SFUψUJP

Simon Fraser University Undergraduate Journal of Psychology

Volume II
2015

ISSN 2368-6340 (Print)
ISSN 2368-6359 (Online)

Journal Staff

For more information: visit members.psyc.sfu.ca/ujp, or email ujp@sfu.ca

Journal layout design by Filip Kosel, Erin Fuller, and Ryan W. Carlson.

Contents

Letter from the Editor

It is with great pleasure that I introduce Volume II of the Simon Fraser University Undergraduate Journal of Psychology. The volume and quality of submissions we received for this issue have been outstanding; they stand as a testament to the effort put forth by those who made the first issue a reality. It was their vision, their patience, and their dedication that gave the SFU community the opportunity to share our knowledge with the larger world.

I thank the editors and reviewers for their tireless work on this issue; they have volunteered countless hours to reviews and revisions of each article we received, purely out of a desire to help their fellow students develop as authors and researchers. I also extend my gratitude to our faculty advisors, Dr. Kate Slaney and Dr. Neil Watson, for their support and encouragement throughout the process. I would also like to thank the Department of Psychology and the Psychology Student Union for their generous support in making this issue a reality.

I would also like to thank all of our authors, as it is your work that serves as the foundation of the Journal. While we can only print a small number of the articles we receive, the Journal team extends its appreciation to all those who submitted articles; each submission offers us a unique perspective into the human condition, and we feel honoured for the opportunity to experience these views.

Finally, and most importantly, I'd like to thank you, dear reader. The authors, editors, reviewers, and everyone else involved in creating the Journal do so to share their knowledge with you. I sincerely hope that this publication inspires you to go forth and pursue your own research; and with that, dear reader, I dedicate this volume to you.

- Filip Kosel, *Editor-in-Chief*

State and Trait Influences on Inhibition in Pre-Clinical Depression

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The cognitive symptoms of depression may be the result of the interactive effects of mood state and depressive trait factors on inhibition. Both innate (trait) and environmental (state) factors are known to be involved in depression. Previous research suggests both contribute to inhibition of emotionally valenced material. However, the use of clinical (currently depressed and remitted) populations in the literature poses a substantial problem for the study of the interaction between state and trait effects on cognitive processes. Therefore, this study used a sub-clinical population. Participants were randomly selected via the online research participation system and divided into high (BDI ≥ 9, n = 27) and low (BDI ≤ 8, n = 25) depressive trait groups. In addition a within-subjects mood induction component was used to dissociate the effects of trait and state on inhibition for valenced material. To measure inhibition for negative and positive words, participants completed the Negative Affective Priming (NAP) task. Consistent with the hypotheses, the results from a Mixed-Factor ANOVA show a significant interaction between state and trait effects. Thus, it is concluded that a reciprocal relationship between environmental and innate factors exist, resulting in depressive symptoms.

Keywords: depression, Negative Affective Priming (NAP), inhibition, mood induction

Negative content appears to be more salient to depressed individuals (Gotlib & Joormann, 2010; Phillips, Hine, & Bhullar, 2012), which indicates that unconscious priming of negative material may be occurring in depressed individuals. Consistent with this explanation, there appears to be a pattern of attentional biases unique to depression. The Negative Affective Priming (NAP) task was developed by Joormann (2004) to examine the role of inhibitory processes in depression. It requires subjects to respond to a target word (denoted by a particular colour) while ignoring a distractor word of the opposite valence (e.g., "please indicate if the blue word is positive or negative"). On some trials the target is positive, on others it is negative, and reaction times are analyzed based on the previous target valence. By subtracting reaction times on congruent (positive prime) trials from reactions times on incongruent (negative prime trials), it is possible to calculate the cost associated with previously ignoring a word of the same valence as the current target. This NAP effect indicates the strength of inhibition associated with each word type, because responding to the target requires inhibition of the distractor. This inhibition is not specific to the word presented, but rather generalizes to semantically related words. Thus, typically participants are slower to respond to a target word if it shares a valence with a previously ignored word (Joormann, 2004). However, depressed individuals do not show this expected cost for negative words (Frings, Wentura, &

Holtz, 2007; Gotlib & Joormann, 2010; Joormann, 2004), which suggests that they are unable to inhibit the negative material.

Inhibition, Negative Schema, and Rumination

A predisposition towards negative thought patterns may constitute a vulnerability towards depression. It has been proposed that a negative schema results in a lack of inhibition for negative material, which then makes negative material in the environment more salient. Consequently, more negative material enters working memory (WM), reducing the amount of space available for positive material and reinforcing the negative schema (Gotlib & Joormann, 2010). In support of this prediction, participants with high scores on the Ruminative scale of the Response Style Questionnaire (RSQ-R) showed significant inhibition of emotional material while low RSQ-R scorers showed no inhibition (Joormann, 2006). Using a 4-point Likert scale, the RSQ-R measures a person's endorsement of sad/depressed thoughts. Higher scores indicate a greater propensity to ruminate on negative material. Hence, those who tended to dwell on negative situations were less able to prevent negative material from entering WM. Of particular note, the relationship between negative patterns of cognition and rumination increased with age (LaGrange et al., 2011), which is consistent with the idea of a negative schema being continually reinforced. Interestingly, although this negative cognitive bias may predict the intensity of depressive symptoms (Carter & Garber, 2011) it does not predict the onset of depression (LaGrange et al., 2011) suggesting an interaction between an innate factor (e.g., negative schema) and some environmental trigger (e.g., negative stimuli).

State vs. Trait Effects on Depression

There is strong evidence for environmental factors playing a role in depression. For example, it is more common in isolated individuals (Sadock & Sadock, 2003), and in any given time period approximately 5% of Canadians and as much as 20% of Egyptians suffer from depression (Beshai, Dobson, & Adel, 2012). This difference may be due to political instability and the salience of conflict in Middle Eastern countries, suggesting a negative mood induction component. More importantly, depression presents differently in Middle Eastern countries. Beshai and colleagues (2012) found that Islamic patients had more somatic symptoms and fewer guilty feelings. They attributed this to cultural norms of suppressing ones emotions and externalizing guilt (compared to the Christian notion of original sin, thus internalizing guilt). This suggests that even broader situational factors (e.g., culture, religious environment, political situation, etc.) in addition to the more immediate environment (e.g., family situation, job satisfaction, social encounters, etc.) play a crucial role in determining how the internal affective state is expressed (Meyer & Hokanson, 1985).

There is evidence suggesting that innate and external factors interact. For example, higher stress levels lead to increased depressive symptoms in people who are prone to negative cognitions (i.e., the glass if half empty; Carter & Garber, 2011). Similarly, following a negative mood induction, low self-esteem subjects remembered more negative material, thus demonstrating more mood congruent recall (Joormann & Siemer, 2004). However, the model proposed by Gotlib and Joormann (2010) does not fully account for this possible interaction. More specifically it is unclear how this external factor can exert its influence on the inhibitory processes central to their model. The NAP paradigm shows a very robust NAP effect for negative words in depressive trait individuals, such that a general lack of inhibition for negative words in high trait individuals compared to controls is found (Frings et al., 2007; Gotlib & Joormann, 2010; Joormann, 2004) However, several problems exist with the operational definition of *high depressed trait*. Firstly, using a clinically depressed population is problematic since an ongoing depressive episode is not simply an effect of innate factors (disease diagnosis), but there is also an ongoing environmental component (severity of symptoms). This is due to a tendency to withdraw from the world, which translates into less engagement in pleasurable activities (Veale, 2008). Thus, their world becomes progressively more negative, which acts as a constant negative mood induction.

The fact that Positron Emissions Tomography (PET) data show similar brain regions are activated in remitted patients following a negative mood induction and currently depressed individuals (Liotti, Mayberg, McGinnis, Brannan, & Jerabek, 2002), suggests that the remission stage of the disorder is in fact the depressive trait with state effects removed. However, these populations show highly mixed results on the NAP task. Joormann (2004) showed no negative priming for negative words in the previously depressed groups. However, the remitted group in Gotlib and Joorman (2010), showed the exact opposite. In addition, remitted patients seem particularly affected by environmental cues (Harkness, Jacobson, Duong, & Sabbagh, 2010; Scher, Ingram, & Segal, 2005). Consequently, when a self-referential component was added to the NAP task, inhibition for negative words was further reduced in the previously depressed group (Joormann, 2004). Therefore the mixed result may be due to the depressive trait and mood state being conflated in some studies but not in others. Thus, this population does not provide the necessary control needed to properly examine the state-trait interaction in inhibition.

The Current Study

To simulate this interaction within the laboratory a mood induction paradigm devised by Goeleven, De Raedt, and Koster (2007) was superimposed on the NAP task as described by Joormann (2004). Thus, two specific questions could be addressed: 1) is there a similarly robust effect of mood state as there is for depressive trait on inhibition as measured by the NAP task? 2) Is the interaction between trait and state evident when these factors are not confounded as they are in clinical populations?

