Concrete Resolve: How Concrete Mindset Spurs Approach Motivation and Improves Task Persistence and Performance for Behaviourally Inhibited People

by

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The following served on the Examining Committee for this thesis. The decision of the Examining Committee is by majority vote.

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Author's declaration

This thesis consists of material all of which I authored or co-authored: see Statement of Contributions included in the thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners. I understand that my thesis may be made electronically available to the public.

Statement of contributions

I hereby declare that this thesis incorporates material that is a result of joint research as follows: Study 1 was conducted as part of my Master's thesis with Dr. Steven Bray at McMaster University, Study 4 was a joint research project with my current supervisor Dr. Ian McGregor at York University prior to his relocation to the University of Waterloo. I was the first author and main contributor to this manuscript, with editing help from my supervisors.

Abstract

This dissertation examines the motivational consequences of concrete mindset, e.g., thinking about specific details of *how* to do things (vs. *why*). The guiding premise is that concrete mindset initiates a motivational state that can carry forward to affect success on subsequent tasks, even those that are unrelated to the initial task. For example, according to my general hypothesis, thinking concretely about making a shopping list (vs. bigger questions about shopping priorities) would cause motivational changes conducive to more persistence at the gym. Theory guiding my work suggests that these effects are especially effective for individuals high in behavioural inhibition system (BIS) activation whom are vulnerable to overwhelming, conflicting action-tendencies (Hirsh, Mar, & Peterson, 2012; Harmon-Jones, Amodio, & Harmon-Jones, 2009). These conflicting action-tendencies detract from the ability to persistently pursue goals (e.g., Harmon-Jones & Harmon-Jones, 2008). Given that a concrete mindset induces a narrow-minded focus, and emphasizes specific behaviours, (Trope & Liberman, 2003) it may shield those high in BIS activation from conflict to enable persistence. This dissertation probes the basic motivational states induced by a concrete mindset which can assist those experiencing high BIS activation. I provide evidence that this motivational process occurs through approach motivation and its ability to mute the BIS and spur greater persistence. Findings converge on the idea that for behaviourally inhibited people, concrete mindset liberates tenacious persistence by activating a transient state of approach motivation, causing lasting reductions in behavioural inhibition.

In five experiments (N = 738), I found that concrete mindset exercises in non-focal domains heighten approach motivation and helped people high in state (Study 1)

and trait (Studies 2-4) behavioral inhibition become more persistent in focal tasks. Concrete (vs. abstract) mindset helped them persist and generate more joules of energy on a bicycle endurance task (Study 1). It heightened their persistence on data entry and hand-squeeze tasks (Studies 2 and 3), and increased their determination to accomplish self-generated personal projects (Study 4). Concrete mindset also heightened approach motivation as assessed by electroencephalography (Study 3) and self-reported behavioral activation (Study 4). In Study 5, I manipulated the presumed mediator (approach motivation) and found that it caused lasting reductions in BIS activation which mediated the effects on persistence. Results are interpreted from the perspective of theory and research linking approach-motivated states with single-minded mental narrowing, freedom from conflict, uncertainty, and behavioral inhibition (Harmon-Jones et al., 2009; McNaughton & Corr, 2008). Clinical implications are also discussed.

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Dedication

To my awe-inspiring, extraordinary, caring, and ever-patient wife. Without you this dissertation, and this journey, would have been impossible. You changed what would have been a perilous voyage through the unknown, into an adventure of self-discovery and passion. I will never be able to thank you enough for your boundless support and unconditional love. I know that no matter what challenges lie ahead (as this dissertation is only the beginning), I can surmount them with you behind me. You are my rock, my muse, my sounding-board, my safe place and my other half, I am so lucky to have found you.

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List of Abbreviations

Anterior Cingulate Cortex…….ACC

Anterior-Frontal……AF

Behavioural Approach System…….....…….BAS

Behavioural Inhibition System…….....……..…….BIS

Behaviour Identification Form……BIF

Construal level theory …….....CLT

Common-mode-sense……CMS

Driven-right-leg…….DRL

Electroencephalography……..…EEG

Entropy model of uncertainty……...EMU

Electrooculogram……..EOG

Error-related Negativity…….ERN

Fast-Fourier-Transform……...……FFT

Frontal……..F

Fronto-central……FC

Joint-subsystems hypothesis……...JSH

Kilojoules……...kJ

Left frontal asymmetry……...LFA

Mean……...M

Occipital……..O

Parietal…….P

Positive affect and Negative affect Schedule……..……PANAS

Personal projects analysis……...PPA

Reinforcement Sensitivity Theory…….....RST

Standard deviation……SD

Temporal……..T

Concrete Resolve: Concrete Mindset Helps Behaviorally Inhibited People Become More Persistent, Determined, and Approach-motivated

Persistence often predicts success, but for some people it can be especially tempting to give up when the going gets tough. People high on trait levels of conflict are less determined, more prone to boredom and negative affectivity, and tend to withdraw effort during stressful circumstances (Anand, Oehlberg, Treadway, & Nusslock, 2016; Hayes, Ward, & McGregor, 2016; Mercer-Lynn, Bar, & Eastwood, 2014; Storbeck, Davidson, Dahl, Blass, & Yung, 2015; Williams, Hundt, & Nelson-Gray, 2014). The present research investigates whether generalized concrete mindsets might help such people become more tenacious. My rationale for this prediction is based on how concreteness (vs. abstraction) should affect two basic motivational sub-systems that interact with the environment and each other to maintain goal persistence—the behavioural inhibition (BIS) and the behavioural approach (BAS) systems (Corr & McNaughton, 2012; Gray & McNaughton, 2000).

BIS, goal conflict, and persistence

The behavioural inhibition system is sensitive to conflict, threats and uncertainties, causing diffuse-vigilance and the tendency to disengage in favour of more viable alternative goals (Gray & McNaughton, 2000). Based on these functions, activation of the behavioural inhibition system may increase the tendency to give up on goals. BIS-activated organisms remain approach-oriented, while at the same time adopting a stance of passive avoidance (i.e., approach-avoidance conflict, Corr, 2013, p.12). For instance, while a mouse forages for food (i.e., approach), it may encounter

signs that a cat is present (i.e., avoidance) and respond with hesitation and vigilance, though continuing to cautiously approach. Such a stance allows for some persistence at the original goal, while at the same time readying the organism to disengage from unrewarding goals, (i.e., continued exposure to conflicts, threats, or uncertainty). In other words, the BIS causes a "shift of the balance between approach and avoidance tendencies in the direction of avoidance" (Gray & McNaughton, 2000, p.86), hence reducing motivation toward conflicted goals.

In animal models of the BIS, anxious distress, hesitation, and palliative, displacement behaviours are responses to conflict (Gray & McNaughton, 2000; Rapoport, Ryland, & Kriete, 1992; see Ito & Lee, 2016 for a recent review). For instance, rats that were trained to experience shocks in an alleyway containing a food reward (i.e., facing an approach-avoidance conflict) moved a fixed distance toward the reward and oscillated between approach and avoidance behaviours (see Gray, 1987, Chapter 9). Similarly, rhesus monkeys experiencing uncertainty (a hallmark of BIS activation, Hirsh et al., 2012) responded with hesitation, and checking behaviours analogous to individuals with obsessive-compulsive disorder (Bosc et al., 2017)[1]. Presumably this type of hesitation would impede goal persistence. Smith, Beran, Redford, and Washburn, (2006) also found that both humans and monkeys demonstrate a bias away from uncertain, conflicting stimuli in a dot-estimation task. During critical, uncertainty trials (i.e., a dot-array at the mid-point between two response options) both species rejected these trials for distinct,

[1] Uncertain, conflicting stimuli, that could signal either reward or non-reward (i.e., an approach-avoidance conflict) in a "check-or-go" task caused monkeys to re-check their selection rather than move on to receive the reward. Although the checking behaviour increased accuracy in the task, I argue that in some cases, hesitation can undermine task persistence.

easier to discriminate stimuli. These comparative biology studies provide support for the idea that this primitive conflict-detection-system, (i.e., the BIS) may inhibit eager goal-striving and persistence.

General goal conflict has been shown to be negatively correlated to goal achievement and well-being (Boudreaux & Ozer, 2013; Emmons, King, & Sheldon, 1993; Gollwitzer, 1993). In one prospective study, participants nominated 8 personal goals and rated the degree to which all possible goal-pairs were in conflict (Boudreaux & Ozer, 2013). One month later, participants rated conflict between the same goal-pairs, reported their goal attainment for each of the 8 goals, and their subjective well-being. Overall levels of conflict between goals was negatively related to overall levels of goal attainment and subjective well-being. In another study by Emmons and King (1988), participants reported 15 of their personal goals in a 15 x 15 goal matrix, and rated the degree to which each goal was in conflict (scoring goal pairs from -2 = very harmful to 2 = very helpful). Participants were asked 4 times a day over 3-weeks to list what they were doing, what they were thinking about, and whether their thoughts and actions were related to one of their 15 goals. For goals that were rated highly in conflict, participants were less likely to report that they were actively working on those goals and therefore less likely to be progressing toward goal achievement.

Experimentally manipulated goal conflict also impairs task-specific persistence and performance (Bailis, Thacher, Aird & Lipschitz, 2011; Stroebe, Mensink, Aarts, Schut, & Kruglanski, 2008; Vinkers, Adriaanse, Kroese, & de Ridder, 2015). For instance, Bailis et al., (2011) found that individuals primed with conflicting goals of academic achievement and exercise (explicitly, Study 1; implicitly, Study 2), reported

greater distress, shame, and reduced physical activity 1-week later. Similarly, Stroebe et al., (2008) found that dieters primed with the conflicting goal of eating enjoyment demonstrated slower reaction times to weight-control words in an implicit association task (IAT, Greenwald, McGhee, & Schwartz, 1998). Vinkers and colleagues (2015) also showed that creating conflicting if-then plans for the same goal increased cognitive conflict (measured by slower reaction times on incongruent Stroop trials) and increased unhealthy eating behaviours. Given that any conflict is a cardinal cause of BIS activation (Gray & McNaughton, 2000, p. 28) poor task persistence resulting from goal conflicts may be due to increased BIS activity.

Some recent research has found a direct relationship between BIS activation and reduced goal persistence. In a recent study, BIS activation primed by reflecting on an unresolved personal dilemma significantly mediated a decrease in persistence on an anagram task (i.e., an unrelated domain) and made people over three times more likely to quit (Alquist et al., 2018). In addition, Hayes et al., (2016) demonstrated that individuals with low life satisfaction given a mortality salience prime (a BIS-activating threat; see Jonas, McGregor et al., 2014) responded by reducing their desire to live, effectively withdrawing from all goals in life (presumably to provide relief from BIS activation). These findings support theoretical work that suggest that *any* conflict, threat, or uncertain event elicits BIS activation and causes disengagement from current pursuits, for more viable goals (Proulx, Inzlicht, & Harmon-Jones, 2012; Jonas, McGregor, et al., 2014)

BAS and goal persistence

In contrast, the behavioural approach system (BAS) predicts goal engagement and eager approach of desired incentives (Carver & Scheier, 2001; Carver & White,

1994; Corr, 2013; Gray & McNaughton, 2000; Harmon-Jones et al., 2009; Gray, 1983; Fowles, 1987). The BAS is comprised of dopaminergic-circuits, is activated in response to positive, rewarding stimuli, and is responsible for behavioural facilitation (Depue & Collins, 1999; Ikemoto & Panksepp, 1999). Its activation increases task performance, and attention to, and desire for rewards (Berkman, Lieberman, & Gable, 2009; Robinson, Meier, Tamir, Wilkowski, & Ode, 2009; Threadgill & Gable, 2016). In neurophysiological studies, blocking dopamine receptors or damaging dopamine dependent cells (i.e., ventral tegmental area, nigro-striatal system) impairs habit forming, and motivation for basic survival needs such as food and water (Wang, Wang, Xie, Wang, Shen & Tsien, 2011; see Wise, 2004 for review). Given these functions, the BAS should predict behavioural persistence, especially when goals are conflicted (i.e., high BIS activation and a strong tendency to disengage).

Indeed, animal models of motivation have found that reward (presumably BAS activation) can mute aversive cues. Rats that were trained to run down an alley for a food reward but shocked while running (i.e., approach-avoidance conflict), maintained higher speeds of running when the reward was larger (Bower & Miller, 1960). Although shock intensity was gradually increased, the larger reward sustained approach behaviour amidst stronger punishment cues. Similarly, other work has found that rabbits receiving a reward of water (i.e., activating BAS) were slower to learn that a noise signalled a shock. That is, if rabbits were concurrently given water while learning that the noise signalled impending punishment (approach-avoidance), they showed lower sensitivity to, and vigilance for, the noise cue (reviewed in Gray, 1987).These studies suggest that the reward system can dull reactivity to negative punishment cues, thus improving goal striving. Given that the

BAS is rooted in dopaminergic reward systems (Depue & Collins, 1999) then, its activation should mute conflict and enable persistence.

Neural indicators of the BAS in humans also predicts persistence at difficult tasks (e.g., unsolvable anagrams, key-pressing task; Hughes, Yates, Morton, & Smillie, 2014; Bassel & Schiff, 2001; Price, Hortensius, & Harmon-Jones, 2013). In an Effort Expenditure for Reward Task (EEfRT; Treadway, Buckholtz, Schwartzman, Lambert & Zald, 2009) participants had to choose between an easy task that offers a low reward (pressing a key with your dominant index finger 30 times in 7 seconds) or a difficult task for higher rewards (pressing a key with the pinky of your non-dominant hand 100 times in 21 seconds). The probability of payout was also varied across trials (low, medium and high probability of reward). Higher left frontal asymmetry (LFA, an indicator of BAS activation, Davidson, 1992; Harmon-Jones & Allen, 1997) was correlated to choosing the more difficult task for higher rewards (rather than the easy, low reward task) regardless of probability. The findings suggest that the BAS increases preference for reward despite difficult, and uncertain circumstances. Another study by Price et al., (2013) found that individuals donning a determined facial expression had higher LFA compared to neutral and satisfied faces. Furthermore, in the determined face condition, LFA was positively correlated to time spent on unsolvable anagrams. These studies support my hypothesis that BAS activation should predict greater task persistence.

Relationship between the BAS and BIS

In the Reinforcement Sensitivity Theory (RST) the behavioural functions of the BIS (i.e., inhibition, hesitance, and vigilance), are discussed in isolation of the

behavioural functions of the BAS[2]. That is, the RST assumes separate effects of the BAS and BIS, and that behavioural output is a result of a single, dominant system (see Corr, 2004). However, more recent research on the BAS and BIS suggests that these systems have joint, rather than separable effects (e.g., Berkman et al., 2009). Corr (2004, Corr & McNaughton, 2012) proposed the Joint Subsystems Hypothesis (JSH), which suggests that BAS and BIS activation may be reciprocally active. BIS activation could therefore undermine persistence directly through its effect on readiness to disengage and also indirectly through its suppression of the BAS (Carver & Scheier, 1988; Nash, Inzlicht, & McGregor, 2012; Veling, Holland & Van Knippenberg, 2008; see also Carver, 2015). The relationship between BAS and BIS activation can go both ways, however, according to the JSH (Corr, 2004; Corr & McNaughton, 2012). That is, BAS activation can mute BIS activation reducing inhibition of behaviour, and indirectly increase persistence. This relationship may be why focal goal commitment and progress, which activates BAS-mediated engagement, is relatively immune to conflicts or distractions (Harmon-Jones et al., 2009). Trait levels of BAS also mutes BIS activation (as indicated by reduced neural responsiveness to errors, Corr, 2013; Potts, George, Martin & Baratt, 2006; Olvet & Hajcak, 2008). Potts et al., (2006) found that individuals higher on self-reported impulsivity (i.e., BAS activation) had lower error-related negativity (ERN, Gehring, Goss, Coles, Meyer, & Donchin, 1997) on error trials that were punished. Higher dispositional levels of BAS activity appear to mute distress signals that result from

[2] I note that there is also a proposed third system, the fight-flight-freeze system or FFFS, which is related to the BIS and BAS. Its behavioural effects and response to punishment cues are collapsed in the JSH framework and therefore will not be discussed in the context of the current investigation (Corr, 2004).

committing errors, and thus should allow for persistent behaviour under challenging circumstances (see also Nash et al., 2012).

Research on goal conflict and goal achievement from a self-regulation perspective also supports a reciprocal relationship between BAS and BIS. When strongly committed to a goal, individuals often shield themselves from conflicting alternative goals (Shah, Friedman & Kruglanski, 2002; Veling & Van Knippenberg, 2006). This shielding is adaptive because when multiple goals are primed, individuals have difficulty finding a means to achieve their goals and are less able to mount action (e.g., Köpetz, Faber, Fishbach, & Kruglanski, 2011). Köpetz et al., (2011) found that individuals primed with a focal goal and an alternative goal had more difficulty finding means (i.e. choosing from a list of foods) to achieve their goal of satiety. The authors suggest that the alternative goals creates conflict and constrains the possible set of actions (Study 1; Köpetz et al., 2011). However if participants were made to concretely focus on a single goal; through mental contrasting (Study 3), by subliminally priming the focal goal (Study 4), or inducing a hungry-state (Study 5), they were able to goal-shield, and presented more means to achieve their focal goal (Köpetz et al., 2011). Goal conflict (and presumably BIS activation) appears to be inimical to goal striving, however, activating the BAS (via goal commitment, or other means) may trump these effects.

Abstraction, goal persistence, and the BIS

My guiding hypothesis is that concreteness boosts persistence for people high in state- or trait-BIS activation. Before developing that line of reasoning and the tests of my hypotheses, it is important to acknowledge that at least for some people in some circumstances, abstract mindsets are helpful. Abstract goals that are related to values or

identity can powerfully facilitate persistence (e.g., Lydon & Zanna, 1990; Cohen & Sherman, 2014). When abstract goals are clear, they can organize subordinate goals in a way that reduces uncertainty, conflict, and BIS activation to strengthen persistence and performance (Hirsh & Kang, 2016; Hirsh, Mar, & Peterson, 2012). In many studies, abstract goals have been found to increase goal striving and performance (Fujita, Trope, Liberman, & Levin-Sagi, 2006; Naufel & Beike, 2009; Schley & Fujita, 2014; Schmeichel & Vohs, 2009; Vasquez & Buehler, 2007). Similarly, within the construal level theory (CLT) framework, an abstract mindset in highly valued goal domains promotes effective goal pursuit and immunity to tempting distractions (Fujita et al., 2006, Study 4). Abstract perspectives on goals can lead to greater persistence at academic goals, health goals, and encourage delayed gratification (e.g., Davis, Kelley, Kim, Tang & Hicks, 2016; Mischel, Shoda, Rodriguez, 1989; Sweeney & Freitas, 2014). In a similar vein, regulatory focus has found that a promotion focus (which is linked to abstract mindset; Förster & Higgins, 2005) increases approach motivation and persistence following success feedback (Förster, Grant, Idson, & Higgins, 2001; Roney, Higgins, & Shah, 1995). Broadening one's mindset can help to generate ambitious, powerfully approach-motivated goals aimed at an ideal end-state (Amodio, Shah, Sigelman, Brazy & Harmon-Jones, 2004; see Epton, Harris, Kane, van Koningsbruggen, & Sheera, 2015 for review). However, if experiencing conflict (i.e., BIS-activated), the same motivational properties of an abstract mindset may not be as readily available (e.g., following failure feedback as in Förster et al., 2001, see also Vohs, Park, & Schmeichel, 2013).

In the entropy model of uncertainty, people aim to minimize levels of *psychological entropy* when pursuing their goals (Hirsh et al., 2012). Building on

cybernetic control theory and its underlying principles, the entropy model suggests that goals are guided by perceptual and behavioural affordances or options (Carver & Scheier, 1982; Hirsh et al., 2012). Conflict between behavioural options increases entropy, which activates the BIS, prompting individuals to seek a means to manage and reduce the conflict. For example, if a regular commute to work is impeded by road construction, there would be an increase in entropy and uncertainty, prompting a search for an alternate route. Behavioural affordances would be limited to a set number of routes, however, and resolving the conflict would be relatively simple. Alternatively, entropy and conflict at a more abstract level would be more problematic. Arriving at work to discover that you are being fired and must now search for a new career would result in considerably more entropy. The behavioural options available for this type of BIS-eliciting entropy state would be higher and significantly more challenging to resolve. If abstract goals are conflicted, they "can lead to states of profound behavioral and affective destabilization" due to the increase in psychological entropy when "the many behavioral and perceptual affordances previously constrained by this goal are allowed to vary freely" (Hirsh et al., 2012, p. 6).

Although the BIS is a situationally responsive system that varies according to circumstance, people also differ in trait levels of BIS-sensitivity. People with tendencies toward anxiety have BIS-related processes that are chronically active (Boksem, Tops, Wester, Meijman, & Lorist, 2006; Proulx et al., 2012; for review see Olvet & Hajcak, 2008). These individuals would exhibit higher baseline levels of vigilance for conflicts, hesitation, and willingness to disengage. Abstract mindsets facilitate top-down processing, inferences about global trait-evaluations, broader meaning of events, (see

Trope & Liberman, 2010; Nussbaum, Trope, & Liberman, 2003) and may impose a generalized self-concept of higher BIS-related traits to persistence tasks (e.g., Libby, Valenti, Pfent & Eibach, 2011). For instance, low self-esteem individuals (with a negative self-concept) primed with an abstract mindset were more likely to catastrophize a personal failure (Libby et al., 2011). Participants were asked to recall an instance where they failed at something important, from a first-person (concrete) or third-person (abstract) visual perspective. Those with low self-esteem and primed with a third-person perspective were more likely to overgeneralize their failures, had increased accessibility to other unrelated failure events (Study 2), and implicitly identified more negative traits about themselves (Study 3). Marigold, Eibach, Libby, Ross & Holmes, (2015), also found that anxiously attached individuals are more likely to internalize relationship conflicts when primed with abstraction. Anxiously attached participants that were asked to recall a transgression performed by them (Study 1) or a partner (Study 2) from third-person perspective, tended to overgeneralize these remembered conflicts and consequently rated their overall relationship quality as lower (compared to a concrete, first-person perspective). These studies provide evidence that abstraction for some personalities may be harmful[3], and I aim to extend this work by demonstrating that, abstractions, for high BIS individuals can also limit persistence. From an entropy model perspective, given that at least some degree of uncertainty is inherent in all abstractions, (as they lack concretely

[3] Important to note, is that abstract mindsets alone are not harmful to these personalities. Rather, only when abstraction is coupled with a negative outcome (see Libby et al., 2011)

observable referents) they could pose a threat of higher level goal-system entropy for people high in trait BIS activation (Hirsh et al., 2012).

Concrete Mindset, BIS, and Approach Motivation

Due to the difficulties high-BIS people may encounter with abstraction, my main hypothesis is that the higher in BIS activation one is, the more concrete (as opposed to abstract) mindsets should be conducive to approach motivation and persistence. Relative to an abstract mindset, a concrete mindset is specific and contextual, (Trope & Liberman, 2003) and should facilitate bottom-up processing, preventing overgeneralizations of BIS-related self-concept. I contend that for those high in BIS activation, concreteness should manage, or even diminish conflict, and result in greater persistence. Indeed, anxious and depressed individuals (i.e., those prone to BIS-activation; Olvet & Hajcak, 2008) who mount a concrete mindset exhibit reduced worry, rumination, and depressive symptoms (i.e., consequences of persistent BIS activation; Carver & White, 1994; Rimes & Watkins, 2005; Watkins, 2008; Watkins & Moberly, 2009). Given that BIS activation impairs task persistence (e.g., Alquist et al., 2018), I aim to extend this work and demonstrate that concreteness should benefit those high in BIS activation to improve persistence. I tested my hypothesis in 4 of the present studies by assessing the BIS X concreteness interaction effect on persistence. In Study 5, I tested the proposed mechanism and manipulated the mediator (BAS) to examine changes in BIS and persistence.

By managing the risk of further BIS activation, concrete mindsets should indirectly sustain BAS, however concreteness might also directly activate the BAS. The narrow perceptual, and conceptual consequences of a concrete mindset may lead to

approach-motivated states. Focusing attention on narrow details is akin to a concrete mindset (Büttner et al., 2014; Freitas, Gollwitzer, & Trope, 2004; Liberman, Trope, McCrea, & Sherman, 2007; Trope & Liberman, 2003) and has heightened BAS-related motivation in past research (Gable & Harmon-Jones, 2011). Narrow attention, induced by having participants focus on the local elements of a Navon letter (i.e., a large letter composed of different, smaller letters; Navon, 1977), increased approach motivation as assessed by ERP responses (N1 component) to pictures of appetitive stimuli. Furthermore, approach motivation increases the potential to ignore competing, conflicting goals (e.g., Harmon-Jones, Schmeichel, Inzlicht, & Harmon-Jones, 2011). For instance, in a dissonance paradigm, participants were asked to choose between two experiments that they rated as highly interesting. Dissonance reduction (as measured by devaluing the unchosen option) was greater for those higher in approach motivation, indicating reduced cognitive conflict and discounting of alternative options. Unnoticed conflicts would not be able to activate the BIS and thus approach motivation and its perceptual narrowing should improve persistence (i.e., joint subsystems hypothesis, Corr, 2004). Moreover, the relation between approach motivation and its perceptual narrowing appears to be bidirectional. Approach motivation causes perceptual narrowing (Gable & Harmon-Jones, 2010; Gable, Poole, & Harmon-Jones, 2015; Gable, Poole, & Cook, 2013) and perceptual narrowing increases approach motivation (Gable & Harmon-Jones, 2011). Based on these expected perceptual-motivational dynamics, I propose that activating a concrete mindset should increase approach motivation, increasing persistence and tenacity in focal tasks for BIS-sensitive people (who are otherwise inclined toward the experience of entropy, vigilant caution, and disengagement).

Past research has focused on the effects of concreteness as it directly relates to focal tasks. A wide range of literature has shown that concreteness improves goal planning during difficult tasks, views on personal failures and shortcomings, judgments about relationship conflicts, and goal achievement (Libby et al., 2011; Locke & Latham, 1990; Marigold et al., 2015; Oettingen, Pak & Schnetter, 2001; Pham & Taylor, 1999; Taylor, Pham, Rivkin & Armor, 1998). For instance, concretely identifying a single goal decreases accessibility and activation of alternative goal pursuits (see Shah et al., 2002). In addition, concrete plans (if-then, implementation intentions) filter out disruptive anxiety-provoking distractors (Bayer, Gollwitzer, & Achtziger, 2010, Study 3). Thus it is well documented that concreteness within a focal task is beneficial to performance.

Here, in contrast, I propose that for BIS-sensitive people a concrete mindset should be able to spur approach-motivated goal persistence even when concreteness is induced in a domain unrelated to the focal goal. I accordingly induce generalized concrete mindsets and assess persistence and motivation, under the assumption that mindset inductions should cause systemic, domain-general motivational consequences (Freitas et al., 2004; cf., Trope & Liberman, 2003). Other research by Kille and colleagues (2017) has found that domain general primes of concreteness (i.e., how vs. why task, Study 2; subordinate vs. superordinate words, Study 3) demonstrate similar results as direct manipulations of mindset on a focal task (i.e., first vs. third person perspectives of a compliment, Study 4; Kille, Eibach, Wood & Holmes, 2017). Broadly priming the mindset in an unrelated domain allows for a test of the implications of basic motivational consequences related to mindset inductions, rather than how they might operate through the framing of the focal task.

Priming a general concrete, implemental mindset has been shown to increase self-reported determination toward unrelated tasks (Harmon-Jones, Schmeichel, Mennitt, & Harmon-Jones, 2011; Study 1), as well as reduce attitudinal and cognitive conflict in other domains (Henderson, de Liver & Gollwitzer, 2008). A general, action-oriented mindset, increases approach motivation-related responses toward unrelated tasks and evaluation of conflicting choices (Harmon-Jones & Harmon-Jones, 2002; Harmon-Jones, Harmon-Jones, Fearn, Sigelman, & Johnson, 2008). For instance, Harmon-Jones and Harmon-Jones, (2002) asked participants to think about an action-oriented goal which could be completed in the next 3 months. Participants completed a dissonance paradigm, and were asked to choose between two equally rated options (as in Harmon-Jones, Schmeichel, Inzlicht, & Harmon-Jones, 2011). Those in a generalized action-oriented mindset demonstrated less cognitive conflict (i.e., greater dissonance reduction) as measured by devaluation of the unselected option. Activating approach-motivated states in focal-task-irrelevant domains may be an important addition to concrete framing of focal goals. In some cases, focusing concretely on conflicted focal tasks can increase risk of distress-provoking rumination and disengagement (Carver & Scheier, 1988; Cochran & Tesser, 1996; Soman & Cheema, 2004; Street, 2001). However, manipulating concreteness in a neutral domain may accordingly optimize chances of resolving conflict and motivating persistence for BIS-activated people.

