Acta Psychologica 135 (2010) 252–256

Contents lists available at ScienceDirect

Acta Psychologica

journal homepage: www.elsevier.com/ locate/actpsy

The voice of self-control: Blocking the inner voice increases impulsive responding

Alexa M. Tullett *, Michael Inzlicht

University of Toronto, Department of Psychology, 1265 Military Trail, Toronto, Ontario M1C 1A4, Canada

ARTICLE INFO

Article history:
Received 26 May 2010
Received in revised form 12 July 2010
Accepted 13 July 2010
Available online 7 August 2010

PsychINFO classification:
2340 cognitive processes

Keywords:
Self-control
Working memory
Cognitive load
Attention

ABSTRACT

Philosophers and psychologists have long-debated the notion that the voice in our heads might help us to control our actions. Evidence from a number of lines of research suggests that verbal resources help us to focus attention, providing reason to believe that the inner voice might aid self-control via this capacity. In this study we explored the link between verbal resources and self-control by occupying the inner voice and then assessing behavioral indices of self-control. Participants completed regular and switching versions of the Go/No-Go task while doing verbal or spatial secondary tasks. Compared with the spatial task, doing the verbal task resulted in more impulsive responding, as indicated by a greater tendency to make a 'Go' response, a pattern that was accentuated in the switching version of the Go/No-Go. Our results suggest that the inner voice helps us to exert self-control by enhancing our ability to restrain our impulses.

Most of us face temptation on a daily basis. Giving in to these temptations can sometimes lead to detrimental consequences for both the individual and society; drug-abuse, crime, obesity, and violence can all be attributed, at least in part, to the failure of self-control (Baumeister, Heatherton, & Tice, 1994). While this may paint a pessimistic picture, people also manage to effectively control their impulses in a wide variety of contexts, an ability that is essential to successful social interaction and is arguably one of the defining characteristics of being human (Damasio, 1994). Indeed, if people were incapable of denying their impulses, many aspects of the human experience would be unattainable. For example, saving money, maintaining a healthy lifestyle, and peacefully resolving a heated argument would all be hopeless endeavours without the aid of self-control.

So, how do we resist? One possibility, long-debated by psychologists and philosophers, is that language—as implemented by the inner voice—can help us curb our impulses and allow us to pursue our most important goals. Historically, views on the nature of the inner voice have varied dramatically, with some arguing that the inner voice is nothing more than "speech minus sound" (Muller, 1864) or "sub-vocal speech" (Watson, 1919), while others maintain that inner speech is nothing less than the medium of conscious thought (Davidson, 1975; Wittgenstein, 1921). Developmental psychologist Vygotsky (1962) positioned himself somewhere between these two extremes, suggesting that the inner voice develops out of self-directed speech, and that its purpose is primarily self-regulatory. According to this view, the inner voice functions specifically to help us to control our actions.

For Vygotsky, self-control was a broadly defined ability involving the guidance of our actions in the service of a particular goal (Vygotsky, 1962). Within contemporary psychology, however, self-control can be conceptualized more specifically as the ability to overcome impulses — behaviors that are innate or have become automatic (Sherman et al., 2008). Consistent with this idea, Metcalfe and Mischel (1999) have proposed a model of control as a cognitive-affective processing system. In this model, behavior is governed by two antagonistic forces: a cognitive "cool" system that provides objective and rational decisions for action, and an affective "hot" system that drives emotional responses. In a given situation, the hot system is the foundation for the impulsive reaction, while the cool system becomes engaged when we attempt to override that impulse and pursue a different, rationally assessed course of action. It has often been suggested that two of the key capacities underlying this "cool" system are attention and working memory (Barkley, 2004; Lavie, 2000; Mischel, & Ayduk, 2004; Norman & Shallice, 1986; Rueda, Posner, & Rothbart, 2004).

Links between attention, working memory, and the inner voice are well-defined in the original Baddeley and Hitch (1974) model of working memory, which postulates three distinct capacities: the phonological loop, the visuo-spatial sketchpad, and the central executive. The first two units are traditionally thought to serve short-term storage, manipulation, and rehearsal functions for verbal (phonological loop) and visual (visuo-spatial sketchpad) information. While the authors concede "the central executive is the most complex and least well-understood component of working memory," (Baddeley & Hitch, 1994, p. 490) it is generally considered to be a multi-faceted system for providing overall attentional control. Thus, working memory is addressed in the model as a whole, attention is encompassed in the central executive, and the inner voice is

* Corresponding author. Tel.: +1 416 208 4828; fax: +1 416 287 7642.
E-mail address: alexa.tullett@utoronto.ca (A.M. Tullett).