Three a priori hypotheses were generated based on previous research: 1) the effect of depressive trait found in the original Joormann (2004) paper would also be found. Thus, the high depressed trait (H-BDI) group would show a reduced overall NAP effect for negative words compared to positive words, 2) the low depressed trait (L-BDI) group would show a reduced NAP effect for both positive and negative words (Pnap and Nnap) following the positive mood induction (based on findings by Goeleven et al., 2007), and 3) that an interaction between depressive trait and mood state would exist. If this is true then not only would trait influence the material entering WM, but mood state would also have an effect. Specifically it was hypothesized that in the H-BDI group, the positive mood induction would reduce inhibition for positive material (decreased Pnap), while the negative mood induction would further reduce inhibition for negative material (decreased Nnap).

Methods

Participants

A total of 56 undergraduate students at Simon Fraser University, with normal or corrected to normal vision, received course credit for their participation. A BDI cut-off of 9 was used to split subjects into L-BDI (BDI $\leq$ 8) and H-BDI (BDI $\geq$ 9) groups. This cut-off has no clinical significance, but represented a logical split between two clusters of BDI scores in the current sample. Four participants were dropped from the analysis due to extremely low accuracy. Thus, the final analysis included 27 H-BDI (females n = 22, males n = 5, average BDI = 14, average age = 20) and 25 L-BDI (females n = 20, males n = 5, average BDI = 4, average age = 20) individuals. Students with a history of depression or anxiety (as reported on the medical questionnaire) were excluded from the study to avoid any unnecessary distortions of the results. It should be noted that for ethical and practical reasons subjects were not excluded based on ethnic and linguistic background. Instead, subjects with less than 60% accuracy on all words types were excluded.

Materials

Words were selected from the Affective Norms for English Words (ANEW) database. A total of 64 positive and 64 negative words were selected based on valence rating, and controlled for length and arousal rating. Words with a valence rating above six were considered for the positive list, and words with a valence rating below four were considered for the negative list. Words that may be associated with fear (such as snake, serpent, spider, etc.) were excluded from consideration. The final lists had an average valence of 7.54 (SD = .48) for positive words and 2.55 (SD = .66) for negative words. Average word length was 6.55 characters (positive = 6.80, negative = 6.30), while average arousal rating was 5.40 (positive = 5.60, negative = 5.20). T-Tests showed that positive and negative words did not significantly differ with regards to length (p = .68) or arousal (p = .88).

BDI-II. The Beck Depression Inventory-II (BDI-II) is used to measure the severity of depressive symptoms during the preceding two weeks. It consists of 21 multiple choice questions worded such that it reflects phrases often used by depressed individuals to describe their own symptoms. The BDI-II was used to assign participants to either the L-BDI or H-BDI groups.

PANAS-SF. The Positive Affect and Negative Affect Scale –Short Form (PANAS-SF) is a short 10-item questionnaire designed to measure a person's current mood state. This was used to document the current mood state prior to completing the NAP task.

STAI. The State-Trait Anxiety Index (STAI) is a 40-item anxiety scale consisting of trait anxiety and state anxiety subscales. This was used simply to collect independent measures of state and trait anxiety, to further describe the sample.

Design

The computerized NAP task was completed in a quiet, secluded room containing only a cathode ray tube (CRT) monitor and a few tables. The task was controlled from a computer in the next room to avoid unnecessary distractions. The same monitor was used for all subjects, who were positioned approximately 60 cm from the screen.

During the task participants saw a fixation cross appearing for 500 ms, alternating with response slides containing two words. Response slides remained on screen until the subject responded (see Figure 1). Letter dimensions were approximately 1 cm x 1 cm, and words were presented 1 cm apart in the centre of the screen. Each slide contained both a red and a blue word indicating which word was to be ignored and which was to be attended to. The attended colour was counterbalanced such that half of the participants attended to the blue word and half attended to the red word. The colour was independent of valence. Hence, though each slide always contained both a positive and a negative word, the status as either target or distractor was randomly assigned. Each trial was analyzed relative to the valence of the previous target since each slide primed the subsequent slide. Thus, there are two positive prime conditions where the target valence corresponded to the previous target valence and two negative prime conditions where they were incongruent. The order of the four conditions was randomized, with the proviso that each appeared 32 times in each block. Thus, each block contained 128 trials for a total of 384 experimental trials and 16 practice trials. Reaction time and accuracy of responses to the target

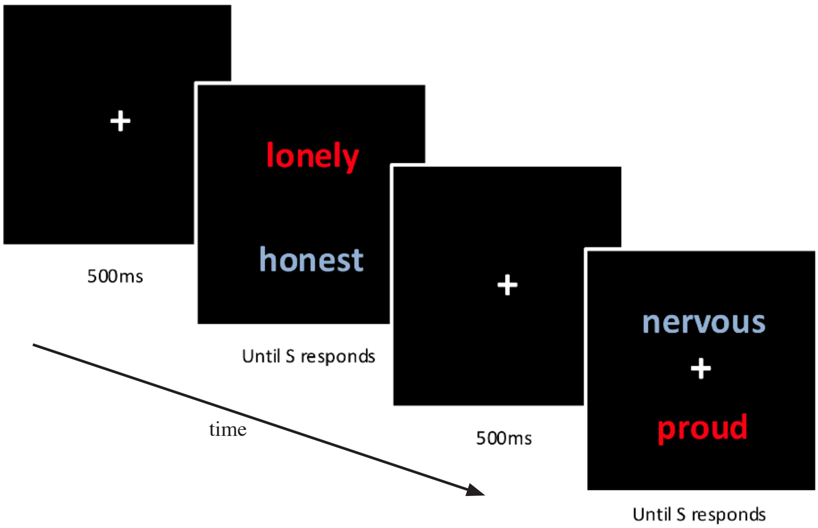

Figure 1. Example of the NAP task. Subjects respond to each set of words. Thus each slide is both a probe for the previous slide as well as a prime for the next. The first slide of each block was discarded from analysis as no priming occurred prior to its presentation.

word were recorded with button click.

Videos were used as a mood induction at the beginning of each block. These were matched for length (~3 min each) and featured light verbal interaction between characters. Thus, the only significant difference was valence. The block order was counterbalanced such that half of the subjects received negative first and half positive first with the neutral mood block always presented in the middle to establish a baseline and remove any residual effects of the initial mood induction. At the beginning and end of each block participants were asked to indicate how they felt on a 7-point scale, with 1 being *very sad*, and 7 being *very happy*. This served as a manipulation check to determine the strength and duration of the mood induction.

Procedure

Informed consent was obtained from all participants, after which they completed the BDI-II, a medical history questionnaire, and the PANAS-SF. They then received a set of instructions for the NAP task. Subjects were not made aware of the priming aspect of the study. Following these instructions, participants completed 16 practice trials, before proceeding with the main experiment. Following the experiment, participants were asked to complete the STAI, before being debriefed.

Statistical Analysis

A mixed-factor analysis of variance (one between-factor and two within-factors) was performed on the self-report ratings of mood state following the positive and negative mood inductions to confirm the effectiveness of the inductions. T-tests were conducted on each of the demographic variables to compare the H-BDI and L-BDI conditions on relevant details.

A second mixed-factor analysis of variance (one between-factor and 3 within-factors) was conducted on the reaction times. This was done to determine the differences in response times to positive and negative words on positive priming vs. negative priming trials, depending on which mood induction preceded the block for the H- and L-BDI groups. Two follow-up within-factor analysis of variance tests

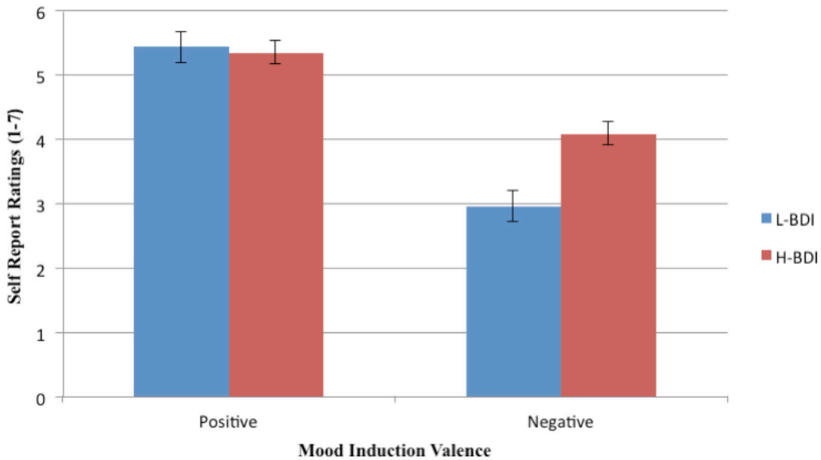

Figure 2. Interaction between mood induction valence and BDI group. The high BDI group reported being much more affected by the negative mood induction than the low BDI group.

were conducted with the between-factor (group) removed to examine the interactions in more detail. T-tests were also conducted comparing the overall Nnap and Pnap, as well as Nnap and Pnap within each mood induction for the H- and L-BDI groups. The probability level for significant effects was set at $\alpha = .05$ for all tests.