Overview of studies[4]

In four studies, I test the hypothesis that the higher in BIS activation participants are, the more concrete (vs. abstract) mindsets should improve their tenacious persistence and approach motivation. In Study 1, conflict (i.e., BIS activity) was induced using the Stroop task (Stroop, 1935) and concreteness was primed using a categories vs. exemplar manipulation (Fujita et al., 2006). I then measured persistence at an effortful cycling task. I expected the BIS-induced (vs. not induced) participants to cycle harder when primed with concreteness than with abstraction. In Studies 2-4, I measured self-reported trait BIS (Carver & White, 1994) and manipulated concreteness using a how vs. why manipulation (adapted from Freitas, et al., 2004; Liberman & Trope, 1998). I predicted that the higher participants' BIS scores were, the more a concrete mindset would improve tenacious persistence during a timed data-entry task (Study 2), elevate a neural index of approach motivation, improve performance at an effortful handgrip task (Study 3), heighten self-reported state-approach motivation, and encourage persistence toward real-life, ongoing personal goals (Study 4). To test my idea that the BAS and BIS mediated persistence, in Study 5, I directly manipulated approach (BAS) then measured BIS activation and persistence.

[4] Studies 2 and 4 had additional exploratory materials related to other hypotheses. Their full design is not reported here and instead can be found in Appendix A.

Study 1

The BIS is activated by conflicts and discrepancies (Gray & McNaughton, 2000; Proulx et al., 2012). I accordingly manipulated Stroop conflicts to induce BIS activation (Wallace & Baumeister, 2002) and also experimentally manipulated concrete mindset in a 2X2 factorial design. The dependent variable was a behavioral measure of persistence, energy (kilojoules, kJ) burned over the course of a strenuous, 10-minute cycling task. I expected an interaction effect such that more kJ of energy would be burned by high than low-BIS participants in the concrete condition than the abstract condition.

Method

Participants and procedure. Seventy-two McMaster University undergraduates were paid $10 for an hour of participation in this "health and exercise psychology study." Seven participants failed to follow instructions on the cycling task, resulting in a final sample of 65 participants (females = 34, M_{age} = 21.72). Participants were randomly assigned to one of four conditions in a 2 (BIS: Stroop vs. no Stroop) X 2 (Concreteness: exemplar vs. category) design with energy output measured across the 10-minute dependent cycling task.

Participants first entered the lab and completed demographic questions (exercise history, age, gender) after which they performed an initial 6-minute baseline cycling task. Amount of energy generated during this baseline period was used in statistical analyses as a control for differences in cycling endurance capacity. Participants then completed either 7 minutes of an incongruent Stroop task, or 7 minutes of quiet rest, followed by a manipulation check. Next, they were given the concreteness manipulation that involved

writing down either an example (concreteness) or a category (abstraction) for 40 different words. This task was followed by a measure of task persistence; the amount of energy generated during a 10-minute endurance cycling task. Following the cycling task participants were debriefed and paid.

Baseline cycling persistence. Participants completed the cycling exercise on an electronically-braked ergometer (Lode Corival^{TM}). The initial 6-minute baseline period consisted of 2 minutes of no resistance warm-up, 2 minutes of resisted cycling and 2 minutes of no resistance cooldown. Cycling persistence varies as a result of gender differences (Heyward, Joannes-Ellis, & Romer, 1986) as well as level of training (Demello, Cureton, Boineau, & Singh, 1987). To account for these differences, energy expended (kJ) during the 2 minutes of resistance was used as a covariate in the analyses.

BIS manipulation. In order to activate BIS, participants performed a modified Stroop task for 7 minutes (Bray, Martin Ginis, Hicks, & Woodgate, 2008; Wallace & Baumeister, 2002)[5]. During incongruent Stroop trials, participants are required to overcome the automatic tendency to read colour words (e.g. blue, black, pink) and instead identify what colour ink the words are printed in—constituting a behavioral conflict. In the modified version, experienced conflict is increased by including an additional rule. For one specific colour, participants had to read the word rather than say

[5]Although this task has been used in past research as a measure of self-control depletion (Inzlicht & Gutsell, 2007), I contend that the Stroop task essentially represents a conflict between wanting to read a word vs. perceive the colour of the word. In support of this idea, past research has found that successful performance on the Stroop (a BIS-eliciting conflict) was moderated by BAS (Prabhakaran, Kraemer, & Thompson-Schill, 2011). Based on the joint subsystems hypothesis of BAS and BIS, as well as work relating approach motivation to conflict, this suggests that the Stroop may activate BIS (Corr, 2004; Nash et al., 2012).

the colour of ink (e.g., please say the colour of the ink, EXCEPT for all red inked words, for these words please *read* the word instead). Therefore participants had to override the first rule for 25% of the words and were instructed to read all red inked words. Participants in the no-conflict control condition simply sat quietly for 7 minutes.

According to Gray and McNaughton (2000), conflict is the essential cause of BIS activation and so conflict between the habitual goal of reading the lexical meaning of a word and intentional goal of attending to the font colour should activate the BIS (see Proulx, et al., 2012 and Jonas, McGregor, et al., 2014 for review of evidence that various forms of conative and cognitive conflict can similarly activate BIS-related processes).

Manipulation check. A four-item manipulation check was used to measure participants' ratings of mental effort, fatigue, frustration and pleasantness in regard to the Stroop task, participants rated the statements on a 7-point Likert scale, where 1=Strongly Disagree and 7=Strongly Agree. Participants in the control condition responded to the same questions in reference to the quiet rest period.

Concreteness manipulation. Concreteness was induced using an exemplar vs. category word-listing task (Fujita & Han, 2009; Fujita et al., 2006). Concreteness is specific and detail oriented, therefore it can be primed by coming up with examples of words, whereas broad, general categories should lead to more abstract thinking (Fujita et al., 2006; Trope & Liberman, 2010). To induce concreteness, participants were given a list of 40 different words (e.g. drink, computer, king) and asked to give an example (concreteness condition) or a category (abstraction condition) for each word. I expected that following the conflict manipulation, the narrower focus would activate approach-motivated states, thereby down-regulating the BIS and liberating task persistence. All

participants spent 5 minutes working on this concreteness (vs. abstraction) mindset-priming task.

Cycling persistence. During the primary measure of task persistence, participants again completed a 2 minute warm-up period at no resistance. They then cycled for a 10-minute period while their rate of energy production (watts of power) was recorded. The average amount of energy (kJ) produced was measured by multiplying average power (kilojoules per second) by time in seconds, and dividing by 1000.

Results and Discussion

Manipulation checks. I tested whether the high-BIS condition responded with higher ratings on the four-item manipulation check. Participants in the high-BIS condition reported higher levels of frustration, F (1,63) = 21.10, $p < .001$, (M_{BIS} = 3.58; M_{noBIS} = 1.69), less pleasantness, F (1,63) = 16.05, $p < .001$, (M_{BIS} = 5.12; M_{noBIS} = 3.88), more fatigue, F (1,63) = 20.22, $p < .001$, (M_{BIS} = 4.15, M_{noBIS} = 2.38), and exerted more effort, F (1,63) = 135.04, $p < .001$, (M_{BIS} = 5.36, M_{noBIS} = 1.91).

Interaction and simple effects analysis. There were no main effects of BIS, F (1,60) = .005, p = .95, d = .02 or concreteness, F (1,60) = .20, p = .66, d = .11. Consistent with my primary hypothesis, there was a significant BIS X concreteness interaction effect on cycling persistence, F (1,60) = 4.34, p = .04[6], d = .53 (See Figure 1). Concreteness (vs. abstraction) predicted significantly higher cycling energy output in the high (vs. low) BIS condition. The simple effect at high BIS revealed a non-significant difference between

[6] The analysis without the baseline covariate was, F(1,61) = 1.94, p = .17, d = .36.

concreteness and abstraction, t (60) = -1.16, p = .25, d = .30, however the effect was in the predicted direction with a small-to-medium effect size (Cohen, 1992). High-BIS participants in the concrete mindset condition burned more energy (M_{conc} = 62.55 kJ) than those in the abstract condition (M_{abs} = 56.93 kJ). There was a marginal simple effect at low BIS, t (60) = 1.77, p = .08[7], d = .46, such that those in a concrete mindset burned less energy (M_{conc} = 55.64 kJ) than those in the abstract condition (M_{abs} = 64.31 kJ).

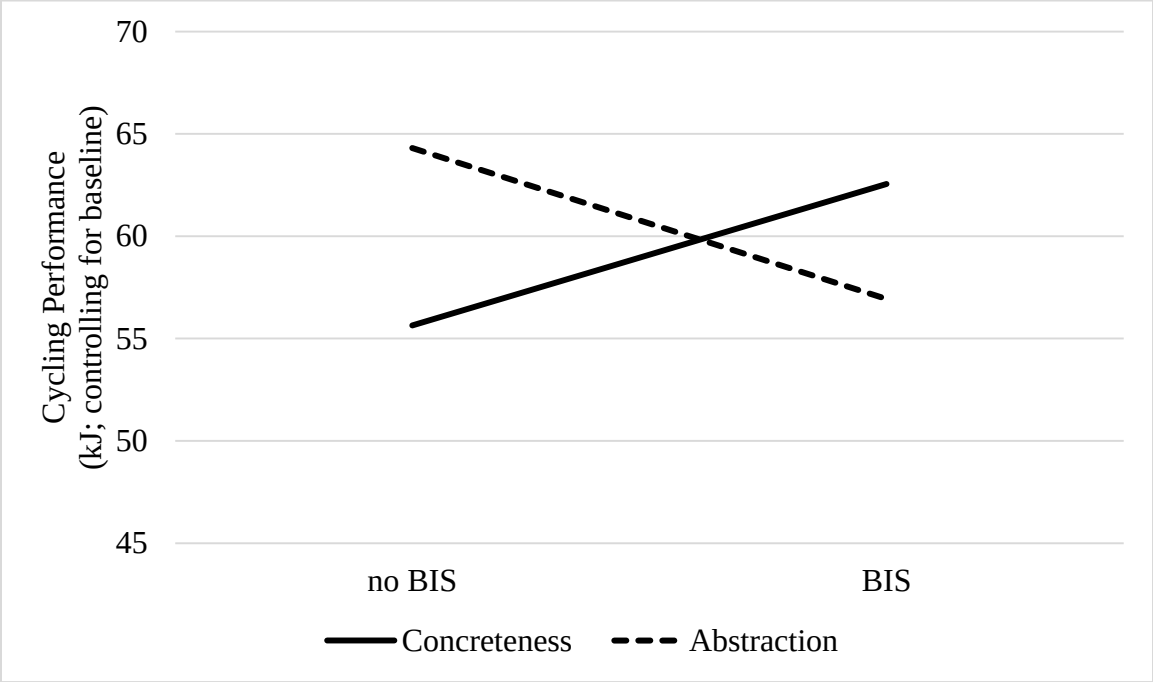

Figure 1. Interaction of concreteness and BIS on kilojoules generated (Study 1).

These data were collected prior to the field's increased emphasis on power analyses and sample size (Simmons, Nelson & Simonsohn, 2011). A post hoc power analysis (G*Power) indicated that the observed power for the interaction effect was underpowered relative to current standards (Power (1-β error probability) = .56). Given

[7] This effect is in line with previous work on abstraction and persistence (e.g., Fujita et al., 2006).

the observed effect and a desired power of 0.8, in order to have obtained a significant interaction at $p = .05$, follow up studies would require a sample of 113 to detect the interaction effect. To address this issue, I increased the sample size in the next three studies in an attempt to have adequate power to detect my hypothesized BIS X concreteness effect.

Another limitation of Study 1 is that it cannot rule out the possibility that Stroop-condition factors unrelated to conflict and BIS activation could have increased mental effort, fatigue, frustration, negative affect, and the effect on energy output. Goal conflict has been linked to effort, fatigue, goal frustration, and negative affect, but Study 1 does not provide direct evidence for BIS involvement (Carver, 2006; Inzlicht, Schmeichel & Macrae, 2014; van Beek, Kranenburg, Taris, & Schaufeli, 2013). In Studies 2-4, I directly measured BIS activation by using a personality measure and tested whether a concrete mindset would similarly mobilize persistence for people high in trait BIS-sensitivity (Carver & White, 1994).

Study 2

To provide convergent evidence for my hypothesis, in Study 2 I used a trait scale to measure BIS-sensitivity, a different manipulation of concreteness (a how vs. why thought task; adapted from Freitas et al., 2004), and a different dependent measure of persistence (a speeded data entry task). I also addressed the limitation of power by increasing sample size well beyond the 113 suggested by the post-hoc power analysis in Study 1. Based on the trend in Study 1, I hypothesized that concrete (vs. abstract) mindset would increase behavioral tenacity among higher (vs. lower) BIS-sensitive participants.

Method

Participants and procedure. To achieve my desired power I increased the sample size, and asked three hundred and thirty-two York University undergraduates to participate in exchange for a partial course credit in an introductory psychology class. Seven participants[8] failed a compliance check or failed to perform the data entry task correctly and were removed (n = 328, females = 225, M_{age} = 20.63). I collected the data online; each participant completed a single 45-minute-long survey that began with demographics questions, trait measures of BIS and BAS, and several other personality scales. Next, participants completed the concreteness manipulation (a how vs. why thought task; adapted from Freitas et al., 2004) and a manipulation check (the behavioural identification form, BIF, Vallacher & Wegner, 1989). They then completed the behavioural measure of persistence—a 3-minute, speeded data entry task, followed by

[8] Inclusion of the 7 participants partially attenuated the effects, see Appendix B.

measures of mood (PANAS, Watson, Clark, & Tellegen, 1988). Finally they answered questions about compliance and were debriefed.

Trait BIS and BAS. I used a validated, 20-item personality scale to assess trait BIS and BAS activity (Carver & White, 1994). Sample BIS items include; 1) *If I think something unpleasant is going to happen, I usually get pretty worked up;* 2) *I worry about making mistakes*; 3) *I feel worried when I think I have done poorly at something important*[9]. The BAS scale is composed of 3 different subscales that are related to eager determination (BAS Drive), sensitivity to rewarding stimuli (BAS Reward-Responsiveness), and desire to explore novel sensations and fun experiences (BAS Fun-Seeking). I collected measures of the full BAS scale, however for my analyses I used only the BAS-Drive subscale based on the practice recommended by Carver (2007) to keep the subscales separate. I used this subscale due to its face-validity as a measure of the "impulse to move toward" a desired end state (Harmon-Jones et al., 2009), and past precedent of focusing only on the BAS-Drive subscale as a marker of approach motivation (Eftekhari, Tran, & McGregor, 2017; McGregor, Nash, & Prentice, 2010, Study 2)[10]. Items included; 1) *If I see a chance to get something I want, I move on it right away*; 2) *When I want something, I usually go all-out to get it.* I included the BAS-Drive scale as a covariate in my analyses based on the assumption that high trait-BAS scores would correlate with tenacious persistence on the data-entry task.

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[9] Some research has found this BIS scale to contain an anxiety (BIS) and a fear subcomponent (FFFS, see Heym, Ferguson, & Lawrence, 2008). I also ran all analyses using the anxiety subcomponent and found no differences in my results. These can be found in the Appendix B.

[10] Statistics with the additional two BAS scales included do not significantly change the results and can be found in Appendix B.

Concreteness manipulation. Participants were randomly assigned to a concrete or abstract mindset condition. A concrete mindset was induced by having participants think about the means of behavior (i.e., "how" to perform something) and an abstract mindset was induced by having participants think about the ends of behavior (i.e., "why" they are performing it; Freitas et al., 2004). Participants read six different scenarios (adapted from Liberman & Trope, 1998) and were prompted to write about "how" or "why" they might act in those scenarios. Participants in the concreteness condition were given the following instructions:

> For every goal we have in life, **we must engage in simple steps to move towards the end goal**…below you will find several scenarios of different behaviors. Please write a couple of sentences about **how** you would complete each behavior.
>
> e.g. Imagine you were applying to graduate school, please describe **the first steps** you would **take** to do that.

Participants in the abstraction condition were given the following instructions:

> For every goal we have in life, **we have a primary reason for pursuing that goal**…below you will find several scenarios of different behaviors. Please write a couple of sentences about **why** you would complete each behavior.
>
> e.g., Imagine you were applying to graduate school, please describe **ultimately why** you would **want** to do that.

BIF. Participants completed a 24-item forced-choice questionnaire that was designed to measure abstraction and concreteness (see action identification theory, Vallacher & Wegner, 1989). For each item participants were asked to think about whether the behaviour better matched a means-related or ends-related description. For

example participants were asked if "locking a door" seemed more appropriately described as "securing the house" (abstract identification) or "turning a key" (concrete identification). This measure has been used in previous studies to assess level of concreteness and abstraction (Fujita et al., 2006).

Data entry task. A speeded data entry task was used as a behavioural measure of approach motivation. A text box and a set of instructions prompted participants to enter as many consecutive numbers as possible in the format of "1, 2, 3, 4, 5, 6" etc. for a 3-minute period. Participants could not progress to the next part of the study until the full 3-minute time period expired. They were instructed to *"Try to get as far along as possible within the 3 minute time frame, however at any time you may decide to stop and wait until the 3 minute period is up at which point you may continue with the study."* At the end of the 3-minute period the screen automatically advanced. Performance was measured as the number of characters that participants entered into the text box.

Mood. Given the manipulation-check results for pleasantness and frustration in Study 1, I assessed positive and negative affect. Participants completed the positive and negative affect scales (PANAS, Watson et al., 1988) that measure subjective ratings of affect related to positive (e.g. energized, happy, proud) and negative (e.g. guilty, sad, jittery) emotions.

Results and Discussion

Manipulation check. Analysis of the BIF scores indicated that participants in the concrete condition scored significantly lower on the BIF (indicating greater concreteness,

M_{conc} = 15.54) than participants in the abstract condition (M_{abs} = 16.81), *t (*329) = -2.50, *p* =.01, *d* = .28.

Mood measures. An unanticipated finding was that there was a significant interaction effect on negative affect, *t (*328) = 3.10, *p* =.002, *d* = .34, such that there was higher negative affect in the high BIS, abstract condition compared to the concreteness condition. This effect was not replicated in subsequent studies and therefore is not discussed further.

Interaction and simple effects analysis. There was a main effect of BIS, *t (*327) = 4.84, *p* < .001, *d* = .41 and main effect of concreteness, *t (*327) = 2.77, *p* =.006, *d* = .31. Importantly, this was qualified by a significant BIS X concreteness interaction effect on data entry performance with trait BAS entered as a covariate[11], *t (*327) = -2.93, *p* =.004, *d* = .32 (See Figure 2). Simple effect analyses at high BIS revealed more characters entered in the concreteness condition (M_{conc} = 489.42) than the abstraction condition (M_{abs} = 415.50), *t (*327) = -2.58, *p* = .01, *d* = .28 (Aiken, West, & Reno, 1991). At low BIS, there was a simple effect trend, *t (*327) = 1.62, *p* = .11, *d* = .18, such that the concreteness condition typed less (M_{conc} = 352.89) than the abstraction condition (M_{abs} = 399.84). The results of Study 2 support the notion that in high-BIS people, concreteness can encourage persistence. Persistence and approach motivation are theoretically related (Carver, 2006; Harmon-Jones, Harmon-Jones, & Price, 2013) and these results are consistent with the interpretation that those who typed longer were more approach-motivated. Studies 3 and

[11] The analysis without BAS as a covariate had similar results; interaction effect, *t* (328) = -2.66, *p* =.008, *d* =.29, simple effect at high BIS, *t* (328) = -2.32, *p* = .02, *d* = .26. Including the 7 outliers, the interaction effect was, *t* (334) = -2.17, *p* = .03, *d* = .24, simple effect at high BIS, *t* (335) = -2.20, *p* = .03, *d* = .24).

4 directly assessed whether this same BIS X concreteness interaction would also predict approach-motivated states.

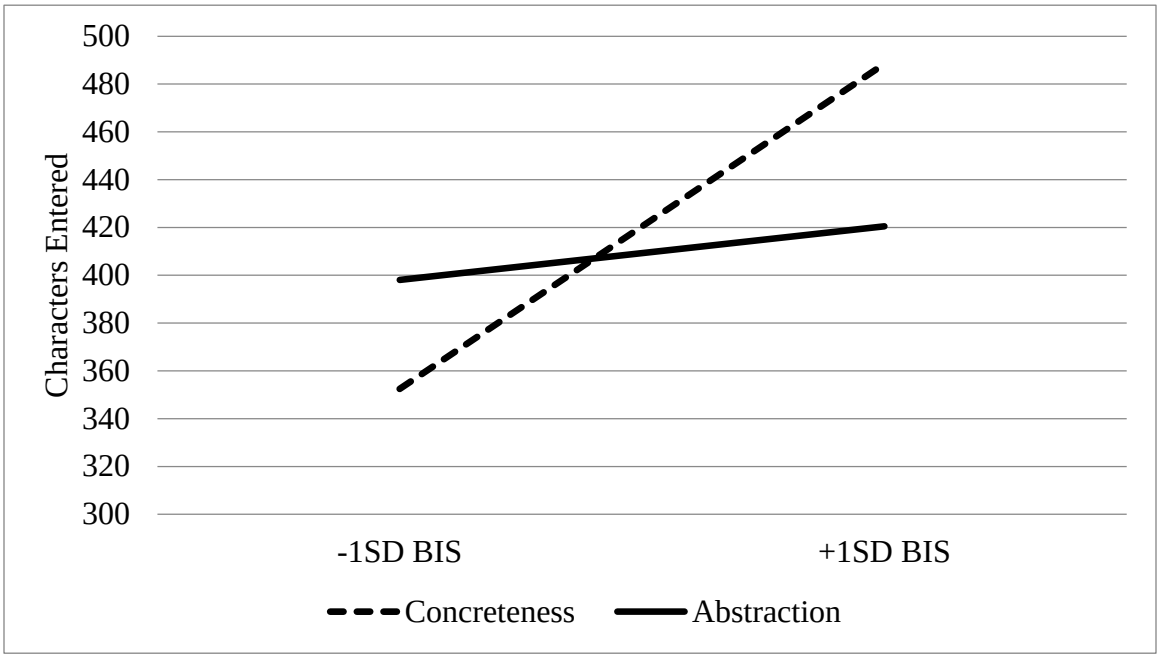

Figure 2. Interaction of concreteness and BIS on number of characters entered during data entry task (Study 2).

Study 3

Study 3 focused on physical endurance as a behavioural measure of persistence—time spent performing a handgrip endurance task. For a neural measure of approach motivation, I also used a common electroencephalographic (EEG) index of approach motivation—left frontal alpha asymmetry (Harmon-Jones & Allen, 1997). I expected a BIS X concreteness interaction effect with higher-BIS participants in the concrete (compared to abstract) mindset condition demonstrating greater persistence and approach motivation.

Method

Participants and procedure. In keeping with the post-hoc power analysis from Study 1, I collected a sample of 142 York University undergraduates, but excluded 8 participants that were missing data, or had outlier scores (described below; n = 134 females = 79, M_{age} = 19.56). Participants volunteered for a lab study that lasted 45 minutes in exchange for course credit in an introductory psychology class. All participants were given the option to refuse the collection of EEG measures for various reasons, (unable to remove religious headdress, discomfort with experimenter contact, thick hair etc.) which resulted in a higher N for analyses with the handgrip and self-report scales than neurophysiological measures[12].

Participants were first familiarized with the equipment (i.e., handgrip, EEG headset, and computer interface) and then completed an initial baseline EEG

[12] In total, there were 117 participants that chose to perform the EEG portion of the experiment.

measurement lasting 90 seconds. Next, participants performed a baseline handgrip squeeze to be used as a control for individual differences in strength. Participants then filled out demographics questions, a trait measure of BIS/BAS (Carver & White, 1994), the how vs. why concreteness manipulation (as in Study 2; 6 scenarios) and a 90-second EEG measurement period immediately post-manipulation. Next, participants completed a concreteness manipulation check (BIF; Vallacher & Wegner, 1989), the handgrip persistence measure, followed by a distal 90-second EEG measurement. Finally, participants completed a measure of mood (PANAS, Watson et al., 1988) and were debriefed. As in Studies 1 and 2, I predicted that at high BIS, priming concreteness would improve performance on the endurance handgrip task. Furthermore I predicted that these participants would show the highest EEG evidence of approach motivation (i.e., left frontal alpha asymmetry).

On the handgrip task, to screen for outliers I residualized their handgrip persistence post-manipulation on their baseline performance. Based on these scores I removed five participants with standardized residual values that were 2.5 scores outside of the mean (I used this 2.5 SD cut-off for any outlier exclusions in all other studies). That is, they likely performed either the baseline or main handgrip task incorrectly (i.e., demonstrated an unusually high or low performance relative to baseline).

For the EEG analysis, I excluded an additional 9 participants for incomplete EEG data due to equipment malfunction, or due to excessive EEG signal noise that resulted in EEG scores more than 2.5 SD from the mean.

Concreteness manipulation. Participants were randomly assigned to a concrete or abstract mindset condition as in Study 2, and they read the same 6 scenarios asking

them to write about how (concreteness) or why (abstraction) they might perform a number of different behaviors.

Trait BIS-BAS. Dispositional BIS and BAS activity was measured using Carver and White's (1994) scale as in Study 2.

Handgrip tenacity. Participants used a spring-loaded Isoflex^{TM} medium tension handgrip device. At the very beginning of the study, the experimenter demonstrated how to fully squeeze the handgrip such that the handles completely touched. Participants then went to their private cubicles and squeezed it closed with their dominant hand, for as long as possible. This initial handgrip squeeze provided a baseline measure of persistence. Participants timed and recorded their own handgrip performance to reduce experimenter influence and the possibility that participants could have been trying to impress the experimenter. Following the concreteness manipulation, participants completed a second, privately timed handgrip squeeze which served as a dependent measure of persistence. Squeeze-times were recorded in seconds and baseline persistence was used as a covariate for the handgrip-related analyses.

BIF. As in Study 2, participants completed the 24-item BIF as a manipulation check measure of concreteness vs. abstraction (Vallacher & Wegner, 1989).

EEG data collection. To test my hypothesis that concreteness increases approach motivation in high-BIS people, I measured an electroencephalographic (EEG) index of approach motivation (left frontal asymmetry, LFA, Harmon-Jones & Allen, 1997). Left frontal asymmetry is a reliable indicator of BAS and approach-related states (Coan & Allen, 2003; Harmon-Jones, Sigelman, Bohlig, & Harmon-Jones, 2003; McGregor, Nash, & Inzlicht, 2009). Participants' EEG was measured at three points during Study 3; once

at the beginning of the experiment (baseline), once immediately following the concreteness manipulation (immediately post-manipulation), and once following the dependent handgrip task (distally post-manipulation). For each of the three time periods, participants were asked to focus on a '+' sign that was presented in the center of the screen for the duration of the brain measurement period. Participants were also asked to avoid excessive blinking, to try to keep as still as possible, and to avoid any large movements. Based on previous literature, I focused my analyses on the F3 and F4 electrodes, however other nodes are presented in Table 1 (Amodio et al., 2004; Tomarken, Davidson, Wheeler, & Doss, 1992).

The EEG data were collected using Emotiv^{TM} EPOC wireless EEG neuroheadsets. These devices contain 16 gold-plated electrodes arranged in a 10-20 system (AF3/4, F3/4, F7/8, FC5/6, T7/8, P7/8, O1/2, DRL/CMS) referenced to a common mode sense (CMS) electrode located on the left mastoid. The electrodes are attached by plastic arms to a structural apparatus that runs across the posterior aspect of the head. Each electrode node has a small plastic cavity that holds a felt pad soaked in saline solution in order to increase signal conductance. I recorded the data using TestBench software that sampled at a rate of 128 Hz and applied an online bandpass filter of 0.1-100 Hz. Each electrode was setup to have no more than 10 kΩ of resistance prior to starting the study.

EEG data pre-processing. I applied various filtering and artifact rejection procedures offline, after the data were collected using Brain Vision Analyzer (Brain Products, Munich, Germany). The data were treated with a 0.1 Hz cutoff high pass filter, a 30 Hz cutoff low pass filter, as well as a 60 Hz notch filter. Due to the lack of

electrooculogram channels (EOG), I did not apply an ocular correction and simply rejected trials that were outside of the artifact criterion. Literature has suggested that ocular activity is accompanied by EEG signals, and thus using algorithmic corrections for ocular artifacts may only serve to distort the data (Luck, 2005). The data were subjected to amplitude, low activity, step increase and slope artifact rejection criteria[13]. The data were segmented into 2-second epochs overlapping by 75% and the power spectra were extracted using fast Fourier transform (FFT) method with a 10% Hamming window on the distal ends. The alpha band (8-12Hz) was extracted from the F3 and F4 electrodes, and log transformed to normalize values. Since alpha power is inversely related to cortical activity (Harmon-Jones & Allen, 1997; Pfurtscheller, Stancak, & Neuper, 1996), left frontal asymmetry was calculated such that higher values reflect greater right alpha activity (Ln F4 power – Ln F3 power).

Results and Discussion

Manipulation check and mood measures. As a manipulation check, I tested to see whether the concreteness task resulted in differences in BIF scores. There was a non-significant trend of condition on BIF, such that the concrete condition scored lower (i.e., more concrete identification, M_{conc}= 15.41) than the abstract condition (M_{abs}= 16.59; t *(*132) = -1.52, p = .13, d =.26). This effect size was nearly identical to Study 2, thus although it failed to reach the $p < .05$ threshold of statistical significance, the manipulation operated similarly across both studies. I did not find a significant main

[13] EEG segments that contained a gradient more than 100uV/m over a 100 second window, with amplitudes of greater than +/- 75uV, and with a slope that was greater than 35uV were considered to contain artifacts and were therefore rejected along with 100ms before and after the segment.

effect of condition t (133) < 1, p > .8, or interaction effect, t (133) < 1, p > .48 on negative mood (in contrast to Study 2).

