*Journal of Experimental Social Psychology*, in press

# The role of valence weighting in impulse control

Peter V. Zunick[a], Javier A. Granados Samayoa[a], and Russell H. Fazio[a, b]

[a] The Ohio State University

Department of Psychology

1827 Neil Ave

Columbus, OH 43210

[b] Corresponding author

fazio.11@osu.edu

Word count: 4,999

Acknowledgements: We would like to thank Aaron Hatchett for his assistance with data collection and Elise Bui, Lindsey Johnston, Evava Pietri, and Matthew Rocklage for their helpful input. This research was supported by a grant from the John Templeton Foundation (grant# 52462).

Abstract

We propose that individuals' valence weighting biases – the extent to which they tend to overweight positive or negative valence in attitude generalization – play an important role in impulse control. Specifically, people who tend to overweight positive valence should likewise overweight impulses, which are essentially urges to achieve positively-valued outcomes, in their initial appraisals of self-control situations, leading to a greater likelihood of impulse control failure. Conversely, people who underweight positive valence should also underweight impulses in these initial evaluative appraisals and should thus be more likely to successfully control their impulses. However, we predicted this relationship would hold only for individuals low in trait self-control, since those high in trait self-control should be both motivated and able to override their initial valence weighting-based appraisals. We supported these predictions across two studies using different impulse control performance measures: a frustrating anagram task (Study 1) and a Stroop task (Study 2).

*Keywords*: valence weighting, impulse control, attitude generalization, self-control, inhibition

Self-control conflicts are a ubiquitous part of everyday experience (Hofmann, Baumeister, Forster, & Vohs, 2012). We all know the feeling of struggling to reign in impulses that clash with our long-term goals, whether this means resisting the temptation to have a second slice of pie, holding one's tongue when the discussion at a family gathering turns political, or controlling the urge to check one's e-mail. Self-control conflicts are usually characterized by two competing forces: an impulse or desire toward an immediate, concrete reward, and a more abstract long-term goal (e.g., Kotabe & Hofmann, 2015; Mischel, 1974). Successful self-control is thus often a matter of inhibiting impulses (e.g., Baumeister & Heatherton, 1996; Hofmann, Friese, & Strack, 2009; cf. Fujita, 2011). Past research has explored numerous factors that affect self-control, including (but not limited to) trait willpower (Tangney, Baumeister, & Boone, 2004), working memory capacity (Hofmann, Gschwendner, Friese, Wiers, & Schmitt, 2008), abstract vs. concrete construal (Fujita, Trope, Liberman, & Levin-Sagi, 2006), hot vs. cold cognition (Metcalfe & Mischel, 1999), implementation intentions (Gollwitzer & Sheeran, 2006), recent exertion resulting in depletion of resources (Vohs, Baumeister, & Schmeichel, 2012) or motivational shifts (Inzlicht & Schmeichel, 2016), and beliefs about depletion (Clarkson, Hirt, Jia, & Alexander, 2010; Job, Dweck, & Walton, 2010). The current research explores another variable related to self-control: individuals' valence weighting tendencies.

*Valence weighting tendencies as a fundamental individual difference*

An individual's valence weighting tendencies reflect how one integrates positive and negative information about novel situations or stimuli and, in particular, whether positive or negative attitudes generalize more strongly in the formation of one's initial evaluation (Fazio, Pietri, Rocklage, & Shook, 2015; Rocklage & Fazio, 2014). For example, imagine visiting a quirky local ice cream parlor that serves chocolate cayenne ice cream. This new flavor might in some ways resemble both things you like (e.g., chocolate, spiciness) and dislike (e.g., you were disappointed by the last bizarre flavor combination you tried). Forming a quick initial evaluation of the new flavor requires weighting its resemblance to these known positives and negatives. As such, any general tendencies you have to overweight either positive or negative valence during this process would bias your initial appraisal of the new flavor.