Results

Mood Induction Analysis

A global, mixed-factor ANOVA conducted on the self-report rating of mood state following the mood inductions showed main effects for mood induction and time, $F(1, 50) = 63.94$, $p < .001$, and $F(1, 50) = 78.99$, $p < .001$ respectively. Thus, participants responded more strongly to the positive mood induction compared to the negative mood induction (5.4 ± .13 vs. 3.53 ± .17). They also reported higher values immediately following the mood induction compared to after completing the block (4.99 ± .11 vs. 3.94 ± .12). This suggests that people were more willing to endorse the positive mood compared to the negative mood and the effect of the mood induction declined towards the end of the block.

A main effect for BDI group was also evident, $F(1, 50) = 7.21$, $p = .01$. The H-BDI group seemed to be more affected by the mood inductions compared to the L-BDI group (4.72 ± .14 vs. 4.2 ± .14). This was corroborated by a statistically significant Mood Induction x Group interaction, $F(1, 50) = 6.82$, $p = .012$, $p\varepsilon^2 = .12$. Means for the positive mood induction did not differ between the H- and L-BDI groups (5.35 ± .18 vs. 5.44 ± .19). However, the H-BDI group reported being much more affected by the negative mood induction than the L-BDI group (4.09 ± .24 vs. 2.96 ± .19). This difference is illustrated in Figure 2.

RT Analysis

The global mixed-design ANOVA returned main effects of Trial type and Word type, $F(1, 50) = 13.83$, $p < .001$, and $F(1, 50) = 39.44$, $p < .001$, respectively. The former confirmed that the NAP task worked as expected, with participant taking on average 23.54 ms longer to respond to emotional words after attending to a word of the opposite valence on the preceding trial (negative priming) relative to attending to a word of the same valence (positive priming) (874.12 ± 21.26 ms vs. 850.58 ± 19.67 ms). The Word type effect was due to participants being on average 50 ms slower to respond to negative than

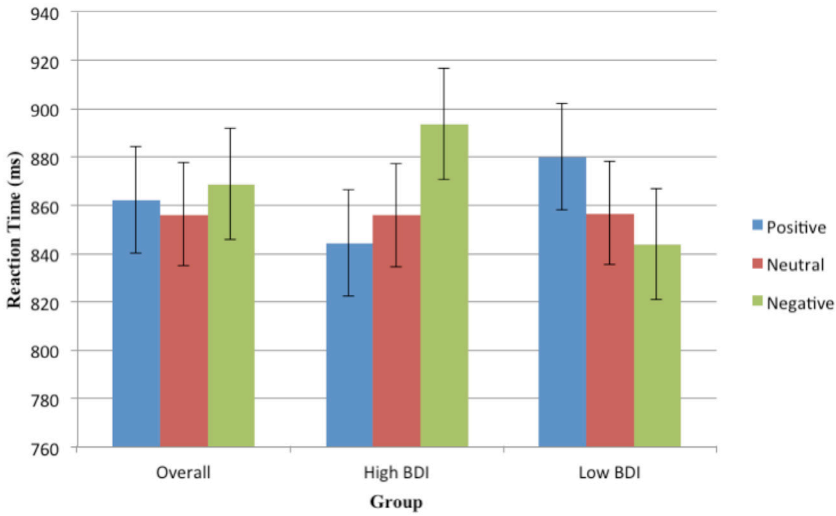

Figure 3. Main effects for mood induction across groups. Note the inverse effects of mood induction in the H-BDI vs. L-BDI groups.

to positive words (887.37 ± 22.34 ms compared to 837.33 ± 18.75 ms) independent of Trial type or Group. The main effects of Mood Induction and Group were not statistically significant, $F(2, 100) = .34$, $p = .71$, and $F(1, 50) = .012$, $p = .91$.

The statistically significant main effects were qualified by a number of interactions. Of particular interest here are the interactions involving BDI group. First, Mood Induction x Group was statistically significant, $F(2, 100) = 4.05$, $p = .020$, $p\varepsilon^2 = .075$. This took the form of a state-dependent emotional interference effect with the H-BDI group being slower while in the sad state relative to the happy state (893.58 ± 31.77 ms vs. 844.29 ± 30.28 ms), while the L-BDI group was slower while in the happy state relative to the sad state (880.11 ± 31.47 ms vs. 843.81 ± 33.01 ms; see Figure 3). The neutral induction yielded very similar responses across groups (856.55 ± 30.77 ms vs. 855.77 ± 29.61 ms). This effect was best captured after computing a "state emotional interference index" (S-EI) as the mean difference between Sad Mood and Happy Mood RT in the H- and L-BDI groups (43.33 ± 121.42 ms vs. -29.87 ± 133.17 ms), $t(51) = 2.04$, $p = .046$.

Neither the 2-way Word type x Group nor the 3-way Trial type x Word type x Group interactions were statistically significant, $F(1, 50) = 3.80$, $p = .057$, $p\varepsilon^2 = .071$, and $F(1, 50) = 3.65$, $p = .062$, $p\varepsilon^2 = .068$ respectively, most likely due to insufficient power. However, there is some evidence suggesting that the word valence asymmetry differed across BDI status and that Negative Priming differed as a function of word valence and BDI Group, supporting the second hypothesis of this study. None of the other interactions approached statistical significance. In particular, the 4-way interaction of Mood Induction x Trial type x Word type x Group was not statistically significant, $F(2, 100) = 1.57$, $p = .21$, $p\varepsilon^2 = .030$.

In order to explain some of the above group interactions, and bring support to our hypotheses, restricted ANOVAs were carried out in each BDI Group separately.

The ANOVA conducted in the H-BDI group showed the main effect of Mood induction was statistically significant, $F(2, 52) = 3.21$, $p = .049$, $p\varepsilon^2 = .11$, although the contrast between Sad and Happy mood induction did not attain statistical significance as a paired t-test (893.58 ± 36.12 ms vs. 844.29 ± 24.76 ms, $t(26) = .42, p = .52$). As expected, the main effects of Trial type and Word type were statistically significant, $F(1, 26) = 7.74, p = .010, p\varepsilon^2 = .23$ and $F(1, 26) = 28.48, p < .001, p\varepsilon^2 = .52$, respectively, confirming the presence of a general NAP effect (on average 28.1 ms) and the valence asymmetry with slower RTs to negative words (on average 65.59 ms). More importantly, the interaction Trial type x Word type was statistically significant, $F(1, 26) = 7.04, p = .013, p\varepsilon^2 = .21$. There was no difference in RT to negative words regardless of the trial type (positive prime = 895.59 ms, negative prime = 899.09 ms). However reaction times were faster on positive prime trials than on negative prime trials (805.44 ± 25.06 ms vs. 858.07 ± 26.21 ms). This interaction effect was better captured after separately calculating a NAP score (difference in RT between negative prime and positive prime trials) for Positive and Negative words as previously done in the literature. Consistent with our hypothesis, H-BDI participants had significantly greater NAP scores for positive than negative words, Pnap: 52.63 ± 12.24 ms; Nnap: 3.50 ± 15.00 ms, $t(27) = 2.65, p = .013$. In other words, it is difficult for high depressed trait individuals to switch attention away from previous negative target word in order to respond to a current positive word, resulting in a sizable negative priming effect to positive words. In contrast, there is no cost associated with switching attention away from a previous positive target word to a current negative word, resulting in a negligible NAP for negative words.

Finally, the Mood Induction x Trial type x Word type interaction was not significant, $F(2, 52) = 1.25, p = .29, p\varepsilon^2 = .046$. While the hypothesis of an influence of mood induction on the size of the NAP effect was not supported, inspection of the data suggest that the effect may be present, however it may be more complex than anticipated. In particular, Figure 4 shows that, consistent with the hypothesis, in the sad mood state a facilitation effect was present for negative words (Nnap = -13.98 ms), while in the positive mood state the Pnap was reduced (Pnap = 40.34 ms). However, the positive mood state also reinstated the Nnap (Nnap = 22.21 ms), which contradicts the hypotheses. Regardless, it appears that there is an effect of mood induction that interacts with BDI group, but this effect was too weak to yield a significant three-way interaction, likely due to lack of power (see Figure 4).

The ANOVA in the L-BDI group showed the main effect of Mood Induction was not significant, $F(2, 48) = 1.34, p = .27, p\varepsilon^2 = .053$. However, the main effects of Trial type and Word type were significant, $F(1, 24) = 6.66, p = .016$ and $F(1, 24) = 12.15, p = .002$, respectively, confirming the presence of global negative priming effect (NAP: averaging 16.03 ms) and the faster overall RTs to positive than negative valence words (842.90 ± 28.21 ms vs. 877.41 ± 29.61 ms).

However, unlike the BDI group, there was no significant Trial type x Word type interaction, $F(1, 24) = .015, p = .90$. When NAP scores for each emotional valence were calculated, there was no difference between Pnap and Nnap scores (Pnap: 20.01 ± 9.04 ms; Nnap: 18.05 ± 12.49 ms, $t(24) = .12, p = .90$, suggesting that the L-BDI group experienced the same degree of negative priming for positive and negative valenced words.

Finally, the 3-way interaction of Mood Induction x Trial type x Word type was not significant, $F(2, 48) = 1.11, p = .34, p\varepsilon^2 = .044$. However, the relationship between the Nnap and Pnap was inverted in the negative mood induction compared to the positive mood induction. This suggests that mood induction did have an effect on the L-BDI group, however the manipulation may not have been strong enough to detect a difference.

