Ego Depletion and the Strength Model of Self-Control:

A Meta-Analysis

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Abstract

According to the strength model, self-control is a finite resource that determines capacity for effortful control over dominant responses and, once expended, leads to impaired self-control task performance, known as *ego depletion*. A meta-analysis of 83 studies tested the effect of ego depletion on task performance and related outcomes, alternative explanations and moderators of the effect, and additional strength model hypotheses. Results revealed a significant effect of ego depletion on self-control task performance. Significant effect sizes were found for ego depletion on effort, perceived difficulty, negative affect, subjective fatigue, and blood glucose levels. Small, non-significant effects were found for positive affect and self-efficacy. Moderator analyses indicated minimal variation in the effect across sphere of depleting and dependent task, frequently-used depleting and dependent tasks, presentation of tasks as single or separate experiments, type of dependent measure and control condition task, and source laboratory. The effect size was moderated by depleting task duration, task presentation by the same or different experimenters, inter-task interim period, dependent task complexity, and use of dependent tasks in the choice and volition and cognitive spheres. Motivational incentives, training on self-control tasks, and glucose supplementation promoted better self-control in ego-depleted samples. Expecting further acts of self-control exacerbated the effect. Findings provide preliminary support for the ego-depletion effect and strength model hypotheses. Support for motivation and fatigue as alternative explanations for ego depletion indicate a need to integrate the strength model with other theories. Findings provide impetus for future investigation testing additional hypotheses and mechanisms of the ego-depletion effect.

Key words: self-control strength, self-regulation, limited resource, dual-task paradigm, research synthesis

Ego depletion and the Strength Model of Self-Control:

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In everyday life people show a remarkable capacity to regulate the self and overcome the impulses and drives that tempt us to overeat, drink too much alcohol, take harmful recreational drugs, engage in violent actions when provoked, say hurtful things to others, spend money beyond our means, engage in inappropriate sexual activity, or procrastinate when we should be working (Steel, 2007; Tice & Bratslavsky, 2000). This ability to attain deliberative control over impulses (Ainslie, 1975; Eisenberg et al., 2003; Fujita & Han, 2009) and abstain from gratifying immediate needs and desires (Metcalfe & Mischel, 1999; Mischel, Shoda, & Rodrieguez, 1989) is extremely adaptive and enables people to engage in goal-directed behavior to bring about long-term desirable outcomes (Baumeister, 2005; Fishbach & Labroo, 2007; Logue, 1988). If people were unable to regulate their behavior, life would become a series of unconstrained impulsive actions to service immediate urges, desires, and emotions. Goal directed behavior and the achievement of long-term outcomes would become impossible as people would not be able to engage in the disciplined, focused effort required (Loewenstein, 1996).

Despite the human capacity to regulate the self, many behavioral and social problems stem from persistent lapses of self-control. Problems like obesity, drug abuse, violent crime, inability to manage finances including personal debt and gambling problems, unplanned pregnancy, eating disorders, sexually-transmitted disease, and some chronic diseases like cancer and heart disease, have their roots, directly or indirectly, in self-regulation failure (Baumeister, Heatherton, & Tice, 1994; Muraven & Baumeister, 2000; Wills & Stoolmiller, 2002). Analogously, successful regulation of the self contributes to many adaptive outcomes in society such as success at school, at college and in the workplace, cohesive personal relationships, superior physical and mental health, better ability to cope with problems, and

reduced susceptibility to social ills like drug abuse and criminality (Gailliot & Baumeister, 2007a; Hammer, 2005; Levy, 2006; Tangney, Baumeister, & Boone, 2004). The high importance of self-regulation to such behaviors and concomitant outcomes has meant that it has become the focus of a considerable body of research in social psychology.

Research into self-regulation and failure of self-control has frequently adopted cognitive models in which self-regulation is viewed as a function of beliefs, judgments, expectations, attitudes, and intentions (Ajzen, 1985; Bagozzi, 1992; Koestner, Bernieri, & Zuckerman, 1992; Sansone & Smith, 2000). In contrast, capacity-based approaches propose that self-control is a limited commodity that restricts self-regulatory capability (Baumeister & Heatherton, 1996; Fishbach, Friedman, & Kruglanski, 2003; Metcalfe & Mischel, 1999; Mischel et al., 1989). Inspired by this approach, Baumeister and colleagues (Baumeister, Bratslavsky, Muraven, & Tice, 1998; Baumeister & Heatherton, 1996; Baumeister, Vohs, & Tice, 2007; Muraven & Baumeister, 2000; Vohs & Heatherton, 2000) developed the *strength model* of self-control[1]. A major tenet of the model is that engaging in acts of self-control draws from a limited 'reservoir' of self-control which, when depleted, results in reduced capacity for further self-regulation. In the model, self-control is viewed as analogous to a muscle. Just as a muscle requires strength and energy to exert force over a period of time, acts that have high self-control demands also require strength and energy to perform. Similarly, as muscles become fatigued after a period of sustained exertion and have reduced capacity to exert further force, self-control can also become depleted when demands are made of self-control resources over a period of time. Baumeister and colleagues termed the state of diminished self-control 'strength' *ego depletion*.

An increasing body of research has supported the short-term self-regulatory deficits predicted by strength model (Baumeister, Gailliot, DeWall, & Oaten, 2006; Muraven & Baumeister, 2000). Self-control resource depletion has also been shown to coincide with increased subjective and physiological effort, fatigue, and task difficulty. The model has been

further extended to include hypotheses based on the strength or energy metaphor. For example, anticipating future self-control demands results in people conserving energy for future effort just as an athlete spares his or her muscles in anticipation of forthcoming demands (Muraven, Shmueli, & Burkley, 2006). Regular training on tasks requiring self-regulation can attenuate the ego-depletion effect; just as training a muscle increases its endurance and strength (Gailliot, Plant, Butz, & Baumeister, 2007; Muraven, Baumeister, & Tice, 1999; Oaten & Cheng, 2006a, 2006b, 2007). Finally, rest and recuperation can regenerate self-control just as a muscle's strength returns after a period of rest (Muraven & Baumeister, 2000; Tyler & Burns, 2008).

Given the burgeoning literature in the field of self-control and the strength model, a meta-analytic synthesis of the ego-depletion effect is important and timely. The analysis will make a unique contribution to knowledge on self-control by testing the size and consistency of the ego-depletion effect in the extant literature. It will resolve whether inconsistencies in the size of the effect are due to methodological artefacts or whether there is substantial variation in the effect across studies due to the existence of extraneous moderating variables. The analysis will also test whether the self-control deficits observed in ego-depletion experiments can be accounted for by alternative explanations such as skill, fatigue, motivation, self-efficacy, and negative affect and whether these are consistent with, or contradict, the strength model. Another aim is to identify potential moderators of the effect such as the defining characteristics of self-control tasks and experimental design. The effect of ego depletion on other variables that have been suggested as indicators of depletion such as effort, perceived difficulty, subjective fatigue, and blood glucose levels will also be examined. Finally, the conservation, training, and recovery hypotheses based on the strength model will be tested. The theoretical background to each of these issues is discussed next.