0001-6918/$ – see front matter © 2010 Elsevier B.V. All rights reserved.
doi:10.1016/j.actpsy.2010.07.008

represented (in part) in the phonological loop. Although this conceptualization seems to portray attention and the inner voice as subcomponents of working memory, more recent investigations of these three constructs and their roles in self-control seem to suggest a less hierarchical, less compartmentalized relationship (Baddeley, Chincotta, & Adlam, 2001).

Looking broadly at the link between attention and self-control abilities, previous work has revealed that tasks that are generally distracting — those that place a large demand on attentional resources — can impair self-control, especially when temptations are made salient. In one study, restrained eaters ate more food when under high cognitive load than when under low cognitive load (Ward & Mann, 2000). Expanding on these findings, it was shown that when cues that promoted smoking were made salient, cognitive load led to increased smoking, but when available cues discouraged smoking cognitive load had the opposite effect, reducing smoking (Westling, Mann, & Ward, 2006). Along the same vein, cognitive load has also been found to increase the accessibility of suppressed thoughts (Wegner & Erber, 1992; Wegner, Erber, & Zanakos, 1993). These findings reveal the repercussions of occupying attentional resources; when distracted, people exhibit weakened abilities to control thoughts and behaviors. In other words, when the "cool" system is occupied, the "hot" system takes over. What remains to be seen, however, is whether all types of distraction are created equal. We suggest that when cognitive load occupies verbal resources specifically it may have particularly notable consequences for self-control impairment due to the interconnectedness of verbal resources, working memory, and attention.

The possibility that the inner voice might have a unique role to play in self-control processes has been hinted at by previous work. For example, one study demonstrated that blocking the phonological loop impairs the facility with which people alternate between tasks — an ability traditionally thought to be the realm of the central executive (Baddeley et al., 2001). Consistent with this work, research on stereotype threat — which taxes executive resources by inducing people to suppress their anxiety about confirming negative stereotypes about their group (Johns, Inzlicht, & Schmader, 2008) — has shown both that it can decrease self-control (Inzlicht, McKay, & Aronson, 2006) and that it specifically impairs verbal rather than spatial working memory (Beilock, Rydell, & McConnell, 2007). Findings like these reveal the interconnectedness of working memory, attention, and the inner voice, and suggest that the inner voice might thus be well situated to play a role in inhibiting impulsive behavior.

In this study, we directly examined the inner voice's role in self-control by blocking the inner voice using an articulatory suppression task. To evaluate the impact of this manipulation on self-control we assessed Go/No-Go performance when participants executed this verbal task compared to a spatial control task. Although the Go/No-Go task taps only one circumscribed form of executive control — specifically the ability to inhibit a pre-potent response — it, and other tasks like it, significantly predict broad self-control outcomes, such as academic performance (Hirsh & Inzlicht, 2010), emotion regulation (Compton et al., 2008), and problems with impulse control, such as gambling and smoking (Ellis, Rothbart, & Posner, 2004; Romer et al., 2009). In the Go/No-Go task participants can make errors of commission where they press the button when they shouldn't or errors of omission where they don't press the button when they should. Because Go trials typically outnumber the No-Go trials by a ratio of 2:1, pressing the button becomes the pre-potent response tendency. As such, researchers have sometimes used errors of commission — pressing the button when you shouldn't — as indicators of impulsive responding (e.g. Kertzman et al., 2008; Newman, 1987). A recent cognitive analysis of the Go/No-Go task, however, has indicated that a lack of behavioral inhibition is demonstrated by both high rates of commission errors and low rates of omission errors (Yechiam et al., 2006). In this analysis, the authors applied the strongest of 3 alternative cognitive models to Go/No-Go performance to calculate a parameter indicating each participant's relative attention to gains and losses. Their results demonstrated that attention to gains is positively associated with commission errors and negatively associated with omission errors. This attentional bias is characteristic of impulsivity (Barratt, 1994; Eysenck, 1993), and therefore a pattern of impulsive responding should be comprised of both lower rates of omission errors and higher rates of commission errors.