Interaction and simple effect analyses. In three separate regression analyses, I regressed handgrip tenacity, and the two LFA measures (proximal and distal, post-manipulation) on BIS, concreteness, and the BIS X concreteness interaction term. The handgrip and LFA analyses included the relevant baseline, pre-manipulation measurements as covariates.

For the handgrip analysis there was a main effect of BIS, t (129) = 2.02, p = .046, d =.36 and main effect of concreteness, t (129) = 2.28, p = .024, d =.40. However, these effects were qualified by a significant BIS X concreteness interaction effect on handgrip-scores, t (129) = -2.52., p =.01[14], d = .44. The simple effect analysis at high BIS revealed that participants in the concrete condition squeezed for a significantly longer period of time (M_{conc}= 83.13) than those in the abstract condition (M_{abs}= 64.70), t (129) = -2.77, p

[14] Analyses including handgrip score outliers (i.e., 2.5SD outside of the mean) showed a similar non-significant trend: interaction effect t (137) = -1.50, p = .13, d = .26; simple effect at high-BIS t (137) = -1.26, p = .2, d = .22.

=.006, *d* = .49 (See Figure 3). There was no simple effect at low BIS, *t (*129) = .85, *p* =.40, *d* =.15.

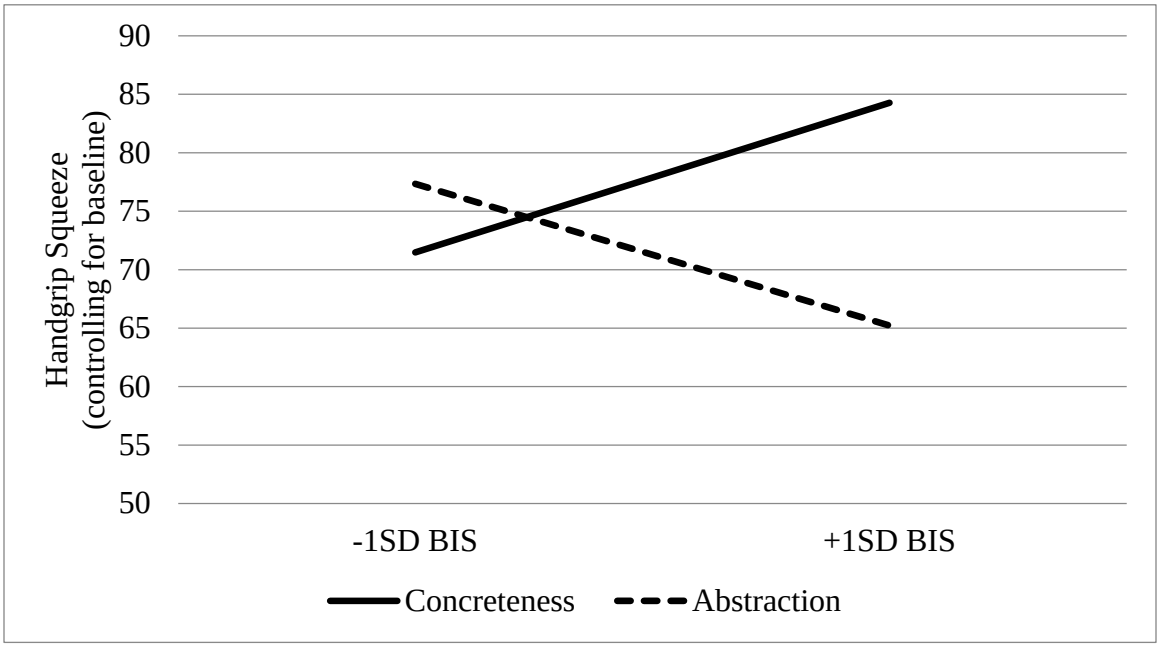

Figure 3. Interaction of concreteness and BIS on handgrip performance (Study 3).

For the proximal LFA indicator of approach motivation, there was no main effect of BIS, *t (*103) = 1.18, *p* = .24, *d* =.23 or main effect of concreteness, *t (*103) = -.42, *p* = .67, *d* =.08, or interaction effect, *t (*103) = .04, *p* = .97, *d* =.007, in the full BIS X concreteness model. In a simpler model with only condition, there was however, a significant main effect of concreteness on this proximal LFA measure, immediately following the manipulation. Participants in the concrete condition (M_{conc}= -.12) had significantly higher LFA than those in the abstract condition (M_{abs}= -.30), *t (*103) = 2.31, *p* = .023, *d* = .46. I did not predict this main effect of concreteness, but a post-hoc speculation is that the remote and location of the basement lab, under the York University, activated state BIS (as in Study 1) for most participants regardless of trait BIS. To access the lab, participants had to descend down a narrow, rusted, staircase to an

isolated, inaccessible hallway. These uncertain and strange experiences resemble other manipulations of BIS (see Proulx et al., 2012). To support this speculation, I analyzed only the female participants[15] (who would experience the most BIS activation) and found a much stronger main effect such that concreteness increased LFA (M_{conc}= -.03) compared to abstraction (M_{abs}= -.32), t (57) = 2.71, p = .009, d = .72.

[15] At the time of data collection, a high-profile Canadian magazine had also recently identified the York campus as "a hunting ground for sexual predators." http://www.macleans.ca/society/life/the-real-danger-for-women-on-campus/. The general perception of the University campus may have added to the sense of threat at the time for the female participants.

Table 1.

EEG-LFA at All Locations.

Scalp Location	LFA Time 2 (Proximal)		LFA Time 3 (Distal)	
	b	*p*-value	*b*	*p*-value
F3 – F4	.005	.96	-.2	.08
AF3 – AF4	.03	.69	.06	.44
F7 – F8	.05	.33	.004	.93
O1 – O2	-.10	.48	-.33	.05*
T7 – T8	-.06	.42	-.003	.98
P7 – P8	.05	.72	.06	.73
FC5 – FC6	.007	.90	-.08	.13†

*Note: Nodes were filtered for contact quality of **F3-F4 nodes**, and therefore may vary in number of data points included.*

For the distal post-manipulation measure of LFA, there was a marginal main effect of BIS, t (103) = 1.96, p =.053, d = .39, no main effect of concreteness, t (103) = 1.65, p =.10, d = .32. These effects were qualified by a marginal interaction effect of the predicted shape, t (103) = -1.73, p =.08, d = .34. Exploratory analysis of this interaction

effect demonstrated a simple-effect trend[16] at high BIS, with higher LFA in the concrete (M_{conc}= .10) than in the abstraction condition (M_{abs}= -.05), *t* (103) = -1.49 *p* = .13, *d* = .29 (See Figure 4). There was no simple-effect trend at low BIS, *t* (103) = .97, *p* =.33, *d* = .19. Together with the results of Studies 1 and 2, these findings support my main concreteness-helps-high-BIS-people hypothesis. For high BIS people, concreteness increased persistence on a third behavioural measure (handgrip squeeze) and resulted in some weak evidence of increased approach motivation (LFA).

There was also a marginal correlation between residualized handgrip-scores and baseline LFA (*r* = .18, *p* = .058), as well as proximal LFA (*r* = .15, *p* = .11). However, there was no correlation between handgrip persistence and distal LFA (*r* = .09, *p* = .37). These findings provide partial support for the claim that handgrip persistence is related to approach motivation.

The loose correspondence between handgrip and EEG scores calls for future research on how approach motivation unfolds across time, in the context of focally provided tasks. It is possible that different subsets of people mobilized approach motivated states in different ways, i.e., some by eagerly embracing the focally provided hand-squeeze task[17], and others by imagining engagement in other more personally relevant goals (explored in Study 4). A related, speculative possibility as to why the interaction effect on LFA only emerged during the distal EEG assessment (aside from

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[16] Exploratory, given the lack of significant interaction. The trend, though supportive of my hypothesis, should be interpreted with caution.

[17] Indeed, analysis of handgrip performance in only females demonstrated a non-significant trend of concreteness, *t* (53) = 2.08, *p* = .15, *d* = .57. Although the females demonstrated significantly more approach motivation in EEG measures, this did not directly translate to handgrip performance.

possible habituation to the bewildering laboratory experience) is that the passage of time, freedom from distraction, and the study coming to an end all helped turn the participants who were not engaged by the handgrip task to imagine to their own goals. Study 4 tested this idea by measuring approach motivation toward personally relevant goals rather on less meaningful in-lab tasks of persistence.

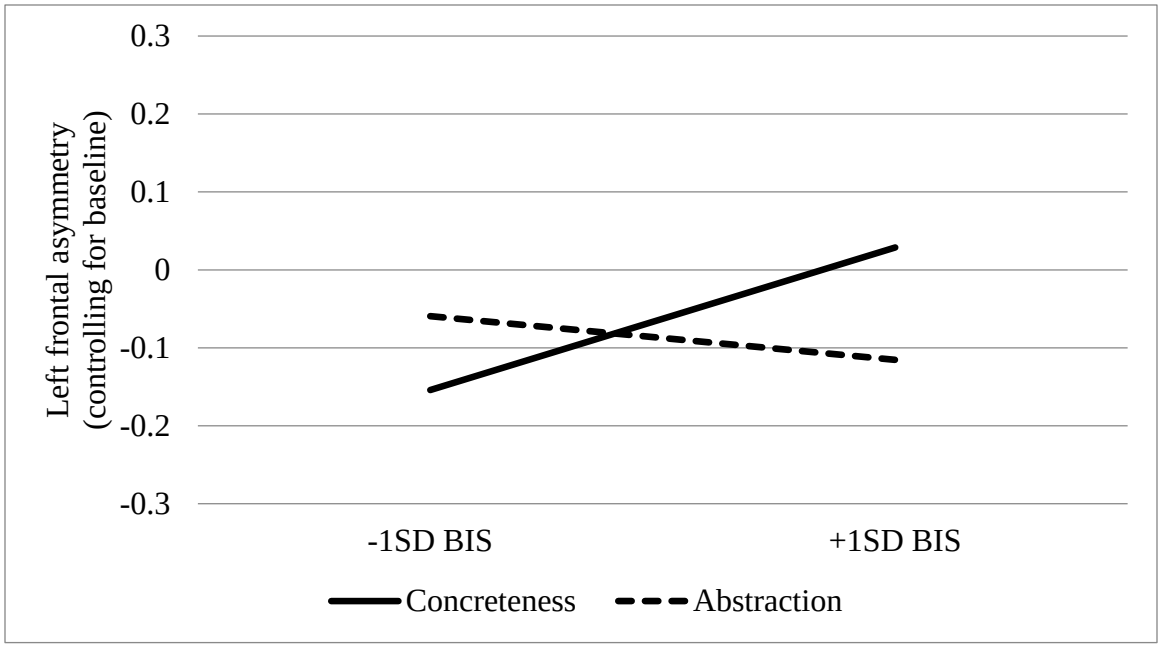

Figure 4. Interaction of concreteness and BIS on left frontal asymmetry distally post manipulation (Study 3).

Study 4

I designed Study 4 to provide clearer evidence that for high BIS people concreteness can increase approach motivation. For the dependent variables I used a self-report measure of state-BAS activation (adapted from Carver & White, 1994) and the personal project analysis (PPA, Little, 1989), a measure of approach motivation toward participants' main, ongoing personal goals.

Method

Participants and procedure. One hundred and thirteen York University undergraduates participated in exchange for course credit in an introductory psychology class. Three participants were removed for unconscientious responding (n = 110, females = 84, M_{age} = 20.34). They completed the online *Personality and Your Self-Views* materials in a single, hour-long session. After a battery of motivation-related trait scales, including the BIS, they were then randomly assigned to a concrete or abstract mindset condition through the same manipulation used in Studies 2 and 3. Participants then completed a state-modified BAS scale, measures of mood (PANAS, Watson et al., 1988), and a measure of the extent to which participants were highly approach motivated toward their personal projects in life (Little, 1989). Finally they completed a conscientiousness check (an item rated on a 5-point Likert scale stating: *I sometimes just clicked random responses in order to get through this survey as quickly as possible.*) and were debriefed.

Trait BIS. As in Studies 2 and 3, I used Carver and White's (1994) BIS subscale to measure trait-BIS activation.

Concreteness manipulation. Concreteness was induced using the same manipulation in Studies 2 and 3, however to increase the potency of the manipulation, participants wrote about 10 "how" or "why" scenarios rather than 6. By nearly doubling the number of statements I aimed to increase the power of manipulation following the marginal of condition on BIF scores in Study 3.

State-BAS. To capture state levels of approach motivation, I modified the BAS scale by adding the instructions "*Please rate the extent to which each of the following statements applies to you RIGHT NOW, AT THE PRESENT MOMENT*" and adjusted the wording of the BAS scale items to emphasize state (rather than trait) levels of approach motivation. The BAS scale items were changed such that each statement referred to feelings in the present moment, (as in Study 2 and following McGregor, Nash, Mann, & Phills, 2010) e.g., "*I would go all-out to get something I wanted"* compared to trait wording: *"When I want something, I usually go all-out to get it."* Contrary to the previous studies, I only collected the BAS-Drive subscale. All ratings were made on a 5-point Likert scale (where 1=Strongly Disagree and 5=Strongly Agree).

Mood. As in Studies 2 and 3, I measured mood with the PANAS (Watson et al., 1988) following state-BAS.

Personal Projects Approach-motivation. Participants then listed 3 personal projects that characterized their lives at the present moment and rated them on 16 dimensions (6 of which were directly related to approach motivation, as in McGregor, Gailliot, Vasquez, & Nash, 2007; McGregor, Nash, Mann, & Phills, 2010). Personal projects are powerful units of analysis for measuring approach motivation because they

are self-generated, personally relevant goals that people plan on completing in the real world (Little, 1989). Participants read:

> Most of us have a number of projects at any given time that we think about, plan for, or try to accomplish… We all have many of these projects, some of which are oriented toward getting what we want and some toward preventing what we do not want.

Participants were then asked to "Please enter the 3 projects that are most characteristic of you at present" into 3 text boxes that were carried forward into the different project dimension items. After nominating three projects, they rated each one on 6 different face-valid approach-motivated dimensions that ranged on 5-point Likert scale (where 1=Strongly Disagree and 5=Strongly Agree). The six items were: 1) *I am eagerly determined to accomplish this project*, 2) *I am tenaciously committed to this project*, 3) *I will persist over obstacles and hardships if necessary with this project*, 4) *I will not neglect or procrastinate with this project*, 5) *I enjoy doing this kind of project*, and 6) *This project is likely to succeed*. Several other dimensions relating to other goal characteristics were also included for exploratory purposes and to provide evidence for discriminant validity (described in Appendix A). The set of approach-related items were created a priori to reflect the action-emphasis in Studies 1-3 and past empirical linkages between PPA, approach motivation, and tenacious-determination ratings (McGregor et al., 2007; McGregor, Nash, Mann, & Phills, 2010; Nash et al., 2011). I then computed participants' scores for each dimension by averaging ratings for that dimension across each of their three personal projects. For the overall personal projects approach-

motivation scores, I created a composite average of participants' six approach-related items ($\alpha = .82$).

Results and Discussion

Mood measures. As in Studies 2 and 3, there were no main effects, t (109) = 1.31, p = .19, d = .25 or interaction effects t (107) = .31, p = .76, d = .06 on positive affect. There were also no main effects, t (107) = .08, p = .93, d = .02, or interaction effects negative affect t (107) = .33, p = .74, d = .06.

Interaction and simple effects analysis. In two separate analyses, I regressed self-reported BAS and personal projects approach-motivation on BIS, concreteness, and the BIS X concreteness interaction term. For self-reported BAS, there was a main effect for BIS, t (107) = 3.10, p = .002, d = .60, a main effect for concreteness, t (107) = 2.78, p = .006, d = .54, and as anticipated, there was a significant interaction effect, t (107) = -3.21, p = .002, d = .62. For the personal projects approach-motivation, there was a marginal main effect for BIS, t (107) = 1.71, p = .091, d = .33, a marginal main effect for concreteness, t (107) = 1.94, p = .055, d = .38, and a significant interaction effect, t (107) = -2.20, p = .03, d = .42 (for analyses of each PPA dimension see Table 2[18]). Simple effect analyses of self-reported BAS revealed that at high BIS, there was significantly higher BAS in the concrete condition (M_{conc} = 4.02) than in the abstract condition (M_{abs} = 3.25), t (107) = -4.05, p = .0001, d = .78 (See Figure 5). At low BIS, there was no difference between conditions, t (107) = .49, p = .62, d = .09. Simple effects analysis of

[18] Exploratory analyses with the remaining 10 PPA dimensions demonstrated some marginal effects ($p > .1$) but no clear pattern. Thus they will not be discussed further, the analyses of these PPA items can be found in Appendix B.

personal projects approach-motivation revealed that for high BIS participants, concreteness increased goal-related approach motivation (M_{conc} = 4.08) compared to the abstract condition (M_{abs} = 3.71), t (107) = -2.63, p = .01, d = .51 (See Figure 6). Again, at low BIS, there was no effect of concreteness, t (107) = .48, p = .63, d = .09. Finally, given the significant positive correlation between state-BAS and personal projects approach-motivation, r = .29, p < .003, I also assessed whether the interaction effect on personal projects approach-motivation might be mediated by state BAS. Using Hayes' PROCESS macro, (model 8, 5000 bootstrap samples, Hayes, 2017) I found a significant indirect effect of BIS X concreteness on personal projects approach-motivation through state-BAS, b = -.11, 95% CI [-.30, -.02]. The mediation is considered statistically significant when the confidence interval does not include zero. Importantly, this mediation effect was significant at high BIS, b = -.12, 95% CI [-.28, -.03] and not at low BIS, b = .02, 95% CI [-.04, .12].

Table 2.

Study 4: Interaction effects on individual Tenacious Approach PPA items

PPA Dimensions	Interaction Statistics		Simple Effects Statistics	
	b	*p*-value	*t*-value	*p*-value
I will persist over obstacles and hardships	-.69	.0008*	-2.96	.004*
I enjoy doing this kind of project.	-.30	.23	-2.09	.03
I am eagerly determined to accomplish this project.	-.25	.19	-1.12	.26
I will not neglect or procrastinate with this project.	-.37	.13	-1.05.	.29
This project is likely to succeed.	-.49	.02*	-2.19	.03*
I am tenaciously committed to this project.	-.08	.77	-1.89	.06

Note: All effects trended towards the "how" condition having higher scores vs. the "why" condition.

In sum, for high-BIS participants, the concrete "how" mindset (vs. abstract why) heightened state approach-motivation and approach-motivation toward personal goals. These findings extend the results of Study 3, demonstrating that concreteness increases state-BAS (recall, Study 3 only found weak support of this relationship with the EEG measure). This surge in state-BAS mediated greater approach-motivation in participants' real-life personal goal intentions. The increase in approach motivation activated by concreteness for high-BIS individuals can mobilize enthusiastic resolve for important personal goals as well as the more menial and researcher-provided tasks assigned in Studies 1-3.

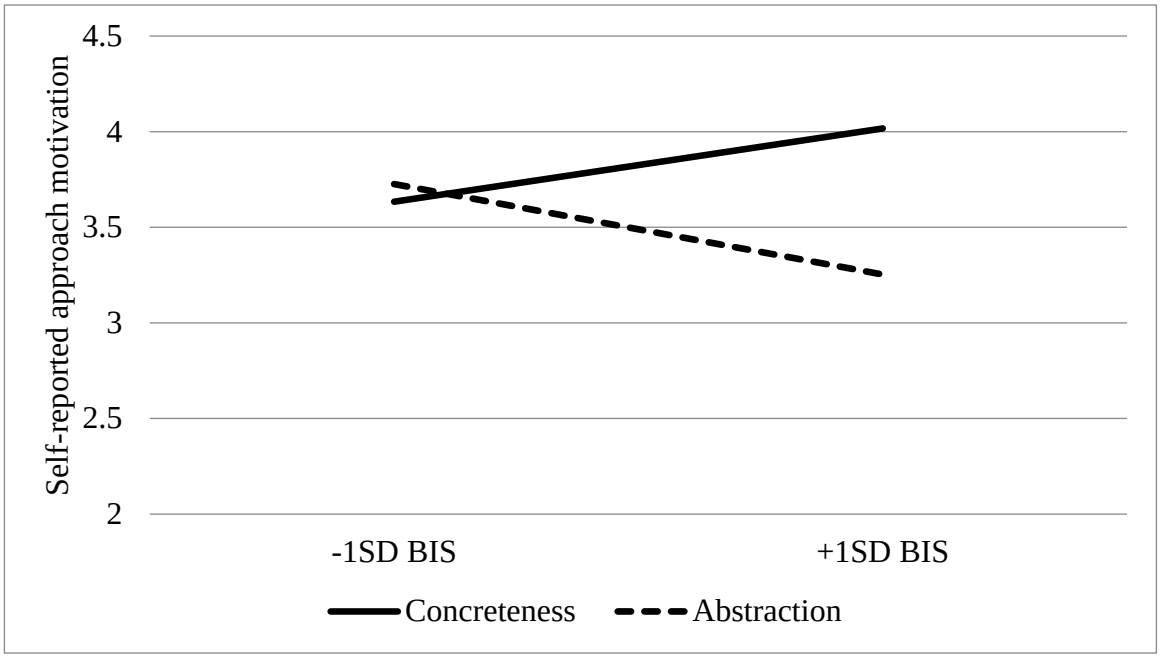

Figure 5. Interaction of concreteness and BIS on self-reported approach motivation (Study 4).

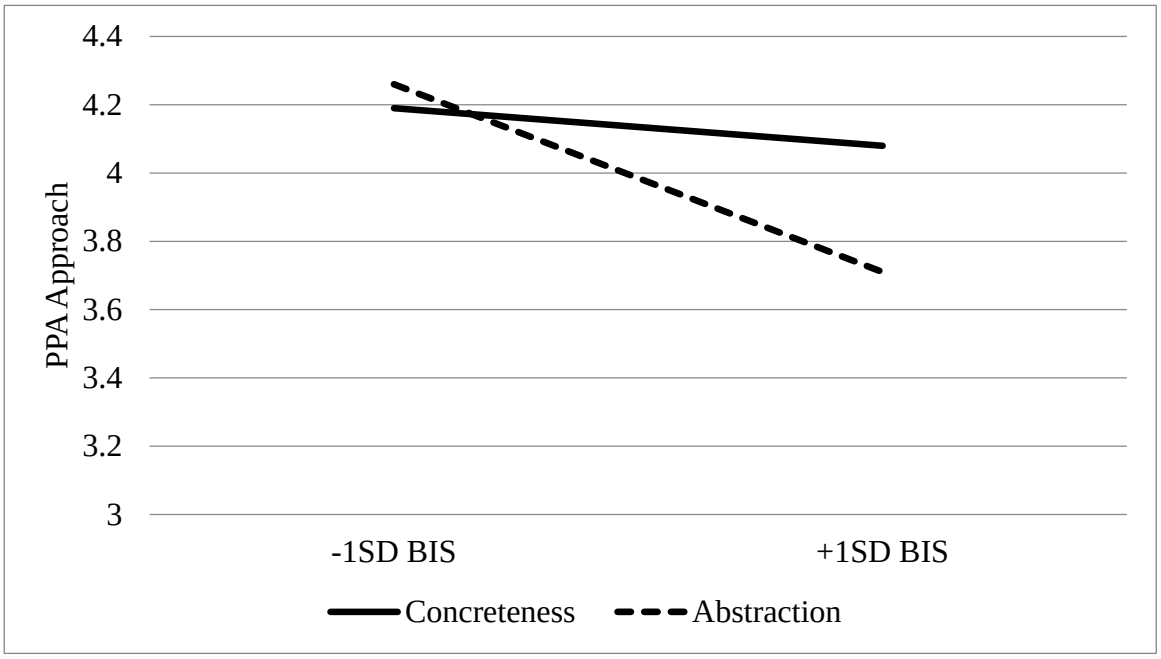

Figure 6. Interaction of concreteness and BIS on approach motivation toward personal goals (Study 4).

Study 5

Following the robust findings of a BIS X concreteness interaction on persistence in Studies 1-4, I aimed to directly test BAS and BIS activation and examine how their activation unfolds over time to predict persistence. In two pilot studies I found evidence that approach motivation might encourage persistence through its effects on the BIS and that changes in BAS activity may be transient. Study 4 showed some evidence that persistence at personal goals was mediated by increases in state BAS, however the measures of state BAS and goal persistence were taken in close succession and were significantly correlated ($r = .29$, $p < .001$, which suggests a possible single, latent construct). To avoid these demand characteristics and more precisely test the mechanism, I manipulated approach motivation and measured state BAS, state BIS, and persistence.

In an intial pilot (Pilot Study a), I found that directly priming approach motivation led to increased persistence at the same data-entry typing task used in Study 2 (See Appendix C). These findings were in line with my theorizing that increased persistence is caused by BAS activation, however there was evidence that approach-motivated states quickly dissipate. That is, participants did not report higher self-reported approach motivation toward the end of the study, despite demonstrating greater persistence on the data-entry task. To test the idea that BAS activation is transient, in a second pilot (Pilot Study b) I again primed approach motivation and took measures of BAS and BIS immediately following the manipulation, as well as after a persistence task (i.e., anagrams). Exploratory analyses revealed that the approach prime predicted greater anagram persistence through its effects on state BIS, rather than state BAS (contrary to my hypothesis that BAS directly predicts persistence). The methods, analyses and results

of these studies can be found in Appendix C. In Study 5, I aimed to replicate the findings of these pilot studies and demonstrate that an approach motivation increases persistence, but is mediated by the BIS (i.e., JSH, Corr, 2004). In other words, approach motivation is a brief, transient state, that results in lasting reductions in state-BIS. Reduced BIS activation allows for conflict-free, motivated persistence at subsequent tasks.

Method

Participants and procedure. Eighty-two undergraduates from the University of Waterloo participated in exchange for course credit toward their psychology class. Seven participants were removed for unconscientious responding (i.e., responded with a 3 or above on the item: *I sometimes just clicked random responses in order to get through this survey as quickly as possible*). After deletion of these participants, there were seventy five remaining for the analysis (n = 75, females = 54, M_{age} = 19.25, SD_{age} = 1.99). Participants completed an in-lab experiment in a single 45 minute session about *Life Experiences and Brain Activity*[19].

First, participants were shown the consent form and ask to indicate their age, gender, and cultural identification. They were then randomly presented with 1 of 4 condition blocks (approach, conflict, along with the two exploratory conditions used in Pilot Study b and reported in the Appendix C). Each block consisted of a manipulation, an EEG measurement period, a word-generating task, and a state BIS measure.

[19] I collected measures of EEG as in Study 3, however the results were undifferentiated between conditions. It may be due to the relatively brief design of the experiment. The manipulations were in close succession and so the headsets may not have been sensitive enough to measure differences in LFA. I do not report these results in the body of this manuscript, though their detailed analysis can be found in Appendix D.

Participants briefly wrote about a topic for 1-minute (in random order; approach, conflict, anger, relaxation) and were interrupted for an EEG measurement before being given another minute to complete the writing task on a separate page. Following each prime, I measured performance at a word-generating task; participants had to think of, and type, as many words as possible beginning with one letter (i.e., C, M, P, R; order was also randomized). Next, participants rated their state-BIS activation during the word-generating task (i.e., how they felt while completing the task). This procedure was repeated for all the conditions until participants completed all 4 writing primes (approach, conflict, anger, relaxation) and dependent measures (4 different letters for each word-generating task, and state-BIS during each task). Finally, at the very end of the study, participants responded to a retrospective BAS and BIS manipulation check and a compliance check used to remove unconscientious responders (described above).

Approach/Conflict Manipulations. In a within-subjects design, participants were assigned in random order, to an approach and a conflict condition[20]. Both manipulations were face-valid and designed to either activate BAS (through an approach prime) or BIS (through an uncertainty/conflict prime). The wording for each manipulation can be found below:

Approach manipulation:

[20] I tested these conditions in Pilot Study b, the results of which can be found in Appendix C. The results showed that the approach condition was effective in promoting persistence and the approach condition (relative to the conflict condition) resulted in higher self-reported BAS and lower self-reported BIS.

"*In the text box, please describe something* (*e.g., a person, state, or outcome) that makes you feel like you want to* ***enthusiastically approach it****. You have two minutes to describe it and how you feel about it.*"

Conflict manipulation:

"*In the text box, please describe something* (*e.g., a dilemma, frustration, or difficulty) that makes you feel* ***uncertain or conflicted****. You have two minutes to describe it and how you feel about it."*

Performance task. Next, participants were given 2 minutes to write down as many words as possible starting with 1 of 4 letters (C, R, P, M; selected based on relative frequencies as the *first letter* of a word, and relative overall frequency in English; https://en.wikipedia.org/wiki/Letter_frequency). To measure performance, I calculated the total number of words typed excluding words that were derivatives (e.g., adding suffixes or compounds; cramp, cramped, cramping etc.).

State BIS. To measure state-BIS, participants reported the extent to which they experienced the following emotions: *bothered, confused, uncomfortable, mixed, uneasy,* and *torn.* These adjectives were selected based on the re-analysis of a previous study linking BIS activation to anagram performance. The re-analysis found that these conflict-related emotions were the best mediators of poor self-control performance (I. D. McGregor, personal communication, August 24, 2017, from Alquist et al., 2018). These items were rated on a 5-point Likert scale from 1=Strongly disagree to 5=Strongly agree.