Self-Control and the Strength Model

The strength model offers an explanation for self-control that transcends cognitive and associative-learning models (Baumeister et al., 1998). It predicts that acts of self-control draw from a common, global resource. The resource is limited and vulnerable to becoming depleted over time, just as a muscle becomes tired after a period of exertion. As a consequence, after people have engaged in an act of self-control, their capacity to exercise further self-control becomes exhausted, leading to decreased performance on subsequent acts of self-control. According to the model, once a person's self-control reserves have been depleted, the resulting state of ego depletion can be counteracted by replenishing the resource through rest or relaxation (Tyler & Burns, 2008) or by taking on fuel (Gailliot, Baumeister et al., 2007).

Empirical tests of the ego-depletion effect have typically adopted an experimental procedure using two unrelated self-control tasks, known as the *dual-task paradigm* (Baumeister et al., 1998; Finkel et al., 2006; Muraven, Tice, & Baumeister, 1998). Participants assigned to an experimental ego-depletion group are required to engage in two consecutive tasks requiring self-control. Control participants are also required to engage in two consecutive tasks, but only the second task requires self-control. The strength model predicts that experimental-group participants' performance on the second self-control task will be impaired relative to control-group participants. This is because the finite self-control resources of the experimental participants will be diminished after the initial self-control task leaving little to draw on for the second task (Baumeister et al., 2007).

Adopting this paradigm, Baumeister and coworkers (Baumeister et al., 1998; Muraven et al., 1998) provided initial support for the ego-depletion effect. For example, one study required the experimental group to suppress their emotions when watching an evocative video while controls were informed they could freely express their emotions. Participants were then required to hold a spring-loaded hand-grip to exhaustion. Participants that suppressed their emotions had significantly impaired performance on the hand-grip task compared with the

control group (Muraven et al., 1998). In another study, participants assigned to the experimental group were required to eat radishes and resist the temptation of appetizing chocolates while controls were asked to eat the chocolates and leave the radishes. The experimental participants exhibited significantly lower persistence on a subsequent unsolvable geometric puzzle task (Baumeister et al., 1998). According to the strength model, suppressing emotions or resisting the tempting food required the overriding of a habitual or dominant response and lead to the depletion of self-control resources. This resulted in impaired performance on subsequent tasks due to the reduced availability of self-control resources. The effect has been replicated on numerous occasions by Baumeister and colleagues (for reviews see Baumeister & Vohs, 2007; Baumeister et al., 2007) as well as researchers in other laboratories (e.g., Martijn et al., 2007; Tyler, 2008; Wright, Martin, & Bland, 2003) and it has been shown to be relatively consistent across different spheres or domains of depletion. The findings provide support for a global self-control resource because the transfer of the effect across spheres suggests that ego depletion is not an artefact of a particular task or domain.

However, a minority of studies adopting these methods have reported non-significant ego-depletion effects (e.g., Stillman, Tice, Fincham, & Lambert, 2009; Wright et al., 2007; Wright, Stewart, & Barnett, 2008). For example, Stillman et al. (2009) found that participants assigned to an ego-depletion group requiring them to engage in a thought suppression task did not differ in their persistence on a word production task relative to controls that were not required to suppress their thoughts. Wright and coworkers (2007) used a difficult counting task to deplete self-control resources and found that performance on a subsequent mental arithmetic task did not differ from a control group that performed an easy initial counting task. These findings suggest that support for the ego-depletion effect is not unequivocal and there are variations across the literature. Furthermore, the inconsistencies may be due to the presence of moderating factors such as the features of the tasks used. The present meta-analytic synthesis

of the findings of ego-depletion studies will therefore make an important contribution to the literature by estimating whether the effect is present in the population, resolving inconsistencies in the literature, and testing the degree of heterogeneity associated with the effect.

Alternative Explanations

Other explanations have been put forward to explain the self-regulatory failures observed in ego-depletion experiments. The aim of this section is to review these alternative explanations, compare their tenets with those of the strength model, and identify whether they are consistent with, compete with, or compliment, its predictions.

Skill. Self-control capacity can be conceptualized as a skill that is developed over time and enables people to actively invest the required effortful action to bring about future goals or outcomes (Carver & Scheier, 1998; Wills & Dishion, 2004). Baumeister and coworkers (Baumeister et al., 1998; Muraven et al., 1998) proposed that a skill model would predict relatively little change in performance across the first and second tasks in dual-task paradigm experiments as people would merely apply the well-learned skill to each task they encounter. According to this view, self-control capacity is an acquired, relatively-stable skill that, once learned, would result in a relatively consistent performance on consecutive self-control tasks. The consistent decrement in self-control task performance observed in ego-depletion experiments led Baumeister et al. (1998) to reject skill as a plausible explanation.

However, Baumeister and colleagues recognized that people may experience learning (Baumeister et al., 1998) or ‘warm-up’ (Muraven et al., 1998) periods in performance on self-control tasks, particularly novel ones, suggesting that there may be circumstances where performance improves with time. Indeed, research in the area of skill acquisition and motor learning suggest that people’s learning of skills over time is both gradual and transferable (J. R. Anderson, 1982; Rosenbaum, Carlson, & Gilmore, 2001). Therefore in the early stages of the

development of self-control skills performance may increase but, assuming the transferability of the self-control 'skill', this would eventually stabilize and be applicable across different spheres or domains. In addition, skill improvement is a relatively slow, long-term process while ego depletion has generally been tested as a relatively short-term deficit in studies adopting the dual-task paradigm (Vohs et al., 2008). As a result, short-term variations in self-control capacity may not be influenced by the gradual changes in self-control capacity due to the learning of self-control 'skills'. This is supported by observed decrements in post-depletion second-task performance in dual-task paradigm experiments rather than no change or improvement. The overall weight of evidence seems to lend support to a limited resource model of short-term self-control capacity rather than a skill-based model.

Although much of the research on the strength model has focused on short-term resource depletion (Vohs et al., 2008), there is evidence that chronic experience or practice on self-control tasks results in improvements in self-regulatory capacity. Individuals practiced on self-control tasks appear to be less vulnerable to ego depletion (Hui et al., 2009; Muraven et al., 1999). This is consistent with the strength model in that exercise increases self-control strength allowing for a deeper pool of resources to be available for subsequent performance on self-control tasks. Alternatively, a skill model implies that the increased practice results in increases in the efficiency with which self-control resources are used. This is not inconsistent with the strength model as a limited self-control resource is implicated in the process, but it provides an alternative to the 'extended pool' explanation. A skill model may therefore have utility in explaining long-term improvements in self-control capacity. An aim of the present analysis is to examine the effects of self-control practice as a means to promote self-regulatory capacity. The issue of training and ego depletion is discussed further in the section on extensions to the strength model.

Fatigue. Fatigue is likely to be implicated in the ego-depletion effect. Theory suggests that people experience subjective fatigue when mental resources are taxed (Cameron, 1973). Furthermore, self-control resource depletion appears to coincide with subjectively-felt and physiological indicators of fatigue. Decrements in subjective fatigue have been shown in people engaging in depleting tasks in ego-depletion experiments (e.g., Finkel et al., 2006; Friese, Hofmann, & Wanke, 2008; Stewart, Wright, Hui, & Simmons, 2009). In addition, subjective fatigue evoked by engaging in cognitively-demanding tasks leads to elevated physiological indicators of generalized fatigue and reduced performance on subsequent tasks (Segerstrom & Nes, 2007; Wright et al., 2007; Wright et al., 2008). Such effects suggest that fatigue may not be a mere indicator of ego depletion but a mediator the effects of self-regulatory resource depletion on subsequent task performance (Muraven et al., 1998). For example, the exertion of self-control requires effort which can lead to fatigue and, in turn, decreased capacity to exert self-control in the future. Fatigue may also motivate people to conserve their self-control resources when depleted (Muraven, Shmueli et al., 2006). However, few studies have examined subjective fatigue as a mediator of ego depletion. We aim to examine the average effect of ego depletion on fatigue as well as other subjective indices of self-regulatory demand such as effort and perceived difficulty in the present meta-analysis.