This valence weighting tendency (i.e., the extent to which one overweights positives or negatives during attitude generalization) is a fundamental individual difference with implications across a variety of domains. For instance, biases in valence weighting predict judgments regarding the potential for interpersonal rejection and threat assessment more generally (Pietri, Fazio, & Shook, 2013b), as well as emotional reactivity to negative events (Pietri, Fazio, & Shook, 2012). In one study, weighting bias predicted how many new friends first-semester college freshman made as they navigated the rocky transition to college life (Rocklage, Pietri, & Fazio, 2015), and in another, weighting bias predicted changes in depressive symptoms across a semester (Pietri, Vasey, Grover, & Fazio, 2015). In addition, weighting bias has been found to relate to judgments involving risk assessment, as well as with actual behavior in a “push your luck” game with money at stake (Pietri et al., 2013b). Other work has produced similar results by manipulating weighting bias, demonstrating its causal effects (Pietri, Fazio, & Shook, 2013a; Pietri & Fazio, 2017).

Valence weighting tendencies are both empirically and conceptually distinct from other individual difference constructs regarding valence sensitivity (see Fazio et al., 2015). For example, empirically, weighting bias does not relate to measures of approach/avoidance temperament (Elliot & Thrash, 2010), promotion/prevention focus (Lockwood, Jordan, & Kunda, 2002), or BIS/BAS (Carver & White, 1994). Conceptually, it is distinct from these constructs in that valence weighting tendencies shape the initial evaluative appraisals that people construct on-the-spot upon encountering novel stimuli (Rocklage & Fazio, 2014). Many factors affect what people *do* with those appraisals, but those effects likely occur farther "downstream" relative to valence weighting.

*Valence weighting and impulse inhibition*

We propose that valence weighting plays an important and as yet unstudied role in self-control. As discussed earlier, inhibiting an impulse to gain an immediate, salient reward is often central to self-control conflicts. Consistent with recent theoretical perspectives (Kotabe & Hofmann, 2015), we argue that impulses are by their very nature associated with positive valence – they are "desires" or urges to act (or not act) so as to achieve some immediate positive outcome. Even impulses that might on their surface seem negative (e.g., the urge to skip one's dentist appointment) actually lead to outcomes that are desired in the moment (e.g., not being at the dentist). Thus, when forming an initial appraisal of a self-control situation, people with a more positive valence weighting bias should tend to overweight the impulse or desire and hence be more likely to act on the impulse, whereas those with a more negative valence weighting bias should underweight the impulse and hence be more likely to successfully inhibit it.

*Potential moderators of the relation between valence weighting and impulse control*

We do not expect, however, that valence weighting tendencies will *always* influence impulse control. Past research suggests that weighting bias influences initial evaluative appraisals, which only affect downstream judgments and behaviors when people lack the opportunity or motivation to override those initial appraisals and engage instead in more extensive deliberation (Rocklage & Fazio, 2014). For instance, participants exposed to a news article espousing the value of following one's intuition showed a relationship between weighting bias and risky behavior, such that those with a more positive weighting bias tended to gamble more in the same “push your luck” game mentioned previously; however, for those exposed instead to an article espousing the value of overriding one’s intuition, this relationship was attenuated (Rocklage & Fazio, 2014, Experiment 2). Similarly, the relationship between valence weighting tendencies and self-control should be strongest among people who lack the opportunity (e.g., poor executive control) or motivation (e.g., weak or inconsistent goals) to override their initial evaluations (Fazio & Olson, 2014). In the current work, we assessed one such potential moderator, participants’ trait level of self-control. Trait self-control, measured via self-report predicts outcomes as varied as college grades, psychological adjustment, binge-eating, and alcohol abuse (Tangney et al., 2004). People who are especially adept at self-control should have both the ability and the motivation to override their initial valence-weighting-based response tendencies, thus attenuating the link between weighting bias and impulse control performance.

## *Current research*

We sought to explore the relationship between valence weighting biases and impulse control across two studies, each with a different behavioral task requiring impulse inhibition. In Study 1 we measured how readily participants gave in to their impulse to skip particularly frustrating anagrams, and in Study 2 we used a Stroop (1935) task as a measure of impulse inhibition. In each study, we also measured trait self-control (Tangney et al., 2004) to assess whether it moderated the relationship between valence weighting tendencies and performance.

## *Study 1*

We administered a performance-based measure of valence weighting tendency,[1] along with a behavioral measure of impulse control (a frustrating anagram task) and a self-report measure of trait self-control. We entertained two related hypotheses. First, we expected that the extent to which participants overweighted positives (vs. negatives) would predict how often they gave in to the impulse to pass on particularly frustrating anagram trials. However, given the potential moderators discussed previously, we thought it possible that this relationship would only occur for participants low in trait self-control. For participants high in trait self-control, the relationship between valence weighting and impulse control might be attenuated, since these participants would be motivated and able to override their initial valence weighting-based appraisals.