To emphasize state-BIS activation, participants were asked to report how they felt during completion of the word-generating task. Specifically, they were asked to: *Please*

rate the extent to which you experienced the following feelings while completing the write as many words as possible starting with the letter __ task.

Retrospective manipulation checks. At the very end of the study, participants summarized what they wrote about for each of the four manipulations. For instance, they were asked to "*Briefly summarize what you wrote about when asked to describe something you eagerly wanted to approach.*" Participants had to retrospectively recall the motivational states they experienced during each manipulation and were asked, "*To what extent did you feel the following emotions while you wrote about that?"* (approach items: *strong, energetic, confident, determined, urge to move toward something, prepared to go all-out to get something you wanted;* conflict items: *urge to quit, frustrated*). That is, participants summarized their topics and recalled their emotions for each condition. This manipulation check was also presented in randomized order. The items were rated on a 5-point Likert scale from 1=Strongly disagree to 5=Strongly agree. I formed a BAS manipulation check composite by averaging together the 6 approach-related items for each manipulation ($\alpha = .84$ with respect to the conflict prime, $\alpha = .84$ with respect to the approach prime). I also created a BIS manipulation check composite by averaging together the two BIS items for each of the primes ($\alpha = .53$, conflict prime, $\alpha = .69$, approach prime).

Results and Discussion

Manipulation checks. I ran a paired samples t-test on the retrospective BAS and BIS-manipulation checks. There was a significant difference between conditions on the retrospective BAS manipulation check, $t\ (74) = 10.31$, $p < .001$, such that the approach

condition reported more approach motivation ($M_{approach}$ = 3.76) than the conflict condition ($M_{conflict}$ = 2.76). There was also a difference on the retrospective BIS manipulation check, t (74) = 8.70, p < .001, such that the approach condition ($M_{approach}$ = 2.13) showed less conflict-related emotions than the conflict condition ($M_{conflict}$ = 3.25). These results provide evidence that the within-subjects experimental manipulation effectively changed BAS and BIS in the expected directions.

Main analysis. I also ran separate paired-samples t-test on word-generating performance and state-BIS. Unexpectedly, there were no effects in performance, t (66) = .95, p = .35[21], ($M_{approach}$ = 24.37, $M_{conflict}$ = 23.84). There was a marginal effect of condition on state-BIS, t (68) = -1.80, p = .076, such that the approach condition ($M_{approach}$ = 2.51) had marginally less state-BIS activation than the conflict condition ($M_{conflict}$ = 2.66).

Indirect effect of BIS. Following the findings of my pilot studies, I expected an indirect effect of condition on persistence through state-BIS (see Hayes, 2009 for discussion on indirect effects when total effects are absent). I ran a within-subjects mediation model (MEMORE, Montoya & Hayes, 2017) with condition predicting state-BIS and subsequent word-generating performance. I found a significant indirect effect through my hypothesized path, β = .32, 95% CI, [.06, .85], see Figure 7.

[21] Due to a programming error, data were lost for two participants in the word-generating task.

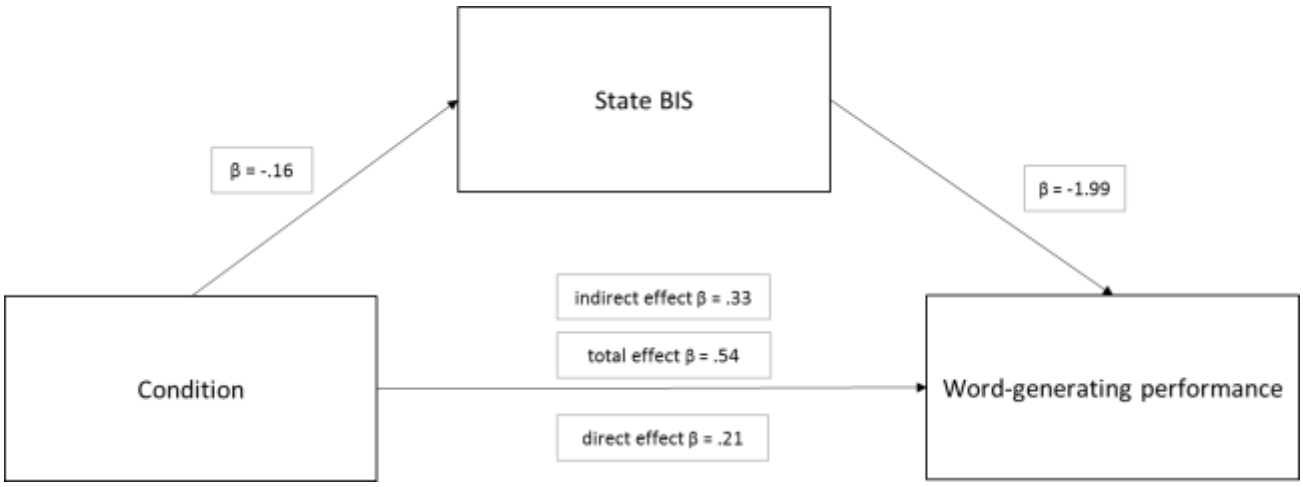

Figure 7. Mediational model of condition on state BIS and word-generating performance.

Study 5 demonstrated that, contrary to my initial theorizing, approach motivation may increase task persistence indirectly. The approach prime (vs. conflict prime) did not directly increase word-generating performance, however it marginally reduced state-BIS. Furthermore, consistent with the results from Pilot Study b, I found evidence that the reduction in state-BIS indirectly predicted task persistence. These findings support the idea that the approach manipulation causes a transient surge in approach motivation, which causes prolonged reductions in BIS activation, allowing for persistence. This finding is consistent with other goal-priming literature, which suggests that the motivating effects of goal primes are short-lived and weaken upon goal completion (Liberman, Förster, & Higgins, 2007). Noteworthy, is the fact that the manipulation checks were measured retrospectively at the very end of the study, making them susceptible to demand bias. That is, participants may have merely imagined how they must have felt during each writing task given the topic matter. Still, the primes were face

valid and the manipulation checks suggest they were effective. As other researchers have noted, however, using implicit and cognitive behavioural methods to manipulate approach motivation may address this concern in future studies (Robinson, Boyd, Liu, 2013).

General Discussion

In four experiments, high-BIS individuals randomly assigned to concrete (vs. abstract) mindset primes experienced a reversal of the usual high-BIS performance decrement. High-BIS activation (manipulated in Study 1, measured in Studies 2-4) interacted with concrete-mindset primes (vs. abstract mindset) to predict approach-motivated persistence on physically demanding tasks (endurance cycling in Study 1, handgrip squeeze in Study 3), on a repetitive mundane task (speeded data entry, Study 2), and on self-reported and tenacious, approach-motivated goal pursuit (Study 4). In all cases the higher the BIS activation, the more concrete mindset heightened persistence and approach motivation[22]. A meta-analysis of the interaction effect (Rosenthal, 1991) of BIS X concreteness on persistence and approach motivation revealed a small-to-medium effect size, d = .35, 95% CI [.15, .55]. I included 7 weighted effect sizes based on sample size in this analysis: cycling tenacity (d = .53) from Study 1; data entry persistence (d = .32) from Study 2; handgrip persistence (d = .44), immediately proximal LFA (d = .01), and distal LFA (d = .34) from Study 3; as well as self-reported approach motivation (d = .64), and personal projects approach motivation (d = .42) from Study 4. The meta-analyzed significance level of this effect was p = .009 (two-tailed)[23]. These findings suggest that for increasing BIS activation, a generalized concrete mindset becomes superior to an abstract one and encourages persistence. In Study 5, I directly manipulated

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[22] In Study 1 I showed that situational BIS manipulations have a marginal effect, however the strongest effects were for those with high self-reported trait BIS.

[23] I also meta-analyzed the simple effect at high BIS using the same 7 effects and found that it was also small-to-medium in magnitude (d = .40, 95% CI [.25, .56]) and the meta-analyzed significance level was p = .01. In addition, I meta-analyzed the simple slopes of BIS in the abstraction and the concreteness conditions; these results can be found in Appendix B.

the proposed neural strucutres responsible for these effects (i.e., the BAS and the BIS). The results indicated that a manipulation of BAS increases persistence indirectly, by reducing BIS.

BIS and Poor Goal Persistence

Motivation researchers have identified many reasons for why people might give up in the face of adversity: self-control depletion or fatigue from prior tasks (Baumeister, Bratslavsky, Muraven, & Tice, 1998; Baumeister, Heatherton, & Tice, 1994; Inzlicht et al., 2014); low-level construals of focal goals (Fujita et al., 2006); inability to identify and attend to goal discrepancies (Carver & Scheier, 1982); absence of intrinsic motivation (Ryan & Deci, 2000); insufficient cognitive control (Robinson, Schmeichel, & Inzlicht, 2010). Theory guiding my work, suggests that BIS activation should undermine goal persistence because BIS activity inhibits ongoing goals and prepares the organism to do something else when conflicted or uncertain (Amodio, Master, Yee, & Taylor, 2008; Avila & Torrubia, 2006; Corr & Mutnelli, 2017; Gray & McNaughton, 2000; Hirsh et al., 2012). BIS-sensitivity is also correlated with neuroticism, negative affect (Jorm et al., 1998), and depression (Harmon-Jones & Allen, 1997; Kasch, Rottenberg, Arnow, & Gotlib, 2002); all of which have been linked to lower levels of goal engagement. Recent laboratory research and the present results converge with classic theory to indicate that BIS activation can directly impede goal persistence (Alquist et al., 2018; Gray & McNaughton, 2000; Hayes et al., 2016). Alquist and colleagues found that experimentally induced state-BIS mediated poor task performance and made participants more than three times as likely to give up. This dissertation suggests that trait-BIS (and some weak evidence for situationally-induced BIS) interacts with concrete mindset to

predict goal persistence. Across my studies, there was some support for the negative relationship between BIS activation and task persistence; I found that trait-BIS marginally correlated to less baseline LFA (i.e., approach motivation, Study 3, r = -.15, p = .11), predicted poorer baseline handgrip performance (Study 3, r = -.24, p = .006), and predicted lower motivation towards personal projects (Study 4, r = -.32, p = .001). In addition, in Study 5 state-BIS predicted poorer word-generating performance (r = -.21, p = .081 in approach prime, r = -.26, p = .034 in conflict prime). This main effect of BIS on persistence, however, was not reliable across all studies and highlights the need to further understand the conditions under which the BIS reduces persistence.

How Does Concreteness Help?

My assumption is that concreteness increases BAS and mutes BIS to increase persistence, because the two motivational subsystems are reciprocally active (JSH, Corr, 2004; as found by Nash et al., 2012). There has been some past, main-effect evidence that concrete narrowing of attention can heighten BAS (Gable & Harmon-Jones, 2010; Harmon-Jones, 2004; Harmon-Jones & Harmon-Jones, 2002). I found some evidence for this effect in Study 3 (i.e., a main effect of concreteness on LFA), however the main finding of this dissertation was that trait-BIS moderates the capacity for concreteness to heighten BAS. Thus my work extends research linking concreteness to BAS by identifying a key personality moderator (i.e., for whom concreteness might activate the BAS).

I hypothesized that concreteness would be especially helpful for high-BIS individuals under the assumption that the narrow cognitive constraints of concrete mindsets reduce simultaneous accessibility of conflicting thoughts and behavioural

affordances (Harmon-Jones et al., 2009; Hirsh et al., 2012; Newby-Clark, McGregor, & Zanna, 2002; Trope & Liberman, 2003). This narrow clarity should reduce the potential for uncertainty, perceived conflict, psychological entropy, and BIS activation; indirectly translating into elevated BAS. Thus, a concrete mindset should be especially relevant for people who are chronically or temporarily mired in the conflict-related distress associated with BIS activation.

Although I did not measure state-BIS activation in the studies manipulating concreteness, analyses of other data suggests that state-BIS is reduced by concreteness for those high in dispositional BIS-activation (thus liberating BAS). In a recently collected study, participants wrote on four different days during the term about personal topics (values, meaning, approach goals, relationships). After each session, they rated the extent to which what they wrote was 1) very specific, 2) more general than specific (reverse-scored), 3) very abstract (reverse-scored), and 4) more concrete than abstract, and then rated state BIS. The trait-BIS X concreteness interaction effect on state-BIS was significant, t (68) = -3.25, p = .002, d = .69. Participants high on trait-BIS reported significantly lower state-BIS-related distress to the extent that they spontaneously wrote more concretely than abstractly, t (69) = -3.40, p = .001, d = .80 (Tran & McGregor, 2017, unpublished data). Regardless of the content that high-BIS individuals chose to write about, if their topic was written more concretely than abstractly they reported lower state BIS, supporting my concreteness-reduces-BIS-activation hypothesis.

Might Abstraction Sometimes Work Better?

It is important to acknowledge that all of the effects were cross-over interactions with concreteness helping high-BIS individuals, but showing a non-significant tendency

to hinder persistence for low-BIS individuals. If anything, abstraction was more motivating than concreteness for low-BIS people. A meta-analysis of simple effects of concreteness at low BIS revealed a non-significant trend for abstraction to increase approach motivation and tenacity than concreteness, d = -.12, 95% CI [.04, -.28], p = .24 (two-tailed). I again included the 7 weighted-effect sizes: cycling tenacity (d = -.46); data entry persistence (d = -.18); handgrip persistence (d = -.15), proximal LFA (d = .34), and distal LFA (d = -.19); as well as self-reported approach motivation (d = -.10), and personal projects approach-motivation (d = -.09).

To the extent that this trend is meaningful, it might be explained by the fact that low-BIS individuals can think about broad and abstract thoughts without risk of experiencing psychological entropy and uncertainty (Hirsh et al., 2012). Indeed, if the abstract mindset were grounded in a topic area more important and self-affirming than those in the present manipulations (which merely involved focusing on word categories or why one might do basic tasks), then the abstractions might be significantly more motivating for low-BIS people. For low-BIS people, abstract (vs. concrete) mindset may open windows to an expanded sense of purpose and meaning (Emmons, 1992; McGregor & Little, 1998) allowing them to feel inspired and highly approach motivated (as in McGregor et al., 2007; McGregor, Nash, Mann, & Phills, 2010; McGregor, Prentice, & Nash, 2013). Indeed, abstractions that are directed, purposeful, and unburdened by conflicts triggering BIS activation will heighten feelings of competence and motivation (Zunick, Fazio, & Vasey, 2015), increase self-control (Fujita et al., 2006; see Fujita, 2008 for review), improve delay of gratification (Metcalfe & Mischel, 1999), improve academic achievement (Vasquez & Buehler, 2007), increase weight-loss (Logel &

Cohen, 2012), increase goal commitment (Lydon & Zanna, 1990), reduce stress responses to anxiety (Creswell et al., 2005), and make people less defensive, more approach motivated, and more successful in threatening circumstances (Cohen & Sherman, 2014; Wakslak & Trope, 2009).

In the typical goal-framing literature, abstract or concrete mindsets are induced, framed, and manipulated in reference to a focal goal (e.g., Davis et al., 2016; Fishbach & Choi, 2012; Gollwitzer, 1999; Locke & Latham, 1990). This past work has often found (in apparent contradiction to the present results) that abstraction is more conducive to success. For instance, Davis et al., (2016) asked participants to write down an academic goal they were pursuing (e.g., get a good grade in one of my classes) and asked them in a successive manner why or how they would pursue that goal (e.g., get a good grade → why? → find a good career → why? → achieve stability etc.). In contrast, my work focuses on mindsets induced by simple exercises outside of the context of participants' everyday thoughts and goals (i.e., I focused on hypothetical scenarios that were all unrelated) and also focuses specifically on high-BIS individuals. As outlined earlier, exercising abstraction outside of the focal goal may be an important reason why I did not find main effects of abstraction as demonstrated in previous work (e.g., Fujita et al., 2006).

Abstractions are associated with global, trait-evaluations and foster higher-level, meaning-related interpretations of events (Trope & Liberman, 2003). Abstract mindsets may link present experiences to the chronic tendency to experience conflict, to be vigilant, and to disengage, (consequences of high BIS activation), resulting in an overgeneralization of frustrating experiences (as suggested by Libby et al., 2011).

Attributing the current frustrations to dispositional causes might further encourage the tendency to withdraw effort at a current goal. In addition, abstractions should introduce a wider horizon of potentially conflicting goal possibilities, thereby hindering task persistence (as theorized by Hirsh et al., 2012). Future research should directly test this speculative mechanism of why concreteness improves persistence for high-BIS individuals (and why are abstractions de-motivating for these individuals). Understanding these effects would be important in harnessing abstractions to reliably improve rather than detract from motivation and persistence.

A path to persistence through the JSH

The theory inspiring my work suggests that the BAS and BIS have important independent functions (i.e., impulse to move toward, and behavioural inhibition respectively) but that they also interact to predict behaviour (Corr, 2004; Corr, 2013). The findings from Studies 1-4 provide indirect evidence of this reciprocal relationship; that is, trait-BIS should impair persistence, however concreteness increased BAS (which presumably muted BIS) and improved persistence. Study 5 provided support for this path; the manipulation of BAS indirectly increased persistence and reduced state BIS. The interaction between these systems, however, may explain why there were inconsistent correlations between BAS or BIS and persistence, as initially hypothesized. Indeed, research on neural markers of approach motivation have also hypothesized that BAS should directly increase persistence, but found mixed results (e.g., Price et al., 2013). In one study, approach motivation as measured by LFA, was positively correlated to unsolvable anagram persistence, but only when participants maintained determined facial expression and not a neutral or satisfied facial expression (Price et al., 2013). The

authors speculated that the persistence task was not sensitive enough to reliably measure the effect of BAS activation on persistence. Given the present results[24] and the JSH, however, it may be that both BAS and BIS jointly (i.e., the relative difference of activation between these systems) predict persistence.

Given my assumption and findings that motivated goal pursuit is predicted by BAS, it appears plausible that goal-priming effects, to some degree, activate BAS-related processes. Evidence from two pilot studies (in Appendix C) suggested that BAS activation was relatively short-lived (akin to goal-priming, see Liberman et al., 2007) and dissipated quickly. In a first pilot study, a manipulation of BAS directly increased persistence but did not carry over to self-reported approach motivation (Pilot Study a). A second study (Pilot Study b) found that manipulating BAS caused changes in manipulation check measures of state-BAS and state-BIS. However, only reductions in BIS lingered to indirectly predict persistence at anagrams whereas BAS did not. Study 5 of the current research replicated these findings and demonstrated that an approach manipulation (vs. a conflict manipulation) reduces state-BIS which in turn predicts performance at a word-generating task.

BIS and BAS in anxiety and depression

Clinical studies show that high self-reported BIS predicts generalized anxiety and depressive symptoms (Johnson, Turner, & Iwata, 2003; Kasch et al., 2002; Meyer, Johnson, & Winters, 2001; Vervoort et al., 2010). Affective neuroscience research further

[24] Pilot Study b found an indirect effect of an approach motivation prime (BAS) on solvable anagram performance through reduced BIS.

indicates that neural markers of BIS activation predict a wide range of anxiety and depression-related syndromes (Meyer et al., 2013; Moser, Moran, Schroder, Donnellan, & Yeung, 2013; Weinberg, Klein, & Hajcak, 2012; Weinberg, Olvet, & Hajcak, 2010), and that underactive BAS also contributes to anhedonic experiences of depression (Beevers & Meyer, 2002; Harmon-Jones & Allen, 1997; Henriques & Davidson, 1991). Depressed individuals likely exhibit poor persistence and goal-striving when tasks demand effort, due to their chronically high BIS activity as well as their low BAS activity (American Psychiatric Association, 2013; Hershenberg et al., 2016).

My work and its theoretical grounding in BAS and BIS joint motivational subsystems provides a process model for understanding why and for whom concrete mindsets can be therapeutic and adaptive. If BAS and BIS are indeed joint subsystems that are reciprocally active (as has been found in animal research and some neuropsychological work with humans; Blanchard, Griebel, & Blanchard, 2001; Corr, 2004; Nash et al., 2012; Novak, Novak, Lynam, & Foti, 2016; McNaughton & Corr, 2008), then the capacity for concrete mindsets to activate BAS for high-BIS individuals could have important therapeutic implications for depression and anxiety. Others have found that a concrete focus on immediate experiences (vs. abstract focus on implications, or a neutral control condition) improves social problem-solving skills as well as emotional control in depressed patients (Watkins, Baeyens, & Read, 2009; Watkins & Moulds, 2005). My research, however, is unique in that concreteness is induced with a simple exercise that does not directly involve participants' focal goals or sense of self.

My work also holds promise for understanding mindfulness meditation, bare attention, and decentering techniques as means to manage BIS-related emotions (i.e.,

anxiety). A common emphasis across various forms of meditation and decentering practice is on viewing thoughts that occupy attention relatively concretely, i.e., simply as transient phenomena, without elaborating their multiple possible meanings (Hereen & Philloppot, 2011; Tang, Hölzel, & Posner, 2015). Such approaches may accordingly induce a concrete mindset, increase BAS, and mute anxiety in high-BIS people during high-conflict circumstances. Indeed, decentering manipulations have significantly increased BAS-activation, specifically among high-trait-distress individuals (Eftekhari et al., 2017). For instance, participants were asked to write down thoughts in their mind, "just as they are" and to "try to observe your thoughts nonjudgementally" which emphasized the concrete qualities of their thoughts, without abstracting higher-level meaning from them. Compared to a free thought control condition, this concrete observation of thoughts caused individuals high in trait distress to report more approach motivation.

BIS and other related personality traits

Some work has implied that a neural marker of BIS activation (i.e., the ERN; Olvet & Hajcak, 2008) may be an indicator of anxiety disorders. Although two closely related constructs, there is an important distinction to be made between the BIS (a situationally active system with many functions, in the general population; Gray & McNaughton, 2000) and anxiety disorders (a generalized feeling of apprehension, in clinically assessed samples; Dugas, Gagnon, Ladouceur, & Freeston, 1998). According to Gray & McNaughton (2000), an output of BIS-activation is anxiety, along with inhibition, vigilance and scanning for alternatives. BIS should therefore encompass more than simply anxious affect, but include other behavioural consequences as well. That is,

an individual may encounter goal conflicts but not experience disproportionate levels of anxiety (as would be expected of an anxiety disorder). Importantly, the current research is focused on how concreteness might limit BIS activation and the behavioural inhibition that results, rather than anxious affect. To support this notion, I tested the same BIS X concreteness interaction with traits related to BIS activation collected in Study 4 of this manuscript. I probed for the same interaction effect using several personality traits that share variance with the anxiety-aspect of the BIS: depression, uncertainty aversion, perceived stress, prevention focus, and rumination. I found a significant rumination X concreteness interaction effect and marginal prevention focus X concreteness interaction effect on state BAS, but all other traits were non-significant (Study 4, $p > .16$; rumination $p = .046$, prevention $p = .057$). These findings are significantly weaker than my robust effect of BIS X concreteness ($p = .002$). In addition, I tested the same effects on approach motivation toward personal goals and found no significant effects (Study 4, *ps* > .29). These findings provide some evidence that anxiety disorders, though related, do not interact with concreteness to predict persistence and instead there is discriminate validity to the BIS scale.

Limitations and Future Directions

A limitation of the current research is that I lacked a control condition to compare to the abstraction and concreteness manipulations. Thus I cannot definitively say whether concreteness improves, or abstraction detracts, from approach motivation for high BIS individuals. My conclusions must focus on the significant interaction effect—the higher the BIS, the more tenacious approach arises from concreteness compared to abstraction. To provide some illumination to this question, however, I dug into our data archives from other experiments conducted in the lab during the semester that Study 4 was being collected. One of those experiments had a parallel structure and a relaxation control condition (Eftekhari, Tran, Arbiv, & McGregor, 2014). Comparing this relaxation condition to the abstraction condition in Study 4, there was no BIS X condition interaction on approach motivation (*ps* > .84). In contrast, when comparing this relaxation condition to the concreteness condition, there as a significant interaction on approach motivation, t (115) = -2.01, p = .05. These results provide some support for my claim that it is the concreteness manipulation that increased approach motivation for the high BIS participants.

Another limitation is that in Study 1, where I experimentally manipulated the BIS, there was a significant BIS X concreteness interaction effect but only a non-significant trend for concreteness vs. abstraction at high BIS. My interpretation of these findings is that interaction effect of BIS X concreteness using state-induced BIS appears to be weaker, but future studies should confirm this speculation. Another possibility is that the Stroop manipulation may not have been strong enough to induce high levels of BIS activation. My main hypothesis was that the higher the BIS activation, the more concrete

vs. abstract should improve persistence. If, however, the Stroop task was not a potent manipulation of the BIS (as it lacked personal relevance and was not a powerful manipulation of goal conflict), then it may have resulted in a weaker interaction effect and null effect at high BIS. Future work should extend my research and determine if state-induced BIS and trait-BIS both interact with concreteness in an equivalent manner to predict persistence.

In Study 5 the results found that the approach motivation prime increased BAS, which decreased BIS, and indirectly increased persistence. Given that the approach prime was compared to the conflict prime, it is also equally likely that the conflict prime increased state-BIS, indirectly reducing persistence. Under the assumption that the two motivational systems are jointly active (Corr, 2004), I aimed to compare focal manipulations of each system. Therefore in this study it is difficult to determine which manipulation was the primary cause of the changes in persistence. Still, upon closer inspection of the means of the manipulation checks, it may be that the approach prime was driving the effect. The means of the retrospective manipulation check on approach-related affect had a scale mid point of 3 (the scale ranged from 1 to 5) and the approach deviated further from the mid point ($M_{approach}$ = 3.76) than the conflict condition ($M_{conflict}$ = 2.76). Similarly, for the conflict manipulation check, the approach condition also deviated farther from the mid point for the approach ($M_{approach}$ = 2.13) compared to the conflict condition ($M_{conflict}$ = 3.25). Though not completely ruling out the alternative explanation that the conflict condition caused a decrease in persistence, it provides some support for my initial interpretation.

In addition, a limitation of Study 5 was the absence of a direct effect of my approach prime on persistence. In Studies 1-4, I found that concreteness for high BIS individuals directly activated BAS (Study 4) and directly increased persistence (Studies 1-3). In contrast, in Study 5 there was only an indirect of approach motivation through state-BIS on persistence. Given that I hypothesized a concrete mindset activates the BAS, I anticipated direct effects of an approach prime on persistence in Study 5, in line with my earlier studies. A potential cause for the lack of a direct effect in Study 5 may be due to the use of a within-subjects design. Across the 4 conditions, I used the same persistence task (albeit, with different letters) and thus participants completed the same task 4 separate times. Neurophysiological research has found that practice at a task is related to reduced activity in the anterior cingulate cortex (ACC, a proposed structure related to BIS activation, Olvet & Hajcak, 2008; Petersen, van Mier, Fiez, & Raichle, 1998). All individuals, then, may have experienced reductions in BIS over the course of the experiment. This potentially confounding effect may have influenced performance independently of my approach motivation prime. Future work should aim to extend my work and determine if directly manipulating approach motivation in other experimental designs can result in greater persistence.

A final limitation of the present work is that the manipulations of concreteness are tedious and are unlikely to be effective for use in the real world. Future research should investigate benefits of more intuitively appealing concreteness interventions, such as preparing food, gardening, doing housework, or walking. Varieties of yoga and meditation that focus people on concrete sensations might also operate according to similar processes (Mantzios & Wilson, 2014). A less artificial means of inducing

concreteness may be to notice one's thoughts in a concrete, non-judgemental way, inducing state-BAS and overcoming distress (Eftekhari et al., 2017).

Concluding Comment

The present results indicate that concrete mindset can fortify resolve for high-BIS people and help overcome their tendency to shrink from challenging tasks and life goals. The results further suggest that approach motivation might help bolster persistence by limiting the frustrating experiences in challenging circumstances (i.e., high BIS). It is important to emphasize that a concrete mindset was helpful even though it was primed in a domain far removed from that of the challenging task. Accordingly, these results are distinct from other results in the literature on how goal framing can affect motivation (e.g., furnishing goals with specific, if-then statements, action–oriented mindsets, emphasis on the goal process vs. fantasizing; Gollwitzer, 1999; Gollwitzer & Sheeran, 2006; Pham & Taylor, 1999). The current studies also provide some evidence for the process through which concreteness and approach motivation lead to persistence. It appears that BAS activation is a brief, but powerful state, which causes longer lasting reductions in BIS activation. The dulled BIS allows for subsequent conflict-free persistence. When in need of tenacious persistence at a stressful project on one's desk, there might be wisdom in first taking a moment to bake a cake, weed the garden, walk the dog, or do some yoga.

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Appendix A: Full materials

Study 1 Materials

To begin, we are interested in getting to know some basic information about you. Please complete the following questions.

Age: _____

Sex: Female _____ Male _____

EXERCISE SCREENING QUESTIONNAIRE

Do you lift weights for exercise? Yes _____ No _____

Over the past 6 months, how many times **on average** have you done the following kinds of exercise for 30 minutes or more during your **free time** in a week? Free time is your leisure time, it represents the time in which you freely chose to do things, not because you have to do them for some other activity or task.

