. An increasingly spaced schedule of practice thus leads to far superior long-term retention than can equally spaced practice when to-be-learned information is susceptible to forgetting. In this way, students are able to gain the benefit of long-term retention for the later cumulative exams.

Implementation

The SA questions on the final exam will cover a half term's worth of materials; therefore, long-term retention is needed in order to perform well on the final SA questions. Based on findings that repeated testing is better than single-test and repeated studying, it is optimal for a student to test him or herself repeatedly. In addition, expanded retrieval practice is most optimal when the first test is a delay test (e.g., four days later) instead of an immediate one (e.g., one day later). In this way, a student could test him or herself three days after the study period and gradually increase the spacing of repeated tests. An increasing amount of spacing (i.e., expanding schedule) between trials would be sufficient if to-be-learned materials are more vulnerable to forgetting. Interestingly, long-term performance might be better in the expanding condition than in the equally spaced condition, even if an interfering interpolated task is not introduced (Karpicke & Roediger, 2007). Overall, it would be desirable for a student to start using expanded retrieval practice earlier instead of right before the final exam.

Conclusion

This paper has described three strategies to improve performance on SA question for a final exam. One of the difficulties in answering SA questions is missing detailed information. The first strategy to improve SA performance is to encode acoustic information while reading (i.e., production). Findings have suggested that reading aloud produces a stronger production effect than mouthing or silent reading. Considering that SA questions require students to recall and produce answers, merely reading textbook and lecture notes are insufficient since SA questions require deeper processing—recall rather than recognition. Therefore, the second strategy—testing further optimizes to provide greater retention in final SA performance, relative to rereading and no testing during studies. Nonetheless, the effect of a single test only is restricted to short-term retention. Because SA questions of final exam cover long-term materials, a long-term retention study strategy is essential. Thus, the final strategy—expanded retrieval practice—has combined the positive effect of spacing and testing. The effect is most optimal when expanding retrieval practice is integrated with delayed initial test. Future research should address other kinds of study strategies, such as writing notes while rehearsing and how that effects memory in terms of both short-term and long-term retention. Also, it would be interesting to analyze the relationship between time-consuming efforts and exam performances.

Declaration of Conflicting Interests

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

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COGNITIVE
Literature Review

Prior Knowledge Creation and Update: Cognitive vs. Statistical Models

Quentin Raffaelli[1]
[1]Department of Psychology, University of British Columbia

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Abstract

Over the last decades, statistical models have gained popularity as a candidate mechanism for explaining cognitive processes. Those models rely on the idea that the brain, rather than being reactive to its inputs, is proactive. It uses stored knowledge to make predictions about the world. An important gap in the literature, however, is the lack of formal explanation, based on behavioral or biological evidence, about how stored knowledge is created, used, and updated in those models. I first offer to gather from the cognitive literature in order to propose schema as a basis for stored knowledge. schema contains two components, features and context, both of which match very well with the two components of prediction described in statistical models of cognition, prior and likelihood, respectively. Second, I offer a view of how schema are created, used for prediction, and updated. Though statistical models imply that update processes are automatic and non-selective, evidence from the memory literature suggests that the updating of schema is selective and partially delayed in time. In sum, howbeit schema account very well for prior and likelihood at the conceptual level, there are discrepancies between statistical models accounts of prediction update mechanism and evidence from the memory literature.

Keywords: predictive coding, statistical models, schema, selective attention, prediction error update, context

Statistical Models to Explain Cognition

From the brain point of view, sensation is most often partial. One does not perceive the same stimulus the exact same way every single time. As a result, there is uncertainty in interpreting neural signal resulting from sampling the environment for information. The brain has to identify stimulus based on partial evidence. Statistical models of cognition propose to overcome the problem of information uncertainty by suggesting that the brain uses predictions based on partial evidence to infer or foresee the environment (Chater, Oaksford, Hahn, & Heit, 2010). Statistical models have been proposed to explain perception (Hohwy, 2013; Rao & Ballard, 1999), semantic organization (Mittelman, Sun, Kuipers, & Savarese, 2014), decision-making (Rushworth, Mars, & Summerfield, 2009), and cognition in general (Chater, Tenenbaum, & Yuille, 2006; Shanks, 2006). The proposal that statistical models can explain all cognition is based on the claim that most cognitive processes require dealing with uncertainty (Chater, Oaksford, Hahn, & Heit, 2010; Jacobs & Kruschke, 2011). In fact, the brain has to interpret environmental stimuli solely on the sensory signals resulting from them (Clark, 2013). That is, the brain does not experience the world but only the effects (electrochemical reactions) caused within it. Uncertain-

UBC Ψ UJP

Corresponding Author:
Quentin Raffaelli
quentinraffaelli@hotmail.fr

ty follows because the brain has no way to be sure its interpretations are accurate. As perception allows recognition, recognition allows categorization, and categorization leads to creation of schema, which in turn support reasoning (Chater, Oaksford, Hahn, & Heit, 2010), thus the uncertainty resulting from perception is therefore carried in all cognition.

To overcome uncertainty, the brain makes use of statistical predictions about the potential cause of the effects it experiences (Clark, 2013). Predictions are composed of two elements. The first is likelihood which corresponds to a prediction's ability to account for the neuronal signals currently experienced by the brain. The second is prior, the probability that a prediction can explain a cause regardless of the currently experienced sensory signals. The brain computes both of these elements in order to select the best prediction; the one that has the highest probability of occurrence based on likelihood and prior. The best prediction is compared to the actual inputs. The difference, termed prediction error, updates the prediction so that future predictions more accurately fit environmental inputs (Hohwy, 2013).

Statistical models assert that cognition results from predictions based on prior knowledge. Although statistical models attribute learning to predictive processes (Chater, Oaksford, Hahn, & Heit, 2010), the question of how those models account for prior knowledge acquisition and update seems to be ignored (Clark, 2013) or dealt with using its own statistical model devoid of behavioral or neurological evidence (Jacobs & Kruschke, 2011). Drawing on current knowledge in perception and memory, this article proposes schema as a potential mechanism for prior knowledge acquisition and update.

Schema as a Basis for Predictions

Memory Formation: From Sensory Inputs to Prior Knowledge

Three levels of stimuli perception organized as schema. There are three levels of perception: feature, object (Baddeley, Allen, & Hitch, 2011), and scene (Friedman, 1979). Features are the smallest unit of a stimulus that one can process. Shapes, colors, textures are all examples

Glossary:

Categorization: identification as belonging to a category

Context: information that is preceding or concomitant to the processing of a stimulus

Conscious perception: perception occurring at the conscious level; what we are aware of processing

Higher-order: types of processing that rely on integration of information coming from different sources; for instance, integration of information from multiple sensory modalities, or integration of past representation with current representation

Likelihood: part of a prediction attempting to explain the cause of neuronal activity based on the current input; it is an attempt to determine the stimulus most likely to be currently experienced using the stored stimulus that has the highest level of brain activity overlap as a proxy

Prediction: inference about the potential cause of neuronal activity

Prediction error: the discrepancy between the brain's prediction and the actual sensory inputs, i.e. the difference between neuronal activity caused by prediction and neuronal activity caused by sensory inputs

Prior: part of a prediction attempting to explain the cause of neuronal activity independently of the activity; based on past evidence, what types of neuronal activity can I expect to happen?

Prior knowledge: accumulation of knowledge; in the context of this article, prior knowledge is equated to a statistical model version of schema

Schema: structured knowledge about a part of the world (people, object, event, scene, action) based on accumulated chunking of information

Statistical models: models offering to explain various components of cognition based on the principle that the brain is an inference machine constantly making predictions about the possible causes of its activity

Uncertainty: the lack of confidence associated with inferences of the cause of neural activity

Unconscious perception: attention that occurs below consciousness level; what we are unaware of processing

Update: process of modifying prior knowledge based on the most recent experienced version of the world. Prior knowledge is updated by prediction error

of features. Features are bound together to form larger, more complex objects (Treisman & Gelade, 1980). A rectangle, flat, white, smooth object is mentally assembled into a piece of paper. Finally, visual scenes are a collection of objects. A classroom is composed of desks, chairs, chalkboard and other objects typical of an academic environment. Those three perceptual levels are the main components of memories.

The relationship between features as well as the relationship between objects forms the basis of schema – organized structures of knowledge of various aspects of the world. Schema are the result of chunking of information (Baddeley, Eysenck, & Anderson, 2009). Over time, features and objects that are often perceived together come to become associated in long-term memory (Bliss & Lomo, 1973). As with the classroom example, classroom objects often processed together come to form the basis of a classroom schema.

Schema content. Schema contain two important pieces of information: templates and context. First, the main features of a stimulus are held as templates – an internal average representation of the most typical features of an object, or objects of a scene (Ackermann & Landy, 2014). Templates allow categorization. Based on associations between features (for objects) or associations between objects (for scenes), templates represent the main characteristic of a specific stimulus. Second, schema also contain context. All the information that is processed before and concomitantly to the actual stimulus, and which becomes part of the schema for that stimulus, is context. Context has been shown to enhance retrieval of a stimulus when reinstated (Palmer, 1975). Indeed, the stimuli preceding encoding of a memory will become predictors of that memory.

Sensory context, for instance, is the information from other sensory channels that is processed before or concomitantly to a stimulus. It has been shown that other sensory modality information can enhance retrieval of a stimulus (Shams & Seitz, 2008). For instance, encoding from the vision and auditory channels lead to enhanced memory (Davies, Davies, & Bennett, 1982) as what occurs in one modality acts as a trigger to recall what happened in the other modality at the same time.

Other elements of contexts that have also been demonstrated to facilitate retrieval include: mood (Eich, Macaulay, & Ryan, 1994), physiological states (Eich, 1980), and cognitive states (Marian & Neisser, 2000). Context also includes spatial (Godden, 1975) and temporal (Power & Schulkin, 2008) information. Therefore, information contained in schema has the potential to be a basis for prediction.

Different types of predictions have been identified. On the one hand, there are predictions about what is perceived (Gregory, 1997) or about what an object is (Anderson, 1991), i.e. likelihood. On the other hand, predictions about what will be (Walton, Woolrich, Rushworth, & Behrens, 2007), i.e. prior. Templates and context provide a potential mechanism for the two types of prediction required by statistical models, likelihood and prior, respectively.

Likelihood and Prior: The Two Components of Predictions

Likelihood: the sensory prediction. According to statistical models, perception is the result of an attempt to predict sensory inputs' effect in the brain. This process involves uncertainty. Indeed, an object is never processed twice the same way. Lighting, positioning, and other contextual details differ from one perception to the next. It follows that the brain's attempts to determine the cause of its sensory activation is based on incomplete information. This corresponds to likelihood.

A possible mechanism through which templates are created and updated is that of perceptual learning. Perceptual learning is an enhancement of sensory discrimination ability gained through experience (Gold & Watanabe, 2010). That is, the more a person perceives multiple stimuli, the better that person is in discriminating between them. For instance, in an experiment aiming at showing the fusiform face area's involvement in expertise, participants were trained to discriminate between greebles (bird-shaped objects). Though discrimination was originally poor, it became very accurate with training (Gore, Gauthier, Anderson, Skudlarski, & Tarr, 1999). An experiment by Kurki and Eckstein (2014) demonstrated that original exposure to a visual stimulus was associated with the creation of a template composed mainly of the peripheral features, that is, the contour of the object. This is the bare minimum that permits rec-

ognition of an object. With more exposure, participants included information that was less informative in terms of basic recognition but richer in details. As a result, their discrimination abilities increased.

Through perceptual learning, individuals create detailed templates of various objects. Pattern completion represents a potential candidate in explaining how templates are used by the brain to form predictions based on partial sensory input information. Pattern completion is the process by which the brain reconstructs complete representation based on partial cues from the environment (Wilson, 2009). Once a potential cause of brain activation has been determined through pattern completion process, this reconstructed object can be used as a prediction and compared to the partial evidence that is the sensory inputs that triggered this process in the first place. The prediction error, the gap between prediction and sensory input, will then update object representation in schema for enhanced future ability to identify the object.

Pattern completion is consistent with the organization of knowledge through schema. The schema of an object contains its prototypical features in the object's template. Neuronal activation of partial cues can trigger extraction of a full representation based on templates. This is consistent with a recent experiment by Bar et al. (2006) in which they found visual low spatial frequency is processed faster than high spatial frequency and activates higher order areas. They suggest this primacy in activation allows higher cortical areas to make a prediction about visual stimuli based on partial information provided by low spatial frequency. The prediction is then sent back to lower cortical areas to be compared to the incoming high-spatial frequency to generate prediction error if required.

Similar processes are believed to allow for complex scenes recognition. Objects often present concomitantly in a scene form the base of that scene schema. Perception of these objects together will therefore trigger the scene schema. This is consistent with studies that have found evidence that scenes recognition is based on superficial categorization of objects and determination of which schema most likely fits the perceived objects (Friedman, 1979; Oliva & Torralba, 2001). In sum, likelihood may imply the creation of schema through repeated exposure to stimuli, which enhances expertise in processing for more efficient pattern completion. Schema can therefore facilitate recognition based on partial sensory evidence, i.e. likelihood.

Prior: the higher-order predictions. Pattern completion allows for the brain to directly explain sensory inputs. Context is another way the brain may use its stored knowledge to make predictions. In that case, it is to determine the prior, that is, what object is the most likely to explain the cause of the brain's effects regardless of the actual sensory input. A recent study provided evidence that predictions activate templates about the expected visual stimulus in the primary visual cortex (Kok, Failing, & de Lange, 2014).

Contextual information in schema can narrow down the potential causal explanation for the effect of sensory inputs on the brain. It helps the brain predict what will be perceived based on what was associated in the past with the currently experienced context. This contrasts with sensory predictions which attempt to determine what is perceived based on current neuronal activation in sensory areas. Higher-order predictions anticipate what sensory neurons will be activated, i.e. what object(s) will be perceived next, based on what is currently perceived.