### *Method*[2]

#### *Participants*

Based on the sample sizes of past studies employing the BeanFest paradigm as the performance-based measure of valence weighting, as well as participant availability during the semester, we recruited 74 undergraduates who completed the study in partial fulfillment of a course requirement. We excluded two participants who showed very poor learning of game beans (<.4 correctly classified, where .5 is chance)[3] during the BeanFest test phase, leaving a final sample of 72 (34 women, 38 men).

[1] Past research suggests individuals are unable to accurately self-report their valence weighting tendencies, hence the need for a performance-based measure (Fazio et al., 2015; Pietri et al., 2013a).
[2] In both studies, all data were collected prior to data analysis. We report all exclusions, measures, and manipulations.
[3] These two participants' learning scores were extreme (2.86 SDs from the mean of the remaining 72 participants). Including these poor learners slightly strengthens the critical 2-way interaction (from $p = .02$ to $p = .01$).

*Overview*

Participants first completed a performance-based measure of their valence weighting tendencies called BeanFest. The BeanFest game begins with a learning phase in which participants encounter various “beans” and, over time, learn which will add or detract from their score. We measure each participant’s valence weighting tendencies as the extent to which they overweight resemblance to known positive or negative game beans when judging novel beans in a subsequent test phase. Participants then completed our behavioral measure of impulse control, a timed anagram task that, unbeknownst to participants, included unsolvable anagrams. Participants could choose to pass on any anagram. We reasoned that on unsolvable anagrams, participants would become frustrated and experience the impulse to pass. The frequency with which they followed this impulse served as the dependent measure. At the end of the session, following some exploratory measures intended as a pilot test for future research, participants completed a self-report measure of trait self-control.

*BeanFest*

The BeanFest game is a performance-based measure of valence weighting tendencies consisting of two phases: the learning phase, in which participants attempt to maximize their points by learning to approach positive beans and avoid negative beans, and the test phase, in which participants must classify beans as “helpful” or “harmful,” including both game beans, to assess learning, and novel beans, to assess attitude generalization from game beans to novel beans. We used the standard non-contingent feedback version of BeanFest (we describe the measure below, but for more information, see Fazio et al., 2015; Pietri et al., 2013b; Rocklage & Fazio, 2014).

Participants began the game with 50 points and the goal to win, by reaching 100, and avoid losing, by reaching 0 (upon winning or losing, participants "restarted" where they had left off with 50 points). On each trial, participants chose whether or not to select a bean. Selecting a bean resulted in gaining or losing 10 points, depending on its valence, whereas not selecting a bean resulted in no point change, although participants still learned what effect the bean would have had on their score. After six practice trials, participants completed three 36-trial learning blocks. Each trial presented a bean that differed on two dimensions, number of speckles (1 to 10) and shape (circular to oblong in ten levels). Each game bean belonged to one of six distinct regions within the resulting 10x10 matrix (e.g. circular beans with few speckles), three of which were positive and three negative. Each block presented the 36 game beans (18 positive, 18 negative) in a random order, so that during the learning phase, participants saw each game bean and its valence three times. In the test phase, participants viewed, in random order, all 100 beans from the full 10x10 matrix, including the 36 game beans and 64 novel beans, and indicated whether each bean was "helpful" or "harmful." This procedure allowed us to distinguish how well participants learned the game beans from how they assessed the novel beans. As in past research (see Fazio et al., 2015), we calculated participants' valence weighting bias as their average response to novel beans controlling for how well they learned the positive and negative game beans (see Results). A more positive (negative) score reflects classifying more novel beans as positive (negative) than expected on the basis of the pattern of learning exhibited.

*Anagram task*

Participants saw 24 anagrams (5- or 6-letter sequences that could be unscrambled to form a word) in random order and were asked to solve as many as they could in three minutes, maximizing both accuracy and speed. For each trial, participants (who had access to scrap paper) indicated whether or not they could solve the anagram, and if so, were presented a response box to type their answer. Since there was no meaningful guessing (i.e., each response was either clearly a word using the given letters or not), we coded each response as either correct or a pass (including both indicating one could not solve the anagram and indicating that one had solved it but leaving the response blank or entering a non-word).