Times per week

STRENUOUS EXERCISE (your heart beats rapidly): _____
(e.g., running, jogging, hockey, football, soccer, squash, basketball, cross country skiing, judo, roller skating, vigorous swimming, vigorous long distance bicycling, skating)

MODERATE EXERCISE (not exhausting): _____
(e.g., fast walking, weight-training, baseball, tennis, easy bicycling, volleyball, badminton, easy swimming, alpine skiing, dancing)

MILD EXERCISE (minimal effort): _____
(e.g., yoga, archery, fishing, bowling, horseshoes, golf, snow-mobiling, easy walking)

Sample Stroop task

RED	RED
BLUE	GREEN
GREEN	GRAY
BLUE	YELLOW
BLACK	PINK
YELLOW	ORANGE
GREEN	BLUE
ORANGE	GREEN
GREEN	BLUE
RED	RED
PINK	GREEN
BLACK	YELLOW
BROWN	ORANGE
YELLOW	BLUE

4-item manipulation check

These items are statements about your reactions to the task you just completed. Please read each statement and circle your response using the scales below.

1. How much mental effort did you exert while doing the task?

1 2 3 4 5 6 7

Little Effort **Extreme Effort**

2. How tired do you feel after doing the task?

1 2 3 4 5 6 7

Not Tired **Extremely Tired**

3. How frustrated do you feel after doing the task?

1 2 3 4 5 6 7

Not Extremely

Frustrated Frustrated

4. How pleasant did you find doing the task?

1 2 3 4 5 6 7

Extremely **Extremely**

Unpleasant **Pleasant**

Abstraction manipulation (Fujita et al., 2006)

Word-Listing Task

In this task, you will be provided with a series of words. Your task will be to write a word that you think each provided word is an example of. That is, ask yourself the question, "[Provided word] is an example of what?" and then write down the answer you come up with. For instance, if I gave you the word "POODLE," you might write down "DOGS" or even "ANIMALS," as a poodle is an example of a dog or animal. Be creative and come up with the most general word for which the provided word is an example.

SODA	_____	COIN	_____
COMPUTER	_____	RESTAURANT	_____
NEWSPAPER	_____	TREE	_____
PROFESSOR	_____	GAME	_____
PASTA	_____	PAINTING	_____
BOOK	_____	BAG	_____
SPORT	_____	WATER	_____
TABLE	_____	COLLEGE	_____
SHOE	_____	DANCE	_____
MOVIE	_____	CANDY	_____
PEN	_____	GUITAR	_____
SENATOR	_____	MOUNTAIN	_____
LUNCH	_____	POSTER	_____
TRAIN	_____	SOAP OPERA	_____
MAIL	_____	RIVER	_____
ACTOR	_____	MATH	_____
BEER	_____	KING	_____
PHONE	_____	WHALE	_____
SOAP	_____	SINGER	_____
FRUIT	_____	TRUCK	_____

Concreteness manipulation (Fujita et al., 2006)

Word-Listing Task

In this task, you will be provided with a series of words. Your task will be to write down a word that is an example of this word. That is, ask yourself the question, "An example of [provided word] is what?" and write down the answer you come up with. For example, if I gave you the word "DOGS," you might write down the example "POODLE" or even "PLUTO" (the Disney character). Be creative, and try to think of as specific an example of the category as you can.

SODA	_____	COIN	_____
COMPUTER	_____	RESTAURANT	_____
NEWSPAPER	_____	TREE	_____
PROFESSOR	_____	GAME	_____
PASTA	_____	PAINTING	_____
BOOK	_____	BAG	_____
SPORT	_____	WATER	_____
TABLE	_____	COLLEGE	_____
SHOE	_____	DANCE	_____
MOVIE	_____	CANDY	_____
PEN	_____	GUITAR	_____
SENATOR	_____	MOUNTAIN	_____
LUNCH	_____	POSTER	_____
TRAIN	_____	SOAP OPERA	_____
MAIL	_____	RIVER	_____
ACTOR	_____	MATH	_____
BEER	_____	KING	_____
PHONE	_____	WHALE	_____
SOAP	_____	SINGER	_____
FRUIT	_____	TRUCK	_____

Study 2 Materials

BIS/BAS (Carver & White, 1994)

Note that filler items 1, 6, 11 and 17 will be removed from the scale

1 = Strongly Disagree
2 = Disagree
3 = Neither Agree nor Disagree
4 = Agree
5 = Strongly Agree

1. Even if something bad is about to happen to me, I rarely experience fear or nervousness.
2. I go out of my way to get things I want.
3. When I'm doing well at something I love to keep at it.
4. I'm always willing to try something new if I think it will be fun.
5. When I get something I want, I feel excited and energized.
7. Criticism or scolding hurts me quite a bit.
8. When I want something I usually go all-out to get it.
9. I will often do things for no other reason than that they might be fun.
10. If I see a chance to get something I want I move on it right away.
12. I feel pretty worried or upset when I think or know somebody is angry at me.
13. When I see an opportunity for something I like I get excited right away.
14. I often act on the spur of the moment.
15. If I think something unpleasant is going to happen I usually get pretty "worked up."
16. When good things happen to me, it affects me strongly.
18. I feel worried when I think I have done poorly at something important.
19. I crave excitement and new sensations.
20. When I go after something I use a "no holds barred" approach.
21. I have very few fears compared to my friends.
22. It would excite me to win a contest.
23. I worry about making mistakes.

Additional manipulation (not used in analyses)

No depletion manipulation (adapted from Baumeister et al., 1998)

This next task will require you to cross out all of the e's presented in the passage. Please copy and paste the following passage into the text box below and carefully go through the entire passage to erase all instances of the letter e.

The output will now include the cubic polynomial. To see whether this cubic trend has improved the model I again compare the − 2LL for this new model to the value in the previous model. The value of − 2LL is shown in SPSS Output 19.12, and it is 1798.86. I have added only one term to the model so the new degrees of freedom will have risen by 1, from 7 to 8 (again you can find the value of 8 in the row labelled Total in the column labelled Number of Parameters, in the table called Model Dimension). I can compute the change in − 2LL as a result of the cubic-term by subtracting the − 2LL for this model from the − 2LL for the model with only the linear trend. I will look at the SPSS output for this final model in a little more detail (SPSS Output 19.12). First, I are given the fit indices (the − 2LL, AIC, AICC, CAIC and BIC).As I have seen, these are useful mainly for comparing models, so I have used the log-likelihood, for example, to test whether the addition of a polynomial significantly affects the fit of the model. The main part of the output is the table of fixed effects and the parameter estimates. These tell us that the linear, $F (1, 221.39) = 10.01$, $p < .01$, and quadratic, $F (1, 212.49) = 9.41$, $p < .01$, trends both significantly described the pattern of the data over time; however, the cubic trend, $F (1, 214.37) = 3.19$, $p > .05$, does not. This confirms what I already know from comparing the fit of successive models. The trend in the data is best described by a second-order polynomial, or a quadratic trend. This reflects the initial increase in life satisfaction 6 months after finding a new partner but a subsequent reduction in life satisfaction at 12 and 18 months after the start of the relationship (Figure 19.21). The parameter estimates tell us much the same thing. It’s worth remembering that this quadratic trend is only an approximation: if it were completely accurate then I would predict from the model that couples who had been together for 10 years would have negative life satisfaction, which is impossible given the scale I used to measure it.

Depletion manipulation (adapted from Baumeister et al., 1998)

This next task will require you to cross out all of the e's presented in the passage EXCEPT for when the letter e is adjacent to another vowel (e.g. trEAt), or there is a vowel 1 letter before or after (e.g. 1 letter before = tUnE, or 1 letter after = bEtA). Please copy and paste the following passage into the text box below and carefully go through the entire passage to erase all instances of the letter e that follow the above rules.

The output will now include the cubic polynomial. To see whether this cubic trend has improved the model I again compare the − 2LL for this new model to the value in the previous model. The value of − 2LL is shown in SPSS Output 19.12, and it is 1798.86. I have added only one term to the model so the new degrees of freedom will have risen by 1, from 7 to 8 (again you can find the value of 8 in the row labelled Total in the column labelled Number of Parameters, in the table called Model Dimension). I can compute the change in − 2LL as a result of the cubic-term by subtracting the − 2LL for this model from the − 2LL for the model with only the linear trend. I will look at the SPSS output for this final model in a little more detail (SPSS Output 19.12). First, I are given the fit indices (the − 2LL, AIC, AICC, CAIC and BIC).As I have seen, these are useful mainly for comparing models, so I have used the log-likelihood, for example, to test whether the addition of a polynomial significantly affects the fit of the model. The main part of the output is the table of fixed effects and the parameter estimates. These tell us that the linear, $F (1, 221.39) = 10.01$, $p < .01$, and quadratic, $F (1, 212.49) = 9.41$, $p < .01$, trends both significantly described the pattern of the data over time; however, the cubic trend, $F (1, 214.37) = 3.19$, $p > .05$, does not. This confirms what I already know from comparing the fit of successive models. The trend in the data is best described by a second-order polynomial, or a quadratic trend. This reflects the initial increase in life satisfaction 6 months after finding a new partner but a subsequent reduction in life satisfaction at 12 and 18 months after the start of the relationship (Figure 19.21). The parameter estimates tell us much the same thing. It’s worth remembering that this quadratic trend is only an approximation: if it were completely accurate then I would predict from the model that couples who had been together for 10 years would have negative life satisfaction, which is impossible given the scale I used to measure it.

Concreteness manipulation

(adapted from Freitas et al., 2004; Trope & Liberman, 1998)

For every goal we have in life, we must engage in simple steps to move towards the end goal. For this next portion of your self-views, below you will find several scenarios of different behaviours. Please write a couple of sentences about how you would complete each behaviour.

1. Imagine you are considering opening a bank account, please describe the first steps you would need to take to do that.

2. Imagine you are considering enrolling in a fitness program, please describe the first steps you would need to take to do that.

3. Imagine you are considering going to university to find a residence, please describe the first steps you would need to take to do that.

4. Imagine you are considering searching for a part-time job, please describe the first steps you would need to take to do that.

5. Imagine you are considering cleaning your apartment, please describe the first steps you would need to take to do that.

6. Imagine you are considering booking a vacation, please describe the first steps you would need to take to do that.

Abstraction manipulation

(adapted from Freitas et al., 2004; Trope & Liberman, 1998)

For every goal we have in life, we have a primary reason for pursuing that goal. For this next portion of your self-views, below you will find several scenarios of different behaviours. Please write a couple of sentences about why you would complete each behaviour.

1. Imagine you are considering opening a bank account, please describe ultimately why you would do that.

2. Imagine you are considering enrolling in a fitness program, please describe ultimately why you would do that.

3. Imagine you are considering going to a university to find a residence, please describe ultimately why you would do that.

4. Imagine you are considering searching for a part-time job, please describe ultimately why you would do that.

5. Imagine you are considering cleaning your apartment, please describe ultimately why you would do that.

6. Imagine you are considering booking a vacation, please describe ultimately why you would do that.

Behavioural identification form (Vallacher & Wegner, 1989)

Any behaviour can be described in many ways. For example, one person might describe a behaviour as "writing a paper," while another person might describe the same behaviour as "pushing keys on the keyboard." Yet another person might describe it as "expressing thoughts." Below you will find several behaviours listed. After each behaviour will be two different ways in which the behaviour might be identified. Your task is to choose the identification, a or b, that best describes the behaviour for you. Be sure to respond to every item.

1. Making a list
- ❍ a. Getting organized
- ❍ b. Writing things down

2. Reading
- ❍ a. Following lines of print
- ❍ b. Gaining knowledge

3. Joining the Army
- ❍ a. Helping the Nation's defense
- ❍ b. Signing up

4. Washing clothes
- ❍ a. Removing odors from clothes
- ❍ b. Putting clothes into the machine

5. Picking an apple
- ❍ a. Getting something to eat
- ❍ b. Pulling an apple off a branch

6. Chopping down a tree
- ❍ a. Wielding an axe
- ❍ b. Getting firewood

15. Filling out a personality test
- ❍ a. Answering questions
- ❍ b. Revealing what you're like

16. Toothbrushing
- ❍ a. Preventing tooth decay
- ❍ b. Moving a brush around in one's mouth

17. Taking a test
- ❍ a. Answering questions
- ❍ b. Showing one's knowledge

18. Greeting someone
- ❍ a. Saying hello
- ❍ b. Showing friendliness

19. Resisting temptation
- ❍ a. Saying "no"
- ❍ b. Showing moral courage

20. Eating
- ❍ a. Getting nutrition
- ❍ b. Chewing and swallowing

21. Growing a garden
- ❍ a. Planting seeds
- ❍ b. Getting fresh vegetables

22. Traveling by car
- ❍ a. Following a map
- ❍ b. Seeing countryside

23. Having a cavity filled
- ❍ a. Protecting your teeth
- ❍ b. Going to the dentist

24. Talking to a child
- ❍ a. Teaching a child something
- ❍ b. Using simple words

25. Pushing a doorbell
- ❍ a. Moving a finger
- ❍ b. Seeing if someone's home

Persistence measure (Data-entry type task)

The next task is designed to simulate a data entry task. Please type as many consecutive numbers in the comment box below as you possibly can starting with the number 1. Each number should be separated with a comma and a space for instance: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 etc. Try to get as far along as possible, after a period of time, the screen will automatically advance. At any point in time you can choose to stop the task, and wait until the screen advances to the next task.

Positive and Negative Affect Schedule (PANAS; Watson et al., 1988)

1 = Strongly Disagree
2 = Disagree
3 = Neither Agree nor Disagree
4 = Agree
5 = Strongly Agree

1. I feel interested
2. I feel distressed
3. I feel excited
4. I feel upset
5. I feel strong
6. I feel guilty
7. I feel scared
8. I feel hostile
9. I feel enthusiastic
10. I feel proud
11. I feel irritable
12. I feel alert
13. I feel ashamed
14. I feel inspired
15. I feel nervous
16. I feel determined
17. I feel attentive
18. I feel jittery
19. I feel active
20. I feel afraid
21. I feel powerful
22. I feel in control
23. I feel that things are in control
24. I feel confident

Study 3 Materials

EEG Apparatus

EEG Device

The headset has a plastic structure that wraps around the posterior aspect of the head. It contains an array of electrodes that come in contact with the scalp through felt pads. The electrodes of the EEG apparatus has felt pads soaked in a sterile, saline solution (Renu™ multi-purpose solution).

The device is placed such that the F3 and F4 nodes are 60% of the distance from the inion (a bony landmark on the back of the skull) to the nasion (the indentation between the eyes), and the F7 and F8 nodes are 30% of the distance from the nasion to the ear canal. The room was not electrically shielded.

Figure A1. Emotiv EPOC device.

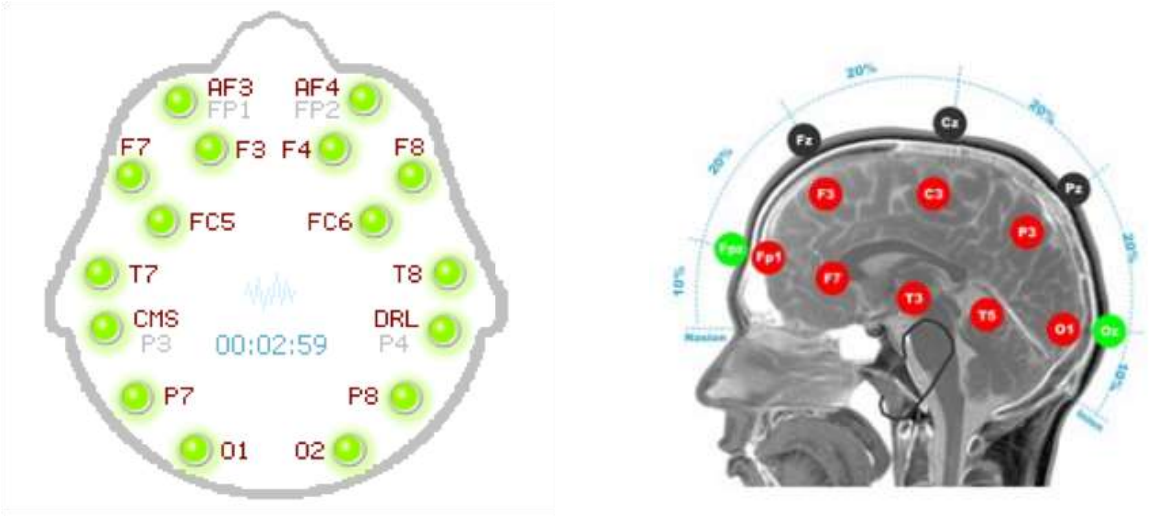

Figure A2. Electrode placements.

Handgrip apparatus

Participants were asked to perform a self-timed handgrip squeeze using a spring loaded exercise device shown below. Participants were asked to squeeze the handgrip until the springs closed and the plastic parts all came into contact and to hold it in that position for as long as they could.

Figure A3. Handgrip device

State measure of approach motivation (adapted from Carver & White, 1994)

Please rate the extent to which each of the following statements applies to you

RIGHT NOW, AT THE PRESENT MOMENT...

1 = Strongly Disagree
2 = Disagree
3 = Neither Agree nor Disagree
4 = Agree
5 = Strongly Agree

1. It would affect me strongly if something good happened to me.
2. I would go all-out to get something I wanted.
3. I would be willing to try something new if I thought it would be fun.
4. I would enthusiastically stick with something I was doing well.
5. I would get excited right away if I saw an opportunity for something I liked.
6. I would move on it right away if I saw a chance to get something I wanted.
7. I could act on the spur of the moment.
8. I would do something for no other reason than that it might be fun.
9. I would go out of my way to get what I wanted.
10. I crave excitement and new sensations.
11. I would feel excited and energized if I got something I wanted.
12. I would be fiercely determined in going after what I wanted.
13. It would excite me to win a contest.

Study 4 Materials

Personal projects analysis (McGregor et al., 2001)

Now, we are interested in your personal projects. Most of us have a number of projects at any given time that we think about, plan for, and try to accomplish. Here are some examples of such projects that people have listed in the past: try to be physically attractive; seek new and exciting experiences; try to avoid being noticed by others; earn as much money as possible; get A's in all my courses; help Gary get along better with others; make my parents proud of me; try to stop fighting in my relationship; clarify my religious beliefs; avoid being dependent on my boyfriend; try to avoid putting on weight; help and be kind to people; stay on top of house chores. In the next two minutes, please jot down as many of the personal projects in your life that you can think of. We all have many of these projects, some of which are oriented toward getting what we want and some toward preventing what we do not want. (The screen will automatically advance after 2 minutes.)

-----PAGE BREAK----

Please enter the 3 projects that are most characteristic of you at present. From your list of projects:

[TEXT WAS PIPED IN FROM PREVIOUS PAGE]

Please select the three that are most important to you, and write them in the boxes below.

Project 1 _____
Project 2 _____
Project 3 _____

Personal projects analysis (continued; McGregor et al., 2001)

Participants then rated their 3 selected projects on the following dimensions on a Likert scale from 1 to 5, with anchors presented below.

1 = Strongly Disagree
2 = Disagree
3 = Neither Agree nor Disagree
4 = Agree
5 = Strongly Agree

1) I am eagerly determined to accomplish this project.
2) I am tenaciously committed to this project.
3) I will persist over obstacles and hardships if necessary with this project.
4) I will not neglect or procrastinate with this project.
5) External forces and factors beyond my control will determine the outcome of this project more than factors within my personal control.
6) This project focuses more on preventing bad outcomes that I want to avoid than getting good outcomes that I personally value.
7) I tend to think about this project in more abstract (e.g., success; health) than concrete (e.g., do well on test, lose weight) terms.
8) This project is more pragmatic than idealistic.
9) I tend to feel self-conscious when thinking about and doing this kind of project.
10) This project is focused more on priorities that are beyond myself than on priorities that are only self-related.
11) I tend to get so fully absorbed in this kind of project that I lose track of time and self-awareness.
12) This project requires compromise and respect for the views of important others or groups that differ from my own views.
13) I enjoy doing this kind of project.
14) In the big picture that includes my life, other people, and the world around us, this project feels meaningful.
15) This project is stressful.
16) This project is likely to succeed.

Full study details

Participants completed a battery of personality scales in the following order: Meaning seeking/presence scale (Steger et al., 2006), religious views, Religious Zeal scale (McGregor et al., 2010), environmental attitudes scale, Behaviour Identification Form (Vallacher & Wegner, 1989), trait BIS/BAS (Carver & White, 1994), Mindfulness Awareness scale (Brown & Ryan, 2003), Adult Hope scale (Snyder et al., 1991), Self-Efficacy scale (Schwarzer & Jerusalem, 1995), Perceived Stress scale (Cohen et al., 1993), Rumination/Reflection scale (Trapnell & Campbell, 1999), Personal Need for Structure scale (Neuberg & Newsom, 1993), self-transcendence scale (Eftekhari et al., 2017), Reality Acceptance scale, Action Control scale (Kuhl & Beckmann, 1994), Promotion/Prevention scale (Lockwood et al., 2002), Promotion focus subscale (Higgins et al., 2001), Attachment style (Hazan & Shaver, 1987), Self-esteem scale (Rosenberg, 1965), Brief self-control scale (Tangney et al., 2004), Horizontal/Vertical individualism scale (Singelis et al., 1995), depression scale (CES-D), emotional uncertainty subscale (Greco & Roger, 2001).

Participants then completed the concreteness manipulation. In addition to measures of BAS, mood, and personal projects, I also collected a measure of state-BIS, (McGregor et al., 2010; Alquist et al., 2018). They then completed a number of other dependent measures that were not related to my persistence hypotheses, specifically, participants completed questions that assessed rationality, the remote associates test (Mednick, 1968), practice questions from the graduate record exam, and were asked to watch 6 videos on the global warming crisis. They also completed a number of items related to each video the compliance check measures and were debriefed.

Study 5 Materials

Approach-motivation condition

For the next task, we are interested in your life experiences. In the text box, please describe something (e.g., a person, state, or outcome) that makes you feel like you want to enthusiastically move towards it. You will have some time to start to think about something that you want to move toward and write your thoughts down below. Then you will stop typing briefly while I measure your brain activity. At that time, you can continue to think about what you were writing about. Don't worry you will have plenty of time to write down the rest of your thoughts afterwards.

----EEG Period in between, and on a new page---

You may now take up to a minute to complete any thoughts you had on your experience below.

Conflict condition

For the next task, we are interested in your life experiences. In the text box, please describe something (e.g., a dilemma, frustration, or difficulty) that makes you feel uncertain or conflicted. You will have some time to start to think about something that makes you feel conflicted and write your thoughts down below. Then you will stop typing briefly while I measure your brain activity. At that time, you can continue to think about what you were writing about. Don't worry you will have plenty of time to write down the rest of your thoughts afterwards.

----EEG Period in between, and on a new page---

You may now take up to a minute to complete any thoughts you had on your experience below.

Word-generating performance task

For this next word task you will be asked to write as many unique words (i.e., avoid words that simply have a new prefix or suffix) as possible. You will be given 2 minutes to complete this task at which point the screen will progress automatically. Please try to work as fast as possible as your speed is a necessary variable I use when calibrating your EEG activity. When you are ready, press continue.

---PAGE BREAK---

Please spend the next two minutes trying to come up with as many words as possible that start with the letter C.

State BIS Measure (adapted from McGregor et al., 2001)

1 = Strongly Disagree
2 = Disagree
3 = Neither Agree nor Disagree
4 = Agree
5 = Strongly Agree

Please rate the extent to which you experienced the following feelings while completing the word typing task that involved entering as many words as possible:

1) Bothered
2) Confused
3) Uncomfortable
4) Mixed
5) Uneasy
6) Torn

Appendix B: Supplemental analyses

Study 2: Additional depletion manipulation

In addition to the main manipulation of concreteness, participants were also asked to complete an e-crossing task to induce BIS-related conflict (see Baumeister, Bratslavsky, Muraven & Tice, 1998). The manipulation was incorrectly programmed; participants did not develop a patterned response (removing all instances of 'e') which they had to later overcome. Instead, some participants received a "cross-out all e's" instruction and others were given a complex set of rules to follow. There was no main effect of e-crossing, F (3,327) = .40, p = .52, or an interaction of e-crossing and concreteness, F (3,327) = .59, p = .44.

Study 2: Analyses of characters entered with mean of all 3 BAS subscales as covariates

There was still a significant BIS X concreteness interaction on characters entered with the full BAS scale as a covariate, t (327) = -3.00, p = .003. This interaction was followed up with simple effects, t (327) = -2.57, p =.01, with concreteness (M_{conc} = 480.56) outperforming abstraction (M_{abs} = 406.45). In addition, the full BAS scale was still significantly related to characters entered (r = .256, p < .001).

Study 2: Analyses of characters entered using BIS-A as moderator

Using the items suggested by Heym et al., (2008) I created a BIS-anxiety subscale from the following 4 items: *1) Criticism or scolding hurts me quite a bit, 2) I feel pretty worried or upset when I think or know somebody is angry at me 3) I feel*

worried when I think I have done poorly at something important 4) I worry about making mistakes. There was a significant interaction effect, t (327) = -2.54, p = .012, as well as a significant simple effect at high BIS-A, t (327) = -2.01, p =.045 such that the concreteness condition typed more characters (M_{conc} = 491.48) than the abstraction condition (M_{abs} = 432.78).

Study 3: Analyses of handgrip and LFA using BIS-A as moderator

There was a significant interaction effect for handgrip, t (129) = -2.09, p = .039, as well as a significant simple effect at high BIS-A, t (129) = -2.42, p =.017 such that the concreteness condition squeezed longer (M_{conc} = 82.76) than the abstraction condition (M_{abs} = 66.06). The interaction effect remained nonsignificant for LFA, t (103) = -1.24, p = .218, and the simple effect at high BIS-A trended in the same direction, but was also still nonsignificant, t (103) = -1.11, p =.271. That is, the concreteness condition trended toward more LFA (M_{conc} = .082) than the abstraction condition (M_{abs} = -.026).

Study 4: Analyses of all 3 self-reported state BAS scales

Separate analysis of the three self-reported BAS scales showed a significant concreteness X BIS interaction t (107) = -2.07, p = .041. However the simple effect at high BIS was only marginal, t (107) = -1.88, p = .063. The concreteness condition (M_{conc} = 3.92) reported higher approach motivation in the Fun-Seeking, Reward-Responsiveness and Drive scales compared to the abstraction condition (M_{abs} = 3.66).

Study 4: Analyses using BIS-A as moderator

There was a significant interaction effect for self-reported BAS, t (107) = -3.42, p = .0009, as well as a significant simple effect at high BIS-A, t (107) = -3.63, p =.0004 in that the concreteness condition reported more BAS (M_{conc} = 4.19) than the abstraction condition (M_{abs} = 3.71). The interaction effect was also significant for PPA approach, t (107) = -2.26, p = .026, and the simple effect at high BIS-A was also significant, t (107) = -2.90, p =.004. That is, the concreteness condition reported more approach motivation toward their personal goals (M_{conc} = 4.13) than the abstraction condition (M_{abs} = 3.71).

Study 4: Full table of PPA dimensions.

Personal Project Analysis Dimensions

	PPA Item Wordings
1	**I am eagerly determined to accomplish this project.**
2	**I am tenaciously committed to this project.**
3	**I will persist over obstacles and hardships if necessary with this project.**
4	**I will not neglect or procrastinate with this project.**
5	External forces and factors beyond my control will determine the outcome of this project more than factors within my personal control.
6	This project focuses more on preventing bad outcomes that I want to avoid than getting good outcomes that I personally value.
7	I tend to think about this project in more abstract (e.g., success; health) than concrete (e.g., do well on test, lose weight) terms.
8	This project is more pragmatic than idealistic.
9	I tend to feel self-conscious when thinking about and doing this kind of project.
10	This project is focused more on priorities that are beyond myself than on priorities that are only self-related.
11	I tend to get so fully absorbed in this kind of project that I lose track of time and self-awareness.
12	This project requires compromise and respect for the views of important others or groups that differ from my own views.
13	**I enjoy doing this kind of project.**
14	In the big picture that includes my life, other people, and the world around us, this project feels meaningful.
15	This project is stressful.
16	**This project is likely to succeed.**

Note: Bolded items were those included in the main analyses of Study 4.

Study 4: Exploratory analysis of other PPA dimensions

PPA Dimensions	Interaction Statistics		Simple Effects Statistics	
	b	*p*-value	*t*-value	*p*-value
External forces and factors beyond my control will determine the outcome of this project more than factors within my personal control.	.01	.97	.09	.93
This project focuses more on preventing bad outcomes that I want to avoid than getting good outcomes that I personally value.	.54	.10	1.18	.24
I tend to think about this project in more abstract (e.g., success; health) than concrete (e.g., do well on test, lose weight) terms.	.54	.11	.54	.59
This project is more pragmatic than idealistic.	-.17	.61	-.11	.91
I tend to feel self-conscious when thinking about and doing this kind of project.	.43	.17	.51	.61
This project is focused more on priorities that are beyond myself than on priorities that are only self-related.	-.14	.66	-.91	.36
I tend to get so fully absorbed in this kind of project that I lose track of time and self-awareness.	-.30	.35	-1,20	.23
This project requires compromise and respect for the views of important others or groups that differ from my own views.	.10	.76	-.58	.56
In the big picture that includes my life, other people, and the world around us, this project feels meaningful.	-.01	.96	-.26	.80
This project is stressful.	.06	.84	-.12	.90

Meta-analyses of effects

Additional meta-analyses of the simple slopes in concreteness and abstraction are presented in the tables below.