Participants in our study did each of the secondary tasks while completing a modified version of the Go/No-Go task in which they were required to occasionally switch the rules for responding. This design allowed us to treat performance on the regular version of the Go/No-Go task as a baseline in order to ensure that any effects could not be attributed solely to differences in secondary task difficulty. Since the switching Go/No-Go should occupy more self-control resources than the regular version, we expect self-control impairment to be accentuated in the switching version. Thus we predicted that the verbal task would result in poorer self-control — in this case, more impulsive responding — than the spatial task and that this effect would be exaggerated in the switching version of the Go/No-Go task.

1. Methods

Participants were 44 University of Toronto Scarborough undergraduate students. Sessions were videotaped to ensure that participants completed the tasks as instructed. Data from 7 participants were excluded from all analyses because of incorrect completion of tasks as indicated by their videotaped session ($n = 5$), or excessive numbers of errors ($zs > 2.4$; $n = 2$). Thus, 37 participants remained (19 females; mean age = 20.92). We used a 2 (Go/No-Go version: normal vs. switching) × 2 (secondary task: verbal vs. spatial) × 2 (error type: commission vs. omission) within-subjects design.

Participants completed the Go/No-Go task four times — once for each combination of Go/No-Go version and secondary task. For the verbal secondary task (i.e. articulatory suppression), participants were instructed to say the word "computer" repeatedly, a modification of the task used by Baddeley et al. (2001, study 6) which required participants to repeat the word "the." This task was chosen because it involves constant verbalization, and consequently ties up verbal resources and prevents people from using their inner voice (Baddeley et al., 2001; Newton & de Villiers, 2007; Hermer-Vazquez, Spelke, & Katsnelson, 1999). Our spatial secondary task was modified from Baddeley et al. (2001, study 5) in which participants tapped four wooden pegs in sequence. Because we considered the tapping motion too similar to a button press, we instead asked participants to continuously draw circles with their non-dominant hand — a similar repetitive task that would not occupy verbal resources (Baddeley et al., 2001). As an additional check on the comparability of these two secondary tasks, video recordings were coded to assess secondary task performance with respect to the number of pauses, duration of pauses, apparent difficulty, and effort. Secondary tasks were done concurrently with the Go/No-Go tasks. The order in which participants did the secondary tasks was counterbalanced across participants, with the order of Go/No-Go version randomized for each secondary task.

Performance on the two versions of the Go/No-Go task was the main behavioral dependent variable. Two versions of the Go/No-Go task were used in order to allow us to observe how each secondary task affects performance in baseline conditions (the normal version) and in conditions of increased self-control demand (the switching version). This design allowed us to account for any baseline differences in error rates that might indicate differences in secondary task difficulty. Stimuli for the normal version were yellow squares and purple squares. Participants were instructed to press a button when they saw a yellow square (a Go trial) and to refrain from pressing a button when they saw a purple square (a No-Go trial). For the switching version, stimuli were pink squares and blue squares. At the beginning of the task, pink indicated a Go trial and blue indicated a No-Go trial. Every 10 trials, participants would see either a white box with an X through the middle, indicating that they should switch the rule associating trial-type with square-colour (i.e. now blue means Go and pink means No-Go), or a white box with a line through the middle indicating that they should continue with the same rule. Switch and No-Switch symbols appeared equally frequently. Each trial of both versions consisted of a fixation cross ("+") presented for 500 ms, followed by a square presented for 100 ms. The maximum time allowed for response was 1000 ms. The Go/No-Go tasks consisted of 5 blocks, each comprised of 40 Go trials and 20 No-Go trials. Performance was evaluated using error rates (number of errors/number of trials) rather than raw number of errors in order to make values for Go and No-Go trials comparable.