Unbeknownst to participants, 11 of the 24 anagrams were unsolvable. From a participant's perspective, the frustration of struggling to solve these unsolvable anagrams would presumably trigger the impulse to pass. We focused on passing behavior on unsolvable rather than solvable anagrams because the latter was confounded with anagram skill.

### *Trait self-control*

The Brief Self-Control Scale (BSCS; Tangney et al., 2004) included 13 statements ($\alpha$ = .81) such as "People would say that I have iron self-discipline" and "Pleasure and fun sometimes keep me from getting work done" (reverse-scored), to which participants responded on a scale from 1 (not at all like me) to 5 (very much like me).

## *Results*

To calculate weighting bias, we first calculated participants' average response to novel beans during the test phase of BeanFest, with possible values ranging between -1 (categorized all novel beans as harmful) and 1 (categorized all novel beans as helpful). We then computed predicted values for each participant from a normative regression equation predicting average response to novel beans from learning of positive and negative game beans (i.e., proportion of each correctly classified in the test phase). This normative regression equation is derived from many past BeanFest studies including over 1800 participants (Fazio et al., 2015).[4] We then subtracted each participant's predicted values from their actual average response to novel beans, creating a residual that is our measure of weighting bias. Conceptually, it represents the extent to which each participant generalized from positive versus negative attitudes when categorizing the novel beans in the test phase, over and above how well each participant actually learned the positive and negative game beans, thus separating biases in learning from biases in generalization.

For the anagram task, we calculated the number of passes on unsolvable trials each participant made within the 3-minute time limit. Weighting Bias did not significantly correlate with Unsolvable Passes, $r$ = .17 (95% CI: -.09, .40), $p$ = .17 (see Table 1). However, a regression model predicting Unsolvable Passes revealed a significant interaction between Weighting Bias and Trait Self-Control, $\beta$ = -.26 (95% CI: -.48, -.05), $t$(68) = -2.46, $p$ = .02 (Figure 1).[5] Weighting Bias significantly predicted Unsolvable Passes at 1 SD below the mean of Trait Self-Control, $\beta$ = .41 (95% CI: .11, .72), $t$(68) = 2.70, $p$ = .01, but not at 1 SD above the mean, $\beta$ = -.12 (95% CI: -.44, .21), $t$(68) = -.72, $p$ = .47. (Additional statistics for both studies appear in the online supplement.)

[4] The equation (available at http://faculty.psy.ohio-state.edu/fazio/fazio/BeanFest.php) is: *Average Response to Novel Beans = .59(Proportion of Positive Game Beans Correct) - .83(Proportion of Negative Game Beans Correct) + .08*.

[5] We report $\beta$s from regression models with outcomes and predictors standardized (prior to computing interaction terms), which can be interpreted as effect sizes.

Table 1

*Correlations and Descriptive Statistics for Study 1*

| | WB | U. Passes | Trait SC |
|---|---|---|---|
| Weighting Bias | -.05 (.19) | .17 | .03 |
| Unsolvable Passes | | 4.17 (2.78) | .05 |
| Trait Self-Control | | | 3.26 (.62) |

*Note*. All correlations shown are non-significant, *p*s > .16. Means and standard deviations (in parentheses) are on the diagonal.