Table B1.

Simple slopes of BIS in concreteness condition across all 4 studies

Study	*t*-value	Effect size (*d*)	*p*-value
Study 1 (Cycling)	*t* (60) = 1.44	*d* = .37	*p* = .16
Study 2 (Characters)	*t* (327) = 4.12	*d* = .45	*p* < .001
Study 3 (LFA-proximal)	*t* (103) = 1.18	*d* = .23	*p* < .25
Study 3 (LFA-distal)	*t* (103) = 1.96	*d* = .39	*p* = .053
Study 3 (Handgrip)	*t* (129) = 2.28	*d* = .40	*p* = .046
Study 4 (PPA)	*t* (107) = 1.97	*d* = .38	*p* = .051
Study 4 (BAS)	*t* (107) = -.72	*d* = .14	*p* = .47
Meta-analysis		*d* = .37 95%CI [.11, .60], *p* =.0017	

Table B2.

Simple slopes of BIS in abstraction condition across all 4 studies

Study	*t*-value	Effect size (*d*)	*p*-value
Study 1 (Cycling)	*t* (60) = -1.49	*d* = -.38	*p* = .14
Study 2 (Characters)	*t* (327) = -.18	*d* = .02	*p* = .85
Study 3 (LFA-proximal)	*t* (103) = 1.14	*d* = .22	*p* < .26
Study 3 (LFA-distal)	*t* (103) = -.55	*d* = .11	*p* = .58
Study 3 (Handgrip)	*t* (129) = -1.57	*d* = .28	*p* = .12
Study 4 (PPA)	*t* (107) = -3.97	*d* = .77	*p* < .001
Study 4 (BAS)	*t* (107) = -2.58	*d* = .50	*p* = .011
Meta-analysis		*d* = -.20	
		95%CI [-.01, -.39], *p* =.44	

Appendix C: Pilot Studies

Pilot Study a

In Pilot Study a, I aimed to establish that a direct manipulation of approach motivation would result in persistence. I tested this hypothesis using two separate approach manipulations (simple and invigorated approach) and compared them to a neutral control condition (typical daily routine). Participants then performed a behavioural typing-task that required persistence (Study 2, Tran et al., in preparation) and an adapted self-report measure of state BAS (adapted from Carver & White, 1994).

Method

Participants and procedure. One hundred and thirty undergraduates from the University of Waterloo participated in exchange for course credit toward their psychology class. Twenty-nine[25] participants were removed for unconscientiously responding to a compliance check item (i.e., responded with a 3 or above on the item: *I sometimes just clicked random responses in order to get through this survey as quickly as possible*). After deletion of these participants, there were one hundred and one remaining the analysis, (n = 101, females = 81, M_{age} = 19.93, SD_{age} = 1.64). The participants completed the online *Experiences and Personality and Behaviour Study* materials in a half-hour session. Participants answered a number of demographics questions as well as 3 trait scales; the BIS/BAS scale, meaning in life questionnaire, and the brief self-control

[25] A chi-square test revealed no differences in attrition between conditions; χ^2 (2, N = 101) = .23, p = .89

scale (Carver & White, 1994; Steger et al., 2006; Tangney et al., 2004). Following the personality variables, they were randomly assigned to one of three manipulations. Participants were randomly assigned to a simple approach, an invigorated approach or a control condition. They then completed the speeded data-entry persistence task (Tran et al., in preparation), a measure of state-BAS (modified from Carver & White, 1994), as well as a measure of mood (PANAS, Watson et al., 1988). Finally, participants completed a compliance check (described above) and were debriefed.

Trait measures. I measured trait BAS and BIS using the Carver and White's (1994) scale. This scale has been well-validated in three separate studies with 932 participants (Smillie et al., 2006; Heym et al., 2006). The scale measures items relating to conflict (i.e., BIS activation) such as: *If I think something unpleasant is going to happen, I usually get pretty worked up; I worry about making mistakes,* as well as items related to approach motivation (BAS). The BAS scale has 3 subscales that capture approach-motivated determination (BAS Drive, e.g., *When I want something, I usually go all-out to get it*), sensitivity to rewards (BAS Reward-Responsiveness, e.g., *When I get something I want, I feel excited and energized*), and impulsivity and novelty-seeking (BAS Fun-Seeking, e.g., *I often act in the spur of the moment*). I also measured the meaning in life questionnaire (MILQ, Steger et al., 2006), composed of a meaning-seeking subscale (e.g., *I am looking for something that makes my life feel meaningful*) and meaning-presence subscale (e.g., *I understand my life's meaning*), and I measured the brief self-control scale (BSCS, Tangney et al., 2004) which measures the ability to manage impulses (e.g., *I am good at resisting temptation,*). The MILQ and BSCS measures are related to dispositional approach motivation and goal-striving (Elnakouri et al., in preparation;

Tangney et al., 2004). All items were rated on a 5-point Likert scale from 1=Strongly disagree to 5=Strongly agree.

Approach Manipulations. Participants were randomly assigned to 1 of 3 conditions. Two conditions were approach motivated (simple approach condition, invigorated approach) and one condition was a neutral control (daily routine). In all 3 conditions participants were given a minute and a half to write about the prime given. The simple approach condition merely asked participants to describe something they wanted to approach. In contrast, the invigorated approach condition was based on the idea that minor impedances toward an approach goal can spur motivation and persistence at that goal. According to Carver & Scheier (2001, p. 61) if impedance occurs but "expectations are for a successful outcome, the person returns to effort toward the goal." Klinger (1975, p. 12) similarly proposed that some degree of goal impedance can cause "an initial stage of invigoration" (see also Csikszentmihalyi, 1997, view of challenge facilitating optimal engagement). The invigorated approach condition was designed to clearly focus participants on a goal that they were approaching, while at the same time invigorating committed engagement with a reminder of a minor challenging obstacle.

Approach manipulation:

"*Please describe something you truly and eagerly want to* ***approach***."

Invigorated approach manipulation:

"*Please describe a goal you are currently working toward but are* ***having some difficulty completing***."

Control condition:

"*Please describe a* ***typical day*** *in your life."*

They were then presented with a text box to type their answer and the screen automatically advanced after 90 seconds.

Although the invigorated approach condition emphasized current commitment and approach with only "some" difficulty being experienced, I was aware that it could still be experienced by participants as a conflict manipulation. I included a measure of state BAS after the persistence task to assess the invigoration vs. conflict interpretation.

Speeded data-entry task. As a measure of persistence and performance, participants completed a rote-typing task under the guise of "speeded data-entry" (Tran et al., in preparation). Participants were told:

"The next task is designed to simulate a data entry task. Please type as many consecutive numbers in the comment box below as you possibly can starting with the number 1. Each number should be separated with a comma and a space for instance: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 etc. Try to get as far along as possible, after a period of time, the screen will automatically advance. At any point in time you can choose to stop the task, and wait until the screen advances to the next task."

This task was designed to demand an approach-motivated focus to maintain persistence and perform well.

State-BAS. After the persistence task I took a measure of state BAS. I modified the BAS scale by adding the instructions "Please rate the extent to which each of the following statements applies to you RIGHT NOW, AT THE PRESENT MOMENT" and adjusted the wording of the BAS scale items to emphasize state (rather than trait) levels of approach motivation as in Study 4 (e.g., "*I would go all-out to get something I wanted"* compared to trait wording;*"When I want something, I usually go all-out to get*

it."). Though I measured all the subscales, all analyses of state BAS in this manuscript refer to only the BAS-Drive subscale. Past work has specifically linked the BAS-Drive subscale to approach motivation (Eftekhari, et al., 2017; McGregor, Nash, & Prentice, 2010, Study 2; Tran et al., in preparation). All ratings were made on a 5-point Likert scale from 1 (Strongly disagree) to 5 (Strongly agree).

PANAS. I measured mood using the positive affect and negative affect schedule and items were rated on Likert-scale from 1=Strongly Disagree to 5=Strongly Agree (PANAS, Watson et al., 1988).

Results and Discussion

Preliminary analysis. There was a negative correlation between meaning-seeking and persistence (r = -.26, p = .01) but no correlations with any other trait variables (ps > .1)[26]. To test for failure of random assignment, I also ran a MANOVA with condition (approach vs. invigorated approach vs. control condition) predicting the 7 personality scales. There was a significant difference between conditions on trait BIS, F (2,98) = 3.22, p = .044 and thus I used BIS and meaning-seeking as covariates in my analysis [27]. I also ran an ANCOVA of condition predicting positive mood (p = .24) and negative mood (p = .73) which showed there were no mood differences due to the manipulation.

Main analysis. To determine if the approach manipulations increased persistence, I ran an ANCOVA with condition predicting number of characters entered and found a

[26] A full correlation table of trait measures and persistence can be found in Appendix D.
[27] There was no condition X BIS effect on state BAS, t (97) = .92, p = .36, and no interaction on persistence, t (97) = -.77, p = .44.

marginal difference between conditions, F (1,96) = 2.30, p = .106. Simple effect analyses demonstrated that there were no significant differences between the simple (M_{simple} = 632.76) and invigorated approach conditions ($M_{invigor}$ = 650.47, p = .557), no difference between the simple approach and neutral control ($M_{neutral}$ = 540.53, p = .156), and a significant difference the invigorated approach and neutral control, (p = .04).

I ran an ANCOVA with condition predicting state BAS-Drive[28] and found no significant differences between conditions, F (2,96) = .89, p = .410. Simple effect analyses showed no differences between simple (M_{simple} = 3.44) and invigorated approach ($M_{invigor}$ = 3.56, p = .534), no differences between simple approach and neutral control ($M_{control}$ = 3.32, p = .509), and no differences between invigorated approach and neutral control (p = .186). This result leaves it unclear as to whether or not the two approach conditions were equivalent, or if they effectively increased approach motivation. Although there were no condition differences on distally measured state BAS (i.e., after the persistence task), it is possible that the approach-motivational state induced by the manipulation dissipated after the dependent variable as has been found in goal literature (e.g., Liberman et al., 2007).

Post-hoc exploratory analysis. Given the similar trends between the two approach conditions on the data-entry task, (simple approach and invigorated approach were higher than control) I decided to collapse the two approach conditions and compared them to the neutral control condition. There was a significant effect of the

[28] I also ran an ANCOVA on the full BAS scale, the results were also non-significant; F (2,96) = .54, p = .586

collapsed approach conditions on task persistence, F (1, 97) = 4.28, p = .041, such that the approach motivation primes increased number of characters entered ($M_{approach}$ = 639.80) compared to the control condition ($M_{control}$ = 543.55).

The approach primes appeared to increase persistence compared to the control condition. The approach primes, however, did not predict greater self-reported, ambient BAS activation after the persistence task. My guiding hypothesis was that an approach motivated state within the context of a conflicted task increases persistence. In this study however, an approach-motivated state was measured as an ambient, free-floating state (i.e., how do you feel in the present moment) rather than in regard to a specific, conflicted task (i.e., how strong was your impulse to approach during the data-entry task). Thus, the null effects on state-BAS may be because the items were not in reference to the data-entry task. An additional possibility for a lack of effect on state-BAS might be that publicly talking about identity-relevant personal goals (via the approach manipulations) made participants feel like they had completed their goals. Research based on symbolic self-completion theory (Wicklund & Gollwitzer, 1981) has found that mere public disclosure of identity-relevant goals caused participants to treat them as if they were completed (Gollwitzer, Sheeran, Michalski, & Seifert, 2009). Indeed, other work has found evidence that after completing goal primes, goal-related thoughts are automatically inhibited (Liberman et al., 2007). If the approach prime instilled the feeling of completed goals, then this confound could explain the absence of differences in state-BAS afterwards. Based on this understanding for why changes in state-BAS were not observed in Pilot study a, in Pilot Study b, I used a manipulation check that assessed approach

motivation immediately after the approach prime, as well as an additional state measure of BAS and BIS that followed the persistence task.

Pilot Study b

To follow up on Pilot Study a, I randomly assigned participants to either the simple manipulation of approach motivation or an unresolved, salient conflict manipulation designed to activate BIS. I expected this contrast to reveal larger effects than in Pilot Study a and given the reciprocal relation between BAS and BIS, it seemed theoretically justifiable (Corr, 2004; Corr, 2013). Pilot Study a found that approach primes increased persistence but had no effect on self-reported state-BAS, afterwards. Pilot Study a also lacked a measure of state-BIS. To build on my findings in Pilot Study a, I introduced three changes to Pilot Study b. First, to conceptually add to my process model, I included measures of state-BIS; measures of the BIS were included to test the idea that BIS activation (in addition to BAS activation) might also reduce persistence. Second, I included a manipulation check immediately following the conflict and approach prime. This measure asked participants to rate the extent to which they experienced affect related to BIS or BAS states, while completing the experimental manipulation. I included these manipulation checks due to the possibility that BAS activation persists for only so long as participants are actively thinking about approach motivation (see Liberman et al., 2007 and following the results of Pilot Study a). Third, I collected distal measures of state BAS and BIS under the premise that persistence might be better predicted by enduring changes in BIS than BAS activation (as Pilot Study a found that state-BAS did not persist after the data-entry task). Furthermore to extend my

findings, I used a different measure of persistence, an anagram task (Alquist et al., 2018). I hypothesized that directly priming approach motivation (vs. conflict) would briefly increase state-BAS, reduce state-BIS and increase task performance.

Method

Participants and procedure. Seventy eight undergraduates from the University of Waterloo participated in exchange for course credit toward their psychology class. Twenty-eight participants[29] were removed for unconscientious responding (i.e., responded with a 3 or above on the item: *I sometimes just clicked random responses in order to get through this survey as quickly as possible,* and spending less than 15 minutes working on the survey, in line with Pilot Study a). After deletion of these participants, there were fifty one remaining for the analysis (n = 51, females = 37, M_{age} = 21.18, SD_{age} = 5.77). They completed the online *Life Experiences and Personality/Word Puzzles and Feelings Study* materials in a one-hour session. The study was presented as a two-part study in order to reduce suspicions that the materials were related. The first half of the study was presented as the "*Life Experiences and Personality"* section, and was composed of the demographics questions, 4 trait scales; the BIS/BAS scale (Carver & White, 1994), self-esteem (Rosenberg, 1965), meaning in life questionnaire (Steger et al., 2006), the brief self-control scale (Tangney et al., 2004), and the manipulation of approach or conflict. Participants were randomly assigned to either the approach or

[29] This was a considerably higher attrition rate compared to the already high attrition rate in Pilot Study a. These differences may have been due to the fact that these data were collected near the end of the term and so there may have been a higher number of unconscientious responders. A chi-square test revealed no differences in attrition between conditions; $\chi 2$ (1, N = 51) = .510, p = .475. A more liberal analyses with only the compliance check item can be found in Appendix D.

conflict condition in which they wrote a short paragraph about “life experiences”. Immediately afterwards, for the manipulation checks, they then provided retrospective assessments of the extent to which they had been feeling states related to BIS and BAS activation while completing the approach and conflict prime materials. Participants ostensibly moved on to a separate study about “*Word puzzles and feelings*”. They completed an anagram task (from Alquist et al., 2018), and reported state-BIS (McGregor et al., 2001) and state-BAS (modified from Carver & White, 1994). Finally, participants completed measures of mood (PANAS; Watson et al., 1988), a compliance check to identify non-conscientious responders, and were debriefed.

Trait measures. I collected measures of self-esteem (e.g., *I feel that I'm a person of worth, at least on an equal basis with others*), BIS/BAS, meaning in life, and trait self-control (Carver & White, 1994; Rosenberg, 1965; Steger et al., 2006; Tangney et al., 2004). All items were rated on a 5-point Likert scale from 1=Strongly disagree to 5=Strongly agree. As in Pilot Study a, I aimed to use these individual difference measures as covariates to control for failures of random assignment or trait predictors of persistence.

Approach/Conflict Manipulations. Participants were randomly assigned to an approach or conflict condition. Both manipulations were face-valid, and designed to either activate BAS (through an approach prime) or BIS (through an uncertainty/conflict prime). The wording for each manipulation can be found below:

Approach manipulation:

"*In the text box, please describe something* (*e.g., a person, state, or outcome) that makes you feel like you want to* ***enthusiastically approach it****. You have two minutes to describe it and how you feel about it.*"

Conflict manipulation:

"*In the text box, please describe something* (*e.g., a dilemma, frustration, or difficulty) that makes you feel* ***uncertain or conflicted****. You have two minutes to describe it and how you feel about it."*

Manipulation checks. Immediately after the manipulation, participants rated a number of face-valid items related to approach motivation and conflict. They were asked, "*As you were writing about your Life Experiences, to what extent did you feel*:", 4 approach-related affect variables ('strong', 'energetic', 'confident', and 'determined'; Harmon-Jones et al., 2009; Gable & Harmon-Jones, 2008; McGregor, Nash, & Prentice, 2010), as well as the extent to which they felt 'an urge to move toward something' and 'prepared to go all-out to get something you wanted' (two items from the BAS-Drive subscale). Unlike the distal measures of state-BAS, there were no additional items from the other BAS subscales (i.e., BAS Fun-seeking or BAS Reward-responsiveness). To measure the immediate effects of the conflict manipulation on state-BIS, participants rated two face-valid conflict items ('frustrated' and 'an urge to quit or give up'). All items were answered on a 5-point Likert scale from 1=Strongly disagree to 5=Strongly agree. I formed a BAS manipulation check composite by averaging together the 6 approach-related items ($\alpha = .85$), and a BIS manipulation check composite by averaging the two BIS items ($\alpha = .73$).

Anagram task. As a measure of persistence and performance, participants completed an anagram task (See further in Appendix C). Participants had to unscramble as many five-letter anagrams as possible in 5 minutes, which has been used and validated as a measure of persistence in previous work (Muraven, Tice, & Baumeister; 1998; Alquist et al., 2018).

State BIS. Immediately after the anagram task I measured self-reported state-BIS activation using the anxious uncertainty scale (McGregor et al., 2001; Alquist et al., 2018). This 19-item scale measures different conflict related emotions, example items include "uneasy", "torn", "confused" etc. Participants were told "*Please take a few seconds to check in with your gut feeling and rate the following statements based on your first reaction. Do not over think it—just rely on your intuitive sense for how you are feeling right now.*" and rated these items on a Likert-scale from 1 (Strongly Disagree) to 5 (Strongly Agree). I aimed to test the idea that state-BIS might mediate the relationship between my approach prime and task persistence, as has been found in past work (Alquist et al., 2018). However, I assessed state-BIS after the anagram task so that its assessment would not interfere with task-persistence inclinations (see Alquist et al., 2018; Hayes et al., 2016 for a similar successful approach). Notably, the measure of state-BIS was ostensibly part of the *Word puzzles and feelings study*, which was emphasized to participants as separate from the *Life experiences and personality study,* (i.e., the manipulation of approach and conflict). This emphasis was included to reduce demand characteristics and distance this measure from the face-valid manipulation checks of BAS and BIS activation. This measure of state-BIS will be referred to as distal state-BIS.

State-BAS. As in Pilot Study a, I used a state modified version of Carver & White's (1994) BAS-Drive subscale. Again participants were told "*Please rate the extent to which each of the following statements applies to you RIGHT NOW, AT THE PRESENT MOMENT..."* and rated the items Likert-scale from 1=Strongly Disagree to 5=Strongly Agree. Similar to distal state-BIS, this measure of BAS was ostensibly collected as part of a separate study (i.e., separate from the *Life experiences and personality study*) and therefore comprises distal state-BAS.

PANAS. I measured mood using the positive affect and negative affect schedule and items were rated on Likert-scale from 1=Strongly Disagree to 5=Strongly Agree (PANAS, Watson et al., 1988).

Results and Discussion

Preliminary analyses. There were no significant correlations between the trait measures and persistence (*ps* > .17)[30]. As in Pilot Study a, to control for failure of random assignment, I ran a MANOVA of condition predicting the 4 personality measures (8 subscales in total). I found significant differences in trait BAS-Drive, F (1,48) = 5.25, p = .026, trait self-control, F(1,48) = 5.05, p = .029, and self-esteem F(1, 48) = 6.87, p = .012. Thus I used these three trait measures as covariates in all of the analyses. The ANCOVA[31] showed significant differences between conditions on the BAS manipulation

[30] A full correlation table between trait measures and BIS, BAS and performance can be found in Appendix D.

[31] There were no condition X trait interactions on the BAS manipulation check, (*ps* > .25), on the BIS manipulation check, (*ps* > .12), distal BIS (*ps* > .72), or distal BAS (*ps* > .14), : There was a significant condition X trait self-control interaction on performance, t (47) = -2.07, p = .043, however this was not predicted or replicated and will not be discussed further.

check composite, F (1, 45) = 11.90, p = .001, such that the approach condition showed more approach motivation ($M_{approach}$ = 3.54), than the conflict condition ($M_{conflict}$ = 2.99). There were also significant differences on the BIS manipulation check items, F (1, 45) = 24.45, p < .001, such that the approach condition ($M_{approach}$ = 1.95) showed less BIS activation than the conflict condition ($M_{conflict}$ = 3.08)[32]. The ANCOVAs on mood (which was assessed at the end of the study, following all other measures) showed no differences in positive mood, F (1,45) = .52, p = .48, and no differences in negative mood, F (1,45) = .00, p = 1.0[33].

Main analysis. I ran three ANCOVAs on anagram performance, distal state-BIS, and distal state-BAS. Unexpectedly, there were no differences between conditions on performance, F (1, 45) = .14, p > .7, and no differences in distal state-BIS, F (1,45) = .07, p > .79. There was a marginal difference in distal state-BAS-Drive[34], F (1,45) = 3.50, p = .068, such that the approach condition reported more state-BAS ($M_{approach}$ = 3.61), compared to the conflict condition ($M_{conflict}$ = 3.26).

Exploratory analyses. Based on the significant effect on the BIS manipulation check and the significant correlation between the BIS manipulation check and distal state-BIS (r = .34, p = .014), I ran an exploratory analysis to test whether the BIS manipulation check might mediate the effect of the approach vs. conflict prime on distal state-BIS. I ran a bootstrap mediation (Model 4, 5000 bootstrap samples, Hayes, 2017)

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[32] Consistent with the joint subsystem hypothesis (JSH, Corr, 2004, Corr, 2013), these manipulation check scores were significantly negatively correlated, r = -.53, p < .001.
[33] This finding suggest that there is no unique variance explained by condition on negative mood (aside from the variance explained by trait differences).
[34] Analysis of the full BAS scale showed a similar result, F (1,45) = 3.63, p = .063.

and found an indirect effect such that the approach (vs. conflict) condition reduced manipulation check BIS, which predicted less distal state-BIS, β = -.56, 95% CI, [-1.14, -.09] (see Figure b1). Thus, although the approach condition did not directly reduce distal state-BIS, it did predict distal state-BIS for participants whom the manipulation worked.

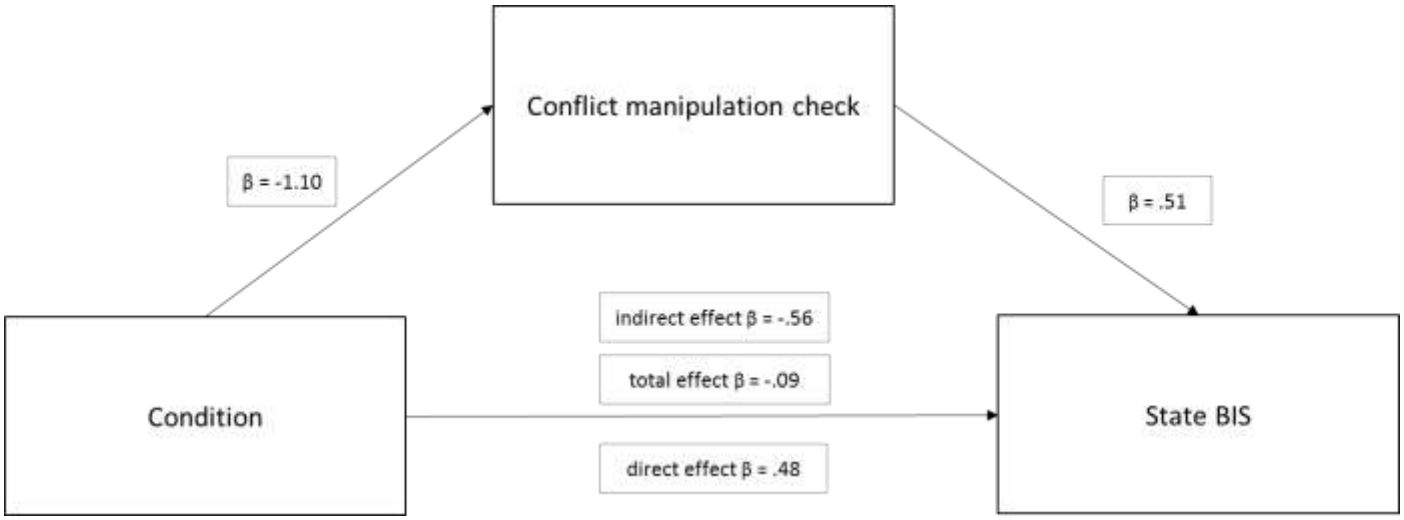

Figure b1. Mediational model of condition effects on distal state-BIS.

I ran a similar mediation analysis of condition, through manipulation check of approach motivation, to distal state-BAS and this model showed marginally significant total effect, β = .43, 95% CI [-.03, .89], *p* = .068, as well as a significant indirect effect, β

= .31, 95% CI [.10, .70] such that the approach prime increased feelings of approach motivation, which predicted distal state BAS (see Figure b2).

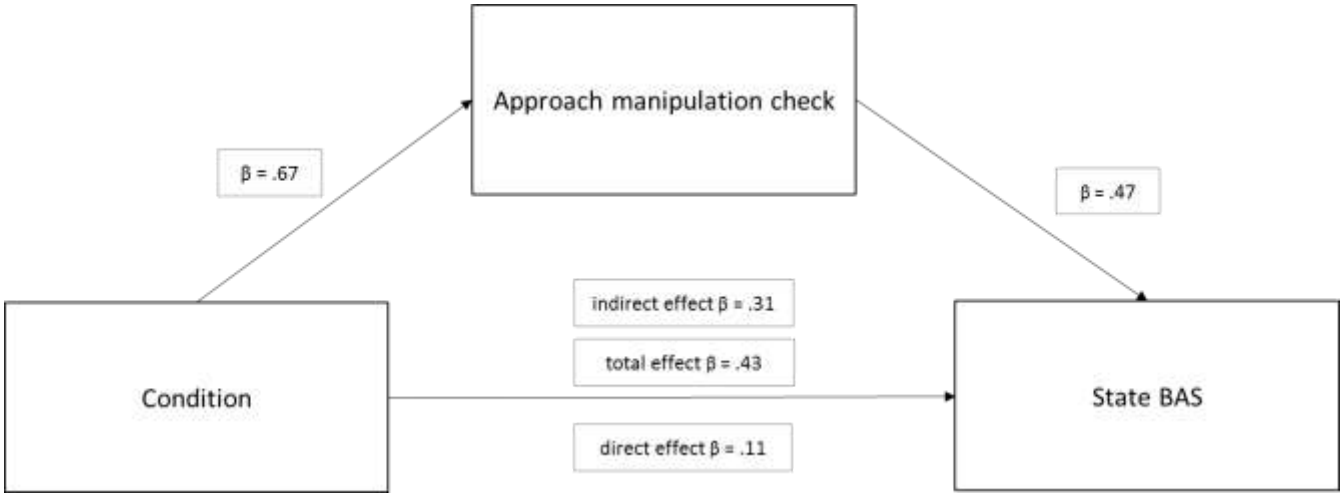

Figure b2. Mediational model of condition effects on state BAS.

In keeping with the exploration of condition effects on the distal state-BIS, distal state-BAS and their mediational effects on persistence, I also tested a model of serial mediation (Model 6, 5000 bootstrap samples, Hayes, 2017). I theorized that reduced conflict (via the manipulation check) might lower distal state-BIS, and increase subsequent anagram persistence (as in Alquist et al., 2018). The model was significant using a 95% confidence interval, β = .13, 95% CI [.001, .44] as well as a 90% confidence interval, β = .13, 90% CI [.02, .39] (see Figure b3). I also tested a similar model to see if manipulation check measures of approach, predicted distal state-BAS which predicted anagram performance. This model was not significant using a 95% confidence interval, β = -.03, 95% CI [-.25, .1] or a 90% confidence interval, β = -.03, 90% CI [-.18, .06]. These results suggest that although the approach motivation manipulation proximally activated BAS (as measured by the manipulation check) and had a marginal effect on distal state BAS (p = .068), distal state-BAS did not mediate changes in persistence. Instead, the

approach vs. conflict manipulations reduced proximal BIS (as measured by the manipulation check) which reduced distal state-BIS which had an indirect effect on task persistence.