Discussion

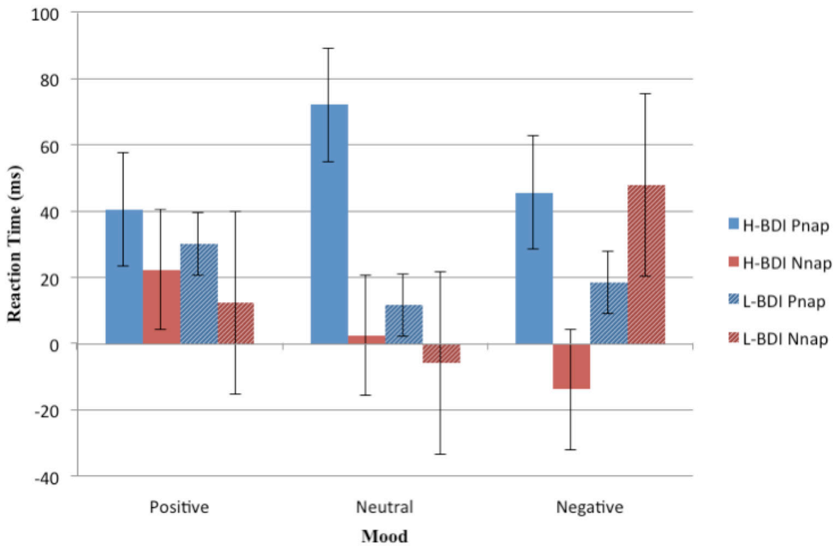

Figure 4. Main effects for NAP across groups. The Nnap effects in the H-BDI group show the expected pattern of results, although these effects are not significant. However, the difference between the Nnap and Pnap in the neutral condition was significant.

The hypothesis that the H-BDI group would show less inhibition for negative words than for positive words was supported. A t-test confirmed that the overall Nnap was significantly reduced compared to the overall Pnap in the H-BDI group. This is in line with previous research that consistently shows decreased inhibition for negative words in high depressive trait individuals (Frings et al., 2007; Joormann, 2006). In particular this replicates the results from the original NAP study by Joormann (2004) suggesting the criterion used to split subjects into the H-BDI and L-BDI groups was appropriate.

No main effect for mood induction was found in the L-BDI group. Thus, the prediction that the positive mood induction would decrease inhibition for all material in the L-BDI group was not supported. A visual inspection of the NAP effects in the L-BDI group confirm that contrary to the results found by Goeleven et al. (2007), the expected reduction in Nnap and Pnap was not present. However, there appeared to be an inversion of the NAP effects between the positive and negative mood inductions (see Figure 4) suggesting the mood induction did have an effect on inhibition, though the manipulation may not have been strong enough to produce statistically significant results. This pattern is consistent with results from Gotlib and Joorman (2010) that showed the inverted Nnap and Pnap in the remitted group compared to the never depressed group. However, care should be taken when comparing clinical and non-clinical populations. The authors suggested that individuals in remission are engaging in compensatory behaviour to negate their negative affect. Similarly, the L-BDI group in the present study may be combatting the negative mood state induced by the negative mood induction. Interestingly, results from the H-BDI condition corroborate this interpretation. The significant interaction between Word type and Group showed that H-BDI individuals were faster to respond to positive words than the L-BDI group, suggesting they may be compensating for the negative bias associated with high depressive trait.

The third hypothesis was not supported. The Group x Word type x Trial type x Mood Induction interaction was not significant, possibly due to a lack of power. However, several results suggest that mood state and depressive traits interact. For example, no main effect for mood induction was found, suggesting the positive and negative mood states affected the H- and L-BDI groups differently. Also, both groups showed mood congruent interference. Thus, the H-BDI group was slowest following a negative mood induction, while the L-BDI group was slowest following a positive mood induction. It appears that trait (either H-BDI or L-BDI) determines what material enters WM resulting in mood congruent rumination. This is consistent with the schema-based model proposed by Gotlib and Joormann (2010) as well as the mood congruent memory bias associated with depression (Joormann & Siemer, 2006). In addition, a significant Mood x Group interaction was evident in the analysis of the mood induction ratings indicating that the H-BDI group responded more strongly to the negative mood induction than the L-BDI group. More importantly however, a visual inspection of the NAP data showed the expected pattern of results was present in the H-BDI group. The Nnap is reduced following a negative mood induction but increased following the positive mood induction, while the Pnap was reduced following the positive induction, compared to the neutral and negative inductions (see Figure 4). This indicates that the positive induction reduces inhibition for positive material, which allowed more positive material to enter WM. With more positive material in WM, there is less space for negative material. This results in more inhibition for negative material, decreasing the amount of negative material entering WM.

Based on these results it was concluded that the modifications to the 3-Factor Model are warranted since the individual's schema and their environment both contribute to the amount of inhibition for valenced material, and consequently what enters WM. However, the lack of a main effect for mood induction in the presence of the robust effect for group does indicate that mood state is the less important factor in this interaction. The manipulation may simply not have been strong enough to produce noticeable effects. Research shows that previously depressed individuals are more susceptible to the effects of a mood induction (Harkness et al., 2010). Thus, with a weak induction it is no surprise that only the H-BDI group was affected. Consistent with this explanation, only the H-BDI group showed a main effect for mood induction. The H-BDI group also rated themselves as more sad after the negative mood induction compared to the L-BDI group. Therefore, given that the pattern of NAP effects is consistent with the proposed interaction, using a stronger manipulation such as autobiographical memories might produce stronger results.

This interaction may explain the efficacy of various treatment options. Many therapeutic approaches centre on increasing the amount of positive material a person is exposed to (i.e., behavioural activation, laughter therapy). For example, behavioural activation (BA) encourages individuals to engage in pleasurable activities such as the exercise of socializing (Hundt, Mignogna, Underhill, & Cully, 2013). BA focuses less on the internal causes of depression (Turner & Leach, 2012), and instead takes a pragmatic approach, identifying specific avoidance behaviours and providing specific solutions (Veale, 2008). Oftentimes these solutions revolve around changing behavioural patterns, and thus changing the contextual factors influencing the individual's affective state (Turner & Leach, 2012). This requires a permanent change in lifestyle, suggesting that it acts as a constant positive mood induction. BA is almost as effective as cognitive behavioural therapy (CBT) and continued medication at a 2-year follow-up (Dobson et al., 2008) and acts on similar regions in the prefrontal cortex as CBT (Dichter, Felder, & Smoski, 2010). However, as with pharmacological treatment regimens, BA is only effective as long as a person continues with the treatment (Dobson et al., 2008), and it is only with adjunct therapies (such as CBT) that an individual truly enjoy the long-term benefits of treatment (Dobson et al., 2008; Huijbers et al., 2012; Padesky & Greenberger, 1995; Siddique, Chung, Brown, & Miranda, 2012). The current study suggests that this mood induction component may be crucial to the treatment of depression, since it temporarily relieves the individual from the negative ruminatory cycle.

CBT takes this one step further and aims to permanently change a person's maladaptive thoughts and actions by training them in more adaptive ways that they can then employ outside the therapeutic setting (Padesky & Greenberger, 1995) In addition to engaging in more positive activities (Corsini, 1984), clients are guided to recognize the maladaptive nature, origin, and consequence of current patterns (Phares, 1984; Richardson & Marshal, 2012). The behavioural component acts as a positive mood induction, providing a window wherein cognitive treatment can be effective in producing long-term effects. This dual action immediately reduces depressive symptoms, as well as protects against relapse (Feng et al., 2012). Thus, the efficacy of CBT lies in the fact that it targets both the negative schema and the negative mood that is conflated in depressed individuals.

Limitations with the study design suggest a degree of caution should be taken when considering these conclusions. Firstly, to avoid conflating currently and previously depressed populations with depressed traits, the low cut-off for the H-BDI group (≥ 9) was used. However this divide reflects depressive tendencies, and not depression as a disorder. For that reason, without knowing how these high trait individuals relate to currently and previously depressed persons, the generalizing of results to the clinical population may not be warranted. It follows from Gotlib and Joormann's (2010) model that there is a positive correlation between the severity of depressive symptoms (particularly cognitive ones) and the negativity of their schema. This would obviously distort incoming information, and thus distort how the individual perceives the mood induction. Future research should examine this interaction in clinical populations to determine to what extent these results are generalizable.

Secondly, the mood inductions used in this study also prevent generalizing the results to the therapeutic situation. The use of videos may not provide a strong enough induction and is not consistent with the types of behavioural changes required of people in therapy. Exercise and social interaction are both much stronger manipulations than watching a brief video clip. Thus, in order to fully determine if the behavioural or pharmaceutical components of therapy do act as a positive mood induction and produce the same effects as is suggested by this study, other mood induction paradigms should be studied. Specifically, paradigms that correspond to therapeutic approaches (e.g., laughter, exercise, social activities, etc.) need to be examined.