In summary, schema offer a view of how prior knowledge is created and updated consistent with statistical models of cognition. Upon initial exposure to a stimulus, there exists no template for that given stimulus, i.e. there is no prior nor likelihood to support a prediction. Therefore, everything that is processed about that stimulus is prediction error. All this prediction error will form the basis of that stimulus's schema which will be used from that point on as prior for prediction. Schema result from features bound together into objects, and objects bound into scenes, forming templates and context. As such, schema are potential neural correlates for likelihood, in the form of sensory predictions, as well as prior, in the form of higher-order predictions, respectively. Update of templates or context through prediction error improves likelihood and prior efficiency for future predictions to be more accurate. Schema are therefore a conceivable source of information for the brain to compute a prediction in order to infer the cause

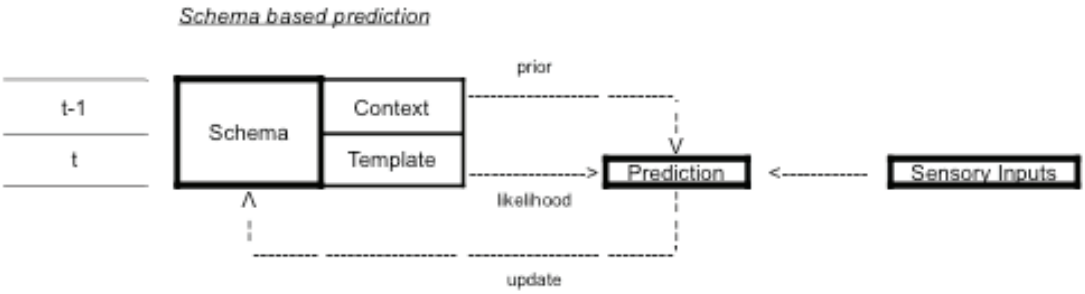

Figure 1. Schemas are composed of context and template. Context makes a prediction about what stimuli is going to be perceived before it reaches the senses. Template makes a prediction about what a stimuli is based on the effects it causes in the brain. Prediction error, the difference between prediction and perception, update schema for better future predictions.

of sensory inputs' effect on the brain (see figure 1 for a visual representation of schema based prediction).

Update Processes

Statistical models intimate that prediction errors automatically and immediately update predictions. The literature on memory suggests, however, that which sensory inputs becomes part of a schema, i.e. update prior knowledge, is selective and not necessarily immediate.

Two Levels of Perception

There are two stages of perception: unconscious and conscious. Unconscious perception is the process by which the brain determines the identity of an object based on sensory inputs (Keizer, Hommel, & Lamme, 2014). Evidence supporting that perception can occur below consciousness level include the cocktail party effect in which participants' attention is drawn to their name spoken in a conversation they did not pay attention (Wood & Cowan, 1995). Another example is those of patients suffering from visuospatial neglect – a neuronal based deficit in which patients ignore one side of their visual field, in most cases the right side (Halligan & Marshall, 1998). Shown consecutively two houses, one of which being on fire in the neglected side of their visual field, patients systematically preferred the non-burning house even though they affirmed that both houses are identical (Halligan & Marshall, 1988).

Conscious perception corresponds to creating meaning out of sensory stimulation at the conscious level, i.e. awareness. The decision as to what stimuli are worthy of being consciously processed happens therefore below consciousness. Nevertheless, only stimuli that are consciously perceived can potentially become part of the stored knowledge. Evidence from that claim comes from inattentional blindness. In the classic "gorilla experiment", a number of subjects failed to notice the dancing gorilla among the basketball players as their attention was focused on the ball being passed around (Most et al., 2001). They are therefore unable to remember it later on when asked if they noticed something unusual.

Selectivity: 3 Types of Attention

The brain constantly perceives stimuli, only a fraction of which are consciously being processed to become potential candidates for updating schema. Therefore, not all perceived stimuli will update predictions. Selectivity of attention suggests that update processes are not automatic as some stimuli have preferential aptitude in influencing the content of schema. The question of which stimuli are being selected for further attentional processing has been investigated by Gottlieb (2012). She suggests that humans have three types of attention: attention for action, attention for liking, and attention for learning, each biasing attention toward different types of stimuli.

The first is attention for action. It is the type of attention required for monitoring different steps of a complex task. For instance, baking requires knowing

which stimuli to pay attention to during each step, such as what to look at when mixing the ingredients, the type of taste indicating the mixing of ingredients is well-done or what types of odors inform the end-product is well-cooked.

The second type of attention is attention for liking. It directs attention towards stimuli that possess a strong rewarding component. In other words, attention for liking is biased toward stimuli that have a history of positive emotional or conditional association (Anderson, 2014).

Finally, there is attention for learning. It consists in attention being biased toward new (Brockmole & Henderson, 2005) or inconsistent (Loftus & Mackworth, 1978; Itti & Baldi, 2009) stimuli in the environment in order to reduce uncertainty. It is suggested that attention for learning may be the basis for curiosity-like behavior and rely on the brain rewarding such novelty processing activities.

The distinction between these three types of stimulus selection is supported by the fact they are thought to rely on different neural substrates. Though unclear in attention for liking, studies with rats suggest attention for action relies on the medial temporal cortex (Maddux & Holland, 2011) and attention for learning on the substantia nigra and amygdala (Maddux, Kerfoot, Chatterjee, & Holland, 2007).

Consolidation of Certain Memory is Sleep-Dependent

Going through the selection process is not the only requirement in order for a stimulus to update a prediction. Indeed, not all memory that made it to the conscious perception stage will become long-term memory. Priming provides a good illustration for this claim. Though items are processed at the conscious perceptual level, not all of the words are later successfully recalled during a stem-completion task (Graf & Mandler, 1984).

Lasting updates of prediction also appear to be influenced by time-dependent factors. Recent studies put forward the idea that the process of memory consolidation depends on the distance between the neuronal circuits that compose it (Breton & Robertson, 2014). Consolidation of proximal circuits may occur during wakefulness. Conversely, consolidation of more distal circuits would require sleep. The reasoning behind this argument is that distal areas' consolidation requires slow brainwave activities, which occur during a certain section of the sleep cycle (NREM sleep) whereas local circuits' consolidation relies on low-frequency oscillations which are typical of wakefulness states (Robertson, 2009).

Consistent with these ideas, Stickgold and Walker (2013) proposed that sleep is responsible for selecting which memory will be preserved. They also propose sleep as a mechanism for creating and updating schema. For instance, participants who had a night sleep between practice and test were better at predicting the order of presentation of tones whose sequences was probabilistically determined than participants who remained awake for an equivalent period of time (Durrant, Taylor, Cairney & Lewis, 2011).

Despite what is intimated in statistical models, the road from prediction error to the update of a schemata is not all inclusive but on the contrary a selective process (see figure 2 for a visual representation). Also, update processes are not automatic, as not everything that is perceived necessarily updates predictions. Indeed, as attention is selective, only a fraction of what is being perceived is actually attended to and have the potential to update prediction. In addition, update processes appear to be sleep-dependent, and therefore are

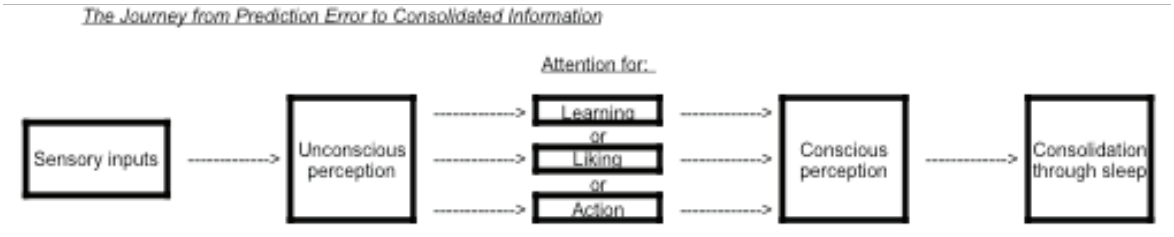

Figure 2. Stimuli first reach the sensory senses. After prediction processes, identity of the stimuli is established below consciousness level. Depending on the valence of the stimuli, it will or will not be transferred to conscious perception. Once a stimuli has reached conscious level of perception, sleep will determine whether it is worthy to update schema.

not instantaneous.

Concluding Remarks: Cognitive Literature Vs. Statistical Models

Statistical models are consistent with a schematic organization of knowledge. Once features are bound together, and associated with the context in which the binding processes occurred, they form schema for those stimuli. Schema are composed of two elements. Templates form the basis of sensory predictions, i.e. likelihood. Context form the basis for higher-order predictions, i.e. prior.

Though failing to provide any specific details about how prior knowledge is created and updated, statistical models intimate prediction error updates priors in an automatic and instantaneous fashion. This contradicts the evidence put together over the years in the cognitive literature.

Long-term update of prior-knowledge relies on a selective process. In order for prediction error to be able to update a schema, it must succeed in getting through various stages: being selected to enter into conscious perception and then for sleep-dependent consolidation processes. Therefore, update processes are not automatic.

Furthermore, the evidence is not consistent with an immediate update of prediction. Statistical models leave the impression that update processes are immediate so that future predictions are instantaneously ready to minimize prediction error. Schema updates however indicate that these processes may require sleep for maximal efficiency.

Statistical models are a very effective framework with which to consider top-down activity. However, in order to gain more applicability and contribute more efficiently to advance knowledge in cognitive understanding, statistical models ought to be more in line with behavioral and biological evidence.

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HEALTH
Research Paper

The Positive Association Between Extrafamilial Prosocial Spending and Cardiovascular Health in Older Adults

Haiyun Liang[1], Ashley V. Whillans[2]
[1]Department of Psychology, University of British Columbia

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Abstract

Spending money on others can reduce blood pressure (BP) in older adults (Whillans, Dunn, Sandstrom, Dickerson, & Madden, 2016), but would this effect last as long as they continue to spend prosocially? The current study explored the idea that the BP-reducing effect of prosocial spending decreases over time (adapts physiologically) as behaviour becomes normalized due to repeated actions. Since spending money on family is a practice that is likely to be normalized by the time one reaches old age, we compared post-spending systolic BP (SBP) and diastolic BP (DBP) between 64 participants aged 65 or above who did not spend on immediate family and those who did spend on immediate family in a weekly spending task repeated for three consecutive weeks. Results showed a significantly lower post-spending SBP in non-family spenders, but no significant difference in post-spending DBP was found between groups due to the low modifiability of DBP relative to SBP. The findings suggest that the BP-reducing effect of prosocial behaviour weakens over time due to physiological adaptation and that novelty may be the key to maintaining the BP-reducing effect of prosocial spending. This contributes to the understanding of how prosocial behavioural strategies may be optimized for BP control, which is increasingly crucial in an aging Canadian population that faces the threat of a higher prevalence of age-related health concerns like hypertension and the associated increase in risk for cardiovascular diseases.

Keywords: prosocial behaviour, cardiovascular health, hypertension, blood pressure (BP), money, aging

Spending money on others can improve cardiovascular health in older adults (Whillans et al., 2016). However, is the target of spending associated with the amount of cardiovascular health benefits that such prosocial behaviour has on the spender? This is one of the novel questions that arose out of the growing interest in health benefits of prosocial behaviours over the past decade. While some people choose to spend money on family, others may spend on strangers by donating to charitable organizations, but the difference in potential benefits remains unclear. The present study seeks to explore this novel topic using correlational methods.

Past research on prosocial behaviours showed that providing social support in the form of housework, child care, errand running for friends and relatives (Poulin, Brown, Dillard, & Smith, 2013), caregiving to ailing loved ones (Brown et al., 2009; Roth et al., 2013), and volunteering (Morrow-Howell, Hinterlong,

UBC Ψ UJP

Corresponding Author:
Haiyun Liang
haiyun.liang94@gmail.com

Rozario, & Tang, 2003; Thoits & Hewitt, 2001) was associated with reduced mortality risk and better overall health. These studies suggested that socially supportive behaviours might have an effect on health. This possibility was verified by Schreier, Schonert-Reichl, and Chen (2013), who found that adolescents' participation in volunteer work led to a reduction of risk level in potential contributing factors to future cardiovascular abnormalities, such as the lowering of cholesterol level and interleukin-6 level.

All of these results lend support to a recent study by Whillans et al. (2016), who were the first to experimentally demonstrate the positive causal effects of prosocial spending—namely, spending money on others—on health, specifically cardiovascular health as measured by physiological indicators. The study found that prosocial spending improved cardiovascular health in older adults aged 65 or above by lowering blood pressure (BP) in a magnitude comparable to that of antihypertensive medication and exercise.

However, such health benefits are likely not permanent due to the relationship between happiness and physical health. According to research on hedonic adaptation, the impact of positive and negative changes in lifestyle is transitory; people adapt to a constant or repeated stimulus over time and return to an inherent level of neutrality in subjective well-being (Diener, Lucaz, & Scollon, 2006). This hedonic treadmill model is often used to explain the relatively stable level of happiness each individual experiences, and such subjective well-being was found to be directly related to physical and physiological health, as measured by the extent to which diagnosed health problems like hypertension, diabetes, and rheumatism interfered with daily activities (Christie-Mizell, Ida, & Keith, 2010). Thus, it is reasonable to believe that a similar pattern of adaptation can be seen in objective physiological health measures such as BP. A study by Dunn, Aknin, and Norton (2008) demonstrated a significant increase in self-reported happiness of working adults following prosocial spending tasks; adaptation to physiological health effects can thereby result from the proven influence of happiness on bodily health (Veenhoven, 2008). This prompted a deeper look into whether the health effects of prosocial behaviour are truly susceptible to physiological adaptation, which is in this case defined as the attenuation of BP reduction when prosocial spending behaviour becomes normalized—that is, it loses its novelty and becomes a typical act in life when one repeatedly spends on similar targets.

Another reason for our interest in this topic is its practical importance. Being a major risk factor for cardiovascular diseases that affect more than 1 billion individuals worldwide, elevated BP is certainly a crucial health issue (Chobanian et al, 2003). This is especially the case for older adults, as even individuals who are normotensive at 55 years of age have a 90% residual lifetime risk for developing hypertension, and the risk presumably increases with age because the number of hypertensive individuals increases with age (Vasan et al., 2002). Unfortunately, despite the proven amenability of elevated BP to prosocial behaviour (Whillans et al., 2016), an incomplete understanding of how BP may be modified can preclude the maximization of an intervention's effectiveness. In other words, it is important to understand whether physiological adaptation occurs in BP modification via prosocial behaviour before prosocial strategies can be advocated as a complement to pharmacological management.