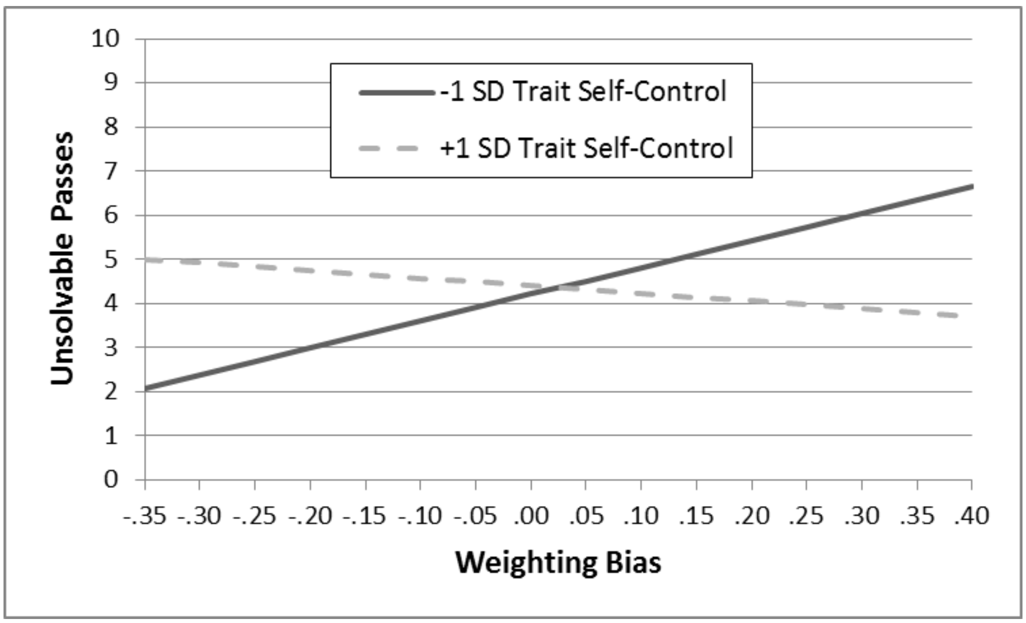


Figure 1. Unsolvable Passes predicted by Weighting Bias, standardized Trait Self-Control, and their interaction term. Axis values approximately indicate the full range of data for each variable.

*Discussion*

The data from Study 1 confirmed our second, more nuanced hypothesis – weighting bias predicted passing behavior, but only for participants relatively low in trait self-control. This result is consistent with past work showing that valence weighting tendencies influence initial appraisals that can be overridden given sufficient ability and motivation (Rocklage & Fazio, 2014). In Study 1, participants low in trait self-control lacked either the ability or the motivation to override their valence weighting tendencies, such that their weighting bias predicted how readily they would succumb to the impulse to pass when struggling with frustratingly difficult (actually unsolvable) anagrams. For these participants, the more positive their weighting bias, the more likely they were to act on their impulse to give up when frustrated. Stated differently, the more negative their weighting bias, the more likely they were to check their impulse and continue working rather than accept failure on a frustrating anagram.

Some readers may wonder whether passing on unsolvable anagrams should be considered impulse control failure. Although on this particular task, readily passing on unsolvable anagrams may seem adaptive, participants were unaware that some anagrams were unsolvable. In fact, participants solved only 47.6% of the solvable anagrams they encountered within the 3-minute time period, so their overall experience was presumably one of hard work and struggle (i.e., inhibiting the impulse to pass in the face of difficulty) occasionally paying off. In support of this interpretation, passing often on unsolvable anagrams was not actually adaptive (number of unsolvable passes was unrelated to total anagrams correct, $r = .07$ (95% CI: -.19, .32), $p = .55$).

Nonetheless, the interpretation of Study 1 rests on the inference that when participants' initial efforts to solve an unsolvable anagram were fruitless, they experienced the impulse to quit. Given the nature of the task, this inference seems reasonable, but it is still an inference. In Study 2, we sought to replicate these results with a more direct measure of impulse inhibition – one which clearly provokes an impulse and, hence, permits a test of our critical theoretical presumption that impulses are associated with positive valence in the moment they are experienced and thus are subject to valence weighting biases.

## *Study 2*

Our goal for Study 2 was to replicate Study 1 with another behavioral measure of impulse control, a Stroop (1935) task. Stroop tasks are speeded-response tasks designed to produce interference effects, such that critical “incongruent” trials trigger an impulse that must be inhibited for optimal performance. Stroop effects have a long history in psychology (e.g., MacLeod, 1991) and have been widely employed by self-regulation researchers to measure self-control (e.g., Gailliot et al., 2007; Inzlicht, McKay, & Aronson, 2006).

As in Study 1, we measured participants’ valence weighting tendencies and trait self-control, but we replaced the anagram task with a Stroop task. We hypothesized that weighting bias would predict Stroop task performance, such that a more positive weighting bias would predict greater Stroop interference (i.e., poorer impulse control), especially for participants lower in trait self-control. We expected that participants high in trait self-control, as in Study 1, would be able to override their initial valence weighting tendencies, such that for these participants, the relation between weighting bias and Stroop performance would be attenuated.

### *Method*

#### *Participants*

Based on the sample sizes of past studies involving the BeanFest paradigm, as well as participant availability during the semester, we recruited 88 participants who completed the study in partial fulfillment of a course requirement. We excluded four participants who showed very poor learning of game beans (<.4 correctly classified, where .5 is chance)[6] during the BeanFest test phase, leaving a final sample of 84 (60 women, 24 men).