Lastly, there is also a logical inconsistency in the original paradigm as developed by Joormann (2004). It requires subtracting reaction times on control trials (which are in fact positive priming trials) from reaction time on negative prime trials. This could lead to an unnatural inflation of the NAP effect. Also, since there are always a positive and a negative word on the screen, the effects of positive and negative words are never truly independent of one another. Thus, it is impossible to fully distinguish between inhibition and priming effects for positive and negative words. The use of neutral words has been adopted by several researchers (e.g., Gotlib and Joorman, 2010), although for simplicity they were not included in the present study. Future research should include neutral words to completely differentiate between inhibitory effects for positive and negative words.

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Being Uniquely Nice: Feelings of Liking and Belonging can Increase Tips

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Tips constitute a large portion of servers' total income, and as such, understanding which behaviors increase tips is of great concern to service providers. Past research indicates that server-diner interactions effectively increase tips, but here we explore whether different types of interactions matter. We investigate whether preferential treatment leads to larger tips, and if feelings of liking and belonging mediate the relationship. Participants were randomly assigned to read one of four scenarios: the participant's table was either told a joke, heard the same joke told to another table, both tables heard the same joke, or neither table heard the joke. Participants treated with preferential treatment (*unique niceness*) – where only their table was told a joke and others were not – reported intentions to leave larger tips. Results support our hypothesis that unique niceness increases tips, but did not support our prediction that feelings of liking and belonging mediated the relationship.

Keywords: unique niceness, server, tipping, liking, belonging

Individuals who have had dining experiences might recognize moments where they made a connection with their server, and as a result tipped more than usual. We questioned whether specific factors might impact a diner to leave a larger tip. We predicted that creating a unique connection with the server might play a role. In North America, tips account for a large percentage of servers' total income – almost 100% in several U.S. states where hourly wages pay only enough for income taxes (Lynn, 2003a). As such, it is important for service providers to understand the determinants of tipping behaviour. In our study, we explored whether preferential treatment (*unique niceness*) increases tip sizes, and if greater feelings of liking and belonging generated by a unique connection might mediate the relationship.

Several studies suggest that a multitude of factors influence tipping behaviour. According to Lynn (2003b), service quality only accounts for 2% of the variability, implying that there are other reasons besides service quality that might impact tipping behaviour. For instance, evidence suggests that levels of sunshine outside were significantly related to patrons' gratuity (Cunningham, 1979). Similarly, servers that merely forecasted sunny weather the next day by writing, "[t]he weather is supposed to be really good tomorrow. I hope you enjoy the day!" on the back of diners' cheques experienced an 18% increase in their tips (Lynn, 2003a). Other findings indicated that when female servers would touch customers on the face of the palm or shoulder (Crusto & Wetzel, 1984), or write "thank you" on the bill before handing it to customers (Rind & Bordia, 1995), customers would leave larger tip percentages than without these actions.

Although the above areas appear to lead to moderate increases in server's tips, the highest increase in tip percentages appear to be related to server-diner interactions that foster a sense of interpersonal connection, such as servers' smiling at their customers. Researchers have found that strengthening interpersonal connection can increase tips by 140% (Lynn, 2003a). Smiling creates an opportunity for friendly interactions between the server and diner (Bujisic, Wu, Mattil & Bilgihan, 2014); however, diners must interpret servers' smiles as authentic for this behaviour to show an increase in tips (Kraut & Johnson, 1979). Studies examining servers' authentic positive display of Duchenne smiles — smiles that engage muscles around the mouths and eyes — revealed that customers had greater positive impressions of the service provider and higher overall satisfaction with the encounter (Grandey, Fisk, Mattila, Jansen, & Sideman, 2005; Lynn, 2003a). These studies emphasize the important role that interpersonal connections can play within server-diner interactions as a means to increase tips.

We speculate that servers' ability to elicit a sense of connection in server-diner interactions may hinge upon customers' feelings of belonging and liking. Baumeister and Leary (1995) posit that the need to belong is an innate drive that motivates humans to form enduring positive relationships with others. Humans seek frequent, enduring, stable, and caring relationships with others. This need to form social bonds is pervasive and affects both emotion and cognition. For instance, researchers found that participants who have been manipulated to feel socially rejected (i.e., told they would be alone in the future) were less likely to engage in prosocial behaviour such as donating money, volunteering time, cleaning up after an accident, or cooperating in a game (Twenge, Baumeister, DeWall, Ciarocco, & Bartels, 2007). Moreover, anxiety ensues when people experience or imagine social rejection, which further demonstrates how the need to belong is intrinsic to the human condition (Baumeister & Leary, 1995). Even at a minimal level during transient service encounters (e.g., buying coffee), social interactions have been shown to increase people's sense of belonging (Sandstorm & Dunn, 2013). Considering these previous studies, the innate need to belong may also drive the relationship between server-diner interactions and tipping behaviour.

Given Baumeister and Leary's (1995) notion of the innate human need for belonging, we speculate that unique niceness (i.e., preferential treatment) will make diners feel that they are uniquely connected with the server. In turn, this unique connection will increase customers' liking for their server and temporarily meet their need for belonging, and that feeling of connection will lead to larger tips. To test this idea, we had participants read one of four hypothetical dining situations to see how they would differ on ratings of liking for their server, feelings of belonging, and tip size. In our study, unique niceness was operationalized as the hypothetical server telling a joke at the participant's table, while surrounded by other customers at different tables who were not told the joke. This unique niceness condition was compared to three other conditions where participants were not treated with unique niceness. Participants were then examined to see whether reading about a scenario where they are treated with unique niceness would influence their reported tip sizes.

Methods

Participants

A total of 200 individuals (M_{age} = 21.74, *SD* = 5.27, 48% female) on the Simon Fraser University campus participated in this study in exchange for either one or two snack-sized chocolate bars or twenty-five cents. One participant was considered a significant outlier, responding five standard deviations above the mean on our key dependent variable. His information was excluded from the data, leaving a final sample of 199 individuals (M_{age} = 21.74,

SD = 5.27, 48% female).

Procedure

Participants were approached in public areas and invited to participate in a psychological study investigating interpersonal interactions. If participants agreed, they were given a consent form and then instructed to read a short vignette and complete a one-page questionnaire. Vignettes depicted one of four randomly assigned scenarios describing an interaction between a server and two customers at a fictitious restaurant. The vignettes included the presence or absence of a joke being told by the server at the participant's table, and the presence or absence of the participant overhearing a joke being told by the server at another customer's table. This resulted in four conditions whereby either (a) no jokes were told to either tables (*both no joke*) (b) no joke was told to the participant's table, but told to another table (*unique exclusion*) (c) a joke was told to the participant's table, but not the other table (unique niceness) or (d) the same joke was told to both tables (*both joke*) (see Appendix for vignette example).

We were interested in the difference between unique niceness and the three other scenarios – whether unique niceness treatment leads to larger tips as a result of greater feelings of liking and belonging. To ensure participants understood the scenario they read, participants were first asked two questions about the scenario they read: (a) whether the server told their table a joke, and (b) whether the server told another table a joke.

Participants then completed a questionnaire where they rated their level of happiness, satisfaction with the meal, feelings of liking for the server, feeling of closeness to the server, and feeling of being cared for and belonging to the establishment. All questions were rated on 7-point Likert scale that ranged from 1 = "*Not at all*" to 7 = "*Extremely*". Participants were asked to report how much of their total bill (in percentage form) they would leave as a tip for the server. Finally, participants answered demographic questions about their gender, age, ethnicity, household income, and whether they frequently ate at restaurants (possible answers were "*yes*", "*sometimes*", or "*no*").

Results

Manipulation Check

To measure whether participants recognized whether a joke was told to their table and/or another table, we used a one-way ANOVA to examine responses to our manipulation check items. Results indicated that participants were aware of our manipulation; of the 100 participants who read they were told a joke to their table, 79% of participants confirmed they read they were told a joke, while 7% erroneously reported reading they were told a joke when they were not told one, $F(1, 197)$ = 219.55, $p < .05$. Of the 99 participants who were told they heard a joke at another table, 78% of participants correctly reported they read they heard a joke, and 13% of participants erroneously reported reading they heard a joke told to another table when the other table was not told one, $F(1, 199)$ = 144.94, $p < .05$. This suggests that most participants accurately recognized when their table or another table was told a joke. Participants who erroneously reported did not pass the manipulation check, and their data was excluded from the analysis.