Motivation. Decreased motivation may provide a further alternative explanation for performance decrements on the second self-control task in dual-task paradigm experiments. One proposed model is that the ego-depletion effect is the result of reduced motivation to attain task goals. This may occur if a person perceives insufficient incentive to pursue the task goal, such as little reward or a lack of value attached to the outcome, relative to the effort demand of the task. The perceived imbalance between incentives and required effort is likely to lead to a drop in motivation. People will persist with tasks only so long as the reward or outcome is deemed worth the effort, when it does not then they will lose motivation and tend to desist. A

motivation-only account of the ego-depletion effect would therefore predict that decreased regulatory capacity was independent of self-control resources. Evidence to support this explanation is evident in the mental fatigue literature in which people are equally effective in performing short-term tasks regardless of their state of mental fatigue provided there are sufficient incentives and their motivational state is high (Boksem, Meijman, & Lorist, 2006; Lorist, Boksem, & Ridderinkhof, 2005; Tops, Lorist, Wijers, & Meijman, 2004).

According to strength model theorists, a motivational account for regulatory failure on tasks is not inconsistent with model predictions. Proponents suggest that the effects of self-control resource availability and motivation on task performance may be interactive (Muraven & Baumeister, 2000). Reduced self-control resources as a result of engaging in self-control tasks may lead individuals to view task goals as unimportant compared to the relatively costly demand doing the task will place on remaining resources. This will result in reduced motivation on future tasks requiring self-control. Consistent with this premise, people may be able to overcome the debilitating effects of self-control resource depletion if they are given sufficient incentive to do so. Research has supported the moderating effect of motivational incentives, such as rewards and increasing the importance of task outcomes, on ego depletion (Muraven & Slessareva, 2003; Stewart et al., 2009). Even though resources may be lowered through prior exertion of self-control, they may only be partially depleted leaving the potential for additional resources to be available (Muraven & Baumeister, 2000). However, motivation may only temporarily stem self-regulatory failure by causing people to tap into additional self-regulatory reserves and “after a certain point, fatigue becomes insurmountable” (Baumeister et al., 2007, p. 353). A limited resource account of ego depletion therefore suggests that increased motivation can only stave off self-control failure to the extent that self-control resources remain available.

In summary, two competing explanations exist. A motivation-only account suggests that impaired performance on self-control tasks is purely a function of motivation and not due to a limited resource. According to this approach, fatigue induced by initial self-control tasks leads to reduced motivation to perform subsequent tasks, probably due to the aversive nature of the tasks, but when motivation is high performance can be maintained. In contrast, the strength model proposes that engaging in initial self-control tasks depletes self-control resources, at least partially, leading to fewer resources being available to perform subsequent tasks. However, increasing motivation to achieve a task goal may lead people to commit more of their increasingly limited self-control resources to engage in subsequent tasks, minimizing the impairment of performance. In the present analysis, we aim to synthesize research that has examined motivation as a moderator of the ego-depletion effect and establish whether motivational manipulations, such as incentives, consistently minimize self-regulatory failure brought about by initial depletion. In particular, we will make comparisons between depleted groups that receive motivational incentives and depleted groups that receive no incentives. This will provide some evidence that motivation can help overcome an ego-depleted state, but may not provide sufficient evidence to resolve the competing motivation-only explanation and the motivation-plus-limited-resource explanation provided by the strength model.

Self-efficacy. The self-regulatory failure observed in ego-depletion studies could be the result of reduced self-efficacy. Although a person may view the goal of the task as attractive or important and believe they could achieve the goal if they exerted the required effort, they may perceive a reduced ability to reach it when in a depleted state. There is limited research examining the role of self-efficacy in ego-depletion studies. Wallace and Baumeister (2002) used bogus competence feedback on the initial task in the dual-task paradigm to induce high or low levels of self-efficacy. Identical patterns of ego depletion were found for participants across feedback conditions leading the authors to conclude that perceptions relating to ability

are unlikely to be implicated in self-control resource depletion. This has been corroborated in studies that have found no relationship between self-reported self-efficacy and ego depletion in dual-task paradigm experiments (Baumeister et al., 2006; Finkel et al., 2006; Gailliot & Baumeister, 2007b). A possible reason for this is that reduced self-efficacy in one sphere may not necessarily transfer to reduced perceptions of ability towards a task in another, as in the dual-task paradigm. Self-efficacy may therefore be inadequate as an explanation for depletion because it does not transfer across task domains. Studies that have included measures of self-efficacy concurrent with ego depletion will be included in the present meta-analysis to provide a cumulative test of the effect of ego depletion on self-efficacy levels.

Affect. The active regulation of emotion or mood has been shown to deplete self-control resources and is a common means to invoke ego depletion in the dual-task paradigm (Baumeister et al., 1998; Bruyneel, Dewitte, Franses, & Dekimpe, 2009). This is because regulating affect requires an individual to overcome the innate tendency to display emotions in response to environmental stimuli. However, negative affect may also be implicated in the development of ego depletion. Tasks that require self-control are demanding and frustrating and may induce a negative affective state (Leith & Baumeister, 1996; Tice, Bratslavsky, & Baumeister, 2001). This may compel a person to actively cope with or attempt to repair the negative affect (Folkman & Moskowitz, 2000; Mayer & Gaschke, 1988). The coping process may reduce effort and motivation on subsequent self-control tasks leading to impaired task performance. Studies including measures of affect as an additional dependent variable in the dual-task paradigm have not generally found a relationship between ego depletion and negative or positive affect (e.g., Baumeister et al., 1998; Bruyneel et al., 2009; Muraven et al., 1998). There are exceptions, for example Ciarocco, Sommer, and Baumeister (2001) and Stewart et al. (2009) found significant post-depletion increases in negative affect after controlling for baseline relative to non-depleted controls. The authors suggested that this served to indicate the

aversive nature of depleting tasks. In the present meta-analysis, we propose to provide a test of the effect of ego depletion on both negative and positive affect. The analysis may help resolve any inconsistency in the relationship between ego depletion and negative affect. A strength model interpretation would predict a null effect as ego depletion is conceptualized as solely due to the depletion of self-control resources. In contrast, a coping hypothesis would predict a significant effect for ego depletion on negative affect. Finally, self-regulatory failure is not expected to undermine or alter levels of positive affect.