[6] These four participants’ learning scores were extreme (> 2.04 SDs from the mean of the remaining 84 participants). Including them in the sample only slightly weakens the interactions predicting Stroop Speed Score and Incongruent Errors (from $p = .029$ to $p = .032$ and from $p = .04$ to $p = .07$, respectively).

*Overview*

The procedure was similar to that of Study 1, with the Stroop task replacing the anagram task. Participants completed BeanFest and then a Stroop task, our performance measure of self-control. Then, following some exploratory measures intended as a pilot test for future research, participants completed the Brief Self-Control Scale (Tangney et al., 2004; 13 items, $\alpha = .82$).

*Stroop task*

The Stroop task began with 10 practice trials, followed by two blocks of 50 trials each. For each trial, participants saw a color name in colored text that was either congruent with the word meaning (e.g., “red” appearing in red) or incongruent (e.g., “red” appearing in blue). Participants wore headset microphones and had to name aloud the color of the text as quickly and accurately as possible, which voice recognition software scored in real time (Inquisit, 2016). If participants failed to respond within 750 ms, they saw “PLEASE GO FASTER” for 1000 ms before proceeding to the next trial, and if they responded incorrectly, they saw a red “X” for 300 ms. Due to the occasional error in the automatic scoring, we also recorded and checked each participant’s audio manually. Our dependent measures were the difference score in response latencies between congruent and incongruent trials (removing trials on which participants made errors) and the total number of errors on incongruent trials.

*Results*

We again calculated weighting bias as the residual from the normative regression equation predicting average response to novel beans from learning of positive and negative game beans (see Study 1). To compute the Stroop task interference score, we first excluded trials on which participants made an error (3.8 % of trials) or responded faster than 300 ms or slower than 3000 ms (4.2 % of trials). As is typical with latency measures (Fazio, 1990), the data were positively skewed, so we performed a reciprocal transformation (1/s), producing a distribution on which higher scores indicated faster responding. We then subtracted participants' average speed scores for incongruent trials from their average speed scores for congruent trials, producing difference scores on which higher numbers represented greater Stroop interference or less successful impulse control, which we then standardized for ease of interpretation.

We also counted errors on incongruent trials as another indicator of poor impulse control.[7] However, this distribution was not only positively skewed, but it was also resistant to transformations due to five outliers with 14 or more errors (over 26% of the 50 incongruent trials, and more than 3.64 standard deviations above the mean of the remaining sample, 2.7). Given the statistical difficulties these responses posed, we excluded these five participants from analyses of errors (but included them in analyses of the speed difference score, as its calculation involved only correct responses). Errors and the speed difference score correlated significantly, $r = .64$ (95% CI: .47, .76), $p < .001$ (Table 2); committing more errors on incongruent trials was associated with slower correct responses on incongruent relative to congruent trials.

[7] Errors on congruent trials were very rare (< 1%), and since there was no conceptual link between congruent errors and impulse control, we did not analyze them further.

Table 2

*Correlations and Descriptive Statistics for Study 2*

| | WB | Speed Diff. | Errors | Trait SC |
|---|---|---|---|---|
| Weighting Bias | -.01 (.19) | .11 | .22$^{\dagger}$ | -.10 |
| Stroop Transformed Speed Difference Score | | .42 (.18) | .64$^{***}$ | -.02 |
| Stroop Incongruent Errors | | | 2.68 (3.10) | -.14 |
| Trait Self-Control | | | | 3.22 (.61) |

*Note*. $^{***}p < .001$, $^{\dagger}p = .054$. For all other correlations, $p > .22$. Means and standard deviations (in parentheses) are on the diagonal.