Despite academic interest and the real-life implication of this topic, however, there is a dearth of research looking at physiological adaptation to prosocial behaviour. Preliminary evidence for the adaptation of BP changes to prosocial spending was offered by Whillans et al.'s study (2016), which reported an attenuation of reduction in systolic blood pressure (SBP) and diastolic blood pressure (DBP) within the prosocial-spending group for the last of the three spending intervals in a six-week study. To determine whether a weaker BP-lowering effect of prosocial spending could be related to behavioural normalization, we compared BP levels between intra-familial spenders and extra-familial spenders. This is because financial expenses on people with whom the spenders have a close relationship are more likely to be prioritized over financial giving to unfamiliar others, making the former group more prone to any physiological adaptation that may occur.

Based on the hedonic treadmill model and the preliminary evidence offered by Whillans et al. (2016), we hypothesized that spending money on people outside the immediate family would be associated with

lower post-spending SBP and DBP levels in older adults. We predicted such because spending money on immediate family is likely to have become normalized in older adults (such as through buying clothes or paying tuition for their own children) and its health effects could thus be attenuated due to chronicity of the practice by the time one reaches old age. This would lend support to the idea that repeatedly spending on the same target induces physiological adaption to the BP-reducing effect of prosocial spending, and that spending on novel targets can help maintain the cardiovascular health benefits.

On the other hand, a failure to support the hypothesis might suggest a non-existence of physiological adaptation in prosocial spending. Alternatively, non-significant results could arise because this study was fairly complex and required a relatively healthy sample to meet its demands; if a large number of participants in the prosocial-spending group did not have prehypertension (above 120/80 mm of Hg) or hypertension (above 140/90 mm of Hg; Chobanian et al., 2003), the capability for BP reduction could be limited due to the body's homeostatic processes. The ultimate goal of the present study was to determine whether prosocial spending target would be related to BP levels, thus providing insight into whether physiological adaptation could occur depending on the degree of normalization of target-specific prosocial behaviour.

Methods

Participants

Sixty-four adults aged 65 or older (M = 70.91, SD = 4.19) were randomly assigned to the prosocial-spending condition of the study after responding to advertisements posted in community centres, newspapers, hospitals, and shopping malls within the Greater Vancouver area and being determined as eligible for the study. This group included 16 males and 48 females. The majority of the participants were Caucasian (82.80% Caucasian, 4.69% East Asian, 3.13% Southeast Asian, 1.56% Middle Eastern, 3.13% Aboriginal, and 4.69% other or mixed), and over half of them had normal BP at the beginning of the study (62.50% normotensive; 32.81% prehypertensive, and 4.69% hypertensive), in line with the classification of BP levels by Chobanian et al. (2003) for adults aged 18 years or older.

To determine eligibility prior to the first lab visit, potential participants underwent phone screening, during which they provided information on demographics and health. To meet the inclusion criteria, participants must: (1) be aged 65 years or older; (2) be able to communicate verbally and in writing using English; (3) be able to shop independently; (4) have no memory deficit that requires medical attention; (5) be free of past and present neurological or psychiatric disorders; (6) be unaware of the identity of other participants; (7) have not started taking new prescription medication in the last three months; and (8) have not started a new exercise program in the last three months. These criteria were determined to ensure participants were mentally and physically able to complete tasks as requested (Criteria 2-5) and to eliminate factors that could compromise the integrity of the study (Criteria 6-8).

The study design was approved by the Behavioural Research Ethics Board at the University of British Columbia. Participants provided written consent after reviewing study procedures. In return, in addition to three separate payments of $40 that participants spent as part of the experiment, they each received $10 reimbursement for travel expenses after each lab visit and a personalized health report constructed using experimental data at the end of the study.

Equipment and Questionnaires

At each lab visit, research assistants used the BP monitor BpTRU (Model BPM-100, VSM MedTech, Canada) to measure SBP, DBP, and heart rate. To ensure the accuracy of the readings, participants sat in an armchair with arms placed on each armrest at heart level and legs planted firmly on the floor. With the appropriately sized BP cuff strapped onto their non-dominant arm, participants relaxed while remaining seated in the armchair for the duration of the measurement. BpTru automatically rejected the first of the six readings to account for the time it took for each individual to adjust to the procedure. The average BP and heart rate levels calculated by BpTru were recorded from the second to sixth measurements. The use of BpTRU in the aforementioned procedure is validated as a standard BP measurement paradigm by the U.S. Association for the Advancement of

Medical Instrumentation (Zorn, Wilson, Angel, Zanella, & Alpert, 1997).

In the follow-up phone call that participants received after each spending task, research assistants asked them about their spending experiences, including who they spent the payment on, what they purchased, the cost of each item if multiple purchases were made, and their level of familiarity with the spending target. In addition, research assistants conducted weekly assessments of participants' affective states either during lab visit or over the phone by administering the Positive Affect and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988). The questionnaire consisted of a 10-item mood scale on positive affect and a 10-item mood scale on negative affect. Participants rated the extent to which they felt each emotion on a scale of 1 (very slightly or not at all) to 5 (extremely) on ten positive items such as "excited" and "enthusiastic," as well as ten negative items such as "distressed" and "hostile." We used PANAS as a potential measure for determining whether affect could play a role in facilitating physiological changes associated with prosocial spending.

Procedures

This study employed a paradigm previously developed by Dunn et al. (2008) to assess the causal benefits of prosocial spending. The study spanned six weeks. Participants travelled to the University of British Columbia in Week 1, Week 4, and Week 6 for an individual lab visit. During each visit, a research assistant collected physical health measures such as BP, waist-to-hip ratio (WHR), and body mass index (BMI). However, the research assistant was not present in the room with the participant while BP measurements were taken, as previous research had shown that the presence of personnel could result in elevated BP readings (Mancia et al., 1983). The PANAS questionnaire was only completed in writing during the first lab visit. All subsequent questionnaires were completed over the phone.

All participants received three payments of $40 to spend (one per week in Weeks 3, 4, and 5). At the beginning of the study, research assistants randomly assigned them to spend the payments exclusively on themselves (self-spending control condition) or on others (prosocial-spending experimental condition), though the condition of interest in this paper is the latter. Participants then received a phone call at night on the date of their spending to report their spending experience and affective states (PANAS). Note that during Week 2, there was no lab visit or spending task, so research assistants only administered the PANAS questionnaire over the phone. In this manner, we established baseline measures in the first lab visit, examined health effects of spending two payments in the second lab visit, and took final health measurements in the third.

After the experiment, we sub-divided participants from the prosocial-spending condition into those who spent at least one payment on immediate family members and those who never did. Immediate family was defined as a participant's spouse, child, parent, guardian, sibling, grandchild, grandparent, or anyone who lives with the participant as a member of the family (Employment Standards Act, 1996). This post-hoc division yielded 32 participants in the family condition and 32 in the non-family condition for our analysis.

Results

Our results showed that, with all measured demographic, physical, and medical factors being equal between groups, participants who only spent outside of their immediate family had a significantly lower SBP than those who spent money on their immediate family. On the other hand, the differences in DBP, positive affect, and negative affect between the two groups were not significant.

One-way analyses of covariance (ANCOVAs) were conducted at $\alpha = 0.05$ to examine the differences in post-spending SBP and DBP between spending money on immediate family and not doing so, controlling for the pre-spending (Week 1 baseline) SBP and DBP, respectively. The post-spending BP data at Week 6 were missing for one participant due to equipment malfunction, so the Week 4 BP data were used in analysis instead and only data from the two spending tasks that took place up to Week 4 were taken into account. This was not expected to compromise the integrity of analysis, as the current study did not intend to examine the effect of the number of payments spent on a certain target. Anal-

ysis showed that participants who spent money on immediate family had significantly higher post-spending SBP (M = 114.44, SD = 11.78) compared to participants who only spent outside of their immediate family (M = 108.50, SD = 11.70) [$F(1, 61) = 6.38$, $p = 0.01$; Figure 1], but the difference in post-spending DBP between family spenders (M = 67.56, SD = 7.11) and non-family spenders (M = 65.84, SD = 7.93) was not significant [$F(1, 61) = 1.48$, $p = 0.23$; Figure 2].

To ensure that potential confounds had no influence on the results, the chi-square test (for categorical variables) and the independent-samples t-test (for continuous variables) were performed at $\alpha = 0.05$ to make comparisons between groups on sociodemographic factors, work and volunteer hours, physical factors (BMI and WHR), and anti-hypertensive medication status as reported at the beginning of the study and any medication changes throughout the study. Analyses showed no significant difference in any of the given measures between individuals who spent money on immediate family and those who did not (Table 1).

To further explore whether differences in affect could explain the physiological benefits of spending outside of immediate family, one-way ANCOVAs were conducted at $\alpha = 0.05$ to analyze the difference in mean PANAS scores for post-spending positive and negative affect between groups, controlling for pre-spending positive and negative affect, respectively. The test showed no significant difference in positive affect (family: M = 3.44, SD = 0.86; non-family: M = 3.34, SD = 0.69) [$F(1, 59) = 0.01$, $p = 0.92$] and negative affect (family: M = 1.13, SD = 0.35; non-family: M = 1.20, SD = 0.34) [$F(1, 59) = 0.40$, $p = 0.53$]. Analyses were based on 62 participants due to missing data from two participants.

Discussion

The present study found that, relative to spending money on immediate family, spending money outside of immediate family was associated with better cardiovascular health in terms of SBP for adults aged 65 or older. To our surprise, this only lent partial support to the hypothesis that non-family spending would be associated with better cardiovascular health overall as measured

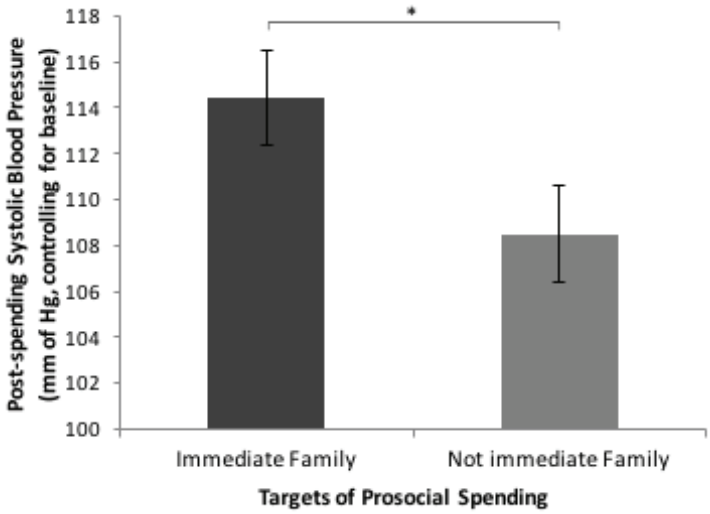

Figure 1. The differences in post-spending systolic blood pressure (SBP) between participants who spent money on immediate family (n = 32) and participants who did not (n = 32), controlling for pre-spending SBP. Data are presented as mean blood pressure level (mm of Hg). Error bars represent standard errors of the mean. Asterisk (*) indicates significant difference between groups ($p < 0.05$).

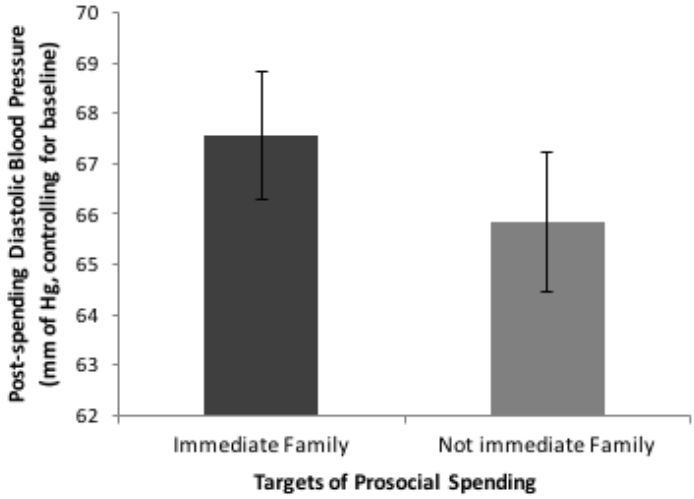

Figure 2. The differences in post-spending diastolic blood pressure (DBP) between participants who spent money on immediate family (n = 32) and participants who did not (n = 32), controlling for pre-spending DBP. Data are presented as mean blood pressure level (mm of Hg). Error bars represent standard errors of the mean. Asterisk (*) indicates significant difference between groups ($p < 0.05$).

Table 1. Comparison of participant characteristics between groups.

Variable (Unit)	n	Mean ± SD	X^2	t	p
Female (%)					
Family	32	78.13%	0.33	–	0.56
Non-family	32	71.88%			
Age (years)					
Family	31	71.87 ± 4.30	–	1.84	0.07
Non-family	31	69.95 ± 3.91			
Caucasian (%)					
Family	32	81.25%	0.47	–	0.49
Non-family	32	87.50%			
Post-secondary education (%)					
Family	32	34.38%	0.67	–	0.41
Non-family	32	25.00%			
Married (%)					
Family	32	37.50%	0.64	–	0.42
Non-family	32	28.13%			
Experiencing financial difficulty (%)					
Family	19	10.53%	0.33	–	0.56
Non-family	24	16.67%			
Paid work per week (hours)					
Family	31	0.97 ± 3.41	–	-1.58	0.12
Non-family	32	3.50 ± 8.37			
Volunteer work per week (hours)					
Family	32	5.84 ± 7.63	–	0.70	0.49
Non-family	31	4.66 ± 5.68			
BMI at Lab Visit 1					
Family	32	17.16 ± 10.76	–	-1.54	0.13
Non-family	32	21.11 ± 9.73			
WHR at Lab Visit 1					
Family	32	0.88 ± 0.11	–	1.28	0.21
Non-family	32	0.85 ± 0.11			
Taking anti-hypertensive medication (%)					
Family	32	37.50%	0.07	–	0.79
Non-family	32	34.38%			
Change in medication during study (%)					
Family	32	9.38%	1.07	–	0.30
Non-family	32	3.13%			

Note. The chi-square test and independent-samples t-test are used for categorical and continuous variables, respectively. For categorical data, percentage is presented instead of mean ± SD.

by both SBP and DBP levels, since the spending target showed no association with the DBP levels.