2. Results

2.1. Error rates

To analyze Go/No-Go performance, we ran a 2 (secondary task: verbal vs. spatial) × 2 (Go/No-Go version: normal vs. switching) × 2 (error type: commission vs. omission) repeated measures ANOVA on error rates. As expected, this analysis revealed a main effect of Go/No-Go version $F(1, 36) = 15.71$, $p < .001$, $\eta^2_{partial} = .30$ with the switching version resulting in a higher error rate ($M = 7.36$, $SD = 6.23$) than the normal version ($M = 4.94$, $SD = 4.41$). This difference demonstrates that there is a "mixing cost" to the switching task; participants perform more poorly when they have to switch the rule periodically throughout the Go/No-Go task (Monsell, 2003).[1] There was also a main effect of error type $F(1, 36) = 6.07$, $p = .02$, $\eta^2_{partial} = .14$, which showed that participants made commission errors at a higher rate ($M = 7.17$, $SD = 5.66$) than omission errors ($M = 5.13$, $SD = 4.98$), consistent with our interpretation of button-pressing as the impulsive response. Importantly, no main effect of task was found, indicating that overall error rates did not differ between the verbal and spatial conditions, $F(1, 36) = .29$, *ns*. This suggests that the secondary tasks were similar in general difficulty — one task didn't simply cause more mistakes than the other.

We found a significant interaction between secondary task and error type, $F(1, 36) = 15.21$, $p < .001$, $\eta^2_{partial} = .30$, such that relative to the spatial task, the verbal task resulted in a higher rate of commission errors (verbal: $M = 8.33$, $SD = 6.63$; spatial: $M = 6.00$, $SD = 4.69$), $F(1, 36) = 11.19$, $p = .002$, $\eta^2_{partial} = .24$, and a lower rate of omission errors (verbal: $M = 4.28$, $SD = 5.06$; spatial: $M = 5.99$, $SD = 4.90$), $F(1, 36) = 4.03$, $p = .052$, $\eta^2_{partial} = .10$ (Fig. 1). This result, along with the fact that there was no significant main effect of task, suggests that while the verbal secondary task did not produce more errors in general, it did produce a different pattern of errors than the spatial task — it caused participants to press the button more often, to act more impulsively. This analysis also revealed an interaction between Go/No-Go version and error type, $F(1, 36) = 6.27$, $p = .017$, $\eta^2_{partial} = .15$, such that compared to the normal Go/No-Go, the switching version resulted in an increase in the rate of commission errors (normal: $M = 5.38$, $SD = 3.34$; switching: $M = 8.96$, $SD = 6.60$), $F(1, 36) = 16.20$, $p < .001$, and a smaller increase

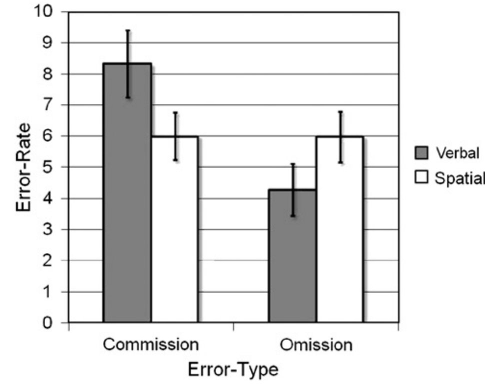

Fig. 1. Error rate (number of errors/number of trials) as a function of error type and secondary task across both versions of the Go/No-Go task. Error bars represent standard errors of the mean.

in the rate of omission errors (normal: $M = 4.49$, $SD = 3.28$; switching: $M = 5.77$, $SD = 4.35$), $F(1, 36) = 4.26$, $p = .046$. It seems, then, that the switching version of the Go/No-Go is both more difficult, and more demanding of self-control resources as indicated by an overall increase in impulsive responding relative to the normal version. Interestingly, no interaction was found between secondary task and Go/No-Go version, $F(1, 36) = .013$, *n.s.*, suggesting that overall error rates for both secondary tasks are affected similarly by the addition of the switching component. If the switching version of the GNG were simply accentuating performance discrepancies between tasks we would expect this interaction to be significant, with the switching Go/No-Go prompting more errors when participants are concurrently doing the more difficult secondary task.