As in Study 1, the simple correlations between Weighting Bias and the dependent measures were positive but small and non-significant: $r = .11$ (95% CI: -.15, .35), $p = .34$ for the Speed Difference Score, and $r = .22$ (95% CI: -.001, .43), $p = .054$ for Incongruent Errors. To test our hypothesis regarding moderation by Trait Self-Control, we ran two regression models predicting each dependent measure from Weighting Bias, Trait Self-Control, and their interaction. For the standardized Speed Difference Score (Figure 2), the interaction was significant, $\beta = -.27$ (95% CI: -.51, -.03), $t(80) = -2.22$, $p = .03$. As predicted, the effect of Weighting Bias on the Difference Score was significant at 1 SD below the mean of Trait Self-Control, $\beta = .37$ (95% CI: .05, .69), $t(80) = 2.29$, $p = .02$, but not at 1 SD above the mean of Trait Self-Control, $\beta = -.17$ (95% CI: -.50, .16), $t(80) = -1.04$, $p = .30$. The regression model predicting Incongruent Errors (Figure 3) revealed a similar interaction, $\beta = -.24$ (95% CI: -.48, -.01), $t(75) = -2.05$, $p = .04$. As expected, Weighting Bias significantly predicted Incongruent Errors for participants 1 SD below the mean of Trait Self-Control, $\beta = .44$ (95% CI: .12, .75), $t(75) = 2.77$, $p = .01$, but not for those 1 SD above the mean, $\beta = -.05$ (95% CI: -.37, .28), $t(75) = -.28$, $p = .78$.


Figure 2. Standardized Speed Difference Score predicted by Weighting Bias, standardized Trait Self-Control, and their interaction term (higher values indicate a larger Stroop effect). Axis values approximately indicate the full range of data for each variable.

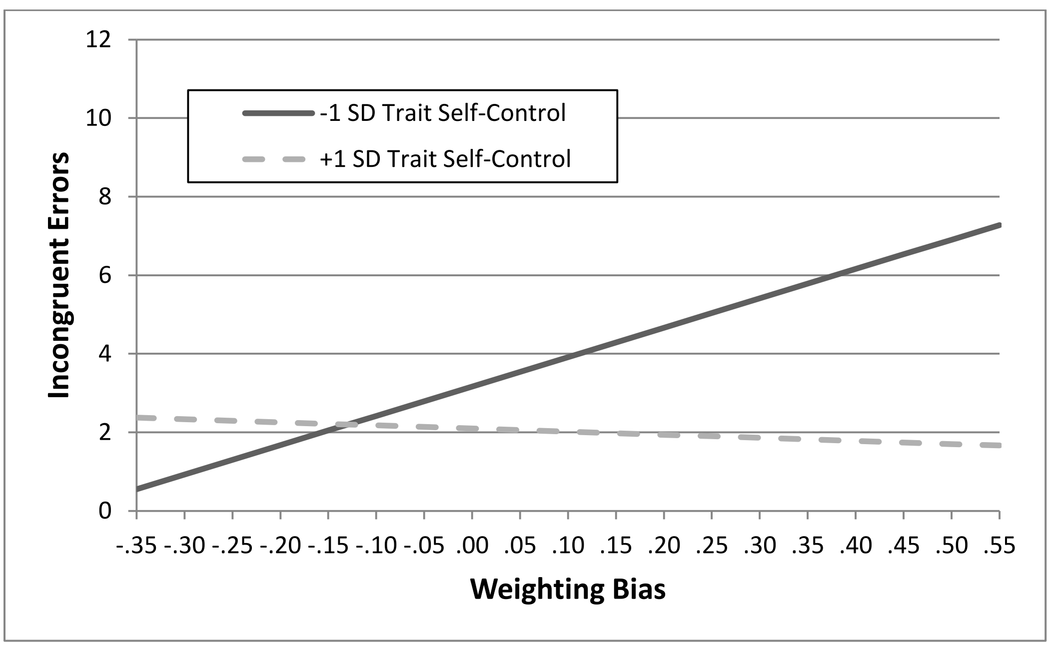


Figure 3. Number of errors on incongruent trials predicted by Weighting Bias, standardized Trait Self-Control, and their interaction term. Axis values approximately indicate the full range of data for each variable.

*Discussion*

Study 2 replicated the pattern of results from Study 1 using two direct measures of impulse control derived from a classic Stroop task. Specifically, participants with a more positive weighting bias tended to struggle with impulse inhibition on the Stroop task, showing a greater decrease in speed on incongruent trials (relative to congruent trials) and committing more errors on incongruent trials, whereas those with a more negative weighting bias tended to perform better on the Stroop task. However, as predicted, this relationship was only present for participants relatively low in trait self-control. As in Study 1, those high in trait self-control were apparently able to override their weighting bias, attenuating its relationship to Stroop performance.