Hypothesis 1: Unique Niceness Treatment Leads to Larger Tips

To investigate whether participants in the unique niceness condition said they would leave larger tips than participants in the other conditions, we conducted a planned contrast with co-efficient weights as follows: both no joke (-1), unique niceness (3), unique exclusion (-1), and both joke (-1), allowing us to determine whether the unique niceness was different than the three other conditions (see Figure 1). As predicted, our analyses revealed a significant difference between unique niceness (M = 14.46, SD = 7.14) and the three

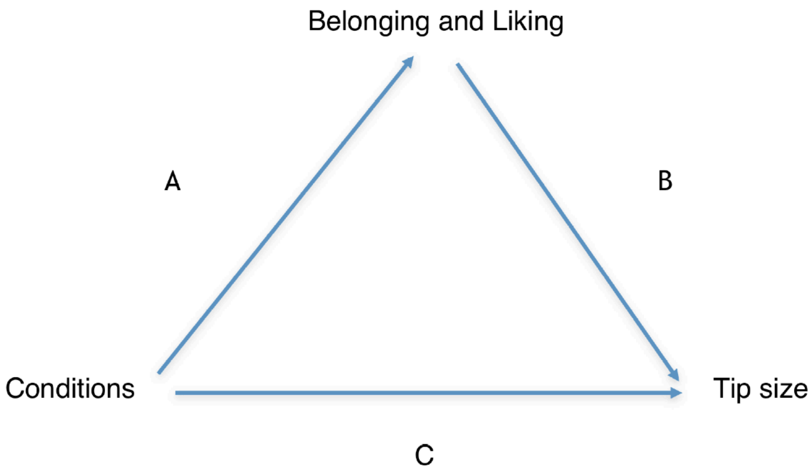

Figure 1. Proposed model between condition, liking/belonging, and tip size. This figure illustrates the different pathways under study: pathway C examines if unique niceness differ from others conditions in tips; pathway A examines whether conditions differ on levels of liking and belonging; pathway B examines whether liking and belonging correlates to tip sizes; and pathway B + C (indirect mediation) examines whether unique niceness is greater than other conditions in its relations to larger tip sizes due to greater feelings of liking and belonging.

other conditions (both no joke, unique exclusion, and both joke; *M* = 12.79, *SD* = 5.59, $F(1, 192) = 2.07$, $p < .05$). Participants who read a scenario where they were told a joke and did not overhear the same joke told to another table said they would leave larger tips than participants who did not hear a joke, heard a joke at both tables, or heard a joke told to another table but not their own. This suggests that servers' unique niceness treatment may lead to customers tipping greater amounts. Interestingly, results also indicate that participants who read they heard the same joke told to both tables (both joke) said they would tip less (*M* = 12.84, *SD* = 5.04) than those who did not read about hearing a joke at all (both no joke) (*M* = 13.6, *SD* = 4.77). Because witnessing the same joke being told to multiple customers likely comes across as disingenuous, this finding suggests that the perceived authenticity of servers' intentions to be friendly may influence reported tip sizes.

Hypothesis 2: Unique Niceness Treatment Leads to a Greater Sense of Liking and Belonging

Given the high degree of conceptual overlap between our dependent variables (feelings of liking, belonging, and closeness to the server and the establishment), we created a composite variable of liking and belonging; reliability analysis reveals Cronbach's alpha to signify variables are statistically similar (*a* = .87). To examine whether unique niceness led to a greater sense of liking and belonging than the other three conditions, we conducted a planned contrast test with the same coefficient weights as hypothesis one and compared unique niceness against the other three conditions (Figure 1, pathway A). Results indicated that the unique niceness condition, where participants read their tables were told a joke and did not overhear it told to another table, was significantly higher on the liking and belonging composite (*M* = 4.70, *SD* = .94) than both no joke, unique exclusion, and both joke conditions together (*M* = 4.16, *SD* = 1.24,

$F(1, 195) = 2.84$, $p < .05$). Our predictions were confirmed; this result suggests that our unique niceness condition is related to a greater sense of liking and belonging than the other three conditions.

Hypothesis 3: Feelings of Liking and Belonging Are Related to Tip Size

We examined whether our liking and belonging composite variable was correlated with tip sizes (Figure 1, pathway B). A bivariate correlational test revealed that tip sizes were significantly correlated with liking and belonging, $r(197) = .194$, $p < .05$. Participants who rated greater feelings of liking and belonging had a tendency to report leaving larger tips. This confirms our hypothesis, showing that greater feelings of liking and belonging are associated with larger tip sizes.

Hypothesis 4: Unique Niceness Leads to Larger Tips through Feelings of Liking and Belonging

Thus far, our analyses have shown the following: unique niceness leads to greater feelings of liking and belonging (Figure 1, pathway A) and larger tips than all other conditions (Figure 1, pathway C), and feelings of liking and belonging are significantly related to tip sizes (Figure 1, pathway B). Given these relationships, we were interested in testing whether there was an indirect mediating effect between pathway A and B. Does unique niceness result in larger tips than the three other conditions due to greater feelings of liking and belonging? We used the distributions of the product coefficients method to evaluate our mediation (Tofighi & MacKinnon, 2011), which revealed our predictions as unsupported. The indirect effect through liking and belonging was not significant, 95% CI [-0.651, 0.774], indicating that there is no indirect effect of liking/belonging on the association between unique niceness and tip size.

Discussion

The results of this study provide a preliminary understanding of how liking and belonging may influence customer-tipping behaviour. Participants who read about experiencing preferential treatment (unique niceness) did indeed have greater feelings of liking and belonging and said they would leaver larger tips than those who read about witnessing servers' treat others with unique niceness, or receiving comparable treatment with others. In addition, we found that participants who read about hearing their server tell the same joke to both tables reported tipping less than those who heard no jokes at all. Inconsistent with our predictions, analyses revealed no mediating association between the conditions and tip sizes via belonging and liking (Figure 1, pathway C). Overall, these results support the idea that preferential treatment is a beneficial strategy for maximizing tips, but only when it is truly unique.

We explored whether treating customers uniquely in comparison to other customers would influence feelings of liking, belonging, and tip sizes. Our findings are consistent with previous research on how interactions between servers and diners can increase tips, and further supports the notion that creating a unique connection is an effective strategy to generate larger tips. This research has valuable practical implications for servers, because tips constitute a large percentage of servers' total income; therefore, strategies to boost a server's income can have significant impact on an individual's livelihood. As demonstrated in our unique niceness condition, participants who read they were uniquely told a joke not only felt greater feelings of belonging and liking, but also said they would tip more than those who read about overhearing a joke told to another table (unique exclusion). Not surprisingly, our results indicate that reading about overhearing the same joke told to both tables (both joke) was related to fewer tips than not reading about joke at all (both no joke). We speculate that this is because participants who read they heard the same joke told to both tables felt the server had insincere ulterior motives for telling a joke. Thus, perceived inauthenticity of servers might undermine the effects of other server-diner interactions on tip amount. This finding is supported by previous studies about the effect of perceived authenticity of service professionals (e.g., authentic smiles) on tip sizes in server-diner interactions (Bujisic et al., 2014; Grandey et al., 2005).

However, our study is not without limitations. Data collection was confined to a university campus and is not a representative sample of the general population. Additionally, our study used hypothetical vignettes, instead of data from actual diners and servers or experiential settings, thus it lacks generalizability to real-life settings. In an attempt to counteract the limitation of our population sample, we asked participants to report if they frequently dine out and found that the majority of participants reported having experienced restaurant dining. This suggests that most participants' were likely to be informed by their relevant dining experience and might have an understanding of tipping practices. In this respect, the majority of our sample is likely similar to the general population in that we can assume they were familiar with dining norms. However, a caveat to this attempt is our lack of operationally defining "frequently" on our questionnaire, which limits how much we can gauge participants' familiarity with restaurant norms. Follow-up studies must take measure of this error.

In spite of the low external validity, using a vignette structure allowed for reliable internal validity. The use of hypothetical vignettes was important to control for extraneous variables that may have interfered with the variables under study. Future research may design studies with stronger external validity based off our preliminary evidence by extending research practices to observe actual dining experiences. It is important to recognize that our study serves as an initial investigation, and further study is needed in the area. For instance, our findings infer that perceived authenticity of servers' intentions to make a connection may be related to tip sizes. In turn, forthcoming research could build upon on our findings by investigating how feelings of belonging and liking are related to tips in respect to perceived servers' authenticity of intentions to be uniquely nice.

Though previous research indicates that various positive server-diner interactions can increase tips (Lynn, 2003a), our findings extend this notion, suggesting that servers should go beyond mere server-diner interactions and aim to build uniquely nice connections. Our results suggest that not all gestures of niceness are the same, and we speculate that perceived inauthenticity (in the form of similar, repeated interactions with multiple customers) may backlash against servers' intentions to increase the size of their tips. Thus, our study reveals that not all server-diner interactions are equal; it is better for servers to create a unique connection if they wish to maximally increase their tips.

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Appendix

Example of Vignette (Both Joke scenario) and Questionnaire

Restaurant Scenario

You have decided to have dinner with a friend at a new restaurant named "Ben's". As you enter the restaurant, the hostess smiles, greets your party and shows you to your table. Shortly after, your server comes over.

Server: "Hi, welcome to Ben's! My name is Sam and I'll be your server today."
You: "Thanks."
Server: "Here are some menus. I'll be back in a few minutes to take your order."
Server leaves and returns a few minutes later.
Server: "Hi there. Have you decided on beverages?"
Both you and your friend reply: "Just water please."
Server: "Sure, I'll be back with water in just a minute"

One minute later.
Server: "Here's your water. Have you decided what you'd like to eat this evening?"
You: "Yes, I'll have the chicken souvlaki."
Your friend: "And I'll have the salmon burger with fries please."
Server: "Great, thanks! I'll punch in your order right away. By the way, have you heard about the new restaurant that opened on the moon—good food but no atmosphere."

Your server leaves and attends to other tables nearby. Fifteen minutes later, your server returns with your food orders. You both start eating. You overhear the server talking with the table beside you.