Finally, we also found the expected three-way interaction, $F(1, 36) = 6.52$, $p = .015$, $\eta^2_{partial} = .15$. In the normal version of the Go/No-Go task, the verbal secondary task results in more errors of commission (verbal: $M = 6.08$, $SD = 4.69$, spatial: $M = 4.68$, $SD = 3.65$) and fewer errors of omission (verbal: $M = 4.05$, $SD = 4.82$, spatial: $M = 4.93$, $SD = 4.47$). This pattern of impulsive responding then becomes augmented in the switching version of the task (verbal commission: $M = 10.60$, $SD = 8.57$, spatial commission: $M = 7.32$, $SD = 5.73$, verbal omission: $M = 4.50$, $SD = 5.29$, spatial omission: $M = 7.04$, $SD = 5.33$). Simple effects reveal that an index of impulsive responding (commission error rate − omission error rate) increases for the verbal task when switching is introduced (verbal normal: $M = 2.03$, $SD = 6.38$, verbal switching: $M = 6.09$, $SD = 9.04$), $F(1, 36) = 9.02$, $p = .005$, $\eta^2_{partial} = .20$, but does not change significantly for the spatial secondary task (spatial normal: $M = -.26$, $SD = 5.88$, spatial switching: $M = .28$, $SD = 5.73$), $F(1, 36) = .36$, *n.s.* (Fig. 2). Treating the regular Go/No-Go task as a baseline, it appears

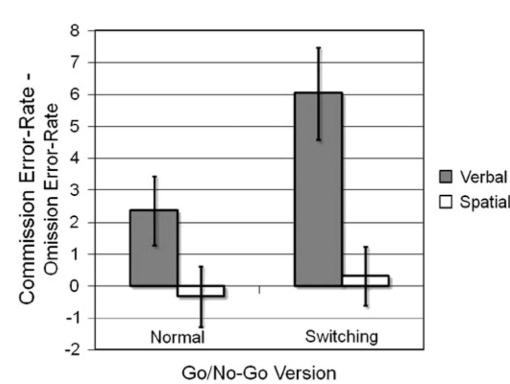

Fig. 2. Impulsive responding (commission error rate–omission error rate) as a function of secondary task and Go/No-Go version. Error bars represent standard errors of the mean.

[1] Although our task was not designed for a traditional Monsell (2003) analysis of "switching" costs — slower responding on switch trials relative to non-switch trials — we attempted to conduct a similar analysis by comparing trials that followed Switch or No-Switch signals with the rest of the trials in the switching Go/No-Go task. This 2 (secondary task: verbal vs. spatial) by 2 (error type: commission vs. omission) by 2 (signal: post-signal trial vs. normal trial) ANOVA revealed no main effects or interactions involving the signal term, $Fs < 3.0$, $ps > .10$. We suspect that substantial floor effects for error rates on post-signal trials limit the informative power of this analysis.

that increasing the self-control demand of the task prompts impulsivity when participants are doing the verbal task, but not when they are doing the spatial task. We interpret this as an indication that the error rate pattern discussed above is not simply a product of differing secondary task difficulty, but is instead due to specific impairments in self-control induced by blocking the inner voice.[2]

2.2. Reaction times

An analysis of reaction times supports the interpretation that the verbal task is causing participants to respond more impulsively. We ran a 2 (secondary task: verbal vs. spatial) × 2 (Go/No-Go version: normal vs. switch) repeated measures ANOVA on reaction times for correct Go trials. We found a significant main effect of secondary task, $F(1, 36) = 31.91$, $p < .001$, $\eta^2_{partial} = .47$, indicating that participants were faster to respond on Go trials when they were doing the verbal secondary task ($M = 197.93$, $SD = 39.91$) as compared to the spatial secondary task ($M = 226.12$, $SD = 34.93$). Thus, participants responded more quickly when doing the verbal task, consistent with the interpretation that blocking the inner voice leads to more impulsive behavior. There was also a main effect of Go/No-Go version, $F(1, 36) = 15.98$, $p = .001$, $\eta^2_{partial} = .30$, which revealed that participants took longer to respond in the switching version ($M = 217.59$, $SD = 36.96$) than the normal version ($M = 206.47$, $SD = 37.88$). No significant interaction was found.

2.3. Video coding

For 26 of the 37 participants, video recordings were clear enough to rate participants on their performance of the secondary task with respect to: 1) the number of pauses, 2) the total duration of pauses, 3) the appearance of task difficulty, and 4) the amount of effort exerted. None of these indices were different between the verbal and spatial tasks, $ts < 1.5$, $ps > .2$, providing convergent evidence that the tasks do not differ in basic difficulty.