Experimenter demand. Ego depletion may be an artefact of experimenter demand. Poorer performance on the second self-control task in dual-task paradigm experiments could be due to participants believing that they have sufficiently fulfilled the experimenter's demands after completing the initial task. In order to rule out this alternative explanation, studies have presented the tasks as separate experiments (e.g., Baumeister et al., 1998; Burkley, 2008; Fischer, Greitemeyer, & Frey, 2008; Seeley & Gardner, 2003; Vohs, Baumeister, & Ciarocco, 2005; Vohs & Faber, 2007) or unrelated tasks (e.g., Johns, Inzlicht, & Schmader, 2008; H. M. Wallace & Baumeister, 2002). Studies have also been conducted in which each task was administered by a different experimenter (e.g., Richeson & Shelton, 2003; Richeson, Trawalter, & Shelton, 2005; Vohs et al., 2008). The ego-depletion effect was found to be consistent in these studies and serves to falsify the experimenter demand explanation. We aim provide further confirmatory support for these findings in the present analysis by including the presentation of depleting tasks either as single or separate experiments or by the same or different experimenters as moderators of the ego-depletion effect.

Moderators of Ego Depletion

Although studies adopting the dual-task paradigm have generally supported the ego-depletion effect, the features of the tasks that deplete self-control resources or serve to measure depletion have not been systematically evaluated. Furthermore, the extent to which second self-

control task performance is a function of the control condition used in the initial task is unknown. The features of these tasks may lead to variations in the strength of the ego-depletion effect and help resolve the inconsistencies observed in some studies (Stillman et al., 2009; Wright et al., 2007; Wright et al., 2008). Extraneous factors other than task features may also influence the size of the ego-depletion effect. For example, individuals with higher trait self-control may have an extended pool of self-control resources to draw from increasing their self-control capacity. We address these factors next.

Spheres of self-control. The dual-task paradigm permits an empirical test of the generality of the ego-depletion effect across different domains or spheres (Baumeister & Vohs, 2007). Baumeister et al. (2007) proposed that tasks requiring self-control be categorized into several domains or spheres: (a) controlling attention, (b) controlling emotions, (c) controlling impulses, (d) controlling thoughts, (e) cognitive processing, (f) choice and volition, and (g) social processing. Alternatively, tasks could be subsumed by more general categories that reflect the global processes demanded by the task, such as whether they require cognitive or affective processing. Regardless of the classification system, levels of ego depletion are expected to be equivalent in all spheres. This is important for the strength model as it would confirm the hypothesis that acts of self-control draw energy from a common, global resource and that self-control failure is domain general and not an artefact of a particular sphere of task.

Notwithstanding the observed consistency of the ego-depletion effect across tasks in these spheres of self-control (Baumeister et al., 2007), there appears to some inconsistency in the literature as to what exactly constitutes a self-control task. A typical feature of the tasks frequently adopted as depleting or dependent tasks in the dual-task paradigm is the requirement for the effortful suppression of an impulse or overriding of a habitual or dominant response. However, questions remain as to whether difficult tasks involving complex and challenging calculations like math problems or analytical reasoning tasks demand self-control resources.

Baumeister and colleagues (Baumeister et al., 1998; Muraven et al., 1998) contend that such tasks do not necessarily deplete self-control resources because they involve the application of well-learned algorithms or heuristics rather than exerting overt control over the self to resist an impulse or override a dominant response. As a consequence, these tasks have been used as the non-depleting initial task in the dual-task paradigm (e.g., Muraven, Collins, & Nienhaus, 2002; Muraven, Shmueli et al., 2006, Study 1; Muraven et al., 1998, Study 3).

However, studies have also adopted difficult and complex tasks as the depleting task or dependent variable in dual-task paradigm studies (e.g., Johns et al., 2008; Park, Glaser, & Knowles, 2008; Schmeichel, 2007; Wright et al., 2008). Such tasks may demand self-control resources for two reasons. First, they are often rated high in difficulty, effort, and unpleasantness such that self-control is required to resist the temptation to quit. For example, Wright et al. (2008) demonstrated impaired performance on regulatory (e.g., incongruent Stroop color-naming task) as well as 'non-regulatory' (e.g., multiplication math task) tasks after working on an initial depleting task. There is also evidence in other literatures such as the 'mental' or 'cognitive' fatigue (Ackerman & Kanter, 2009) and vigilance (See, Howe, Warm, & Dember, 1995) fields that have demonstrated depletion effects using tasks that are high in difficulty but do not share the typical features of self-control tasks. Second, tasks that require executive function place demands on cognitive systems like the need to maintain and update working memory. Such processes may share some features of the tasks typically used in ego-depletion experiments such as response inhibition. For example, memory updating tasks require people to constantly override the tendency to memorize items in a particular order and apply a different rule. This is the case in the reverse span memory tasks adopted by Schmeichel (2007, Study 2) that require the memorization of digits in a reverse order. This was considered more demanding of self-control resources relative to a control task that required one to merely

hold information in memory. The evidence suggests that tasks high in difficulty and complexity also serve to deplete self-control resources.

These findings have two implications for the strength model. First, it seems that effect of self-control depletion on task performance may apply to a broader set of tasks and processes than originally proposed, including difficult or complex tasks. This is not inconsistent with the strength model as such tasks require regulatory effort to resist the temptation to quit or apply complex rules that demand the inhibition of one process in favor of another. Second, tasks vary in difficulty and complexity and, therefore, are likely to vary in the extent to which they require self-control resources (Muraven et al., 2002). An aim of the present review is to examine whether this distinction acted as a moderator. Specifically, we aim to classify tasks used in the depletion of self-control resources and as the dependent measure of self-control capacity in studies adopting the dual-task paradigm according to the demand they present to self-control resources (e.g., complexity) and test this as a moderator of the ego-depletion effect.

Control condition. Experiments adopting the dual-task paradigm have typically used a modified version of the depleting task that ostensibly does not require self-control resources as the control condition. For example, impulse control tasks require a person to override a well-learned or spontaneous response and consciously apply effort to perform the goal of the task. This might mean crossing-out all instances of a particular letter in a passage of text but only when it is adjacent to certain other letters, resisting a tasty, tempting food and eating a bland, less-appetizing food instead, or inhibiting the natural tendency to read the word rather than the font color in an incongruent Stroop color-naming task. In each case the control condition simply requires participants engage in an easier, less effortful version of the depleting task in which participants enact the dominant, impulsive response. So control participants in the aforementioned examples would be asked to cross-out all instances of the letter without the inhibiting rules, given licence to taste tempting foods, and provided with a version of the

Stroop task where the word and font color are congruent. Although some of the 'easier' versions of these tasks may require a modicum of self-control to resist the urge to quit as they are tedious and boring, they are considered far less demanding and not expected to tax self-control resources to the same degree as the depleting versions.

However, some ego-depletion studies have adopted alternative control tasks other than easier versions of the depleting task. For example, control participants have engaged in a different task to that administered to the depletion group which is low in effort and ostensibly does not tax self-control resources (e.g., Burkley, 2008, Study 3; Muraven et al., 1998, Study 3). Alternatively, investigators have required all participants engage in the same initial task (e.g., describing a target person from a minority group) that would only require self-control for people possessing a specific individual difference variable (e.g., motivation to avoid prejudice) (e.g., Gailliot, Plant et al., 2007; Gordijn, Hindriks, Koomen, Dijksterhuis, & Van Knippenberg, 2004; Muraven, 2008b; Park et al., 2008). There are also studies in which control participants did not engage in an initial task at all, sitting passively before engaging in the dependent task (e.g., Baumeister et al., 1998, Study 3; Burkley, 2008, Study 2). Given the variety of approaches to evoking ego depletion and the tasks adopted in the control condition, it is important to establish whether the ego-depletion effect varies according to the type of task to which the depleting task is being compared. The present meta-analysis will use the type of control group as a moderator of the ego-depletion effect to test this hypothesis.