Server: "And how was your meal? Here's the bill."
Customer: "Great, thanks! Yeah, I'll put it on credit please."
Server: "For sure! [hands pin pad over] So, have you heard about the new restaurant that opened on the moon—good food but no atmosphere."
Customer pays.
Server: "Thanks! Have a great night."

The server comes back after a while to take away your finished plates, and leaves to get the bill.

Server: "Here's your bill. Whenever you're ready…"
You pull out your wallet
You: "I'll put it on debit please."
Server: "Okay." *[hands pin pad over]*
You finish the payment.
Server: "Would you like your receipt?"
You: "No, I'm fine, thanks."
Server: "Okay. Thanks for coming."

Did the server tell a joke to you and your table? (please circle) Yes or No

Did the server tell a joke to another table? (please circle) Yes or No

How happy are you feeling right now?

Not at all 1 2 3 4 5 6 7 Extremely

How satisfied are you with the customer service you received?

Not at all 1 2 3 4 5 6 7 Extremely

How satisfied are you with your meal?

Not at all 1 2 3 4 5 6 7 Extremely

To what extent do you like the server that served you?

Not at all 1 2 3 4 5 6 7 Extremely

To what extent do you feel close to your server?

Not at all 1 2 3 4 5 6 7 Extremely

To what extent do you feel a sense of belonging at this establishment?

Not at all 1 2 3 4 5 6 7 Extremely

To what extent do you feel cared for at this restaurant?

Not at all 1 2 3 4 5 6 7 Extremely

What size tip (i.e. percent of your bill) would you give your server? This can range from 0% (no money) to 100% (an amount equal to your total bill) ________%

Gender ________ Age _______ Ethnicity _____________

Income (household income before taxes) ________

Do you eat in restaurants often? (circle one) Yes Sometimes No

Learning by Playing: Taking the Low Road and Coming out on Top

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This critical review discusses the expanding body of research showing the cognitive benefits of playing video games and seeks to establish a neurological understanding of how skill-transfer perceptual motor skills learned in video games can occur in relation to the Perceptual-Motor Skill Transfer Model proposed by Rosalie and Muller (2012). Using this model as a framework, studies examining the neural changes induced by video game are examined and their results are extrapolated upon to determine the extent to which skill-transfer can occur between video game environments and real-world tasks. Overall, research into the effects of video games on cortical areas indicates that significant changes in numerous areas related to perceptual learning and motor efficiency occur, suggesting an improvement in cognitive abilities related to these areas. Opposing viewpoints are discussed and inconsistencies in research are addressed by pointing to the conditions indicated throughout the research by which video game training regimens can be best suited to initiate the most improvement in cognition overall.

Keywords: video games, skill-transfer, cognition, attention, neuroplasticity, flow

Over the past few years, the video game industry has become increasingly popular, with the Entertainment Software Association of Canada (2014) reporting that 62% of Canadians own at least one dedicated gaming console. With the ever increasing encroachment of this expanding industry throughout Canada, it is important to consider the implications this may have on society in terms of how it can affect the cognitive abilities of gaming populations. Examining these effects will help to uncover the potential of video games for improving the performance of gaming populations on real-world tasks that also carry heavy cognitive loads. In fact, this potential has already been implemented in training programs such as in the Israeli Air Force, where video games have been shown to improve actual flight performance, prompting their military to incorporate video game trainers into their training programs before fighter pilots are brought into real planes (Gopher, Weil, & Bareket, 1994). In the laboratory, the literature has tended to report that people who play certain action video games perform better on tests of cognitive ability, such as visual motion direction discrimination and auditory tone location (Green, Pouget, & Bavelier, 2010; Kühn, Gleich, Lorenz, Lindenberger, & Gallinat, 2014; Liu, Cheng, & Huang, 2011). Moreover, research showing these improvements also suggests that cognitive processing skills acquired during video gaming are able to undergo far-transfer, where training in various video game tasks can improve performance in other cognitively demanding domains, such as laparoscopic surgery or even learning economic principles (Dobrescu, Greiner, & Motta, 2015; Giannotti et al., 2013). Some researchers are unable to replicate these effects, and due to the elusive nature of the far-transfer phenomena, the transfer observed in most other research has become a major point of contention within the field (Boot, Blakely, & Simons, 2011). One of the prevailing models explaining this transfer is that of Bavelier, Green, Pouget, and Schrater (2012). This model suggests that far-transfer is accounted for by gamers learning to make statistical inferences about the parameters of the task by drawing on previous experience within video game environments. Focusing primarily on executive functioning within the brain, the model fails to recognize significant contributions made by low-road cortical processes used in everyday cognition to make quick decisions about incoming stimuli in situations where conscious thought would be too slow, such as when reacting automatically to unexpected stimuli. The low-road processes of skill transfer observed in video game research may be facilitated by the effects of video games on areas of the brain associated with the formation of procedural memories – memories of task performance – common to both practiced and novel tasks, making for a more complete picture of how skill transfer occurs.

To briefly illustrate the manner by which subconscious processing could be responsible for far-transfer, a proposed model of how far-transfer takes place for gamers ought to be described. Rosalie and Muller's (2012) Model of Perceptual-Motor Skill Transfer asserts that skill transfer occurs when behaviour is goal-driven and performance-based, as this develops the ability of the mind to make probabilistic inferences about the likelihood of performing a successful action. Furthermore, skill transfer is dependent on anticipatory mechanisms which allow for the successful and timely application of learned skills when they are needed. Uniquely, their model also notes how skill transfer is a continuum of four variables which each contribute uniquely on a case by case basis to facilitate skill transfer. These variables include knowledge of the task at hand, the physical contexts of the task's environment, the temporal context of how quickly the task must be performed, as well as social contexts of who is present when the task is performed (Rosalie & Muller, 2012). Arguably, video games have the potential to contain all four of these variables, as flight simulator games give players knowledge of flight details, while the controller used during gaming may provide physical cues to laparoscopic surgeons using similar controllers to perform surgery. As well, the fast-paced nature of gaming environments demand that gamers are well-equipped to deal with new obstacles quickly and accurately, while the different forms of multiplayer gaming may lead to a better understanding of various social contexts. Of interest to cognitive research however, are the perceptual demands that gaming environments provide, and how exposure to these environments can affect neural substrates involved in basic cognitive processes. These are important as, when the player becomes more acquainted with one video game, the cognitive skills required to advance are reasonably able to transfer from one video game to the next, but because of the generalizability of these basic procedures, the same procedural memories stored for success in a video game environment may also be applied in the context of daily living as well.

In order to suggest that procedural memories of identical task elements can be separated from the context in which they were learned, it is worth briefly examining evidence of this in cortical studies. Specifically, in patients with damage to the medial temporal lobe, anterograde amnesia leaves the patient with an inability to form new declarative memories of facts and events (Smith, Frascino, Hopkins, & Squire, 2013). However, these patients can become quite proficient at novel tasks which they are trained to do, all the while reporting that they have no memory of the training ever having taken place (Gabrieli, Corkin, Mickel, & Growdon, 1993). This suggests that procedural memories do not necessarily need to be joined with any specific declarative knowledge of the context in which they were learned, and that procedures involved in perceiving, attenuating, and reacting to stimuli may be able to be applied outside of the context in which they were first learned. Importantly, in regards to gamers, this shows that as gamers learn procedural memories of how to respond quickly to in-game stimuli, they might then be able to apply these same procedural memories in the real world to respond quickly to real-world stimuli.

Distractor suppression, which refers to the ability to filter out task-irrelevant stimuli, is paramount to facilitating the acquisition of a new skill as it allows for complete focus on the task at hand. Therefore, video games that are able to improve distractor suppression would in turn supplement the learning of new skills in the real world by allowing the mind to allocate more mental resources to the formation of procedural memories necessary for the successful completion of the task. A model proposed by Geng (2014) defines neural mechanisms by which distractors are suppressed, allowing for some insight into the manner by which new growth occurs in the brain in response to behavioral and environmental factors. Geng (2014) proposes the existence of two different attentional pathways. These either specialize in the reactive suppression of distractors where irrelevant stimuli are attended to before suppression can occur, or in the proactive pathway wherein distractors are actively suppressed before they can be attended to. Within this model, both forms of suppression are highly reliant on the functioning of the prefrontal cortex, as well as areas of the brain which encode where to look next and where to set the attentional priority of each stimulus based on both goal-driven and decision processes. The effect of video games on these areas can be seen in training studies where increases in gray-matter volume and density are measured with Functional Magnetic Resonance Imaging (fMRI) before and after undergoing video game training regimens (Kühn et al., 2014). After playing thirty minutes a day over a two month training period, one of the areas that showed the greatest increase in volume was the right dorsal lateral prefrontal cortex (rDLPFC). The rDLPFC is a major contributor to overall executive functioning, and most notably, the rDLPFC tends to activate significantly more in response to executive functioning involving visuo-spatial tasks (Kühn et al., 2014). This is important because, as executive functioning is largely responsible for the proactive suppression of distractors in Geng's model (2014), this increase in volume in executive areas of the brain as a result of gaming is indicative of increase in the likelihood of cognitive improvement taking place. Relating this to the Model of Perceptual-Motor Skill Transfer, the effect of video games on these areas of the brain may facilitate skill acquisition by increasing amount of cognitive resources available to be used in the acquisition of new skills. As per the model, with the effective application of attentional resources, a gamer will be able to pay more attention to subtle details that may indicate incoming stimuli, rendering their anticipatory mechanisms more capable of facilitating the successful execution of previously learned skills in the context of novel tasks.