No other research has yet examined how the target of prosocial behaviour may be associated with BP, or any other aspects of health for that matter. Instead, past research results hinted at the transitory nature of the BP-reducing effect of prosocial spending. Specifically, Whillans et al. (2016) found that spending money on others reduced SBP and DBP compared to spending on self, but no further reduction in SBP and DBP could be elicited after three repeated spending tasks in the prosocial spending condition. The explanation for the weakening of the BP-reducing effect proposed by the researchers was the normalization of the prosocial-spending task. For instance, the task could become more ordinary, less meaningful, and thus less rewarding if spending was made on consistent targets, making the spending target a key potential contributing factor. This is reflected in the present findings, in which we see lower post-spending SBP for immediate family, a group of targets that adults tend to have consistently spent on by the time they reach older ages. What is important to note, however, is that both SBP and DBP were significantly affected in Whillans et al.'s study (2016), whereas in the present study we did not see differences in post-spending DBP based on spending targets. This is likely because SBP is a stronger indicator of physiological changes than DBP, considering that the former is more easily altered than the latter (Griffin, 2012). In other words, the magnitude of differences between groups in factors affecting BP might not have been large enough in this study to produce a significant difference in DBP. The difference between family spenders and non-family spenders in the level of normalization of the prosocial spending practice might be reduced if non-family spenders spent money on friends whom they considered to be as close as family. This reduced difference of normalization between groups might be enough to evoke a between-group difference in the more modifiable SBP but not in the more stable DBP.

Regardless, the overall results provide the first suggestive evidence for the existence of physiological adaptation to (namely, the weakening of) the BP-reducing effects of prosocial spending. Although the correlational nature of the study cannot confer validity to any causal inference, it does suggest the possibility that spending money outside of immediate family lowers BP more than spending within it. This is because spending on family is a practice that has become normalized in older adults due to the chronicity of activities, such as paying tuition fees, buying clothes and toys, and purchasing holiday gifts for their children. This results in physiological adaptation, in which spending on family becomes unable to elicit the same amount of BP benefits as spending activities performed for the sake of non-family members. This possibility is enhanced given that our statistical analysis controlled for pre-spending BP levels, thereby isolating any group differences to the post-spending time point.

If the normalization of within-family spending does reduce the benefits of prosocial spending on BP, what facilitates this physiological adaptation? Though previously theorized to be mediated by the influence of happiness on bodily health (Barak, 2006; Veenhoven, 2008), the physiological benefits of non-family spending did not appear to be related to happiness in this study, since we found no significant difference in post-spending positive and negative affect between family spenders and non-family spenders. Indeed, prosocial spending lacks influence on affect in older adults because their affect fluctuates less than that of younger adults (Cheung, 2014; Röcke, Li, & Smith, 2009). Therefore, it is unlikely that a decrease in the enhancement of happiness by prosocial spending could manifest itself physiologically by causing a concurrent weakening of the BP-reducing effect.

Instead, the health benefits of prosocial spending may be related to agency, which is a sense of confidence, self-efficacy, and autonomy. According to past research, prosocial behaviour increases self-confidence in young volunteers (Hamilton & Fenzel, 1988) and is positively correlated with self-efficacy in middle-aged and senior volunteers (Ohmer, 2007). A well-established sense of agency in turn accounts for better health status (Grembowski et al., 1993; Moore & Fletcher, 2012), possibly because self-efficacious and autonomous individuals exercise more control over their own health (Strecher, DeVellis, Becker, & Rosenstock, 1986). All things considered, the health effects of prosocial spending are most likely resulted from the enhancement of the spender's

sense of agency as opposed to happiness. This is especially the case for spending on novel targets, because extending a helping hand to someone whom one would probably never help before (non-family spending) is much more psychologically rewarding than limiting aid to usual targets (within-family spending). A decrease in the novelty of prosocial spending target can therefore reduce the amount of agentic enhancement, thereby limiting the amount of BP benefits that the prosocial act could yield.

An alternative explanation for the difference in SBP between non-family spenders and family spenders is the rewarding effect of intrinsic motivation (originating within the person) versus extrinsic motivation (originating beyond the person). Because participants were divided a posteriori into family and non-family spending groups, they decided on their spending targets based on their own judgment. People who chose to spend money on their family might have done so out of the social responsibility to take care of their own (extrinsic motivation), whereas those who chose to spend money on less familiar targets or even complete strangers might have done so in order to gain a sense of accomplishment and altruism (intrinsic motivation). The former merely avoided the psychological punishment of not fulfilling a social responsibility while the latter actually provided psychological enhancement, and psychological phenomena are reflected in physiological events (Cacioppo & Tassinary, 1990). Therefore, it is plausible that non-family spending could yield more physiological health benefits. That being said, though motivation may indeed account for some of the BP difference between groups, it cannot discount the possible involvement of physiological adaptation. After all, the former fails to explain why blood pressure reduction induced by prosocial spending levelled off only after a maximal effect was reached in Whillans et al.'s study (2016)—it should have had equal influence on BP in all trials if the difference in motivation was present before the spending tasks. Thus, the aforementioned loss of novelty in agency enhancement could still be a principal cause of physiological adaptation (affecting the end result of BP-reduction overtime), while the conceptualization of motivation could exert a persistent effect (affecting BP-reduction throughout).

However, this study is not free of limitations. A major limitation is that participants had to be fairly healthy in order to travel to and from the lab and to personally carry out the spending tasks. In fact, over 60% of the participants were normotensive. Normotensive individuals naturally exhibit lower BP modifiability than hypertensive individuals due to the body's homeostatic control of arterial pressure. If an individual's BP is already at a normal level, further reduction of BP would only pose a threat to health, as seen in a study that reported periodic hypotension to be a predictor of higher mortality in hospitalized patients (Marchick, Kline, & Jones, 2009). Therefore, any BP changes that could result from prosocial spending and the normalization of the behaviour might not be as salient in this study as it would have been if it was conducted with hypertensive individuals. This also helps to explain why no difference between groups could be detected in DBP. The saliency of change in DBP was probably too low to reveal any significant difference. Future studies may focus on individuals with prehypertension and hypertension. This is encouraged not only based on the aforementioned theoretical standpoint, but a practical standpoint as well. After all, prehypertensive and hypertensive individuals are the intended beneficiaries of research on BP modification.

In addition, this study only provided suggestive evidence for physiological adaptation. Future studies should utilize an experimental design to investigate the causal relationship between prosocial spending target and BP changes. By randomly assigning participants to either spend money on the same target over many trials or spend money on an unfamiliar target each trial, researchers can confirm the occurrence of physiological adaptation. The same paradigm may also be used to test whether results will extend to other prosocial behaviours, such as volunteering.

Despite these limitations, this study contributes to the improvement of behavioural strategies in BP modification. The results of this study suggest that physiological adaptation caused by the normalization of financial generosity towards similar targets weakens the BP-reducing effect of prosocial spending over time. Therefore, increasing the novelty of prosocial spending, such as by spending money on novel targets or for

purchases of novel items or services, can maximize its BP-reducing effect. This is particularly important in an aging population. At least one out of five people in Canada are currently 60 years of age or older (United Nations Department of Economic and Social Affairs, 2013), and this number is expected to grow as more baby-boomers enter their senior years (Christensen, Doblhammer, Rau, & Vaupel, 2009). With that, age-related illness such as cardiovascular diseases will become more prevalent. Since elevated BP is a major but modifiable risk factor for cardiovascular diseases (World Heart Federation, n.d.), prosocial behavioural strategies designed with a deeper understanding of treatment-interfering factors in mind will play an important role in health maintenance.

On the whole, by showing that adults aged 65 or older who limited prosocial spending to outside of immediate family had significantly lower post-spending SBP than those who spent on immediate family, we provided the first suggestive evidence for the theory that physiological adaptation occurs in response to the gradual reduction in the agency-enhancing effect of prosocial spending behaviour as the behaviour becomes normalized over time. This also propounds novelty as a key component in maintaining the BP-reducing benefit of prosocial spending, thus maximizing the effectiveness of such prosocial behavioural strategy in controlling blood pressure.

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

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SOCIAL
Research Paper

Overcoming Barriers to Buying Happier Time

Marisa Gagne[1], Ashley Whillans[2]
[1]University of British Columbia
[2]University of British Columbia

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Abstract
Research has shown that people often fail to use their money in ways that will improve their happiness. One demonstrated method of increasing happiness is outsourcing disliked tasks (paying someone else to complete tasks for you). However, research has also demonstrated that when making the decisions to outsource, people fail to consider opportunity costs (Frederick, Novemsky, Wang, Dhar, & Nowlis, 2009). Specifically, this means that individuals fail to consider what else they could do with their time if they choose to outsource the tasks. The present research investigates how to remove this barrier by reminding participants of other things they could do with their time when making outsourcing decisions. Adults were presented with a hypothetical scenario and reported whether or not they would choose to outsource in the assigned situation. When making the outsourcing decision, participants were either reminded of other opportunities for their time or given no reminders. Results indicated that when women, but not men, were reminded of other opportunities, they were more likely to outsource, particularly when they were reminded that they could spend their time doing "something else". These findings indicate oursourcing as a possible way to improve one's happiness.

Keywords: time, money, outsourcing, happiness, well-being, spending

The pursuit of happiness is a widely researched concept, particularly the methods through which one can achieve greater happiness. There are many different strategies that can be adopted in this pursuit. Research findings on factors that can improve happiness include physical exercise, types of purchases (material vs. experiential), and demographic factors like political conservatism and religiosity (Bixter, 2015; Gilovich, Kumar, & Jampol, 2015; Khazaee-pool, Sadeghi, Majlessi, & Foroushani, 2015). As the world is developing greater interest in promoting happiness, whole countries are striving to make indexes of happiness, to holistically promote health and wellbeing (Ratzan, 2009).

Money and Happiness
Despite this increased interest in investigating how different types of experiences can improve happiness, the idea that money can be used as an avenue to increased happiness is often not considered. In fact, people often fail to perceive money as a means to gain greater happiness (Dunn, Gilbert & Wilson, 2011), despite the fact that money does seem to be able to "buy happiness." For example, when people spend money prosocially, which means spending it on others instead of themselves, it results in greater happiness (Aknin, Dunn, & Norton, 2012; Dunn, Aknin, & Norton, 2014; Geenen, Hohelüchter, Langholf, & Walther, 2014). Interestingly,

UBC Ψ UJP

Corresponding Author:
Marisa Gagne
marisagagne@gmail.com

however, most people underestimate this relationship by assuming that spending money on themselves will boost happiness more than spending money on others (Dunn, Aknin & Norton, 2008). Research has also found that simply thinking about a purchase made for someone else increases happiness, and that the happier people are, the more likely they are to choose to spend money prosocially in the near future (Aknin, Dunn, & Norton, 2012). Together, despite being a surprise to most, these findings show that money can be used as a method to achieve greater happiness.

Time, Money, and Happiness

Prosocial spending and its links to happiness illustrate one method of increasing happiness that people are not usually aware of. Another method of using money to increase happiness that many people overlook is the idea that money can be used as a means to buy time via outsourcing (paying others to complete unwanted tasks). Mogilner (2010) demonstrated that implicitly priming people with the concepts of time, rather than money, motivates them to spend more time with friends and family and less time working, which are two behaviours associated with happiness. These findings suggest that when people focus on time instead of money, they act in ways that lead to greater happiness. Although placing more emphasis on time rather than money is a plausible key to greater happiness, not much research has been conducted to a more affirmative answer this question.

Over half of working parents, both women and men, reported of being stressed about juggling their work and family life, and 48% of fathers and 26% of mothers said they wished they could spend more time with their children (Parker & Wang, 2013). An increasing number of working adults in the United States reportedly felt so overworked, depressed, and exhausted that they were more likely to make mistakes and complete lower-quality work (Bond, Galinksy & Swanberg, 1997). Indeed, keeping up with everyday responsibilities, everything from doing the laundry to maintain a career, can leave people with little time left to spend in ways that make them happy. So, if people are in need of more time, why don't they choose to outsource more often?

Barriers to Outsourcing

When making a decision to outsource their disliked tasks, people may encounter barriers that prevent them from choosing to outsource. In this study, we defined a barrier to outsourcing as any internal or external influence that prevents a person from choosing to outsource. One barrier is that people believe they will have more time in the future than they do in the present (Zauberman & Lynch, 2005). This suggests that people do not plan ahead to outsource their disliked tasks and to thereby buy themselves time, because they undervalue the need for more time in the future. Another barrier is that people may overestimate the cost of outsourcing. Research by Caruso and Shafir (2006) and Wilson, Houston, Etling, & Brekke (1996) has demonstrated that irrelevant thoughts and feelings influence people's decisions, so people may be influenced by the value they place on their own time when considering outsourcing, and estimate outsourcing as more expensive than it is (e.g., people feel that their free time is worth a lot of money, and thus, it must cost a lot of money to outsource).

The barrier to outsourcing that the present research focuses on is that people fail to consider opportunity costs when making decisions (Frederick et al., 2009). In other words, when they consider outsourcing tasks, they do not consider what else they could do with their newly-gained extra time, unless they are provided with a specific reminder about the other ways in which they could spend the time (Whillans & Dunn, 2015). Rather than spending two hours shopping for groceries and doing laundry, one could spend that time on a more enjoyable activity. However, this is what people often fail to consider (Frederick et al., 2009).

In this study, to explore the the effects that reminder of other opportunities for one's time could have on outsourcing decisions, we reminded people of other uses for their time and observed their subsequent outsourcing decisions. To investigate how different types of opportunities could mediate this relationship, we reminded participants of one of three opportunities: "working", "spending time with friends and family", or "doing something else". We hypothesized that reminding participants of any of these opportunities would cause them to decide to outsource more often than par-

ticipants who hadn't been reminded of an opportunity. We also made a secondary prediction that participants would choose to outsource most when reminded that they could spend their time with friends and family.

Methods

Participants

The sample for this study consisted of 296 adults; 42% female, 41% male, and 17% unspecified. Participants ranged in age from 16 to 70 (M = 35.3, SD = 10.8). Their annual household incomes ranged from "less than $5,000" to "between $500,000 and $1 million".