3. Discussion

Having participants do a verbal secondary task resulted in faster responding on the Go-No/Go task as well as a higher rate of commission errors and a lower rate of omission errors relative to when they did a spatial secondary task. We interpret this pattern of responding as increased impulsivity — participants acted more quickly and made the impulsive response (pressing the button) more readily (Barratt, 1994; Eysenck, 1993; Yechiam et al., 2006). Thus, our results support the hypothesis that blocking the inner voice can result in impairments in self-control as exhibited by more impulsive behavior. Mechanistically, we believe this happens because the inner voice can be used for articulating task steps as well as maintaining that information in working memory (Baddeley et al., 2001; DeStefano & LeFevre, 2004). In the Go/No-Go task this may amount to participants verbalizing rules, like "yellow means go" or actions, like "go, don't go, go," functions which appear to keep impulsive response tendencies at bay.

An alternative interpretation, however, is that the spatial task simply caused people to respond more slowly due to motor interference. We expect slowing due to motor interference in the spatial condition may indeed be operating in our experiment, but that it does not fully account for the pattern of error rates that we observe. First, to accommodate baseline differences in the effects of the secondary task, we chose to use two versions of the Go/No-Go task that varied with respect to self-control demand and to treat the regular Go/No-Go as a baseline. Doing this revealed that for the verbal task, increasing the self-control demands by introducing a switching requirement to the Go-No/Go task resulted in even more impulsive responding, while this was not true of the spatial task. This discrepancy suggests that there is something specific about self-control, rather than task performance elements like speed, that is being affected when participants do the verbal, rather than spatial, secondary task. Second, the time that it takes people to respond to Go trials while doing the spatial task ($M = 226.12$, $SD = 34.93$) is slower than during the verbal task ($M = 197.93$, $SD = 39.91$), $F(1, 36) = 31.91$, $p < .001$, $\eta^2_{partial} = .47$, but much quicker than the time allotted for a response (1000 ms). It doesn't seem, then, that when people do the spatial secondary task they are delaying their responses to the extent that they make more errors of omission and fewer errors of commission. This account is further corroborated by the analyses of participants' videotaped sessions which revealed no visible differences in effort or difficulty across the two secondary tasks. We feel, then, that our results are most consistent with an interpretation that emphasizes the role verbal resources play in self-control specifically, rather than in task performance generally.

In light of previous research on working memory and attention, our findings are consistent with the notion that the inner voice, working memory, and attention might be more intertwined than previously thought and that blocking the inner voice can have negative consequences for both attention and self-control (Baddeley et al., 2001; Beilock et al., 2007). With regard to research on cognitive load, this work corroborates evidence from other research (Baddeley et al., 2001) that calls into question the equivalence of cognitive load tasks and suggests that different kinds of distractions may impair task-relevant abilities to different extents. Along these lines, it is also possible that spatial tasks such as the one we've used here may impair specific types of self-control that we have not yet examined. While our data suggests a unique role for the inner voice in curbing impulsivity, the range of consequences of occupying verbal and spatial resources has yet to be fully explored. Furthermore, the two versions of the Go/No-Go task have allowed us to explore both impulsivity and task switching components of self-control, but further research is needed to shed light on whether other domains of self-control also rely on the inner voice.

4. Conclusion

The notion that we can tell ourselves what to do or talk ourselves out of something suggests that we intuitively feel that the inner voice has self-control powers. By examining performance on a classic self-control task, this study provides evidence that when we tell ourselves to "keep going" on the treadmill, or when we count to ten during an argument, we may be helping ourselves to successfully overcome our impulses in favour of goals like being fit, and preserving a relationship. Thus, these results suggest that we can use our inner voices to ignore and resist temptation — one of the defining abilities of our species.