Personality and individual differences. The strength model focuses on state depletion of self-control resources. Self-control strength is viewed as vulnerable to depletion after acute bouts of self-regulatory effort which subsequently limits short-term self-control capacity. However, numerous capacity-based theories of self-control also conceptualize self-control as a dispositional, trait-like construct that differs across individuals (Funder, Block, & Block, 1983; Metcalfe & Mischel, 1999; Muraven & Baumeister, 2000; Schouwenburg, 2004; Tangney et

al., 2004; Wills & Dishion, 2004). For example, delay of gratification is viewed as a generalizable capacity to forego short-term, alluring rewards in favour of greater, long-term rewards (Mischel, 1996; Mischel et al., 1989). This view has been incorporated into the strength model. Although all individuals are vulnerable to state depletion of self-control resources, individuals are proposed to differ in their overall self-control capacity (Baumeister et al., 2006). This implies that people high in dispositional self-control will have more resources at their disposal. Such individuals will have more resources remaining after engaging in a self-control task of a given duration and resource demand relative to individuals lower in trait self-control. Trait self-control may therefore serve to insulate a person from the depleting effects of self-control tasks and moderate the ego-depletion effect. The proposed interaction between dispositional self-control measured on psychometric instruments and ego depletion has been tested empirically and results are inconclusive. Some studies have found a clear interaction effect (Dvorak & Simons, 2009; Gailliot & Baumeister, 2007b; Gailliot, Schmeichel, & Maner, 2007) while others have found no interaction (Gailliot & Baumeister, 2007b; Stillman et al., 2009). While a resolution to these inconsistent findings through meta-analytic synthesis is needed, there are only a handful of effect sizes and few studies report the ego-depletion effect in both high and low dispositional self-control groups.

In addition, few studies have investigated the moderating effect of other traits and individual difference variables on ego depletion. Ego depletion has been shown to be positively associated with high-other orientations and low self-monitoring (Seeley & Gardner, 2003; Wan & Sternthal, 2008), higher levels of fluid intelligence (Shamosh & Gray, 2007), and higher levels of consideration of future consequences (CFC) - immediate (Joireman, Balliet, Sprott, Spangenberg, & Schultz, 2008). The mechanisms behind these individual difference moderators can be explained through greater motivation to allocate self-regulatory resources among those with higher levels of the trait. For example, superior performance on self-control

tasks under depleting conditions for individuals high in other-orientation and low in self-monitoring has been attributed to greater motivation to meet the expectations of others and comply with normative standards (Seeley & Gardner, 2003; Wan & Sternthal, 2008). Fluid intelligence and CFC-immediate may predispose individuals to be more susceptible to the situational demands of tasks leading them to consume more self-control resources in the first task in the dual-task paradigm than individuals in which these traits are absent (Joireman et al., 2008; Shamosh & Gray, 2007). In terms of mechanisms, individuals high in these traits may be more motivated to succeed and more likely to invest effort in the initial task at the expense of making resources available subsequent self-control efforts. These findings indicate that the examination of individual differences in self-control may shed light on the factors that magnify or diminish the ego-depletion effect and provide information on underlying processes and boundary conditions. The inclusion of such moderators in future investigations using the dual-task paradigm is warranted.

Extending the Model

The view that self-control is akin to a limited resource in the strength model has given rise to additional related hypotheses. It is proposed that people will tend to conserve their resources when they are scarce, are able to improve their self-control capacity through practice or training, and are able to recover their self-control resources through rest or supplementation with glucose. These hypotheses are presented in the next section.

Conservation. The ego-depletion effect may be the result of a complete depletion of finite self-control resources, negating any possibility of subsequent acts of self-control. An alternative hypothesis is that self-control tasks only partially deplete resources and ego depletion occurs because people are either unable or unwilling to draw further from their reserves (Baumeister & Vohs, 2007; Muraven & Baumeister, 2000). One reason for this is that people conserve their limited self-control resources, particularly when they expect future

exertion (Baumeister & Heatherton, 1996; Baumeister, Muraven, & Tice, 2000; Muraven & Baumeister, 2000). This is an adaptive strategy from a resource allocation point of view as people are motivated to retain a residual level of their self-control resources in anticipation of future need. According to the strength model analogy, this is akin to an athlete conserving energy for a final effort toward the end of a race. Experiments in which participants were informed that they would be required to perform an additional third self-control task after the second self-control task have supported this hypothesis (Muraven, Shmueli et al., 2006; Tyler & Burns, 2009). Ego-depleted participants expecting another self-control task showed impaired performance on subsequent self-control tasks relative to depleted controls with no such expectations.

The conservation hypothesis is also consistent with a motivational account of ego depletion. Low self-control resources make the prospect of engaging in future self-control tasks more daunting as it is more costly to allocate resources when they are scarce compared to when they are plentiful. As a consequence, motivation to engage in future self-control tasks will be decreased due to the high cost involved and low importance of the task goal relative to the importance of conserving self-control resources. This tendency to conserve is exacerbated when the prospective demands of future self-control are very high such as when the prospect of a third self-control task is highlighted in the dual-task paradigm. The tendency to conserve will be greater and motivation towards the task diminished due to the expected future load. We aim to test whether the conservation hypothesis is supported across ego-depletion studies. We will meta-analyze ego-depletion studies employing the dual-task paradigm that have included conditions in which participants were told to anticipate a third self-control task.

Training. In the previous section we introduced the hypothesis that training on self-control tasks improves self-control capacity and attenuates the ego-depletion effect (Baumeister et al., 1998). According to the strength model, just as a muscle increases in

strength with training, the capacity to exert self-control will be heightened after repeated practice on self-control tasks. Support for this hypothesis has been provided in studies using self-control tasks in different spheres to train self-control. For example, participants required to engage in everyday tasks requiring self-control (e.g., improving posture, regulating mood, monitoring eating habits, and avoiding colloquial language) for a period of two weeks performed significantly better in a subsequent dual-task paradigm compared with untrained controls (Gailliot, Plant et al., 2007; Muraven et al., 1999). Oaten and Cheng (2006a, 2006b, 2007) corroborated these results in a series of studies in which participants engaged in formal programs of academic study, physical exercise, and financial monitoring over a period of months. Participants engaging in the programs also reported being more effective in managing other everyday behaviors requiring self-control (Oaten & Cheng, 2006a, 2006b). These findings demonstrate that regular practice can help attenuate the ego-depletion effect. The mechanism for these improvements may be through increases in the amount of self-control resources available, an 'extended pool' explanation, or, alternatively, through improved efficiency on the task, perhaps in the development of more effective self-control 'skills'. The present analysis will provide a cumulative test of the training hypothesis across studies.