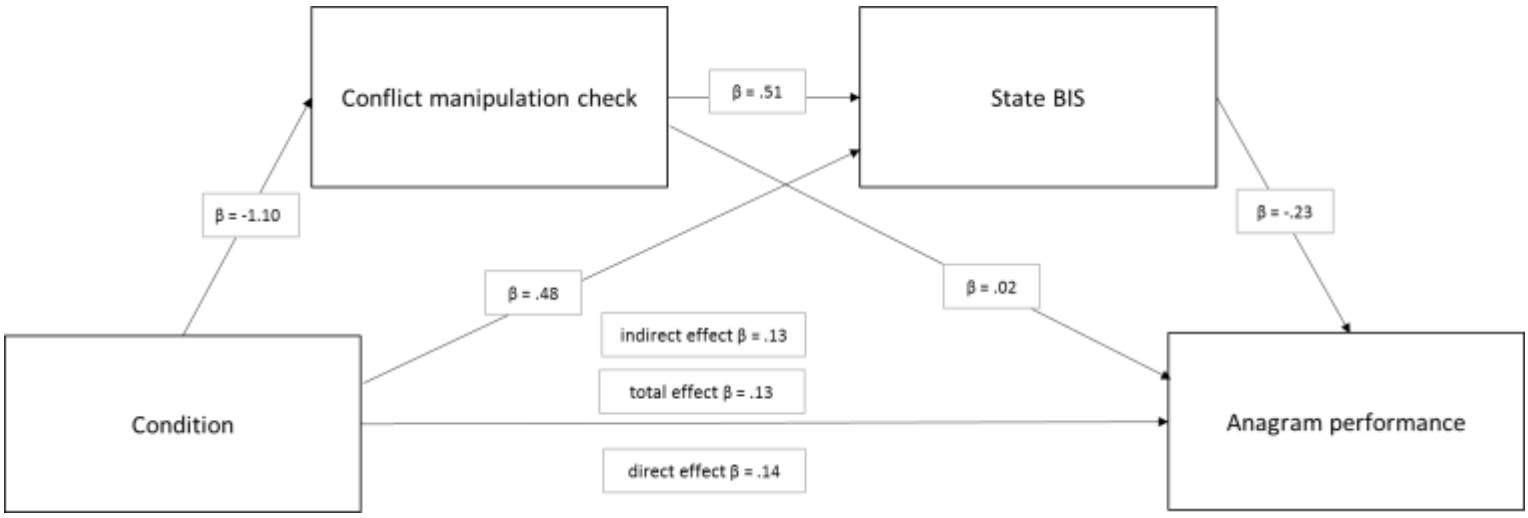

Figure b3. Serial mediation of condition effects on state BIS to anagram performance.

Interestingly, I found a marginal main effect between conditions on distal state-BAS. Pilot Study b results indicate that my face-valid approach motivation condition contrasted with a conflict condition resulted in a stronger effect on distal state-BAS (*d* = .59, Cohen, 1992) rather than neutral control. Pilot Study b also demonstrated that the best manipulation check technique was to assess motivation immediately after and in reference to what participants experienced during the manipulation task itself. These motivational changes associated with the manipulation appear to feed forward to affect distal state-BIS activation and anagram performance. These exploratory analyses elaborate on the process underlying the direct effects observed in Pilot Study a. Although I expected to find direct effects of the approach manipulation on distal state-BIS and persistence, these indirect effects do provide some idea of how these motivational processes affect persistence over time.

The preliminary evidence for a serial indirect effect of condition on the BIS manipulation check, to distal state BIS, to anagram performance should be interpreted with caution, however as this analysis was post hoc. Important to note was that the serial mediational chain was not significant with the BAS manipulation check and distal state BAS as the mediators. Task performance was unrelated to self-reported measures of the proximal BAS manipulation check (r = .03, p = .79), as well as the distal measure of state-BAS (r = .08, p = .3). These findings add to the results found in Pilot Study a; BAS does not appear to be a direct predictor of task persistence, instead approach primes might immediately reduce BIS activation, maintaining lower levels of distal state-BIS and allowing for task persistence. Put another way, changes in BAS-activation appear to be relatively short-lived, and do not distally predict task performance. Instead the extent to which BAS activity reduces BIS activation distally, better predicts persistence.

Limitations of Pilot Study b, however, are its small sample size and high number of exclusions. An important caveat is that the indirect effects were exploratory analyses and not predicted apriori. In addition, the mediation model was significant only if I included the BIS activation manipulation check as there were no direct effects on distal state-BIS. Based on theorizing and past precedent (from Alquist et al, 2018), however, distal BIS should be the main predictor of persistence. These findings informed the design of Study 5 of this dissertation.

Pilot Study a Materials (Not Already Shown in Appendix A)

Meaning in life Questionnaire (MILQ; Steger et al., 2006)

1 = Strongly Disagree
2 = Disagree
3 = Neither Agree nor Disagree
4 = Agree
5 = Strongly Agree

1. I understand my life's meaning.
2. I am looking for something that makes my life feel meaningful.
3. I am always looking to find my life's purpose.
4. My life has a clear sense of purpose.
5. I have a good sense of what makes my life meaningful.
6. I have discovered a satisfying life purpose.
7. I am always searching for something that makes my life feel significant.
8. I am seeking a purpose or mission for my life.
9. My life has no clear purpose.
10. I am searching for meaning in my life

Brief Self-control scale (BSCS; Tangney et al., 2004)

1 = Strongly Disagree
2 = Disagree
3 = Neither Agree nor Disagree
4 = Agree
5 = Strongly Agree

1. I have a hard time breaking bad habits.
2. I get distracted easily.
3. I say inappropriate things.
4. I refuse things that are bad for me, even if they are fun.
5. I'm good at resisting temptation.
6. People would say that I have very strong self-discipline.
7. Pleasure and fun sometimes keep me from getting work done.
8. I do things that feel good in the moment but regret later on.
9. Sometimes I can't stop myself from doing something, even if I know it is wrong.
10. I often act without thinking through all the alternatives.

Full study details

In addition to my measure of typing persistence, I also collected a measure personal projects analysis (Little, 1998) and a measure of revenge against criminals. I anticipated increases in approach motivation toward personal projects (as in Tran et al., in preparation) and increased punishment (indicative of approach motivation, McGregor et al., in preparation) however both were non-significant and thus were excluded from the main body of the dissertation. For methodological transparency I report them here in Appendix C.

Worldview Defense (McGregor et al., in preparation)

We will now discuss some opinions you have on justice, and on punishment for individuals who performed illegal activity. Again, don't think about each question too long or too hard; please just go with your gut reaction to each question.

Imagine that each of the following people had been caught at the age of 72, long after their crimes were committed, and that they were sentenced to a lifetime of surveillance to ensure they could do no more harm. In addition to the surveillance, please indicate your opinions on each of the questions below regarding how justice should be served for each person.

1 = Strongly Disagree
2 = Disagree
3 = Neither Agree nor Disagree
4 = Agree
5 = Strongly Agree

A corporate criminal who cheated millions from trusting investors:

1. Should be jailed for life with no chance of parole.
2. Should have to live in uncomfortable circumstances for life.
3. If wealthy, this criminal should have most of his or her financial assets/ net worth taken away by the justice system.
4. As much money as necessary should be spent by the state on therapy to help rehabilitate this criminal
5. Forgiveness and a second chance should be offered if this criminal apologized and showed sincere remorse.
6. In order to set an example, it is important for the good of society and social order that this criminal be punished severely.

***The same 6-items are repeated for the following scenarios: ***

A religious evangelist who stole and used people's charitable donations for his own lavish lifestyle
A terrorist who had killed people with car-bombs:
An official who had ordered torture of political prisoners:
An exiled leader convicted of war crimes:
A parent convicted of neglect leading to the death of children:
A convicted pedophile:

Pilot Study b Materials (Not Already Shown in Appendix A)

Rosenberg Self-Esteem Scale (Rosenberg, 1965)

1 = Strongly Disagree
2 = Disagree
3 = Neither Agree nor Disagree
4 = Agree
5 = Strongly Agree

1. I feel that I am a person of worth, at least on an equal basis with others.
2. I feel that I have a number of good qualities.
3. All in all I am inclined to feel that I am a failure.
4. I am able to do things as well as most other people.
5. I feel I do not have much to be proud of.
6. I take a positive attitude toward myself.
7. On the whole I am satisfied with myself.
8. I wish I could have more respect for myself.
9. I certainly feel useless at times.
10. At times I think I am no good at all.

Additional manipulations (anger and relaxation)

Anger manipulation:

"*In the text box, please describe something* (*e.g., an injustice, unfairness, or negative state of affairs) that makes you* ***feel angry****. You have two minutes to describe it and how you feel about it*."

Relaxation manipulation:

"*In the text box, please describe something* (*e.g., an activity, place, or thought) that makes you feel* ***relaxed****. You have two minutes to describe it and how you feel about it."*

Anagram task (Alquist et al., 2018)

Next you will complete some anagram word puzzles. Below you are presented with a number of different scrambled letters, each can be re-arranged to form a word. Please re-arrange the letters into a word and write the word you think each one represents into the textbox beside it. You are welcome to spend as much, or as little time as you would like on this task up to a maximum of 5 minutes. Try to complete as many anagrams as possible before you continue on with the study.

1	ETAWS	_____	26	NITSK	_____
2	HUNCL	_____	27	AKYLF	_____
3	OTAGN	_____	28	ZYUFZ	_____
4	LICHD	_____	29	LESHL	_____
5	SEALF	_____	30	SASCL	_____
6	RUTOC	_____	31	LIEOV	_____
7	GANIL	_____	32	RCMEY	_____
8	ROGOM	_____	33	OIEDV	_____
9	TTRHU	_____	34	EESAT	_____
10	MGIIC	_____	35	RDPIA	_____
11	EIUTQ	_____	36	TYRAP	_____
12	CMIAG	_____	37	RCOOL	_____
13	ESRIN	_____	38	ITNPA	_____
14	BEETR	_____	39	ETESH	_____
15	PLAEP	_____	40	NIJOT	_____
16	EDNOZ	_____	41	NRCOS	_____
17	HOINR	_____	42	RSWAE	_____
18	NTALP	_____	43	COKKN	_____
19	OHBOT	_____	44	KAETN	_____
20	LUGAH	_____	45	OKSOH	_____
21	NUSYN	_____	46	LIKCC	_____
22	KNCHU	_____	47	OMESO	_____
23	RYRBE	_____	48	TASSH	_____
24	KOLAP	_____	49	OAHCS	_____
25	EIHGW	_____	50	RUHYR	_____

Anxious Uncertainty Scale (McGregor et al., 2001)

For this next portion of the study, we are interested in how you are feeling in the present moment and particularly how you felt while completing the word puzzles. Please rate the following items with respect to how you were feeling when working on the anagram task.

1 = Strongly Disagree
2 = Disagree
3 = Neither Agree nor Disagree
4 = Agree
5 = Strongly Agree

1. I feel mixed
2. I feel uneasy
3. I feel torn
4. I feel bothered
5. I feel preoccupied
6. I feel confused
7. I feel unsure of self or goals
8. I feel contradictory
9. I feel distractible
10. I feel unclear
11. I feel of two minds
12. I feel muddled
13. I feel restless
14. I feel confused about identity
15. I feel jumbled
16. I feel uncomfortable
17. I feel conflicted
18. I feel indecisive
19. I feel indecisive
20. I feel chaotic

Appendix D: Supplementary analyses of Pilot Studies a and b, and Study 5

Pilot Study a: Omnibus analyses of 3 conditions

Running an ANOVA on all 3 conditions revealed a marginal effect F (2,98) = 2.39, p = .097. Following this analysis, I ran separate analyses between all 3 conditions. There was a marginal difference between the simple approach condition and control condition t (67) = -1.70, p = .095 ($M_{approach}$ = 632.76, $M_{neutral}$ = 540.53). There was a significant difference between the invigorated approach condition and control condition t (66) = -2.14, p = .036 ($M_{facilitated}$ = 650.46, $M_{neutral}$= 540.53). However, there was no difference between the invigorated approach condition and simple approach condition t (63) = .30, p = .76.

Pilot Study a: Full correlation table of traits, persistence and state BAS.

Table D1.

Correlations between traits, persistence and state BAS

Variable	1.	2.	3.	4.	5.	6.	7.	8.
1. Persistence								
2. State BAS	.06							
3. BAS-Drive	-.01	.62***						
4. BAS-Reward	.04	.51***	.45***					
5. BAS-Fun	-.10	.22*	.40***	.27**				
6. BIS Mean	-.02	-.20†	-.27**	.05	-.21*			
7. Meaning-seeking	-.26**	.20*	.16	.28**	.18†	.08		
8. Meaning-presence	.05	.29**	.37***	.32***	-.11	-.05	-.06	
9. Self-control	.16	.01	.06	.01	-.23*	-.34	-.07	.26**

Note: † $p < .1$, * $p < .05$, ** $p < .01$, *** $p < .001$

Pilot Study b: Full correlation table of traits, persistence, state BAS and state BIS.

Table D2.

Correlations between traits, persistence and state BAS

Variable	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
1. Persistence										
2. State BAS	-.16									
3. State BIS	-.19	-.08								
4. BAS-Drive	-.05	.62***	-.11							
5. BAS-Reward	-.02	.34*	.17	.56***						
6. BAS-Fun	-.07	.46***	.03	.40**	.39**					
7. BIS Mean	.06	-.21	.18	-.08	-.27†	-.24†				
8. Meaning-seeking	-.15	.22	.33*	.09	.20	.51***	.03			
9. Meaning-presence	.15	.10	-.19	.16	.14	-.09	-.05	-.36**		
10. Self-control	-.08	.19	-.14	.16	-.02	-.36**	-.09	-.54***	.48***	

11. Self-esteem	.144	.399**	-.147	.406**	333*	.12	-.24†	-.24†	.46***	.42**

Note: † $p < .1$, * $p < .05$, ** $p < .01$, *** $p < .001$

Pilot Study b: Analyses without 15 minute exclusion criterion

An ANCOVA showed significant differences between conditions on the BAS manipulation check composite, F (1, 62) = 19.78, $p < .001$, such that the approach condition showed more approach motivation ($M_{approach}$ = 3.58), than the conflict condition ($M_{conflict}$ = 2.86). There were also significant differences on the BIS manipulation check items, F (1, 45) = 28.97, $p < .001$, such that the approach condition ($M_{approach}$ = 1.99) showed BIS activation than the conflict condition ($M_{conflict}$ = 3.04). There was a marginal difference in positive mood, F (1,62) = 2.99, $p = .089$, and no differences in negative mood, F (1,62) = .24, $p = .62$.

An ANCOVA on anagram performance showed no differences between conditions on performance, F (1, 62) = .65, $p = .43$, and no differences in distal state-BIS, F (1,62) = .007, $p = .93$. There was a significant difference in distal state-BAS-Drive, F (1,62) = 7.25, $p = .009$, such that the approach condition reported more state-BAS ($M_{approach}$ = 3.71), compared to the conflict condition ($M_{conflict}$ = 3.22).

The bootstrap mediation (Model 4, 5000 bootstrap samples, Hayes, 2017) showed an indirect effect such that the approach (vs. conflict) condition reduced BIS activation measured by the manipulation check, which predicted less distal state-BIS, β = -.48, 95% CI, [-.90, -.15].

A mediation analysis of condition, through manipulation check of approach motivation, to distal state-BAS and this model showed a significant total effect, β = .54, 95% CI [.14, .95], $p = .009$, as well as a significant indirect effect, β = .41, 95% CI [.13, .88].

I tested a model of serial mediation of condition on manipulation check BIS, to distal state-BIS and to anagram persistence (Model 6, 5000 bootstrap samples, Hayes, 2017). The model was not significant using a 95% confidence interval, β = .04, 95% CI [-.09, .19] or a 90% confidence interval, β = .04, 90% CI [-.05, .16]. I also tested a similar model to see if condition predicted manipulation check BAS, which predicted distal state-BAS and then anagram persistence, however this was not significant using a 95% confidence interval, β = -.04, 95% CI [-.22, .12] or a 90% confidence interval, β = -.04, 90% CI [-.17, .07].

Pilot Study b: Effect of anger and relaxation on manipulation checks

The MANOVA revealed significant differences in self-esteem, F (3, 103) = 2.78, p = .045 and self-control, F (3, 103) = 3.72, p = .014 between the 4 conditions and were used as covariates in the analyses. I ran an ANCOVA on the manipulation check measures and found significant differences in the approach manipulation check, F (3, 101) = 7.64, p < .001 (see Figure D1), conflict manipulation check, F (3, 101) = 18.72, p < .001 (see Figure D2), as well as anger item, F (3, 101) = 19.15, p < .001 (see Figure D3) and relaxation item, F (3, 101) = 15.02, p < .001 (see Figure D4).

Analyses were similar without personality covariates; approach manipulation check F (3, 104) = 9.82, p < .001, conflict manipulation check, F (3,104) = 18.79, p < .001, as well as anger item, F (3,104) = 19.03, p < .001 and relaxation item, F (3,103) = 15.67, p < .001.

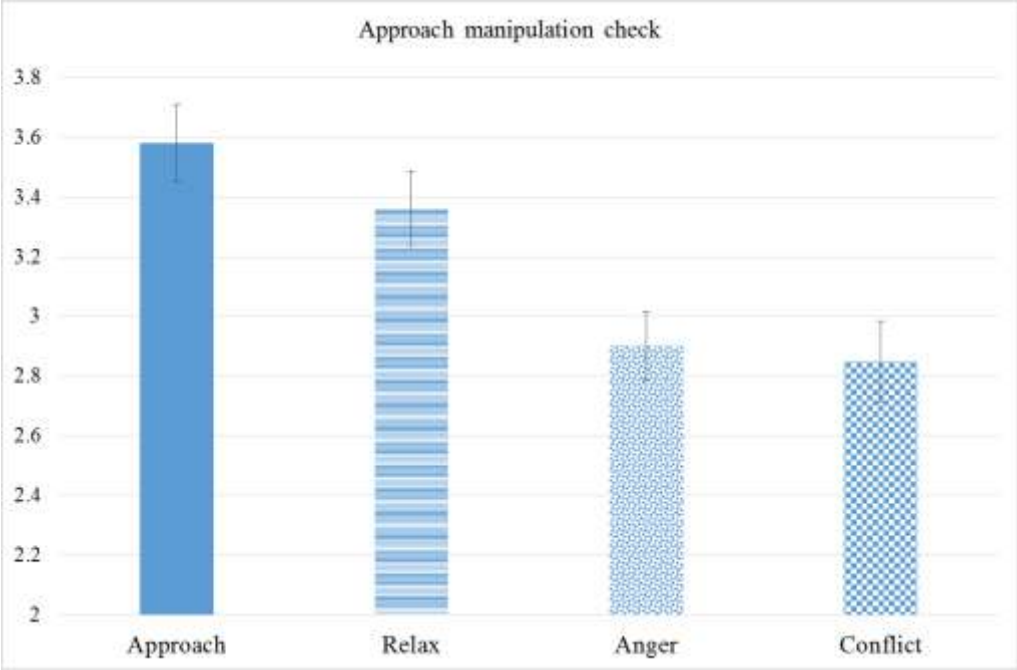

Figure D1. Condition differences on approach manipulation check items. Error bars represent ± 1 SE.

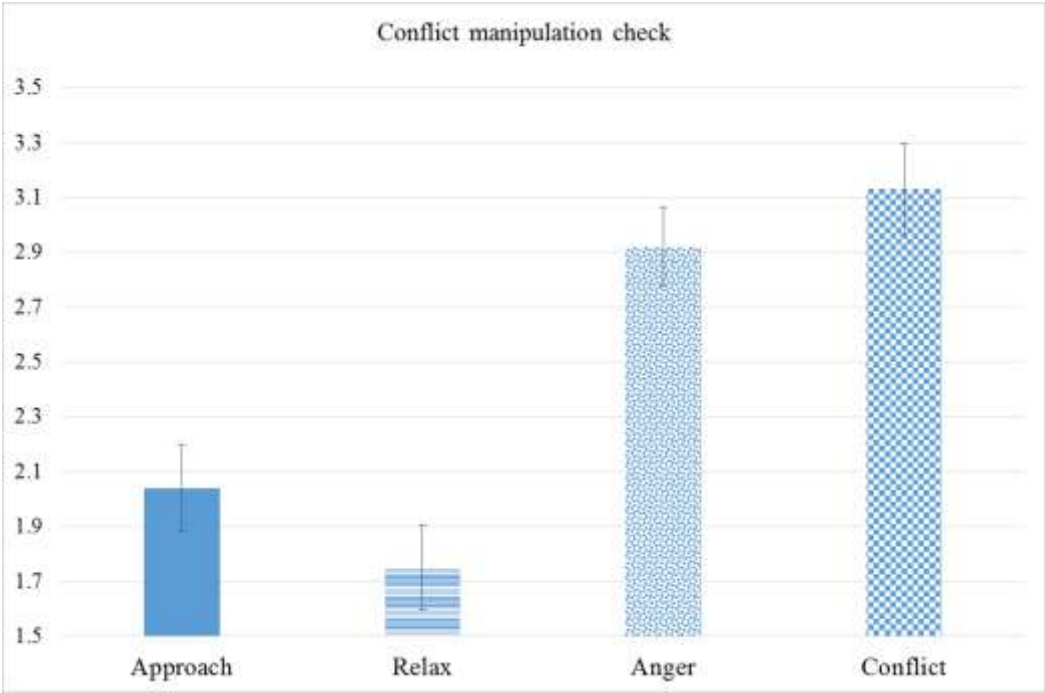

Figure D2. Condition differences on conflict manipulation check items. Error bars represent ± 1 SE.

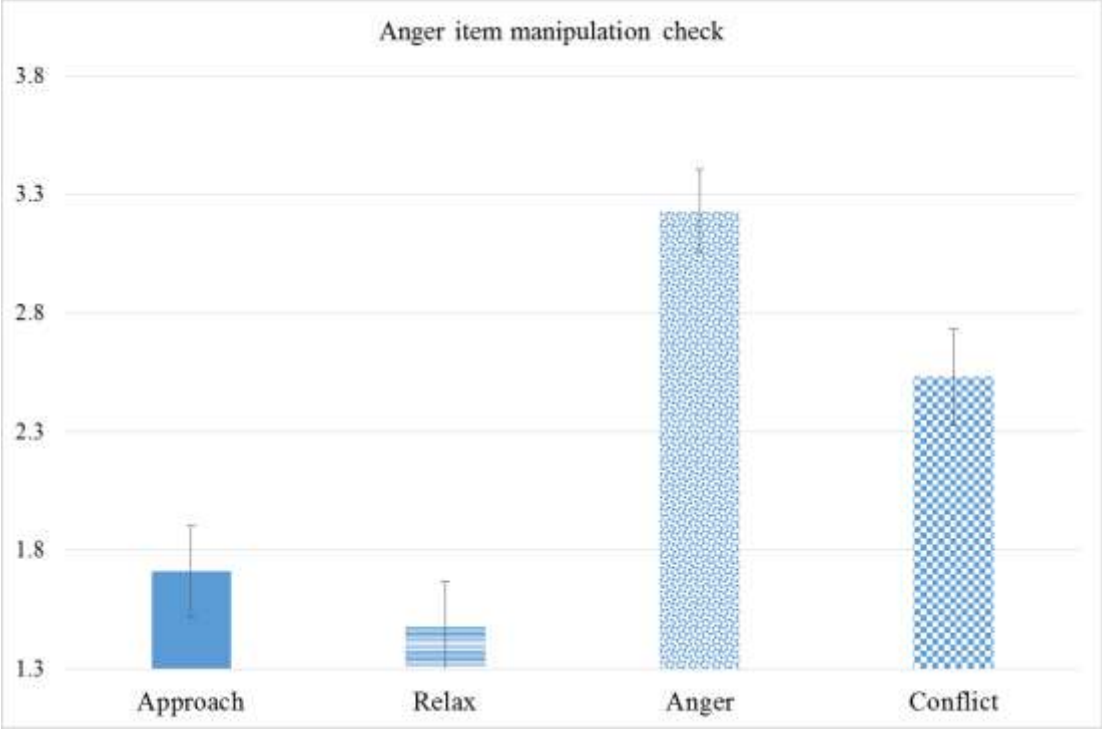

Figure D3. Condition differences on anger manipulation check items. Error bars represent ± 1 SE.

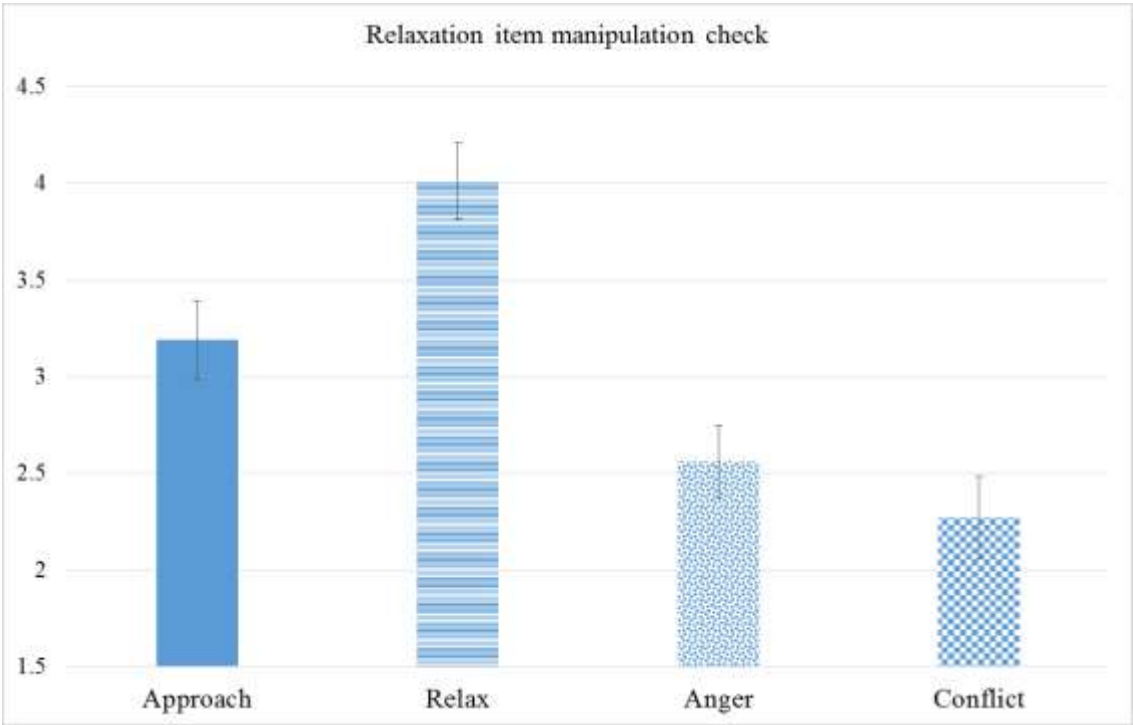

Figure D4. Condition differences on relaxation manipulation check items. Error bars represent ± 1 SE.

Although I found the anticipated effects on the anger item and the relaxation items (see Figure D3 and D4) the anger condition resembled the conflict condition in regard to the approach and conflict manipulation checks (see Figure D1 and D2), rather than acting as an additional approach manipulation (see Harmon-Jones & Allen, 1997 and Harmon-Jones et al., 2001 for the relationship between anger and approach motivation). In addition, the relaxation resembled the approach condition (rather than a positive affect, control condition), see Table D1 for full pairwise comparisons of manipulation check measures. Thus I focused my analyses on my main, face-valid manipulations which demonstrated the anticipated effects on the primary manipulation check measures of conflict and approach motivation.

Table D2.

Pilot Study b pairwise comparisons across 4 conditions on manipulation checks

	Pairwise comparison	*p*-value
Approach Items	Approach vs. Anger	$p < .001$
	Approach vs. Relaxation	$p = .23$
	Approach vs. Conflict	$p < .001$
	Anger vs. Relaxation	$p = .009$
	Anger vs. Conflict	$p = .78$
	Relaxation vs. Conflict	$p < .001$
Conflict Items	Approach vs. Anger	$p < .001$
	Approach vs. Relaxation	$p = .19$
	Approach vs. Conflict	$p < .001$
	Anger vs. Relaxation	$p < .001$
	Anger vs. Conflict	$p = .34$
	Relaxation vs. Conflict	$p < .001$
Anger Item	Approach vs. Anger	$p < .001$
	Approach vs. Relaxation	$p = .41$
	Approach vs. Conflict	$p = .005$
	Anger vs. Relaxation	$p < .001$
	Anger vs. Conflict	$p = .011$
	Relaxation vs. Conflict	$p < .001$
Relaxation Item	Approach vs. Anger	$p = .026$

Approach vs. Relaxation	$p = .005$
Approach vs. Conflict	$p = .003$
Anger vs. Relaxation	$p < .001$
Anger vs. Conflict	$p = .30$
Relaxation vs. Conflict	$p < .001$

Pilot Study b: Effects of 4 conditions on main dependent measures

I ran an ACNOVA of condition predicting distal state BAS, distal state BIS, and anagram persistence. There was a marginal effect of condition on distal state-BAS, F (3, 101) = 2.27, $p = .085$, and pairwise comparisons showed significant differences between the approach and anger condition ($p = .043$) as well as the approach and conflict condition ($p = .016$) but not between any other conditions ($ps >$. 11) see Figure D5. There were no effect on distal state-BIS, F (3, 101) = .21, $p = .89$, or anagram persistence, F (3, 101) = .25, $p = .86$.