Procedure

Participants were recruited from the Telus World of Science in Vancouver, Canada.

They were randomly assigned to one of four conditions. After reading a scenario about an outsourcing service, participants were asked whether or not they would choose to use this service to outsource two hours of their time. Next, participants were asked whether they had already been outsourcing their disliked tasks in a typical month. Finally, data were collected on relevant demographic characteristics, including income, ethnicity, marital status, and age.

Measures

Opportunity cost manipulation. Participants read a scenario about having a very busy week and hearing an advertisement about a service to outsource disliked tasks such as housecleaning and doing the laundry. The service would cost $40 to outsource two hours of housework. Participants were randomly assigned to one of four conditions, which determined what options they were given to respond to the scenario. In the control condition, the participants could either choose "Do these tasks yourself" or ""Use the outsourcing service". In the three experimental conditions, the response options were modified, with the phrase, "Use the outsourcing service", being followed by one of these statements: "Spend these 2 hours working" for the working condition; "Spend these 2 hours with friends & family" for the friends and family condition; or "Spend these 2 hours doing something else" for the something else condition. For further clarification, see Appendix.

Typical outsourcing. Participants were then asked whether they had been spending money to outsource any of their disliked tasks during a typical month. They indicated their answers by checking the box next to either 'Yes' or 'No'. The purpose of this question was to assess whether participants already outsourced their tasks prior to the survey.

Demographic information. Participants were surveyed on their income, marital status, number of children living with them, average work hours per week, type of work payment, age, and ethnicity.

Participants chose one of 21 categories to indicate their income, ranging from "Less than $5000" to "Over $1 million" and including the options "Don't know" and "Prefer not to answer". Participants indicated their marital status by choosing one of three options ("Yes, I am currently married", "Yes, I am currently in a marriage-like relationship", or "No, I am not currently married or in a marriage-like relationship"). The number of children still living with the participant was indicated by circling one of seven options, ranging from '0' to '6+'. Participants filled in a blank space to indicate how many hours they worked at their main job per week, and chose from three options ("I am paid by the hour", "I receive salaried payment", and "Other") to best describe the nature of their payment. Participants indicated their age by filling in a blank space. To collect information on the ethnicity of participants, they chose one of 10 categories ("First Nation", "African American", "Hispanic", "Caucasian", "Asian/Indian Subcontinent", "East Asian", "Asian (other)", "Middle Eastern", "Multi-racial", and "Other"). Finally, participants indicated the gender with which they most identified by choosing one of three options: "Female", "Male", or "Other".

Results

The relationship between our independent variable (where participants were reminded of they could do with their time) and the dependent variable (choice to outsource), as well as the demographic information, was analyzed using SPSS Version 2.1. To assess the relation-

ship between conditions, we used a one-way analysis of variance, which indicated that there was an overall effect between our control and experimental conditions ($F[1, 241] = 3.03$, $p = .03$; Table 1).

However, we found that women and men were significantly different in their choices to outsource in the "control" and the "something else" conditions ($F[1, 241] = 4.00$, $p = .008$). In the control condition, men outsourced significantly more than women, while in the something else condition women outsourced significantly more than men.

We also found that among female participants, those who were reminded that they could do something else with their time were significantly more likely to choose to outsource their time ($X2\ [3, N= 121] = 17.09$, $p < .001$) than those in the control condition, the working condition, and the friends and family condition. No similar results were observed for male participants in any conditions ($X2\ [3, N=120] = 0.99$, $p = .80$); the males chose to outsource approximately equally across all four conditions.

Discussion

Results indicated that participants were significantly more likely to choose to outsource in the experimental conditions than in the control condition. This supports our primary hypothesis that people choose to outsource more when reminded of other opportunities for the use of their time, which is consistent with past research on opportunity costs (Frederick et al., 2009; Whillans & Dunn, 2015).

However, the significance between the control and experimental conditions is primarily driven by our female participants, while our male participants chose to outsource approximately equally across conditions. Women, but not men, who had been specifically reminded that they could do something else with their time were more likely to choose to outsource their time, compared to women who received no reminder, were reminded that they could work during this time, or were reminded that they could be with friends and family during this time. These results do not support the secondary hypothesis that participants in the friends and family condition would choose to outsource more than participants in other experimental conditions.

We also observed an unexpected significant difference between men and women, in which women outsourced significantly less than men in the control condition. One explanation for this result is that outsourcing tasks were all related to housework. Since housework tasks are stereotypically a feminine responsibility (Duxbury & Higgins, 2002), male participants may not have felt much need to outsource these tasks; the latter probably did not feel responsible and felt no reason to have to outsource the proposed task. Since the male participants felt no greater motivation to outsource regardless of whether they were reminded of other opportunities for their time, they chose to outsource approximately equally across conditions. In contrast, women were affected by the reminders of other opportunities for their time, because they did felt responsible for these housework-oriented tasks. Therefore, they chose to outsource significantly less than men in the control condition because of their sense of responsibility and had never considered what else they could do with their time. Future research should address a similar question as the current study, but remove the stereotypic gender bias in the

Table 1. Outsourcing decisions across condition and gender.

Percentage Chose to Outsource	Conditions				F-value	p-value
	Control	Working	Friends & Family	Something Else		
All	29.30%	27.94%	39.25%	51.53%	3.03	.03
Male	18.20%	26.70%	40.00%	69.60%	.99	.80
Female	40.50%	29.20%	38.50%	33.30%	17.09	<.001

activities suggested to be outsourced in order to observe whether this gender effect is still evident then.

Our other unexpected results were that women chose to outsource significantly more than men in the something else condition, on top of the finding that women chose to outsource significantly more in the something else condition than women in the other three conditions. These results illustrate that reminding women, but not men, that they can do something else with their time significantly increases their likelihood to choose to outsource their tasks. One explanation for this effect is that our other two experimental conditions, spending the 2 hours "working" and "with friends and family", are not universally positive activities. Participants may not enjoy spending time at their workplace or with their family, so the idea that they could spend their time this way may not be a motivation to outsource. However, the suggestion of "something else" is most likely to have elicited thoughts about a positive event at which participants would prefer to spend time.

However, it is important to remember that these results are based on self-reported decisions to outsource, but not actions that took place. It would be valuable for future research to investigate how these reminders of other opportunities for time would increase actual outsourcing behaviour, as it may differ from this self-reported data.

In conclusion, women choose to outsource more when reminded of other opportunities, assuming that they are considering to outsource household tasks. This is particularly the case when they are reminded that they can do something else (positive) with their time. However, men are not affected by reminders of other activities when thinking of outsourcing household tasks. These findings have valuable real-world implications, as they point to an avenue to increased happiness that most individuals have not yet utilized. Although our findings conclusively show that reminders of other opportunities increase rates of outsourcing in only women, it is still possible that men can be affected by such reminders when given a different scenario. As such, individuals can apply these findings to their everyday lives by giving themselves conscious reminders of other ways to utilize their time when considering to outsource.

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

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Outsourcing Manipulation by Condition

Participants read the scenario then answered the following question:

"Imagine that you are having a very busy week--one of the busiest weeks you've had all year. During this week, you listen to a radio program about a local service that allows you to pay to outsource your disliked tasks to others--such as housecleaning, making meals and doing laundry. This local company employs people in the community, and through this company you can select the person you like best to help with your daily chores and errands. As part of the advertisement you have learned that for the price of $40, you can outsource two-hours of your chores and errands to someone else.

What would you do in this situation? Please circle only one of the following options"

Depending on the condition assignment, the response options were as follows:

Control Condition

Do these tasks yourself
Use the outsourcing service

Working Condition

Do these tasks yourself
Use the outsourcing service [Spend these 2 hours working]

Friends & Family Condition

Do these tasks yourself
Use the outsourcing service [Spend these 2 hours with friends & family]

Something Else Condition

Do these tasks yourself
Use the outsourcing service [Spend these 2 hours doing something else]

SOCIAL
Literature Review

The Influence of Emotion Saliency and Environmental Stimuli on Field Dependence and Holistic Perceptual Style

Rowena Li Tieng Kong[1]
[1]Department of Psychology, University of British Columbia

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Abstract

This literature review discusses the salience of emotional aspects in relationships and environmental stimuli that could enhance and perpetuate the holistic perceptual tendency in collectivistic individuals. In an interdependent culture, relational harmony is valued and potential conflict between members is avoided. Sensitivity towards emotional cues and expressions of others could be beneficially fostered under the East Asian culture. Emotional dependence is also an observed tendency of those who are field-dependent. This suggests that the salience of emotional characteristics and cues in holistic perception affects field-dependent and East Asian individuals to a greater degree than analytical Westerners of an independent culture. Though the mechanism(s) is still unclear, it could be attributed to psychosocial factors. Morever, a study that compared American and Japanese city scenes suggest the influence of a considerable amount of informational stimuli from background structures on visual perception. East Asians have also been found to exhibit broader attentional breadth and greater frequency of gaze saccades crossing between the object and background of pictures in visual experiments than Westerners. In order for future research to achieve a clearer understanding of the social basis of holistic perception in East Asians, the themes of increased sensitivity to implicit emotional states of others and constant visual exposure to one's external environment are worth considering. It can be said that perception is not a discrete function of the senses but a part of a complex web of information interchange involving the profound influence of psychosocial and external environmental realms of life.

Keywords: emotion, saliency, environment, stimuli, perception

Cultural psychology has contributed to our understanding of how psychological aspects of our culture vary according to their origins and practices around the world. Ancient civilizations developed their region-specific cultures which penetrated and influenced the daily lives of their people through communication. Our ability to perceive with our senses shares complex functional interconnections with other active mental capacities, in particular, cognition, attention and memory. The combined outcome of this rich network of internal information exchange circuit in perceiving and making sense of external stimuli serves to place humans, who are capable of high-fidelity cultural learning—that is, learning that involves efficient imitation of others based on well-de-

UBC Ψ UJP

Corresponding Author:
Rowena Li Tieng Kong
christelwise@gmail.com

veloped language and theory-of-mind abilities, which are an advantage over other animals (Heine, 2010). Our attachment to the culture which influences us is a defining aspect of our identity.

Eastern and Western Cultural Roots

The interesting contrast between Western individualism and Eastern collectivism has attracted much research over the past few decades. In tracing back to their respective ancient Greek and Chinese philosophical roots, efforts have been made to explain the origin of such cultural divergence. Culture not only provides us with a structural framework for our content and conduct in communicating information, but it is also a lens through which certain aspects of our perception of interpersonal interaction are magnified or made less salient, such as by concentrating or diverting our focus of attention with long-time practice and adherence to acceptable norms. Our distinct cultural backdrop underlies the East-West dichotomy in the process of information perception and exchange, perpetuating their influence through familial interactions and along social and visual dimensions within our cultural environment.

Early studies on perceptual processing have led to the categorization of "field-independent" and "field-dependent" tendencies according to the extent to which one decontextualizes an object from its field (Witkin, Dyk, Faterson, Goodenough, & Karp, 1974). To explain differences in visual tendencies of certain occupational groups, Witkin and Berry (1975) proposed that those whose livelihood requires effective cooperative efforts and harmonious relations amongst fellow workers (e.g., farmers) are more field-dependent than those who are self-reliant and socially independent on the job (e.g., herders). This parallels the contrast between Eastern interdependent and Western independent societies (Norenzayan, Choi, & Peng, 2007). In ancient China, geographical features of the land allowed for extensive farming practice as compared with land-limited Greece, where the more autonomous and individualistic trade and fishing were common. Thus, the strong influence of Greek traditions and philosophy on the Western world suggests a basis for cultural promotion of field independence. Compared to Easterners, Westerners are able to separate visual target objects from their background with greater ease. This is described as analytic perceptual tendency that facilitates the perception of each object as an individual and discrete unit by categorization according to object properties and abstract rules (Heine, 2012).

When East Asian participants underwent the Rod and Frame Test, in which they were presented with images of a rod against a distracting graphic background and then tested whether they were able to tell accurately the rod was tilted or vertically straight, they attended more to the entirety of visual information in the pictures shown to them. This led to difficulty and inaccuracy in detecting the rod's subtle angle of deviation from the horizontal and vertical. Such demonstration of a holistic perceptual style is distinguished from an analytic perceptual style. The extent to which they were basing their perception of the rod's position on the misleading graphic background demonstrated that they were more visually field-dependent. A study by Chua, Boland, and Nisbett (2005) reported that Chinese participants looked more at a distracting background instead of objects, similar to the case of the Rod and Frame Test. Therefore, it is the aim of this paper to further discuss two aspects of holistic perceptual style: (1) a relationship-oriented perception of collective objects of stimuli, which is exhibited by field dependence; and (2) an expanded scope of visual focus that takes into account not only the foreground but also the background of the field.

East Asians' Perception of Emotional Content

A study by Chua, Leu, and Nisbett (2005) found that adult Taiwanese participants described more emotional content than American participants in their recall of personal events and video clips that had been shown before engaging in distracter tasks. In another study (Masuda & Nisbett, 2001), Japanese participants were found to be more likely to perceive emotions in fish, when shown videos of them, than Americans. The salience of emotion to the Japanese participants in their perception of the objects' characteristics could be suggestive of a link between the emotional quality and interconnections among components within one's visual field. Since emotional perception plays a significant part in both verbal and implicit human social interactions, leading to purposeful and meaningful relationships, emotion as a

property of visual objects may further enhance perception of their interaction with one another—an implication of a relationship that is active and ongoing.

Although the suppression of explicit emotional expression may be emphasized in East Asian cultures that value harmonious relations, reliance on emotional cues through alternative channel(s) to prevent potential conflict could be a motivation for developing acuity in perceiving implicit social messages attempted to be conveyed under restrained contexts. Kitayama and Ishii (2002) reported that Japanese participants, in comparison with American participants, exhibited more interference effect on their judgement accuracy of words spoken in a contradicting emotional tone. It can be observed that emotional voice tone may serve dissimilar verbal functions in the Western and Eastern worlds. It could be that Eastern traditional customs and etiquette associated with emotional vocal tone moderation are less explicitly defined than the suppression of emotional facial cues. On the one hand, it may be an adaptive strategy by members of a culture rooted in Confucianism, which encourages speech moderation, to communicate implicit information through variation in emotional vocal tone without compromising explicit verbal content.