Acknowledgments

We thank Laura-Ann Pettito, Jason Plaks, and Marc Fournier for their guidance and feedback. Grants from the Social Sciences and

[2] Another way to analyze our data is to focus specifically on commission errors as an index of impulsivity (Kertzman et al., 2008; Newman, 1987). Conducting a two-way ANOVA (verbal vs. spatial; normal vs. switching) on commission rates alone reveals a main effect of secondary task, $F(1, 36) = 11.19$, $p = .002$, $\eta^2_{partial} = .24$ with a higher rate for the verbal ($M = 8.34$, $SD = 6.63$) relative to the spatial task ($M = 6.00$, $SD = 4.69$). The interaction is marginally significant, $F(1, 36) = 2.95$, $p = .094$ with error rates showing a greater increase from the normal to the switching version for the verbal (normal: $M = 6.08$, $SD = 4.69$, switching: $M = 10.60$, $SD = 8.57$), $F(1, 36) = 12.23$, $p = .001$, $\eta^2_{partial} = .25$, relative to the spatial secondary task (normal: $M = 4.68$, $SD = 3.65$, switching: $M = 7.32$, $SD = 5.73$), $F(1, 36) = 13.85$, $p = .001$, $\eta^2_{partial} = .28$. When focusing only on omission rates, there is a main effect of task, $F(1, 36) = 4.03$, $p = .052$, $\eta^2_{partial} = .101$ with a lower rate for the verbal ($M = 4.28$, $SD = 5.06$) relative to the spatial task ($M = 5.99$, $SD = 4.90$). The interaction is not significant, $F(1, 36) = 2.07$, *n.s.*

Humanities Research Council and the Canada Foundation for Innovation supported this research.

References

Baddeley, A. D., Chincotta, D., & Adlam, A. (2001). Working memory and the control of action: Evidence from task switching. *Journal of Experimental Psychology: General*, *130*(4), 641–657.

Baddeley, A. D., & Hitch, G. J. (1974). In G. Bower` (Ed.), *Working memory. The psychology of learning and motivation*, *Vol. 8*. (pp. 47–90) San Diego, CA: Academic Press.

Baddeley, A., & Hitch, G. J. (1994). Developments in the concept of working memory. *Neuropsychology*, *8*(4), 485–493.

Barkley, R. A. (2004). Attention-deficit/hyperactivity disorder and self-regulation: Taking an evolutionary perspective on executive function. In R. F. Baumeister, & K. D. Vohs (Eds.), *Handbook of self-regulation: Research, theory, and applications* (pp. 301–323). New York, NY: The Guilford Press.

Barratt, E. S. (1994). Impulsiveness and aggression. In J. Monohan, & H. J. Stedman (Eds.), *Violence and mental disorder*. Chicago: University of Chicago Press.

Baumeister, R. F., Heatherton, T. F., & Tice, D. M. (1994). *Losing control: How and why people fail at self-regulation.* San Diego: Academic Press.

Beilock, S. L., Rydell, R. J., & McConnell, A. R. (2007). Stereotype threat and working memory: Mechanisms, alleviation, and spillover. *Journal of Experimental Psychology: General*, *136*(2), 256–276.

Compton, R. J., Robinson, M. D., Ode, S., Quandt, L. C., Fineman, S. L., & Carp, J. (2008). Error-monitoring ability predicts daily stress regulation. *Psychological Science*, *19*, 702–708.

Damasio, A. R. (1994). *Descartes' error.* New York: Penguin Putnam.

Davidson, D. (1975). Thought and talk. In D. Davidson (Ed.), *Inquiries into truth and interpretation* (pp. 155–170). Oxford, UK: Oxford University Press.

DeStefano, D., & LeFevre, J. A. (2004). The role of working memory in mental arithmetic. *European Journal of Cognitive Psychology*, *16*, 353–386.

Ellis, L. K., Rothbart, M. K., & Posner, M. I. (2004). Individual differences in executive attention predict self-regulation and adolescent psychosocial behaviors. In R. E. Dahl, & L. P. Spear (Eds.), *Adolescent brain development: Vulnerabilities and opportunities* (pp. 337–340). New York: New York Academy of Sciences.

Eysenck, H. J. (1993). The nature of impulsivity. In W. G. McCown, J. L. Johnson, & M. B. Shure (Eds.), *The impulsive client: Theory, research & treatment*. Washington, D. C.: American Psychological Association.

Hermer-Vazquez, L., Spelke, E., & Katsnelson, A. S. (1999). Sources of flexibility in human cognition: Dual-task studies of space and language. *Cognitive Psychology*, *39*, 3–36.

Hirsh, J. B., & Inzlicht, M. (2010). Error-related negativity predicts academic performance. *Psychophysiology*, *47*, 192–196.

Inzlicht, M., McKay, L., & Aronson, J. (2006). Stigma as ego-depletion. How being the target of prejudice affects self-control. *Psychological Science*, *17*, 323–336.