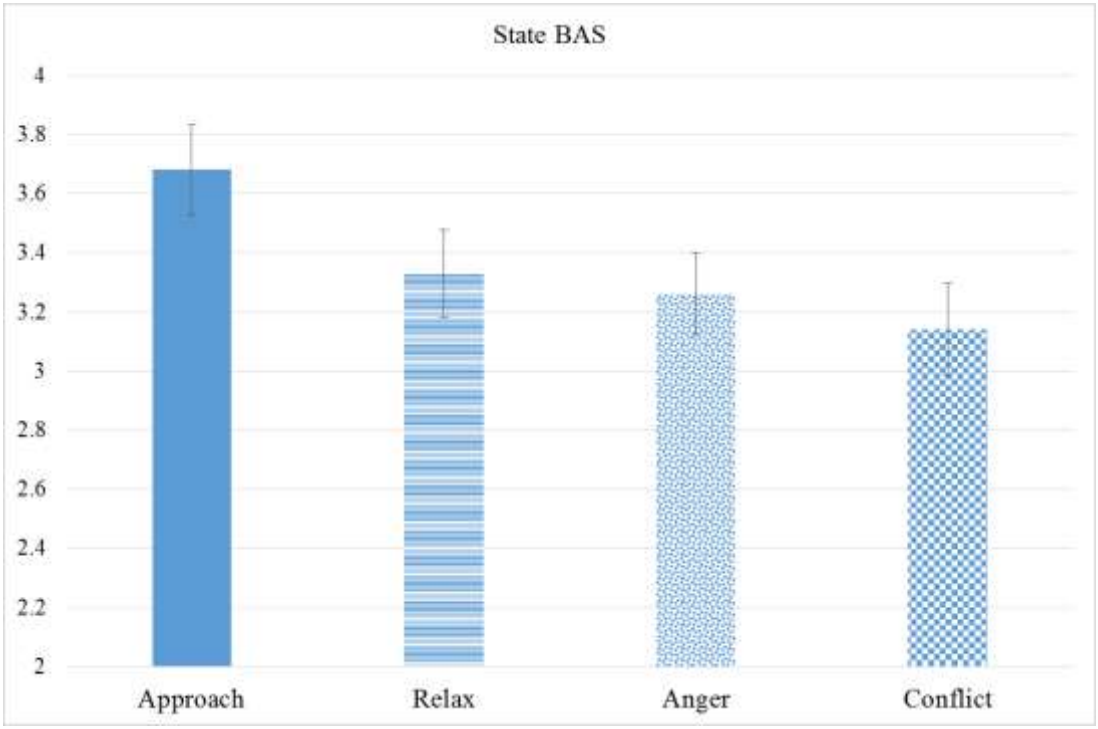

Figure D5. Condition differences on state BAS. Error bars represent ± 1 SE.

The analyses without personality trait covariates on distal state-BIS, distal state-BAS and anagram performance was similar, such that there were significant differences on distal state-BAS, F (3, 104) = 3.93, p = .011 and pairwise comparisons showed significant differences between the approach and anger condition (p = .043), the conflict condition (p = .001), the relaxation condition (p = .048) but no other comparisons were significant (*ps* >. 18). There were no differences on distal state-BIS, F (3, 104) = .49, p = .69 or anagram persistence, F (3, 104) = .33, p = .80.

Pilot Study b: Effects of 4 conditions in exploratory mediational models

I ran the same exploratory mediational model of the 4 conditions, predicting manipulation check measures of conflict, and distal state-BIS controlling for self-esteem

and self-control (Model 4, 5000 bootstrap samples, Hayes, 2017). The omnibus model was significant, β = .08, 95% CI [.02, .19], and analysis of the individual condition comparisons showed that the conflict vs. approach condition indirect path was significant, β = -.33, 95% CI [-.64, -.10], as well as the conflict vs. relaxation condition, β = -.42, 95% CI [-.80, -.14]. The conflict vs. anger condition was not significant, β = -.06, 95% CI [-.23, .07]. Similarly the indirect effect of the anger vs. approach condition on the manipulation check measures of conflict to distal state-BIS was significant, β = -.26, 95% CI [-.59, -.07], as was the anger vs. relaxation condition, β = -.36, 95% CI [-.72, -.10], but not anger vs. conflict, β = .06, 95% CI [-.06, .22]. There was also no indirect effect between the approach and relaxation condition on manipulation check measures of conflict, to distal state-BIS, β = -.09, 95% CI [-.28, .01]. These findings imply that feelings of conflict (from either anger, or the conflict condition) increased distal state-BIS, relative to both the approach and relaxation conditions.

I also ran the same serial mediational model (Model 6, 5000 bootstrap samples, Hayes, 2017) of condition predicting feelings of conflict, then distal state-BIS, then anagram persistence. I found a significant indirect effect through this path between the anger and approach condition, β = .08, 95% CI [.01, .24], but not the anger and relaxation condition, β = .08, 95% CI [-.02, .34], or the anger and conflict condition, β = .01, 95% CI [-.01, .09]. I also found no effect between the approach and conflict condition, β = .12, 95% CI [-.01, .40], or the relaxation and conflict condition, β = .1, 95% CI [-.02, .51] at a 95% CI. I did, however, find a significant difference between the approach and conflict condition at a 90% CI (mirroring the results of Pilot Study b) β = .12, 90% CI [.01, .37], but the relaxation and conflict condition was still not significant, β = .1, 90% CI [-.002,

.42]. There was no indirect effect between the approach and relaxation condition at a 95% CI, β = -.02, 95% CI [-.14, .003], but there was a difference at a 90% CI, β = -.02, 90% CI [-.12, -.0001]. These findings suggest that to the extent the manipulation increased feelings of conflict, followed by increased distal state-BIS, caused reductions in anagram persistence. These effects were strongest between the anger and approach condition and marginal between the conflict and approach condition. Although the relaxation condition reduced feelings of conflict and indirectly BIS, the relaxation condition did not predict anagram persistence when compared to any other condition.

Pilot Study b: Analyses of approach vs. conflict with no personality covariates

I ran an ANOVA on anagram performance, distal state-BIS, and distal state-BAS. There were no differences between conditions on anagram persistence F (1, 49) = .03, p > .86, and no differences in distal state-BIS, F (1,49) = .74, p > .39. There was a significant effect on distal state-BAS, F (1,49) = 12.15, p = .001, such that the approach condition reported more approach motivation ($M_{approach}$ = 3.76), compared to the conflict condition ($M_{conflict}$ = 3.04).

I ran a mediational model (Model 4, 5000 bootstrap samples, Hayes, 2017) such that condition, predicted manipulation check BIS, and distal state-BIS and the indirect effect was significant, β = -.64, 95% CI, [-1.28, -.17], but there was no direct or total effect. I ran the same model such that feelings of approach motivation, predicted state BAS, the total effect was significant, β = .88, 95% CI, [.37, 1.39], and the indirect effect was significant, β = .50, 95% CI, [.23, .94], but direct effect was not significant, β = .38, 95% CI, [-.19, .96]. This finding suggests that the condition increased distal state-BAS

(and distal state-BIS) only to the extent it affected manipulation check measured of BAS (and BIS).

Finally, I ran a serial mediational model (Model 6, Hayes, 2017) such that manipulation check measures of BIS, predicted distal state-BIS, which predicted anagram performance (as in the results of Pilot Study b), however the indirect effect was not significant at a 95% CI, β = .13, 95% CI, [-.03, .44], but was significant at a 90%CI, β = .13, 90% CI, [.004, .39].

Study 5: Effect of anger and relaxation condition on manipulation checks

I ran a repeated measures ANOVA on an average of the 6 approach-related items. There was a significant omnibus effect, F (3,222) = 34.47, $p < .001$, (see Figure D6). There were also significant differences on the two conflict items (i.e., urge to quit, frustrated), F (3,222) = 72.29, $p < .001$, (see Figure D7), as well as the anger manipulation check, F (2.64,187.75) = 123.13, $p < .001$, (see Figure D8), and the relaxation manipulation check, F (3,213) = 87.57, $p < .001$, (see Figure D9). All pairwise comparisons can be found in Table D2.

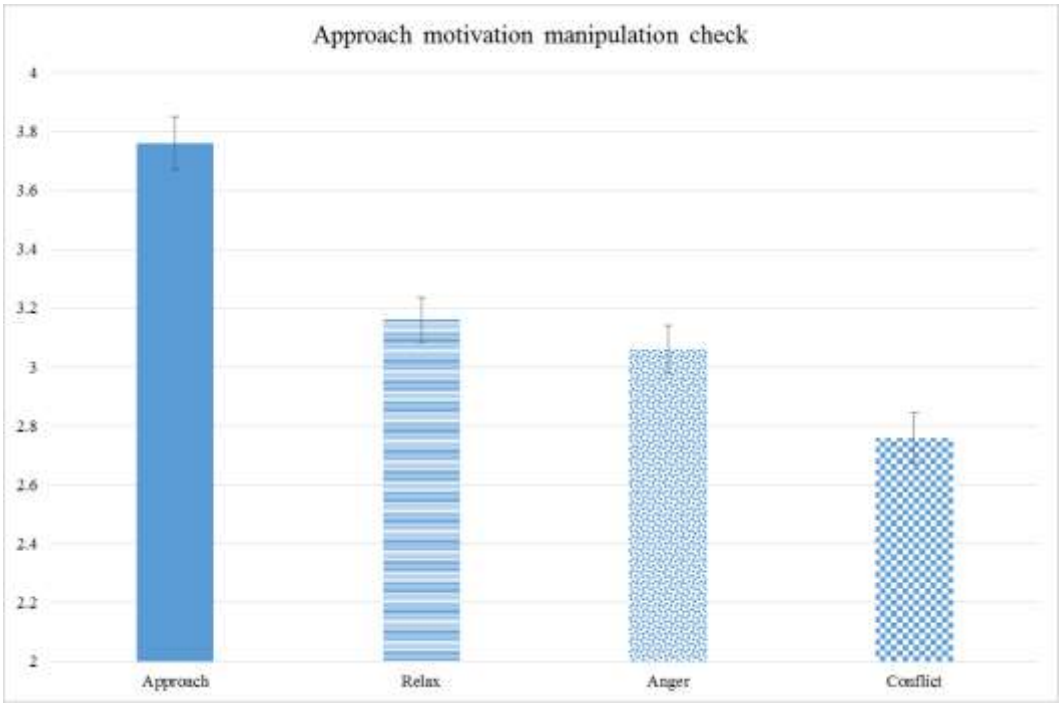

Figure D6. Condition differences on approach manipulation check items. Error bars represent ± 1 SE.

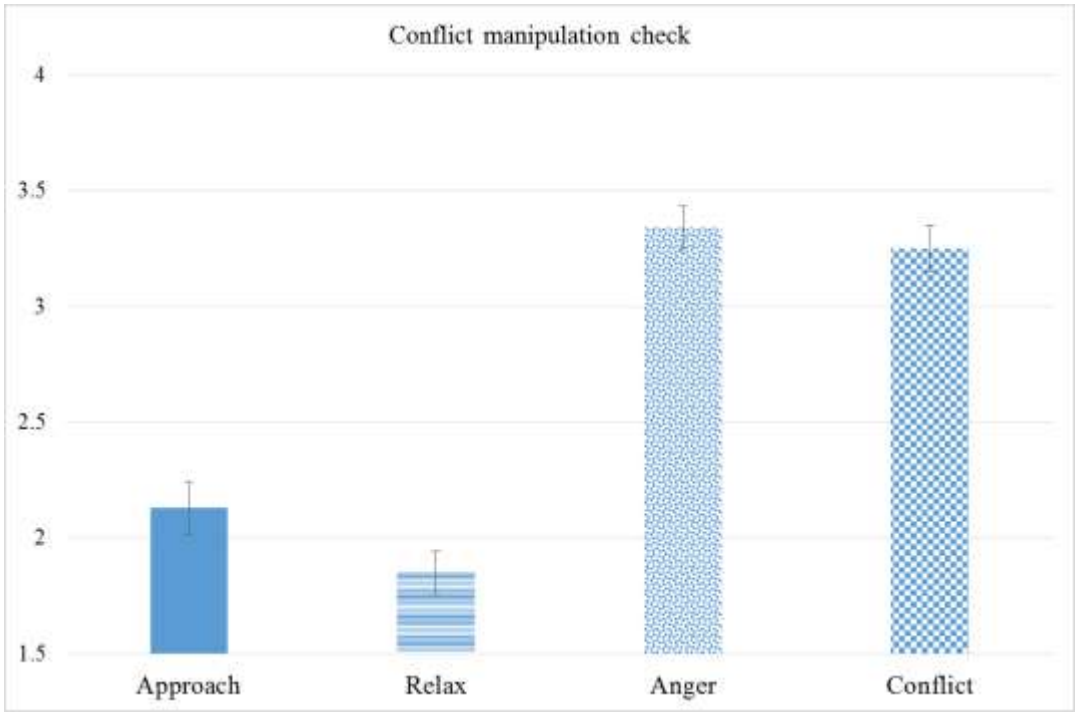

Figure D7. Condition differences on conflict manipulation check items. Error bars represent ± 1 SE.

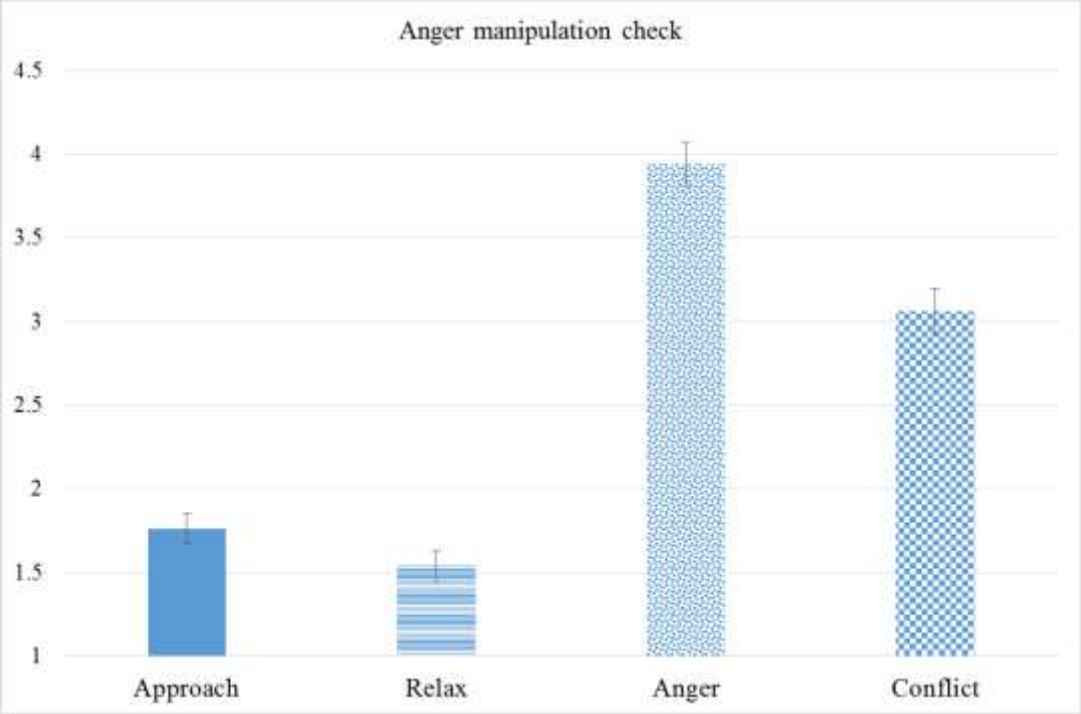

Figure D8. Condition differences on anger manipulation check items. Error bars represent ± 1 SE.

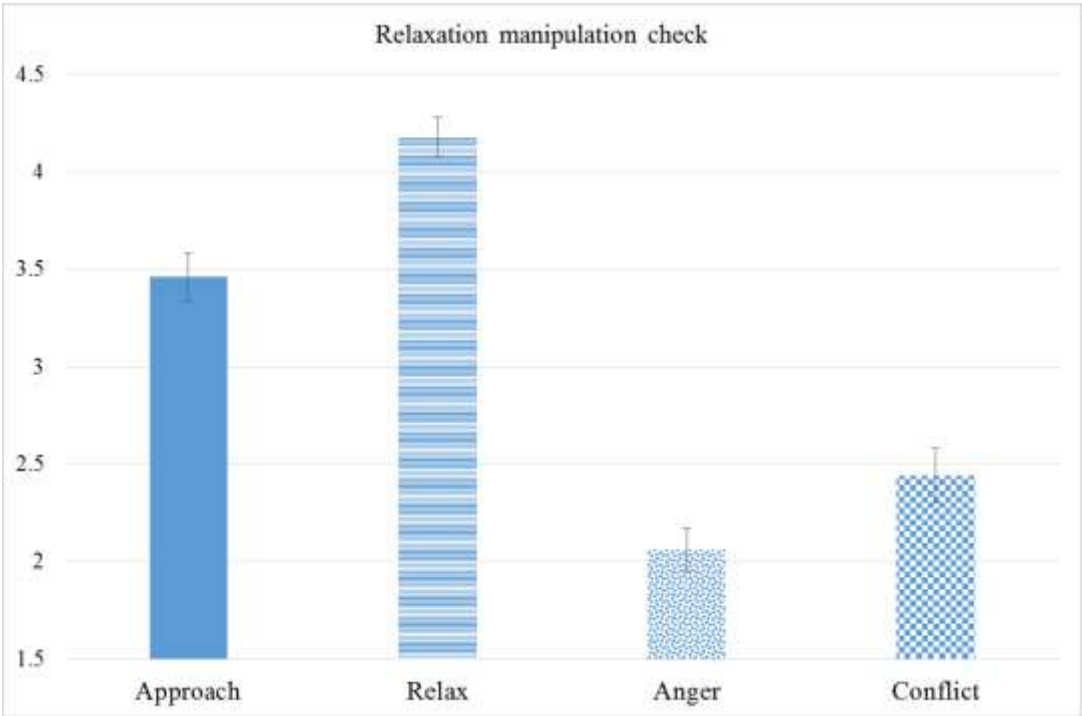

Figure D9. Condition differences on anger manipulation check items. Error bars represent ± 1 SE.

Table D3.

Study 5 pairwise comparisons across 4 conditions on manipulation checks

	Pairwise comparison	*p*-value
Approach Items	Approach vs. Anger	$p < .001$
	Approach vs. Relaxation	$p < .001$
	Approach vs. Conflict	$p < .001$
	Anger vs. Relaxation	$p = .336$
	Anger vs. Conflict	$p = .004$
	Relaxation vs. Conflict	$p = .001$
Conflict Items	Approach vs. Anger	$p < .001$
	Approach vs. Relaxation	$p = .023$
	Approach vs. Conflict	$p < .001$
	Anger vs. Relaxation	$p < .001$
	Anger vs. Conflict	$p = .599$
	Relaxation vs. Conflict	$p < .001$
Anger Item	Approach vs. Anger	$p < .001$
	Approach vs. Relaxation	$p = .038$
	Approach vs. Conflict	$p < .001$
	Anger vs. Relaxation	$p < .001$
	Anger vs. Conflict	$p < .001$
	Relaxation vs. Conflict	$p < .001$
Relaxation Item	Approach vs. Anger	$p < .001$
	Approach vs. Relaxation	$p < .001$

Approach vs. Conflict	$p < .001$
Anger vs. Relaxation	$p < .001$
Anger vs. Conflict	$p = .003$
Relaxation vs. Conflict	$p < .001$

Study 5: Effects of 4 conditions on main dependent measures

I ran a repeated measures ANOVA of condition predicting LFA, state BIS, and anagram persistence. There was a significant omnibus effect on LFA, F (2.97, 154.33) = 2.84, $p = .04$, however pairwise comparisons showed that this was due to differences between baseline LFA and all of the conditions. That is, baseline showed less LFA than the anger condition ($p = .017$), the approach condition ($p = .046$), the conflict condition ($p = .016$) and the relaxation condition, ($p = .048$). The comparisons between conditions showed no LFA effects ($p > .3$), (see Figure D10). There was a marginal omnibus effect on state BIS, F (3, 204) = 2.20, $p = .089$ and pairwise comparisons showed significant differences between the conflict and relaxation condition ($p = .016$) and marginal differences between the approach and conflict condition ($p = .076$) and between the conflict and anger conditions ($p = .072$) but all other comparisons were not significant ($ps >$. 52, see Figure D11). There was a marginal omnibus effect on persistence, F (3, 198) = 2.25, $p = .084$. Pairwise comparisons showed that there was a significant difference between the approach and relaxation conditions, ($p = .023$), and a marginal difference between the conflict and relaxation condition ($p = .07$) but all other differences were not significant ($p > .13$, see Figure D12).

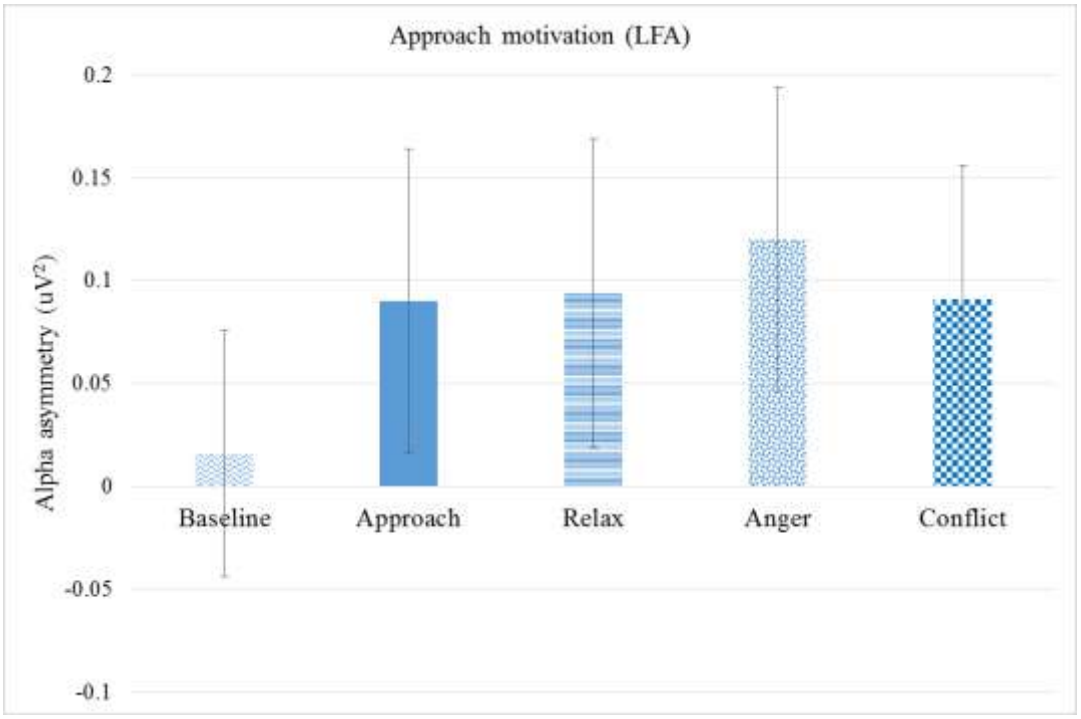

Figure D10. Differences in LFA between baseline and conditions. Error bars represent ± 1 SE.

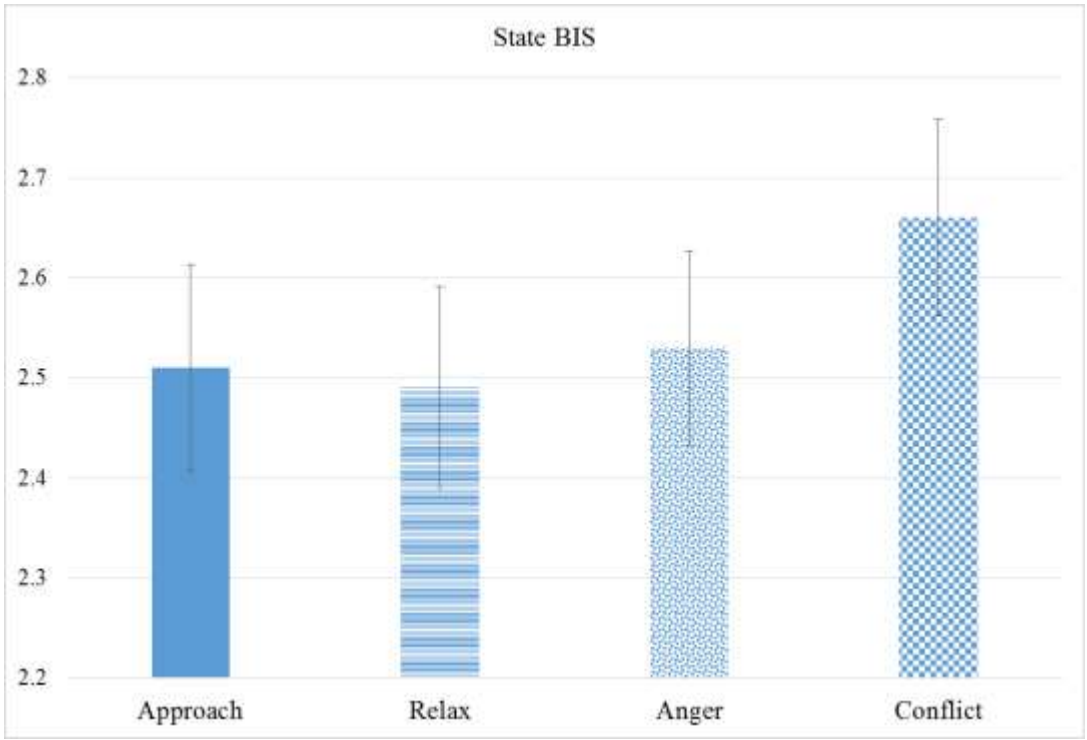

Figure D11. Condition effects on state BIS. Error bars represent ± 1 SE.

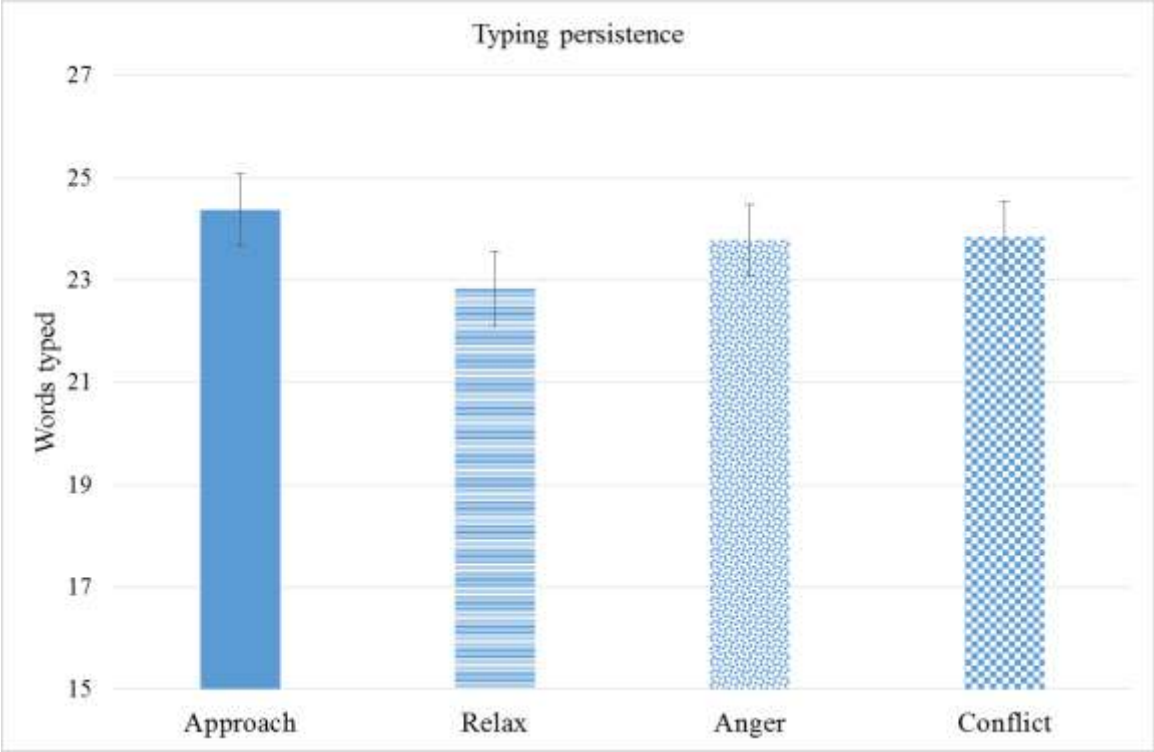

Figure D12. Condition effects on typing persistence. Error bars represent ± 1

Study 5: Effects of 4 conditions on mediational models

I ran the same exploratory mediational model (condition, predicting state BIS and subsequent persistence, MEMORE, Montoya & Hayes, 2017) with all pairwise comparisons between conditions, see Table D3 for all comparisons. There were significant indirect effects between approach and conflict, $\beta = .32$, [.04, .85], as well as between anger and conflict, $\beta = .38$, [.004, 1.00] suggesting that the extent to which the approach (vs. conflict) manipulation decreased state BIS, this resulted in greater word-generating persistence.

Table D4.

Study 3 pairwise comparisons of BIS mediating persistence

Pairwise comparison	Indirect effect statistics (95% CI)
Approach vs. Anger	β = -.08, [-.53, .14]
Approach vs. Relaxation	β = -.01, [-.49, .32]
Approach vs. Conflict	β = .32, [.04, .85]
Anger vs. Relaxation	β = -.14, [-.70, .28]
Anger vs. Conflict	β = .38, [.004, 1.00]
Relaxation vs. Conflict	β = .38, [-.01, 1.13]