While it is debatable whether such results exhibited by Japanese participants can be generalized to other East Asian cultural groups, it suggests the saliency of emotional significance in not only visual perception of characteristics of stimuli but also within the framework of social interaction that can serve as an adaptive function in conflict prevention and resolution. This shows that the underlying emotional quality of both speech and visual stimuli is more salient to holistic perceivers. Just as we have the tendency to detect a person's emotion by our perception of one's facial expression, the relationship between emotion and visual attention in terms of how malleable it is to psychosocial factors should be further explored. It is still unclear as to whether prioritization of emotional aspects by a culture leads to holistic perception or merely serves as an adjunct enhancer of such perceptual processing.

Field Dependence and Emotional Dependence

In addition to sensitivity towards emotional characteristic of auditory and visual stimuli, not many studies have discussed the aspect of emotional dependence with field dependence. A study by Konstadt and Forman (1965) was carried out on children who were divided into field-independent and dependent groups with the goal to test the effect of approving and disapproving examiners while the children worked on a routine clerical task. The children who made up the field-independent group were selected based on their higher scores in the Children's Embedded Figures Test(CEFT), while those in the field-dependent group had lower scores in the test. The CEFT is a version of the Embedded Figures Test specifically modified for children after its creation by Witkin to assess field independence and dependence (Karp & Konstadt, 1963). The results showed that performance of field-dependent children reflected more strongly the negative influence of disapproving statements by examiners. The study also recorded the number of gazes by the children at other people as a measure of their affective dependence. The field-dependent children exhibited a greater frequency of gazes than their field-independent counterparts under the condition of disapproval by the examiners. There appeared to be a certain level of emotional engagement as an extension of one's greater sensitivity to social relations. In order to navigate through and achieve one's goals in a maze of potential conflicts within a relationship-oriented social and/or occupational environment, it is necessary to be skillful in attending to and interpreting emotional cues that can be ambiguous at times. In prioritizing relational harmony, the sensitivity towards the emotion of interacting members plays a significant role in its function as an implicit social climate meter, whereby one's detection of positive and/or negative cues would provide useful feedback to decide subsequent action.

The emotional aspect of an interaction can therefore become a salient element within one's scope of perception that moderates the level of assurance of one's optimum social performance. It also shows that emotional and field dependencies may be closely linked in not only a cultural but also a psychosocial dimension. This could be accounted for by a widely distributed neural system for emotion perception in the brain (Phillips, Drevets, Rauch, & Lane, 2003). It can be seen that field-dependent and holistic individuals have the propensity for emotional awareness, which is likely en-

hanced by cultural norms and social experiences. Such awareness or sensitivity is less pronounced in Western individuals and may provide practical support to the perceptual style that East Asians are accustomed to.

Further, it may be argued that vulnerable young children who participated might have expressed greater emotional needs to a greater degree than adults. However, the purpose of comparison between field-dependent and field-independent children was achieved and the spontaneous display of emotional reliance could offer a better glimpse at the type of possible suppressed response in adults who are more capable of inhibiting expressions in their behaviour. Since Westerners are found to be more field-independent, the results of Konstadt and Forman's study suggest that the children's field-dependent perceptual tendency and relational orientation will also likely wane as they grow older and become accustomed to an individualistic mindset across life domains (Witkin & Berry, 1975). Field dependency is subject to variation in social influence, whether it is by Western independent upbringing or East Asian interdependent culture, despite being observable and assessable by CEFT at a young age.

Emotion as an Interactive and Unifying Component in the Context of Relations

We have seen that individuals' social orientation and vocation play a part in determining their field dependency and holistic perception, which in turn help them to adapt to the needs and demands of the cultural environment in which they live. Our perceptual tendency interacts with culture on a continual basis and beneath the external side of social interactions, it is worthwhile to consider how such active processes are built upon underlying psychological mechanisms, in particular under the East-Asian relationship-oriented environment. The emotional aspect is a potential factor for further exploration to achieve a better understanding of mechanisms that may have a role in consolidating our social orientation and perception.

The greater tendency of emotion perception in field-dependent and holistic study participants implies a seldom studied correlation between emotional saliency and perceptual orientation. Vuilleumier and Driver (2007) discovered that the emotional significance of visual stimuli influenced perceptual processing at the neural level, with enhanced and prolonged responses. Just as social relationships are built upon our sensitivity and responses towards one another's emotions, the interconnectedness between objects in our perceptual field may be supplied by a unifying factor of emotional quality. Thus, emotional salience provides an advantage in the tendency of perceiving interactive relationships between elements. Uchida, Townsend, Markus, and Bergsleker (2009) analyzed television interviews of Japanese and American Olympic athletes and studied participants' descriptions of these athletes and their reactions to winning. The results showed that both the athletes and participants of Japanese descent, compared to those of American descent, associated more emotions with relationships; for example, they included people other than the individuals of interest when they described the athletes' emotional reaction to their victory and group pictures with teammates. The authors concluded that the Japanese perceived emotion as relational in nature and jointly shared with others while the Americans saw emotion as originating from within them and being distinctly separated from others. Thus, under such a context, the Japanese may not be less emotional in their expression than their American counterparts. These findings suggest that emotions can carry a more holistic meaning and significance for Asians than previously assumed.

Holistic Perception and Environmental Stimuli in East Asian Cities

The application of holistic perceptual style has also been explicitly expressed in Eastern aesthetic art, which in turn provided further opportunities to perpetuate holistic perception in their audience and followers (Heine, 2012). Similarly, in a study by Nisbett and Miyamoto (2005), comparisons between typical matched cities in the East and West showed that many background structures and objects along sidewalks in Japan are uncommon in American cities. From paired research photographs taken of city scenes, more displays of street advertisements with enlarged wording were observed in the Japanese city, which sought to attract the visual attention of people in the area. The printed advertisement messages arrayed along the streets conveyed a greater

amount of informational stimuli than in a typical Western city scene. Thus, holistic perception has led to the development of a form of expression through which the medium of its promotive culture produces psychosocial influence on a readily receptive audience. In East Asian societies where printed advertisments are more prevalent, such objects of holistic expression indirectly help maintain a lively attention-stimulating atmosphere that motivates people to communicate and share their time in relationship-bonding activities. The advertisement displays tend to be found massed together in an area, which can also imply a cultural prioritization of closeness and frequent convening of related group members.

On the other hand, it can be understood that through an extended duration of visual exposure to such an abundant and, at times, overwhelming mass of stimuli that direct relevant and rewarding messages to the viewer (e.g., new products and price discounts), a holistic perceptual style is nurtured for apparent self-benefits. Reinforcement can be in effect, encouraging one to act and obtain benefits from the rewarding positive information offered. In a series of experiments by Seitz, Kim, and Watanabe (2009), adult participants were found to be capable of visual perceptual learning in the absence of behavioural task engagement when they were only shown visual stimuli paired with offer of physical rewards. The participants' visual sensitivity was tested by their ability to discriminate correctly the orientations of two sets of stimuli of sinusoidal gratings that were each paired with or without a water reward. The results illustrated that the participants' test performances on the paired stimuli-reward grating orientation were improved from those completed prior to the experiment sessions as compared with those of the unpaired stimuli, which did not show any change. This indicated that learning had taken place in visual perception which bypassed the engagement of behavioural task and intentional decision-making process. Additionally, the technique of continuous flash suppression (CFS), in which presentation of rapidly changing stimuli to one eye suppresses conscious awareness of the presentation of a static stimulus to the other eye, was implemented in one of the experiments to suppress the participants' direct awareness of the stimuli-reward pairing and grating orientation. Still, similar pattern of performance results were obtained. The study shows a fundamental perceptual mechanism at work beyond one's conscious awareness and control. Reward learning could have resulted from the process of visual perception in an environment where there is a crowded presentation of stimuli and an offer of potential rewards to compete for one's attentional focus, irrespective of active task performance. This is to extend the concept of traditional understanding further to the idea that deliberate effort is just one of the routes by which our sensory perceptual process operates; the role of reinforcement in the conditioning of our visual response is just beginning to be explored. With one's long-term exposure to an excessive load of visual stimuli, the content of which can eventually make their way into our cognitive processing stream, it is reasonable to assume that a majority of our perceptual learning actually takes place underneath conscious awareness.

Focus on Background and Foreground of Visual Field

A distinguishing aspect of holistic perceptual style is the subject's attentional focus on both the background and foreground objects of his visual field. A study by Boduroglu, Shah, and Nisbett (2009) hypothesized that East Asians' tendency to focus additionally on the background could be due to their broader scope of visual attention allocation. The results confirmed such by showing that, compared with American participants, East Asians performed better on colour change detection tasks which involved expansion of object positions from their initially closely-spaced distances. When the procedure was reversed (i.e. shrinking the positions of objects that were first displayed as farther apart from one another), East Asian participants performed worse than American participants. With one's frequent exposure and alertness to a greater number of background objects and structures in the environment that carry mentally stimulating messages while having to search for and make judgements on the best choice of displays, this perceptual and cognitive processing tendency can be a likely contributing factor to East Asians' wider attentional breadth.

Additionally, in a comparison between Chinese Singaporean and Caucasian American participants, Goh, Tan, and Park (2009) found greater distance coverage of eye movements as well as a greater proportion

of gaze saccades which alternated between objects and backgrounds in pictures when presented to the former group than the latter. This could imply that the tendency to draw associations between objects and backgrounds or the variation across their boundaries may have attracted more of the Chinese Sinagporean participants' attention. From such observation, one can reason that there is a close overlap between field-dependent and object-background crossover perceptual processes.

On the one hand, it is still unclear what specific mechanisms underlie East Asians' preference for greater visual focus and attention on the background than concentrating on foreground stimuli. It is certainly more complex than deliberate effort. Chua, Boland, and Nisbett (2005) found that Chinese participants made more saccadic eye movements than American participants on complex realistic background of pictures with a single foreground object. In the sample pictures presented in this study, the backgrounds contained a greater variety of multi-coloured visual details. It is worth considering whether the preference for variety in objects' attributes and a broader range of distinct visual qualities carry more positive meanings, such as harmony and completeness of one's group, to East Asians who reflexively prolonged their attention. A study which examined European Americans and East Asians' coloring works on geometric patterns showed that East Asians selected more colours and produced colorings which were judged to be more harmonious than the unique and higher hue-contrast works of the American participants (Ishii, Miyamoto, Rule, & Toriyama, 2014). From the previous study by Nisbett and Miyamoto (2005), the background of Japanese city scenes presented a variety of sign displays in a number of attractive shades of colours. The influence of traditional cultural values and beliefs pertaining to relationship orientation may therefore play a role in the colour preferences and applications. On the other hand, research has not clearly differentiated the extent of participants' focus on visual stimuli with attributes that bear more similarities with those that are more distinctly varied. Should future studies be able to shed more light on this aspect, we may be closer to deciphering another underlying perceptual mechanism that characterizes the holistic style and connects with the Eastern environmental influence.

With respect to external environmental influence, future research could address the possibility of one's greater activation of perceptual and cognitive engagement while being in a typical East Asian environment. In addition, the consideration of ambient auditory stimuli and their effect when combined with visual objects could offer a more complete understanding of overall environmental impact. Not only are East Asian city scenes more visually stimulating, but such environments can also be teeming with richer amounts of auditory stimuli when relationship-bonding opportunities are prioritized.

Possible Sensitive Period in Perceptual Style Development, Parental Roles and Family Structure

There are sensitive periods for culture and language acquisition during one's early years of development prior to full adulthood, and the extent to which these sensitive periods would affect the establishment of a person's perceptual style and cognition when the young brain is particularly most receptive remains to be explored (Heine, 2012). The earlier section of this paper has pointed out that field dependence can be nurtured and enhanced by cultural and psychological factors. It is not unique to the Eastern culture, however, as certain sub-Western cultures exhibit collectivism to a greater degree than others.

Recent research on the impact of culture on one's sensitive developmental period has focused on maternal upbringing with children (Wang, 2006). In contrast, paternal influence has been less studied within the context of culture, and so are the differences between Western and Eastern children's views and expectations of their fathers towards themselves and the family. Paternal participation in a child's growth and development can vary in their activeness, which could be challenging in the face of modern culture, where men and women live in societies that endorse different levels and aspects of gender equality. Canadian statistics showed that the number of single-parent families had risen by 8.0% between the years 2006 and 2011, with those headed by single mothers making up 80.0% of them in 2011 (Statistics Canada, 2015). In East Asia, the rates of divorce, and the resulting single parenthood, have risen in major industrialized countries such as China, where the divorce rates used to be almost zero in the 1970s (Yeung

& Park, 2015). For the average Eastern family, the impacts of placing the father as the central authority figure should also be considered and studied according to the context of a rapidly modernized and globally-connected Asian society. Complex emotional and social issues can affect the stages of children's development when parental roles can be switched, substituted, or not assumed by physically and/or emotionally absent fathers and mothers.

A longitudinal study by Schacht, Cummings, and Davies (2009) reported that children's emotional security played a mediating role in the relationship between their fathers' behavior and their own development. Fathers help determine their children's style of attachment security and dependence (Howard, 2009). From a practical point of view, parental upbringing may not appear as solid and stable as it is generally presumed to be. Globalization sees the developing Eastern world encountering and assimilating Western influence of tradition-contradicting lifestyle and opinions. Parental affirmation and criticism regulate the emotional climate in the home, influencing the children's sense of security during a period when they are most sensitive to culture acquisition. As Eastern families become more subjected to Western influence which alters paternal roles, future research should consider whether a vulnerable level of emotional security due to inadequate or irregular parental participation during a child's period of development may be linked to greater emotional dependency, which as we have seen, is related to field dependence tendency.

Conclusion and Future Directions

Both social and environmental factors work hand in hand to reinforce holistic perception in people of cultural groups characterized by interdependence and harmonious relations. A tendency of holistic perceptual style, field dependence, may lead to the utilization of a greater degree of emotional dependency and sensitivity towards affective expressions and cues from others in order to maintain social order and avoid conflict. Although research has focused on the emotional suppression tendency of East Asians, their moderation in explicit expression through channel(s) unfamiliar to Western societies may mask their underlying sensitivity towards perception of emotion in others.