Low-road methods of far-transfer involve the automatization of domain-general procedures activated in both the context in which the skill was initially learned, as well as the new context in which the procedure is now applicable (Rosalie & Muller, 2012). To understand this however, mechanisms by which skill in video games can enhance cortical mass in areas related to in everyday cognition must be identified. Such processes are likely dependent on a large variety of brain areas including the basal ganglia, prefrontal cortex, and the visual system, as these areas are all involved in task learning to some degree (Censor, Sagi, & Cohen, 2012). Researchers looking into these areas using fMRI examined the neuroplasticity of regions associated with the functioning of working memory before and after playing fifteen, two-hour training sessions of *Space Fortress*, a game designed by psychologists for measuring skill acquisition and expertise (Lee et al., 2012; Nikolaidis, Voss, Lee, Vo, & Kramer, 2014). In particular, lateral and medial occipital areas typically involved with relating motor actions to their outcomes were shown to have a significant decrease in activation for groups that underwent video game training (Lee et al., 2012; Nikolaidis et al., 2014). This decreased activation indicates that the training had made it easier for these subjects to predict the outcomes of their actions. With less effort needed to make predictions in anticipation of incoming stimuli, video gamers may have an improved ability to form new procedural response patterns in response to novel contextual cues, enabling them to make better predictions about how to respond to real-world stimuli as a result. This ties in directly with Rosalie and Muller's (2010) Model of Perceptual-Motor Skill Transfer as it provides evidence of improved anticipatory mechanisms as a result of video game play.

Another way by which these changes could be enacted is through effects of video game training on white matter tracts. White matter is made up of myelinated axonal fibers that interconnect neurons from the various regions of the central nervous system with one another. Specifically, the white appearance of these tracts is due to the fatty myelin that wraps around each axon at regular intervals. The myelin helps to facilitate faster mental processing by insulating the neuronal fibers carrying action potentials from the soma to the synapse. In relation to video game studies, research conducted by Green and colleagues (2010) indirectly shows the effects of video games on white matter, as while the accuracy of scores were the same between gamer and non-gamer groups, reaction times of the gamers were observed to be approximately half that of the non-gamers. When, after this initial assessment, a group of non-gamers received training with an action video game, their reaction times were improved to the point of being comparable to the gamer groups. This finding suggests that while the processing capabilities of the non-gamers had not improved with training, the efficiency of the system involved had been improved drastically. Studies pointing to the effects of practice in general on white matter density show that axons have increased myelination after practicing cognitively demanding tasks (such as juggling), supporting the idea that there is an association between practicing cognitively demanding tasks and improved connectivity within the brain as a result of increased myelination (Scholz, Klein, Behrens, & Johansen-Berg, 2009). Furthermore, such changes might explain the results gathered by Green and colleagues (2010), as changes in white matter density provide a mechanism by which reaction times of subjects trained in such games could be substantially improved while maintaining the same level of accuracy. In the context of Rosalie and Muller's (2012) model, this would indicate an improved ability to respond quickly in response to temporal contexts, allowing gamers to, at the very least, keep up with fast-paced environments in the real world with complex visual inputs similar to the ones encountered in video games. By improving mental processing speeds through increased myelination, low-road processes are better equipped to deal with the sudden appearance of task-relevant stimuli, without executive control even needing to take hold.

Not all researchers agree that video game training is transferable to real-life situations. For example, Boot and colleagues (2011) argue that these changes could be attributed to a number of methodological errors found in many of the studies that show these improvements. In particular, the recruiting strategies used by video game researchers often use posters which explicitly ask for participants who play video games. These participants may feel that that they are expected to perform better than others in the experiment, leading to an improved measure of cognitive ability that occurs as a result of demand characteristics. While acknowledging the existence of studies that do make use of covert recruitment tactics, Boot and colleauges (2011) also point out that the only way to actually argue an effect of video games on cognition is to do training studies. Many training studies exist, but Boot and colleagues draw attention to the fact that control groups are difficult to generate in these experiments as the game given to control group participants may have an effect of its own on the cognitive abilities of gamers, possibly confounding the results. Such difficulties in constructing control groups are easily surpassed by using methods differentiating between casual games, which feature simple repetitive tasks, and action video games, which present gamers with complex visual environments and a wide variety of tasks that must be accounted for along differing timeframes (Bavelier et al., 2012). These casual games have been noted to improve problem solving skills in children, but in terms of perceptual-motor skills, they generally offer little benefit (Monjelat, Mendez-Zaballos, & Lacasa, 2012).

The type of game played is one of the most important factors to consider when facilitating the enhancement of cognitive skills in other domains. The research of Green and colleagues (2010) specifies that only gamers who play action video games are able to enact this change as the complex environments of action games requires the player to quickly respond to multiple onscreen stimuli. As well, action video games present the player with the threat of success or failure, based on their actions, which guides their performance and motivation for the many goals they must keep track of at any one time (Bavelier et al., 2012). These conditions are commonly present in first-person shooter games, racing games, real-time strategy games, and many others, giving a wide range to the number of games that could be classified as action video games. To succeed in these environments, one must stay focused on the task at hand while also being able to perform complex task-switching maneuvers in response to new threats that may temporarily obstruct the player from reaching their ultimate goal. This differs in kind from any casual video games, which are games where the player needs to only think through problems at their own pace, or partake in simple repetitive tasks to achieve goals (Baniqued et al., 2014). This is important to note as it provides a possible explanation for some of the inconsistencies seen in the research showing that the type of game played is vital in determining the extent to which neuroplastic changes will be actualized.

While researchers being able to say that video games make you smarter certainly sounds neat in media reports, not all studies report that video games are able to improve cognition. For example, Baniqued and colleagues (2014), after administering a training regimen of video games to a group of non-gamers, found that no skill transfer had occurred from the video game environment to tests of any cognitive ability. In fact, the scores of the group that received training were nearly identical to that of the active control group in tests designed to measure skill transfer. Another study, conducted by Erickson and colleagues (2010), looked specifically at neuroplasticity in the dorsal striatum, an area of the brain known for coding basic stimulus-response behaviour. Using the *Space Fortress* paradigm, they found that dorsal striatum volume was not altered by video game training, but that dorsal striatum volume could actually be used as a predictor for performance and skill acquisition within the game itself. This finding presents a rather interesting caveat as its implications suggest that people with larger dorsal stratums might simply be more drawn to play video games. This would imply that it is not so much the video games that improve cognition, but rather that gamers tend to be people who are already good at overcoming challenging tasks. However, considering the amount of studies where positive effects of training on far-transfer has been observed in non-gamer groups, the conditions under which training occurs must be examined more closely as it may be that certain combinations of the contextual variables listed in Rosalie and Muller's (2012) Model of Perceptual-Motor Skill Transfer may determine what training conditions are the most conducive to successful skill-transfer for certain cognitive tasks (Kühn et al., 2014; Lee et al. 2012; Nikolaidis et al, 2014).

The motivation and mental state of the player also have a significant effect on the extent to which skills are transferred to other domains. Flow states, which are classified as extreme levels of immersion and focus on a task, are usually achieved when the challenge levels of a task are at or just above the skill level of the person performing the task (Csikszentmihalyi, 1990). If the task is too difficult, the person enters an anxiety state, and if the task is too easy, the person may enter a boredom state. In a study conducted by Liu and colleagues (2011), untrained subjects underwent a series of training sessions wherein they played an action video game as their flow states were monitored. In boredom or anxiety states, Liu and colleagues (2011) noted that cognition was not improved in any of the cognitive assessment tasks. However, players who were able to achieve flow states, as indicated by self-report scales administered periodically throughout the gaming session, were able to experience any significant skill transfer after training. This suggests that future studies into the effects of video games on cognition in everyday life ought to take into account the flow state of research participants in order to determine whether or not the mental state of the players affects the extent to which far-transfer occurs.

Given the right contingencies, video games can improve cognition and help facilitate the acquisition of skills in ways that are transferable to real-world applications and implementations by supporting systems involved with procedural memory. Importantly, these improvements come as the result of neuroplastic changes in areas of the brain not only associated with executive functioning (Bavelier et al., 2012), but also in areas known to enact and assist in the processes underlying the formation and expression of procedural memory (Kühn et al., 2014; Lee et al., 2014; Nikolaidis et al., 2014). To add on, these procedural memories become instrumental in facilitating the transfer of cognitive skills from video games to real-world situations. In particular, not only are the processing capacities of these systems improved, but their efficiency may also be improved as the density and volume of the white matter tracts is increased through training in perceptually demanding tasks (Scholz et al., 2009). While certainly contingent on the presence of certain factors such as the nature of the game and the mental state of the player, far-transfer as a result of video game training seems to be entirely possible (Green et al., 2010; Liu et al., 2011). With the formation of procedural memories for motor programs that are common to both video game environments and real-world tasks, commercialized video games show promise in improving cognition in the daily lives of people.

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