*Meta-analysis*

To assess the likelihood of the current interactions occurring if the null hypothesis were true in both studies, we used Fisher's method of combining independent *p*-values (as described in Borenstein, Hedges, Higgins, & Rothstein, 2009). Because the two effects from Study 2 were non-independent, we reduced them to a single effect by standardizing and then averaging the two dependent measures, yielding $\beta$ = -.31 (95% CI: -.55, -.09), $t(75) = -2.67$, $p = .009$ for the interaction. Combining this result with the interaction result from Study 1 suggested that our results would be unlikely to occur if the null hypothesis were true in both studies, $\chi^2(4) = 20.38$, two-tailed $p = .0008$.

*General Discussion*

Across two studies with different behavioral measures of impulse control, participants' valence weighting tendencies predicted performance, but only if they were relatively low in trait self-control. In Study 1, we measured impulse control with an anagram task structured so that participants would feel frustrated on the unsolvable anagrams and experience the impulse to give up and move on to the next trial. However, because we could only infer the presence of this impulse in Study 1, we included in Study 2 a relatively direct measure of impulse control, a Stroop task, in which successful performance requires repeated inhibition of the dominant response or impulse, in this case saying the word rather than the font color. On both tasks, weighting bias predicted performance among participants lower in trait self-control. These results raise two interesting questions. First, why does weighting bias relate to impulse control at all; and second, why are people high in trait self-control able to sever this link?

With regard to the first question, we argued in the introduction that impulses are by their nature positive; they are urges to achieve some desired outcome. This argument is key to our predictions (and findings) regarding how valence weighting tendencies relate to impulse control. Imagine two scenarios: a dieter encountering cheesecake at a buffet and someone who fears dentists considering skipping a dental appointment. In each case, a want or desire (cheesecake, avoiding the dentist) may lead to the experience of an impulse that conflicts with a long-term goal (good health), which may not have been activated as fully or immediately as the impulse itself. Because impulses stem from these wants or desires, we argue that someone who tends to over-weight positives will give more weight to the impulse in their initial appraisal of the situation and thus be more likely to act on the impulse in the ensuing self-control conflict. In contrast, someone with a more negative weighting bias would give less weight to the impulse in their initial appraisal and would thus be more likely to inhibit the impulse and consider the implications of conflicting goals that may not have been activated with the same immediacy as the impulse. This reasoning led to clear predictions for both of the current studies, which were confirmed by the data.[8] Of course, one's initial appraisal of the impulse evoked in a self-control situation is not the only determinant of the outcome; commitment to long-term goals and individual differences (e.g., tendencies toward approach/avoidance or promotion/prevention; Elliot & Thrash, 2010; Higgins, 1998) are clearly important as well. However, one's initial evaluation based on valence weighting may act as a "thumb on the scale," biasing the outcome toward either success or failure, especially for those low in trait self-control who lack the motivation and/or ability to override their initial default appraisal.

The second question raised by the current findings is why trait self-control moderates the relation between valence weighting tendencies and impulse control. The answer lies in previous work showing that individuals' valence weighting tendencies inform an initial evaluation that can be overridden given sufficient ability and motivation (Rocklage & Fazio, 2014). Trait self-control appears to represent both the ability and the motivation to check one's initial appraisal. Indeed, the authors of the trait self-control scale we used view self-control largely as "the ability to override or change one's inner responses" (Tangney et al., 2004, p. 274), presumably including those stemming from one's valence weighting tendencies. Future research should continue to explore exactly how trait self-control affects self-control outcomes, both in the lab and in the field. In the real world, high trait self-control may help people not only inhibit experienced impulses, but also navigate situations so as to avoid temptation (e.g., Hofmann et al., 2012).

Future work should also continue to explore the relationship between valence weighting tendencies and impulse control, and self-control more generally, including both situational and

[8] A more positive weighting bias may also lead to the experience of stronger impulses. This possibility seems most plausible regarding conflicts that have been encountered often, such that repeatedly acting on (or inhibiting) the impulse could enhance (or dampen) its strength over time (which may explain why people higher in trait self-control report weaker desires in everyday life; Hofmann et al., 2012). It seems less relevant to novel situations.

person-level moderators of the relationship. For example, in the current research we used behavioral, laboratory measures of impulse control, but future research might examine more traditional, real-world self-control conflicts (e.g., resisting a savory dessert). Future work should also manipulate valence weighting tendencies (Pietri et al., 2013a) in order to explore their causal impact on impulse control. Beyond establishing causality, recalibrating individuals with overly-positive valence weighting tendencies toward a more balanced weighting of positive and negative valence could be a powerful tool to help them contend with self-control difficulties.

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