Recovery. Periods of rest or relaxation may help to restore self-control resources after depletion and minimize the deleterious effects of depletion on subsequent task performance (Baumeister & Heatherton, 1996; Muraven & Baumeister, 2000). This is consistent with the muscle metaphor of the strength model: muscles require a period of recovery after exertion before they can apply further force. Studies have tested this hypothesis by introducing rest or relaxation periods between tasks in the dual-task paradigm (Oaten, Williams, Jones, & Zadro, 2008; Tyler & Burns, 2008). Consistent with the hypothesis, findings indicated that ego-depleted individuals given the opportunity to rest or relax exhibited superior second-task performance relative to non-rested depleted controls. Interestingly, Tyler and Burns (2008)

found evidence for a ‘dose effect’ such that the restoration of self-control capacity is proportional to the duration of the recovery period. Given this finding, it follows that variability in the interim period between tasks in the dual-task paradigm may account for some of the variability in the ego-depletion effect across studies. For example, experiments in which participants are required to complete questionnaires or take a break during the inter-task interim period may give them greater opportunity to recover self-control capacity relative to experiments in which participants proceed immediately to the second task. We plan to test the recovery hypothesis by subjecting studies including rest or relaxation periods in a dual-task paradigm to a meta-analytic synthesis. As an additional test, will also examine whether the inclusion of an inter-task interim period moderates the ego-depletion effect.

Glucose and glucose supplementation. In search for physiological mechanisms for self-control resource depletion, Gailliot and coworkers (2007a; 2007) provided preliminary evidence that blood glucose may be the control mechanism for the depletion of self-control reserves. These studies demonstrated that ego depletion coincides with decreases in blood glucose and glucose supplementation attenuates the ego-depletion effect relative to a sweetened placebo (DeWall, Baumeister, Gailliot, & Maner, 2008; Dvorak & Simons, 2009; Gailliot, Baumeister et al., 2007; Gailliot, Peruche, Plant, & Baumeister, 2009; Masicampo & Baumeister, 2008). On the basis of these findings, Gailliot and coworkers suggested that the strength model of self-control was more than just a metaphor and self-control resource depletion occurred concurrent with the utilization of fuel substrates in the body. In the present meta-analysis, we intend to test the consistency of blood glucose as an analog for self-control depletion and the potential of glucose supplementation to moderate the ego-depletion effect.

The Present Analysis

The past decade has seen a proliferation in research on self-regulatory failure from the perspective of the strength model and a cumulative synthesis of these research findings is

timely. At the most basic level, the analysis will be expected to summarize the overall effect of self-control resource depletion on task performance. A cursory glance at trends in the literature and narrative reviews suggest that the effect will be present, notwithstanding a minority of studies that have found non-significant effects. However, it is important to evaluate the extent of the variability in the effect and identify the moderator variables that may resolve this variability. The evaluation of these moderators may assist in determining the adequacy of the strength model in explaining ego depletion, resolving any inconsistencies in the literature, and evaluating whether competing or complementary explanations can offer insight into the variation in the effect.

Overall ego-depletion effect. The effect size of interest is the overall averaged effect of ego depletion on self-control task performance corrected for sampling error variability across published studies using the dual-task experimental paradigm. The effect of ego-depleting self-control tasks on participants' second task performance relative to non-depleted controls will be the key dependent variable. The strength model predicts that the average ego-depletion effect will be significant and homogenous across studies.

Additional dependent variables. We will test the effect of ego depletion on seven additional dependent variables: effort, positive affect, negative affect, perceived difficulty, subjective fatigue, self-efficacy, and blood glucose. Consistent with the highly aversive and effortful nature of self-control tasks, we expect significant effect sizes for the effort, perceived difficulty, subjective fatigue, and negative affect variables. Consistent with previous tests of ego depletion on positive affect, we expect null or weak effects for ego depletion on this variable. The effect of ego depletion on self-efficacy is less consistent and has not been frequently tested. A plausible hypothesis is that self-efficacy may be implicated in the ego-depletion effect because reduced resources may lower estimates of future ability to exert self-control, although this has not been supported empirically. Finally, the analysis will test whether

self-regulatory failure brought about by ego depletion coincides with reduced blood glucose levels. This may provide evidence that substrate use serves as a physiological indicator of self-control resource depletion.

Analysis of moderators. Several moderators hypothesized to magnify or diminish the overall ego-depletion effect will be included in the analysis. We will test whether the sphere of depleting self-control task in dual-task paradigm experiments moderates the ego-depletion effect. Baumeister et al. (2007) propose that that self-control tasks from different spheres will be equally depleting because self-control draws from a single, global resource. An alternative hypothesis is that some spheres of self-control may be more demanding of self-control resources than others, so the moderator analysis may identify spheres that place a greater burden on self-control resources. We will also evaluate whether the sphere of the dependent task used as an index of ego depletion moderates the effect. Although little variance in the ego-depletion effect is expected across these dependent tasks, it is possible that some of these tasks may place fewer demands on self-control resources or be less effortful than others leading to less of a decrement in performance. We will also test the variability of the ego-depletion effect across frequently-used depleting and dependent self-control tasks. This will provide some indication as to whether these types of task are equally effective in inducing and measuring ego depletion. The hypothesis that tasks vary in the extent to which they deplete self-control resources has not been studied systematically and the present study is the first to synthesize studies on self-control resource depletion according to task domain and type. In addition, we will also evaluate whether using depleting and dependent tasks from the same or different spheres in the dual-task paradigm moderates the ego-depletion effect. If the proposed generality of the ego-depletion effect holds, the size of the effect should be invariant regardless of whether or not the depleting and dependent tasks are ‘matched’ on task sphere. This analysis

will also provide an indication of the extent to which these studies provide an effective test of the generality hypothesis.

Task complexity will also be included as a moderator. The aim of this analysis will be to resolve the apparent contradiction in the literature as to whether tasks that are difficult or challenging, but do not ostensibly require overriding a well-learned response, deplete self-control resources. In addition, it is expected that the duration of depleting task in the dual-task paradigm will be linearly related to the size of the ego-depletion effect. We will also test whether presenting tasks as single or separate experiments or by the same or different experimenters moderates the overall ego-depletion effect. The purpose of these analyses is to rule out the alternative explanation that the ego-depletion effect is due to experimenter demand.

The analysis will evaluate whether the dependent task is a behavioral or self-report measure of ego depletion. We expect the ego-depletion effect to be significant in both groups, but a logical prediction would be that the ego-depletion effect will be inflated in the group of studies using self-reported dependent variables due to the increased measurement error associated with such measures (Westholm, 1987).

The effect of the nature of the task used in the control condition alongside the depleting task will also be evaluated as a moderator. This analysis will provide evidence whether using a modified ‘easier’ version of the self-control task, a different task altogether, or the same task alongside an individual difference variable that renders the task more taxing for some individuals are equally effective as comparison groups in ego-depletion experiments. We will also test whether cognitive processing tasks that require complex processing result in greater ego depletion than tasks that are simpler and present fewer demands. Finally, we will compare the ego-depletion effect in tests originating in the dominant Baumeister laboratory relative to tests from other laboratories. No difference is expected in the overall ego-depletion effect across the laboratory moderator groups.