The immediate and frequent exposure to East Asian cities provide a considerable variety of informational stimuli to play a significant role in their residents' expanded attentional breadth and greater frequency of object-crossing-background visual processing. One challenge is to determine at which point in time such visual processing becomes a deliberate effort following spontaneous attentional allocation. It would be useful if the broad definition of holistic perceptual style could be clearer in identifying its distinct components and distinguishing between object-object and object-background visual focus. It would also be useful to investigate whether individuals with a holistic perceptual style attend more to the variation or similarity between visual stimuli, be that the backgound or foreground object in a field. Such division or categorization could expand the discussion and shed light on the common denominator as well as presently unclear distinction between field dependence (also exhibited by Westerners) and Easterners' holistic perception. Further studies could determine the association between non-emotional neutral stimuli and visual perception of a relational context, particularly in holistic perceivers. Furthermore, the concept of field dependence and holistic perception could be extended to focus on stimuli of audible nature. Similar to the contrast in city scenes between a Western and an East Asian environment, ambient noise is more intense and cognitively stimulating in the latter than the former. Culturally nurtured perceptual style can then be likened to a versatile mold that accommodates a range of stimuli streaming through more than one sensory faculty. Lastly, since Easterners are particularly receptive to the perpetuation of holistic perception through generations, future research could look more into the the mutually enhancing properties and intertwining of external environmental elements (as an expression and channel of survival of culture) with psychosocial factors, as opposed to addressing these aspects separately.

Declaration of Conflicting Interests

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

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SOCIAL
Research Paper

The Effects of Communal Values on Men's Career Interests

Puneet Sandhu[1]
[1]Department of Psychology, University of British Columbia

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Abstract

Over the past 50 years, women have shown increased endorsement of agentic values, such as competition, power, and dominance, and have smoothly integrated into traditionally male-dominated professions. Men, however, have not experienced a similarly smooth transition into traditionally female-dominated occupations. One proposal for why this phenomenon has occurred is men's lack of communal values (compared to women), as those values tend to conflict with the drive for competitiveness and agency. In this study, we hypothesized that priming communal values would increase interest in female-stereotypic careers for men and priming competitive values would decrease interest in female-stereotypic careers for men. A sample of 153 undergraduate men completed an essay recall task that primed them with communal values, primed them with competitive values, or asked them to write about an emotionally neutral event. They also completed measures assessing implicit and explicit interest in various careers. Results from a series of one-way ANOVAs suggested that priming communal values did not facilitate men's interests in female-stereotypic careers, and competitive priming did not seem to significantly hamper men's interests in these same careers either.

Keywords: gender; values; social roles; stereotypes; communion/agency

> "Women are not going to be equal outside the home until men are equal in it."
>
> —Gloria Steinem

In the past 50 years, there has been a substantial push towards gender equality in the workplace. While praising this equality movement, it is important to note that men and women have not benefitted equally. Recent representative data indicate that approximately 53 percent of the labour force is now comprised of women, compared to only 38 percent in 1970, reflecting a shrinking difference between genders (Bureau of Labor Statistics, 2013). Most notably, advancements in gender equality have been mainly based on changes in women's roles. For example, women's increasing economic self-sufficiency has only occurred because more women have been entering the labour force, but it is not the result of men leaving the work force to take care of their children (Hooks, 2000).

While both men and women participate in the labour force to equal extents, the gender distribution in many career fields is far from equal: men are evidently not as visible as women in helping-oriented careers and in the domestic sphere. In the current study, we explore how asymmetrical career interests of men and women are influenced by communal values, which are values that are prosocial in nature, including altruistic, marital, familial, religious, and existential values (Bakan, 1966).

UBC Ψ UJP

Corresponding Author:
Puneet Sandhu
psandhu24@hotmail.com

Benefits of Men Entering HEED Roles

Before delving into the current research, it is important to reflect upon the implications of increasing men's pursuit of communal-oriented jobs. Croft, Schmader, and Block (2015) have recently suggested the acronym HEED to refer to female-dominated careers in Healthcare, Early Education, and the Domestic sphere. Fundamentally, men's underrepresentation in HEED is a relevant and concerning issue because it negatively affects four key groups of individuals: children, women, the community, and men.

The first group impacted by this issue is children. Another study conducted by Croft, Schmader, Block, and Baron (2014) discovered that men who engage in more domestic duties in the household tend to have daughters who grow up to develop less gender-stereotyped career aspirations for themselves in the future. Other findings have described an association between fathers' involvement with their children and their children's subsequent behavioural tendencies at school (Carlson, 2006). Carlson (2006) found that the more involved fathers were with their children, the less likely it would be that their children would act out at school or misbehave. Together, literature suggests that men's engagement in more domestic roles positively influences their children.

Women also benefit when men occupy more domestic roles. This occurs as men directly remove some of the burden of the 'second shift' of household responsibilities from women, who can in turn focus more energy and time on their career and towards attaining more agentic goals and values (Croft, Schmader & Block, 2015; Hochschild, 1989). Likewise, marital happiness for women is influenced by men's participation in domestic responsibilities (Frisco & Williams, 2003). It is proposed that women's perception of greater inequality in household labour division leads to lower levels of marital happiness and greater likelihood of divorce (Frisco & Williams, 2003). All the evidence clearly suggests that women are more economically, socially, and psychologically liberated when men help out in the household.

Another population that is affected by the increase of men in communal careers is the community as a systemic social institution. Throughout history, women across many cultures and generations have dominated communal careers, such as elementary school teachers, nurses, and stay-at-home parents. The introduction of more men to these positions would gradually add a nuanced perspective to facets of traditionally feminine jobs in which men excel at compared to women, such as problem-solving, planning, and social relations. Inevitably, this would change the dynamics of the workplace and the field itself. The possibility for growth and development of these ideas and occupations are thereby facilitated by men's entrance to communal roles.

Finally, the last population impacted is men themselves. Bauer and McAdams (2010) have found in both men and women that having communal goals relates to increased well-being, while Holt-Lundstad, Smith, and Layton (2010) have linked communal goals to a longer lifespan for men. Additionally, prioritizing social connection over the attainment of power has been shown to predict better psychological outcomes, such as higher self-esteem (Gable, 2006; Zeldow, Daugherty, & McAdams, 1988). As shown by the reasons presented here, the augmentation of men into HEED roles and occupations has numerous beneficial implications for children, women, the community, and men themselves.

Gender Differences in Values

After reviewing the benefits of encouraging more men into communal roles, it is crucial to understand what processes may be at play when individuals are considering careers. Values may be seen as influencing men and women's career choices through internal forces (values one endorses as an individual) and external forces (values society endorses/associates with certain roles). They can be described as cognitive representations of certain motives that are socially desirable in a given culture (Trapnell & Paulhus, 2012). Women tend to endorse and associate with communal values more strongly than men, and men associate with agentic values more compared to women (Eagly, Diekman, Johannesen-Schmidt, & Koenig, 2004; Twenge, 1997). Agency here refers to values that are more individualistic, such as political, economic, leadership, entrepreneurial, and hedonistic goals (Bakan, 1966). Since the late 1900s, women have begun to increase in endorsing and associating with agentic goals and values (Eagly & Diekman,

2003). However, men have remained lower than women in their display of communal traits and goals. This reflects a gendered disparity in values that is also evident in the workforce.

Values in the Workforce

As more women have begun to associate with agentic values, many have also taken on jobs in fields characterized by agency, specifically in science, technology, engineering and mathematics (STEM fields). These are often considered male-stereotypic, having traditionally been male-dominated spaces. Interestingly though, data show that men have neither experienced a proportionate surge into traditionally female careers nor increased in communal values endorsement (Croft, Schmader, & Block, 2015). In 2011, men represented merely 5% of the population employed in childcare, 9% in nursing, and 2% in early education (HEED) roles (Bureau of Labor Statistics, 2013). These numbers are meagre as opposed to the amount of women employed in traditionally male-dominated careers in 2011: 61% of accountants and auditors, 45% of chemists, and 20% of architects were women (2013). Overall, these figures signify a gap that has manifested within the workforce between men and women's agentic and communal values.

The Gendered Division of Labour

Through the lenses of Social Role Theory (Eagly & Steffen, 1984), Theory of Work Adjustment (University of London, n.d.), and Goal Congruity Theory (Diekman, Brown, Johnston, & Clark, 2010; Diekman & Steinberg, 2013), career decisions can be viewed as being guided by the differences in agency and communion held by men and women. Unpacking each of these discourses will reveal how values or goals affect the jobs men and women choose, how they become associated with certain careers, and how gendered differences in these values and goals relate to the inequitable ratio of men to women in many fields today. In relation to the current research, this existing body of literature can be used to both examine the underrepresentation of men in traditionally female-stereotypic careers and aid in increasing men's involvement in female-stereotypic careers.

Social Role Framework: Female- and Male-Stereotypic Roles are Viewed Differently

Over time, different values can become attached to specific types of careers, as illustrated by the Social Role Theory. This theory posits that men and women tend to endorse different amounts of agency and communion because of a distinguished male-female division of labour. Eagly and Steffen (1984) suggested that different gender role expectations and socialization processes for men and women throughout the lifespan have led these two groups to pursue distinct careers. Once these groups are viewed in different roles, over long periods, the individuals are perceived as intrinsically embodying the abilities and values that suit these roles (Eagly & Steffen, 1984). To illustrate, men in stereotypically male jobs are perceived to be innately more agentic than those who are not in those roles. Likewise, women in stereotypically female jobs have come to be seen as inherently more communal than others who are not in those same roles. In accordance with our research, because of these societal perceptions and expectations, men may be deterred from expressing communal values and, furthermore, from pursuing traditionally female professions. Perhaps this is because these professions are seen as out of line with the overemphasized agency and independence (and underemphasized communion) expected within the masculine gender role.

Theory of Work Adjustment: Values Determine Job Satisfaction

A key theory that can be used to help address the discrepancy between men and women in value endorsement is Dawis, England, and Lofquist's Theory of Work Adjustment, otherwise known as the Person-Environment Correspondence Theory (University of London, n.d.). In line with this theory, a person's values must be reinforced or fortified by that person's workplace environment in order for the person to gain satisfaction. Similarly, when the work place requirements are fulfilled by the person's abilities, the employer gains satisfactoriness from the employee's performance. One can postulate that men or women in gender-atypical occupations may not be able to gain the same level of satisfaction if occupations reinforce gendered values. The underlying assumption is that men and women choose different jobs depending on the job's perceived ability to satisfy different values, but the values that men and women seek are

not the same. Hence, drawing on the Work Adjustment Theory, men may be evading HEED roles because those environments would not match their agentic values.

Goal Congruity Perspective: Roles need to be Congruent with One's Goals

Another way to consider the interconnections of gender, values, and jobs is to look at Amanda Diekman and colleagues' Goal Congruity Perspective (Diekman et al., 2010; Diekman & Steinberg, 2013). This model proposes that certain goals are more endorsed or activated in certain individuals, and that individuals have ideas about what activities and situations may facilitate or impede these goals. Accordingly, the types of goals one endorses most strongly and the beliefs that they hold about how these goals will be fulfilled can influence interest levels in various careers. Hence, men and women's different goal endorsement should lead to different role interests. In fact, causal evidence has demonstrated that activation of communal goals, in general, decreases interest in STEM careers, while it increases interest for women who believe that STEM careers facilitate communal goal fulfillment (Diekman et al., 2010; Diekman, Clark, Johnston, Brown, & Steinberg, 2011). In other words, framing a STEM career to women in a way that portrays its potential for communal goal attainment actually increases women's interest in that career. To expand on this past research is the current question of whether communal goal activation can increase men's interest in HEED roles or not.

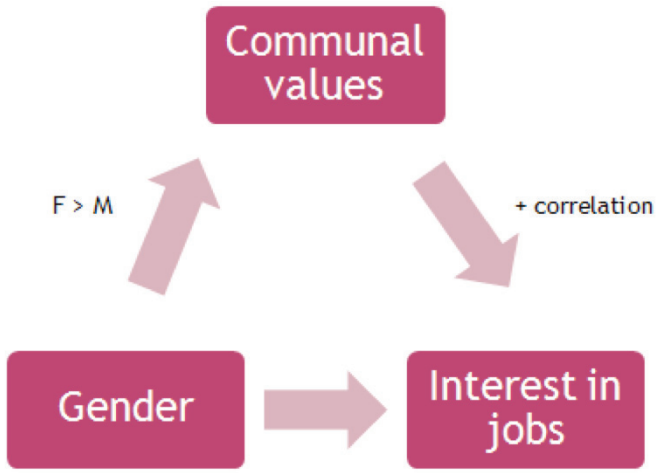
In this respect, men's interests in female-stereotypic careers would be proposed to be mediated by the communal values that are active in their minds. Figure 1 describes this prediction using the previous data supporting that women tend to endorse more communal values than men, and that communal values are positively correlated with the pursuit of female-stereotypic careers (Eagly, Diekman, Johannesen-Schmidt, & Koenig, 2004; Twenge, 1997). Furthermore, since men are indeed higher in their drive for competition and endorsement of agency, these values could be conflicting with any of their communal values and behaviours. Thus, manipulating competitive values in men should also influence their experiences of communal behaviours and interests in female-stereotypic careers.

Current Research and Hypotheses

In this study, we aimed to experimentally demonstrate that manipulating values can in fact influence interest in careers for men. We hypothesized that activating communal values in men should result in heightened interest in female-stereotypic careers. Correspondingly, priming men with competitive values should result in men having less interest in female-stereotypic careers. Our study tested these hypotheses by randomly assigning participants to a competitive, communal, or control (emotionally neutral) prime and assessing their subsequent interest levels in certain careers.

More specifically, we predicted that men whose communal values were activated would rate female-stereotypic careers as more preferable than those in the control or competitive conditions. Conversely, men who had competitive values activated would be less likely to show interest in female-stereotypic careers.

Figure 1. This model depicts how communal values should mediate men's interests in female stereotypic careers.