Johns, M., Inzlicht, M., & Schmader, T. (2008). Stereotype threat and executive resource depletion; examining the influence of emotion regulation. *Journal of Experimental Psychology: General*, *137*, 691–705.

Kertzman, S., Lowengrub, K., Aizer, A., Vainder, M., Kotler, M., & Dannon, P. N. (2008). Go-no-go performance in pathological gamblers. *Psychiatry Research*, *161*, 1–10.

Lavie, N. (2000). Selective attention and cognitive control: Dissociating attentional functions through different types of load. In S. Monsell, & J. Driver (Eds.), *Control of cognitive processes: Attention and performance XVIII* (pp. 713–737). Cambridge MA: MIT Press.

Mischel, W., & Ayduk, O. (2004). Willpower in a cognitive-affective processing system: The dynamics of delay of gratification. In R. F. Baumeister, & K. D. Vohs (Eds.), *Handbook of self-regulation: Research, theory, and applications* (pp. 99–129). New York, NY: The Guilford Press.

Metcalfe, J., & Mischel, W. (1999). A hot/cool system analysis of delay of gratification: Dynamics of willpower. *Psychological Review*, *106*, 3–19.

Monsell, S. (2003). Task switching. *TRENDS in Cognitive Sciences*, *7*, 134–140.

Muller, M. (1864). *Lectures on the science of language.* MT: Kessinger Publishing Co..

Newman, J. P. (1987). Reaction to punishment in extraverts and psychopaths: Implications for the impulsive behavior of disinhibited individuals. *Journal of Research in Personality*, *21*, 464–480.

Newton, A. M., & de Villiers, J. G. (2007). Thinking while talking: Adults fail nonverbal false-belief reasoning. *Psychological Science*, *18*, 574–579.

Norman, D. A., & Shallice, T. (1986). Attention to action: Willed and automatic control of behavior. In R. J. Davidson, G. E. Schwartz, & D. Shapiro (Eds.), *Consciousness and self-regulation: Advances in research and theory*, *Vol. 4*. (pp. 1–18)New York: Plenum.

Romer, D., Betancourt, L., Giannetta, J. M., Brodsky, N. L., Farah, M., & Hurt, H. (2009). Executive cognitive functions and impulsivity as correlates of risk-taking and problem behavior in adolescents. *Neuropsychologia*, *47*, 2916–2926.

Rueda, M. R., Posner, M. I., & Rothbart, M. K. (2004). Attentional control and self-regulation. In R. F. Baumeister, & K. D. Vohs (Eds.), *Handbook of self-regulation: Research, theory, and applications* (pp. 283–300). New York, NY: The Guilford Press.

Sherman, J. W., Gawronski, B., Gonsalkorale, K., Hugenberg, K., Allen, T. J., & Groom, C. J. (2008). The self-regulation of automatic associations and behavioral impulses. *Psychological Review*, *115*(2), 314–335.

Vygotsky, L. S. (1962). *Thought and language.* MA: The M.I.T. Press.

Ward, A., & Mann, T. (2000). Don't mind if I do: Disinhibited eating under cognitive load. *Journal of Personality and Social Psychology*, *78*, 753–763.

Watson, J. B. (1919). *Psychology from the standpoint of a behaviorist.* Philadelphia, PA: Lippincott.

Wegner, D. M., & Erber, R. (1992). The hyperaccessibiliy of suppressed thoughts. *Journal of Personality and Social Psychology*, *63*, 903–912.

Wegner, D. M., Erber, R., & Zanakos, S. (1993). Ironic processes in the mental control of mood and mood-related thought. *Journal of Personality and Social Psychology*, *65*, 1093–1104.

Westling, E., Mann, T., & Ward, A. (2006). Self-control of smoking: When does narrowed attention help? *Journal of Applied Social Psychology*, *36*, 2115–2133.

Wittgenstein, L. (1921). *Tractatus logico-philosophicus.* London, UK: Routledge & Kegan Paul.

Yechiam, E., Goodnight, J., Bates, J. E., Busemeyer, J. R., Dodge, K. A., Pettit, G. S., et al. (2006). A formal cognitive model of the go/no-go discrimination task: Evaluation and implications. *Psychological Assessment*, *18*, 239–249.