Testing strength model hypotheses. We will conduct a meta-analysis of studies that have tested additional hypotheses derived from the strength model: the conservation, training, and recovery hypotheses. For the conservation hypothesis, we will test whether the expectation of future demands on self-control resources will diminish self-regulatory capacity indicating the tendency to conserve resources. The role of incentives and highlighting the importance of task outcomes as means to reduce the ego-depletion effect will also be evaluated. This will determine whether motivation mitigates the self-regulatory failure brought about by engaging in initial self-control tasks. For the training hypothesis, we will meta-analyze studies that have tested the ego-depletion effect in participants provided with a period of training on self-control tasks prior to engaging in the dual-task paradigm. For the recovery hypothesis, we will meta-analyze studies that have included a period of rest, relaxation, or an interim period between the first and second self-control tasks in the dual-task paradigm. We predict that the ego-depletion effect will be attenuated through the provision of motivation-enhancing strategies, training on self-control tasks, or a recovery period after the initial depleting task. Analogously, the ego-depletion effect is expected to be exacerbated if there is an expectation of future acts of self-control. Finally, the role of glucose supplementation as a means to mitigate the deleterious effects of self-control resource depletion on subsequent task performance will be examined. It is anticipated that provision of glucose will improve ego-depleted participants' self-control task performance relative to the provision of a sweet placebo.

Method

Literature Search

Published research articles were located via a search of electronic databases: ERIC, Embase, ISI Web of Science (Science Citation Index Expanded, Social Science Citation Index Expanded), Medline, PsycARTICLES, and PsychINFO covering the literature from 1998 (the year of Baumeister et al.'s (1998) and Muraven et al.'s (1998) initial research articles on ego

depletion) until April 1, 2009. The following search terms in various combinations were used for all searches: *ego depletion, ego energy, self-control,* and *self regulation,* with sub-terms *depletion, failure, limit, resources,* and *strength*. The reference sections of the retrieved articles considered for this review were scrutinized for additional studies. We also examined the reference sections of key narrative reviews of the literature on ego depletion and the strength model of self-control (Baumeister, 2002, 2003; Baumeister et al., 2006; Baumeister et al., 2000; Baumeister, Sparks, Stillman, & Vohs, 2008; Baumeister & Vohs, 2007; Baumeister et al., 2007; Gailliot & Baumeister, 2007a; Muraven & Baumeister, 2000; Schmeichel & Baumeister, 2004; Vohs & Baumeister, 2004). In addition, we searched for articles in key social psychology journals and their repository of articles published online in advance of print.

Inclusion Criteria

Studies were required to provide an experimental test of the ego-depletion effect using variants of the dual-task paradigm outlined by Baumeister et al. (1998). For the overall ego-depletion effect, studies had to include a quantifiable measure of task performance for the second self-control task in the experimental group that received the ego-depleting task and a non-depleted control group. Studies that included a continuous or discrete (e.g., median split) individual difference moderator of the ego-depletion effect were considered eligible provided effect size data for the depleted and non-depleted groups were available for the main effect of ego depletion independent of the moderator (e.g., DeWall, Baumeister, Stillman, & Gailliot, 2007, Study 4; Joireman et al., 2008, Study 3; Richeson et al., 2005, Study 1; Seeley & Gardner, 2003). In some cases, the initial depleting task was identical for all participants and depletion was evoked on the basis of an individual difference variable. For example, Gailliot, Plant et al. (2007) divided their sample into those with high or low scores on internal motivation to respond without prejudice and then presented all participants with a task requiring them to describe a homosexual target and avoid stereotypical statements. The task

was expected to deplete self-control resources only in low-motivation participants because suppressing stereotypes was considered difficult and effortful for people that did not regularly attempt to control prejudiced thoughts. In such cases the individual difference variable served as the depletion 'condition' (e.g., Gailliot, Plant et al., 2007; Segerstrom & Nes, 2007; Vohs et al., 2005). To ensure that the use of individual difference variables to deplete self-control resources did not bias the overall ego-depletion effect, we included this as an additional moderator variable in the meta-analysis. Some studies included experimental manipulations expected to moderate the ego-depletion effect (e.g., Tyler & Burns, 2008; H. M. Wallace & Baumeister, 2002; Wan & Sternthal, 2008). In such cases, the ego-depletion effect was calculated for depleted and non-depleted participants in the condition where the moderator was absent. This represents a simple, unattenuated test of the ego-depletion effect. For example, Tyler and Burns (2008) introduced an experimental condition of 'relaxing' music between the initial and second tasks in the dual-task paradigm to aid relaxation while control participants received no music. In this case the ego-depletion effect was calculated from the dependent task performance of depleted and non-depleted individuals assigned to the 'music-absent' condition.

Non-experimental studies assessing the effect of self-reported, trait measures of self-control on task performance and studies that did not use the dual-task paradigm or include a non-depleted control group were rejected (e.g., Fennis, Janssen, & Vohs, 2009, Study 6; Finkel & Campbell, 2001; Muraven, 2008a; Muraven, Collins, Shiffman, & Paty, 2005; Muraven et al., 1998, Study 4; Neubach & Schmidt, 2008; Oaten et al., 2008; Schmeichel & Zell, 2007; Schmidt, Neubach, & Heuer, 2007; Tangney et al., 2004; J. C. Wallace, Edwards, Shull, & Finch, 2009). The only two exceptions to this were studies that included non-behavioral or judgment measures in place of the second task and studies that did not include a non-depletion control group but provided tests of the conservation, training, and recovery hypotheses from

the strength model. Studies using a non-behavioral or judgment dependent variable were included because such measures are not only an analog of ego depletion but also reflect decisions likely to place a demand on self-control resources (e.g., Burkley, 2008; Fischer, Greitemeyer, & Frey, 2007). However, such measures may be unsuitable to serve as the initial depleting task in the dual-task paradigm. To check that the inclusion of these studies did not bias the overall ego-depletion effect, we also included dependent measure type (behavioral vs. non-behavioral or judgment) as a moderator of the overall ego-depletion effect.

Finally, studies had to contain sufficient statistical information such as cell means and standard deviations, *F*-ratios, *t*-statistics, zero-order correlations (*r*), or effect size statistics (e.g., Cohen's *d*, η^2) to calculate an estimate of effect size. Missing data for studies that were otherwise eligible were requested by contacting the authors. Finally, eligible studies were systematically screened for duplicates to eliminate bias due to duplicate study effects (Wood, 2008).

Meta-Analytic Strategy

We used Hunter and Schmidt's (1994) methods for meta-analysis to correct effect sizes for sampling error variability[2]. Monte Carlo simulation studies have supported the adoption of a random effects model because it permits the generalization of corrected effect sizes to the population (Field, 2003; Hunter & Schmidt, 2000; Kisamore & Brannick, 2008). The effect size metric employed in the current analysis was Cohen's *d* which represents the standardized mean difference score for experimental (ego depletion) and control (non-depletion) groups in studies adopting the dual-task paradigm. Effect sizes were calculated directly from the means, standard deviations, and sample sizes for the experimental and control groups wherever possible. Standard formulas were used to compute the effect size statistic from *F*-ratios, *t*-tests, or zero-order correlation coefficients (DeCoster, 2004; Hullett & Levine, 2003). In cases where

multiple methods for effect size calculation were available we used the test most closely based on the means, standard deviations, and sample sizes (DeCoster & Claypool, 2004).