Method

Participants

One hundred fifty-three undergraduate men (after exclusions) took part in this study at the UBC Vancouver campus (Mage = 20.52, SDage = 3.30). They were either recruited through the Human Subject Pool network, in which they were compensated with course credit, or

responded to advertisements and received a remuneration of $10 for one hour of participation. Half of the participants were of East Asian or Pacific Islander descent (49.7%), 23.5% were Caucasian, and the rest consisted of other ethnicities. Most of them were born in North America (54.9%) as opposed to outside of North America (45.1%). The majority of the sample was composed of men in their third year of study (30.7%) and first year of study (29.4%), with the most common study programs being Psychology (29.4%) and Science (27.5%).

Seventeen participants were excluded from this analysis as they either did not complete the priming exercise or indicated that they had exerted zero effort to complete the study.

Materials & Procedure

Upon arriving at the lab, participants were greeted by a female experimenter who described the study as consisting of two parts, the first part being a personal reflection writing exercise, and the second part being a series of questionnaires assessing their own preferences and opinions. After participants signed consent forms to participate, they were each randomly assigned to one of three essay recall primes modified from a procedure by Diekman et al. (2011). The essay asked participants to write about a specific experience for seven minutes. Participants wrote about: either (a) a time they wanted to help others/connect with others, but were restricted from doing so (communal condition; n = 65); (b) a time they wanted to be competitive, but were restricted from doing so (competitive condition; n = 45); or (c) the forest floor (control condition; n = 43). The restriction on the first two conditions was expected to amplify the individual's motivations, in this case, either communal or competitive values, as demonstrated in previous literature that employed this manipulation during priming (see Diekman et al, 2010).

Subsequently, subjects completed a series of outcome measures pertaining to one's implicit and explicit interest levels in female-stereotypic careers, as described in the following sections.

Manipulation checks. Four measures were employed to evaluate the effectiveness of the essay prime in activating communal and competitive values. On two measures, participants reported the extent to which they found communal goals important and competitive goals important. This was followed by two measures assessing the amount of satisfaction they would receive if they were to engage in a communal or competitive interaction at that moment. Participants completed all four of these checks along scales of 1 (not at all) to 9 (extremely).

Imagine self in male- or female-stereotypic careers. Adapted from Diekman et al. (2011), participants reported their ability to imagine themselves in male-stereotypic (α = .88) and female-stereotypic careers (α = .82) on a 7-point scale ranging from 1 (not at all) to 7 (extremely). An example of this was, "In this moment, how easy or difficult is it for you to imagine yourself in the following occupations?" There were eight careers listed, including nursing and mechanical engineering.

Enjoyment of male- or female-stereotypic careers. Similar to the measure above, participants rated the extent to which they would enjoy male-stereotypic (α = .88) and female-stereotypic careers (α = .78) on a 7-point scale ranging from 1 (not at all) to 7 (extremely). A sample item included, "In this moment, how much do you think you could enjoy the following occupations?" The same eight careers were used as the above measure, again adapted from Diekman et al. (2011).

Future family vs career orientation. On a three-item Likert scale (α = .80), participants indicated where their priorities would lie in 15 years. For each item, participants selected their position on a continuum, such as indicating their preference for having a family as opposed for having a career (Durante, Griskevicius, Simpson, Cantú, & Tybur, 2012).

Importance of communal and agentic goals. Participants reported the importance of 15 agentic (α = .83) and communal goals (α = .84) (Diekman et al, 2010), such as achievement, money, serving humanity, and intimacy. This was done on a scale of 1 (not at all important) to 9 (extremely important).

Gender stereotype endorsement. Borrowing from the

Male Role Norms Inventory (Levant et al., 2012), we employed 15 items explicitly assessing beliefs about gender equality. Ratings were made using a scale of 1 (strongly disagree) to 9 (strongly agree), including items like "When a man is feeling a little pain he should try not to let it show very much."

Competitiveness. Nine items measuring competitiveness were rated from 1 (strongly disagree) to 9 (strongly agree) (adapted from Smither & Houston, 1992). Statements comprising this measure were ones such as "I like competition" and "I find competitive situations unpleasant."

PANAS-X. Adapted from Watson and Clark's (1999) extended version of the positive and negative affect schedule (PANAS-X), participants indicated the extent to which they were feeling each positive and negative emotion while completing the essay writing task. On a scale from 1 (very slightly or not at all) to 5 (extremely), items such as "proud", "attentive," "surprised," and "ashamed" were rated.

Lastly, participants completed a standard demographic survey including age, major, university year level, sexual and political orientations, ethnicity, marital status, and experience with the English language, followed by an oral debriefing.

Results

Data were analyzed in a one-way analysis of variance (ANOVA) with three conditions: communal value activation, competitive value activation, and control.

Manipulation Checks

With a series of one-way ANOVAs we tested whether condition influenced the extent to which participants valued the importance of communal goals, the importance of competitive goals, satisfaction from a communal interaction, and satisfaction from a competitive interaction in the moment of completing the essay task. As shown in Table 1, there were no significant overall condition effects on these four manipulation check items, $F(2, 152) < 2.00$, $p > .14$. However, using the Least Significant Difference (LSD) test, post-hoc comparisons between groups showed that there was a marginal trend towards significance in satisfaction from a competitive interaction, $F(2,152) = 2.00$, $p = .14$. The control group rated higher satisfaction with competitive interactions ($M = 6.42$, $SD = 2.06$) than the communal prime group ($M = 5.62$, $SD = 2.12$; $p = .06$) and the competitive prime group ($M = 5.70$, $SD = 2.25$; $p = .12$). These overall insignificant results suggest that our manipulation did not have the intended effect.

Table 1. Effects of Activated Values on Importance of and Satisfaction from Achieving Goals.

Values Activated	Importance of Communal Goals ($F = .10$, $p = .90$)	Importance of Copetitive Goals ($F = 1.48$, $p = .23$)	Satisfaction from Communal Interation ($F = .10$, $p = .90$)	Satisfaction from Competitive Interation ($F = 2.00$, $p = .14$)
Communal (Mean ± SD)	7.08 ± 1.36	6.52 ± 1.94	7.28 ± 1.56	5.62 ± 2.12
Control (Mean ± SD)	6.95 ± 1.62	7.02 ± 1.88	7.19 ± 1.62	6.42 ± 2.06
Competitive (Mean ± SD)	7.09 ± 1.83	6.32 ± 2.13	7.34 ± 1.78	5.70 ± 2.25

Note. Ratings of importance and satisfaction were made on scales ranging from 1 (not at all) to 9 (extremely). Sample sizes were $n = 65$ in the communal condition, $n = 43$ in the control condition, and $n = 44$ in the competitive condition. Mean = sample mean. SD = standard deviation.

Dependent Measures

There were no significant differences found between conditions on the dependent measures, $F(2, 152) < 1.88$, $p > .16$ (see Table 2 and Table 3). Only the results pertaining to our evaluative measures (interest, enjoyment, and importance of careers and goals) will be discussed in length because the other measures reflect more descriptive personality details of participants.

Imagine self in female-stereotypic careers. Contrary to what we wanted to achieve, ratings on the ease of imagining oneself in female-stereotypic careers did not differ by condition, $F(2, 152) = .07$, $p = .93$.

Enjoyment of female-stereotypic careers. Enjoyment of female-stereotypic careers displayed no effect of condi-

Table 2. Effects of Activated Values on Imagining and Enjoying Careers.

Values Activated	Imagine Self in Female-Stereotypic Career (F = .07, p = .93)	Imagine Self in Male-Stereotypic Career (F = .23, p = .80)	Enjoyment of Female-Stereotypic Career (F = .19, p = .83)	Enjoyment of Male-Stereotypic Career (F = .69, p = .50)
Communal (Mean ± SD)	4.07 ± 1.90	3.77 ± 2.04	4.36 ± 1.73	4.02 ± 1.95
Control (Mean ± SD)	4.17 ± 1.97	3.54 ± 2.12	4.31 ± 1.84	3.83 ± 2.07
Competitive (Mean ± SD)	4.22 ± 2.14	3.80 ± 1.86	4.54 ± 2.02	4.31 ± 1.88

Note. Ratings of imagining and enjoyment were made on scales ranging from 1 (not at all) to 9 (extremely). Sample sizes were n = 65 in the communal condition, n = 43 in the control condition, and n = 44 in the competitive condition. Mean = sample mean. SD = standard deviation.

Table 3. Effects of Activated Values on Importance of Goals and Future Career/Family Orientation.

Values Activated	Communal Goals (F = .26, p = .77)	Agentic Goals (F = .1.88, p = .16)	Future Family vs Career Orientation (F = .04, p = .96)
Communal (Mean ± SD)	7.20 ± 1.24	6.53 ± 1.37	4.95 ± 1.72
Control (Mean ± SD)	7.37 ± 1.06	6.99 ± 1.62	4.91 ± 2.05
Competitive (Mean ± SD)	7.24 ± 1.30	6.47 ± 1.21	4.86 ± 1.59

Note. Ratings of goal importance were made on a scale ranging from 1 (not at all) to 9 (extremely). Ratings of future family or career orientation were made on a scale ranging from 1 (family) to 9 (career) on each separate pole. Sample sizes were n = 65 in the communal condition, n = 43 in the control condition, and n = 44 in the competitive condition. Mean = sample mean. SD = standard deviation.

tion, $F(2, 152) = .19$, $p = .83$.

Imagine self in male-stereotypic careers. No effect of condition emerged when imagining oneself in male-stereotypic careers, $F(2, 152)$, $p = .80$.

Enjoyment of male-stereotypic careers. There was no significant difference between groups in ratings of enjoyment of male-stereotypic careers, $F(2, 152)$, $p = .50$.

Future family vs career orientation. No effect of condition emerged in terms of one's ratings of their future family or career orientation, $F(2, 152)$, $p = .96$.

Importance of agentic goals. After an LSD post-hoc analysis between groups, a trend approaching towards significance was found for the importance of agentic goals, $F(2, 152) = 1.88$, $p = .16$. The control group ($M = 6.99$, $SD = 1.62$) rated the importance of agentic goals as higher than the communal prime group ($M = 6.53$, $SD = 1.37$; $F(2, 152) = 1.88$, $p = .10$) and the competitive prime group ($M = 6.47$, $SD = 1.21$; $F(2, 152) = 1.88$, $p = .08$). The communal and competitive prime groups were not significantly different from each other.

Importance of communal goals. No significant difference was found between groups for the importance of communal goals, $F(2, 152)$, $p = .77$.

Discussion

Understanding the interactions between values, gender, and careers can offer insight into why men and women pursue different occupations, with men predominantly in STEM role careers and women in HEED role careers. We postulated that the activation of communal values would enhance interest in female-stereotypic careers for men. Inconsistent with our hypotheses and the existing literature like the Goal Congruity Theory, this study found that priming men with certain values had no significant effect on their interest in various careers, specifically female-stereotypic careers. Contrary to what we wanted to achieve, men's interests in female-stereotypic careers were not facilitated by priming communal values, and competitive priming did not seem to significantly hamper men's interests in these same careers either. However, after conducting post-hoc analyses, two marginally significant trends were noticed. First, the control group experienced higher satisfaction from engaging in a competitive interaction in comparison to the communal and competitive primed groups. Second, the control group regarded the importance of agentic goals as higher compared to those in the communally and competitively primed groups.

Considering these findings, one can propose a number of limitations and flaws that could be rectified for future research. One of these is that the sample may have been higher in competitiveness to begin (read: post-hoc findings) considering the competitive university context within which this study was conducted. However, in light of the failed manipulation checks that did not result in significance, the best assumption as to why this study did not produce the hypothesized results is that the priming manipulation did not work successfully.

Perhaps the essay recall task was not strong enough as a prime for our sample of older university students whose values may not be as malleable as a younger individual whose identity and endorsement of stereotypic values could potentially be easier to change. Furthermore, although participants were verbally told that they would have seven minutes to complete the writing task, the computer screen also had a timer at the bottom counting down every second. This timer may have induced unnecessary anxiety in participants and may have even incited competitiveness to "beat the clock" and finish writing.

Another aspect of the study that could be changed is the control condition itself. Many participants noted in hindsight during debriefings that writing about the forest floor (control condition) actually made them think in a more communal way. They argued that the forest is associated to nature, which shelters many symbiotic (communal-like) interactions between organisms.

Additionally, this study used the terms "values" and "goals" interchangeably throughout the instructions and various measures. It is possible that participants perceived them as distinct constructs and answered sur-

vey questions inconsistently.

Finally, it is important to note that half of the sample identified as being East Asian or of Pacific Islander ethnicities and this may in part reflect an Eastern cultural bias on the findings in terms of hegemonic ideas of masculinity and views on feminine roles.

Future Research

In line with the existing discourse, three future directions of study are proposed with an emphasis on gender and its intersections with other variables.

One fascinating line of research would be to investigate how this study and its results would differ from a developmental perspective, as alluded to earlier. Just how malleable are the values and goals of adults in university, who tend to have their future in mind? Keeping this in consideration, it would be advisable to conduct this study with men of all ages, but especially boys undergoing puberty, a period full of transitions and internal negotiations of values and beliefs systems.

Another field to investigate is how sexuality and sexual orientation may impact men's pursuit of communal roles and female-stereotypic careers. Existing non-heterocentric literature conveys that lesbian couples often equally share domestic household duties and childcare responsibilities, and they negotiate egalitarian work and vacation schedules (Dunne, 2000; Epstein, 2002; Hines, 2006). Since there is a gap in the literature on the experiences of non-heterosexual men and of men in polygamous or even polyamorous relationships in these domains, this topic would be quite interesting to explore, especially by comparing and contrasting their experiences with heterosexual men, heterosexual women, and non-heterosexual women.

Moreover, a further area of study would be to examine non-able-bodied men and their experiences with and feelings towards communal roles and female-stereotypic careers. Nario-Redmond (2010) discovered that general perceptions of able-bodied men and women are that they are independent, ambitious, and domineering-qualities very characteristic of agency and ones that are seen as high in those who engage in STEM role careers. On the other hand, their disabled counterparts are viewed by the public as being dependent and feminized. This sparks some discussion as to how much these assumptions or stereotypes actually hold true and how this translates in terms of the interests disabled men have in communal roles compared to able-bodied men. While our findings at present were unable to show a causal link between value priming and subsequent job interest, future research may offer promising insight into men and women's career preferences.

Declaration of Conflicting Interests

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

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