In addition to producing the averaged overall effect size corrected for sampling error (d^+), 95% confidence intervals (CI_{95}) were calculated using the standard error of the mean effect size to test the accuracy of effects. We also computed the 'fail safe' sample size (N_{FS}) which represents the number of unpublished studies with null findings that would have to exist in the researchers' 'file drawers' to reduce the effect size to a zero value (Rosenberg, 2005). If the number of 'null finding' tests of an effect is sufficiently large, the researcher can be confident that the chances of such a number of studies existing is improbable. Rosenberg suggests a critical value of $5N + 10$ for the N_{FS}.

In addition, the percentage variance in the effect sizes across studies attributed to within-study sampling error variability relative to overall between-study variance in the effect size was calculated. This ratio of variance is an important first step in establishing the homogeneity of the effect size, that is, whether the vast majority of the variance in the effect across studies can be accounted for by sampling error (Aguinis & Pierce, 1998). Hunter and Schmidt (1994) have proposed that the proportion of variance attributed to within-study sampling variance should exceed 75% for an effect size to be considered homogenous. A formal test of the relative homogeneity of an effect is given by Cochran's (1952) *Q*-statistic. The *Q*-statistic is a relatively conservative test and can lead to type II errors (i.e., increased probability of accepting as homogenous sets of studies that have substantial heterogeneity) so we adopted the 75% rule in the cases where the *Q*-statistic was significant (Sagie & Koslowsky, 1993; Sánchez-Meca & Marín-Martínez, 1997).

As the number of studies (*k*) varies across meta-analyses, the *Q*-statistic cannot be compared across analyses, so we also calculated the I^2 statistic and its confidence interval as an alternative (Higgins, Thompson, Deeks, & Altman, 2003). This represents a measure of true

heterogeneity in the effect size in question expressed as a percentage and is easily interpretable with levels of 25%, 50%, and 75% representing low, medium, and high levels of heterogeneity respectively (Higgins & Thompson, 2002). Should the I^2 value exceed 25% with a wide confidence interval that does not have a zero lower limit, it is likely that substantial heterogeneity in the effect size exists (Huedo-Medina, Sánchez-Meca, Marín-Martínez, & Botella, 2006). This would suggest that the effect may be influenced by extraneous 'moderator' variables.

Finally, we treated the effect size data for the overall ego-depletion effect and all moderator and additional variable sub-analyses for statistical outliers. We adopted Grubbs' (1950) test to identify outliers in accordance with Barnett and Lewis' (1994) recommendations. Identified outliers were set at the value of the next closest effect size in the data set.

Moderator Coding

Sphere of self-control task. We conceptualized sphere of depleting and dependent tasks in three different ways: specific and distinct spheres as suggested by Baumeister et al. (2007), global spheres according to the demands placed on cognitive or affective processing systems[3], and as tasks frequently-used in the dual-task paradigm. Baumeister et al.'s suggested spheres of self-control are based on the features of the task: controlling attention, emotions, thoughts, and impulses, cognitive processing, choice and volition, and social processing. Tasks requiring attention control involved focusing attention and disregarding distractions such as watching the central figure in a video while ignoring words displayed in a corner of the screen (e.g., Fischer et al., 2008, Study 1; Schmeichel & Vohs, 2009, Study 2). Controlling emotion tasks demanded the active suppression of emotional responses such as requiring participants to avoid expressing emotions when watching emotionally-appealing or aversive videos (e.g., Baumeister et al., 1998, Study 3; Hofmann, Rauch, & Gawronski, 2007). Impulse control tasks demanded participants resist gratifying courses of action or override well-learned habits such

as resisting tempting foods (e.g., DeWall et al., 2007, Study 1; Geeraert & Yzerbyt, 2007, Study 1b) or suppressing the urge to name a target word instead of typeface color in Stroop color-naming tasks (e.g., Bray, Ginis, Hicks, & Woodgate, 2008; Webb & Sheeran, 2003, Study 1). Controlling-thoughts tasks demanded participants suppress unwanted thoughts such as Wegner's (1987) paradigm that requires participants to avoid thinking of a 'white bear' (e.g., Burkley, 2008, Studies 3 & 4; Tyler, 2008, Study 4). Tasks requiring choice or volition involved participants making a choice or decision between options in numerous contexts such as consumer choices or choosing to write an essay in a forced-choice paradigm (e.g., Baumeister et al., 1998, Study 2; Bruyneel, Dewitte, Vohs, & Warlop, 2006, Studies 1, 2 & 3). Cognitive processing tasks involved exerting effort to maintain a high degree of executive functioning or information processing like working on challenging anagram, memory span, or counting tasks (e.g., Park et al., 2008; Schmeichel, 2007, Study 3; Wright et al., 2007, Studies 1 & 2). Social processing tasks required the processing of social information that might involve searching for appropriate social cues such as suppressing stereotypes, resisting persuasion, or engaging in high-maintenance social interactions (e.g., Burkley, 2008, Study 1; Finkel et al., 2006; Gordijn et al., 2004, Studies 2 & 4; Richeson & Shelton, 2003). Moderator coding was initially conducted by the three lead authors. An independent judge familiar with self-control tasks and the dual-task paradigm then performed the classification independently. The agreement of the judge's classification with those of the co-authors was high (Kappa = .81, $p < .001$). Discrepancies were discussed with the judge and a consensus decision made to resolve the ambiguity.

Depleting and dependent tasks were also subjected to a global classification according to the extent to which they placed demands on affective or cognitive processing, or a combination of the two. Tasks requiring the control of emotions and impulses were classified as affective. Controlling attention and thoughts, choice and volition, and cognitive processing tasks were

classified as cognitive. Finally, social processing tasks were classified as requiring both affective and cognitive processes. The latter was justified on the basis that such tasks demand a degree of cognitive control or regulation but also the suppression of impulses or emotions. For example, tasks that require participants to identify relational cues involve a cognitive process to focus attention on the appropriate cue and an affective process to avoid the impulse or temptation to fall back on heuristic processing (Tyler, 2008).

Frequently-used tasks. We also created a moderator variable for tasks frequently used to deplete and measure self-control in the dual-task paradigm. Tasks which had a frequency of use greater than 10 in the sample of studies were considered eligible. Frequently-used depleting tasks were the video-watching affect regulation, video-watching attention control, crossing-out-letters, modified Stroop (1935), and Wegner et al.'s (1987) 'white bear' thought-control tasks. Frequently-used dependent tasks included the handgrip, solvable anagram, food taste test, math or mental arithmetic, and modified Stroop (1935) tasks.

A taxonomy of self-control depleting and dependent tasks was developed to summarize the coding of tasks in each sphere of self-control. The taxonomy, provided in Appendix A[4], is organized with depleting tasks in the top half and dependent tasks in the bottom half. The tasks are categorized according to Baumeister et al.'s (2007) spheres of self-control at the subordinate level with global affective, cognitive, and combined affective and cognitive spheres as higher-order categories. A brief description of the task, studies that have adopted the task, and frequency of task use are also included in each cell of the table. The taxonomy is intended as a resource to identify the category and frequency of use of the self-control tasks adopted as depletion and dependent tasks in dual-task paradigm experiments.

Duration of depleting task. The longer the duration of the depleting self-control task in the dual-task paradigm, the greater the expected impairment of performance on the second task. This is because the amount of self-control resource consumed is assumed to be

proportional to the time spent exerting self-control. We extracted depleting task duration in minutes from studies that reported these data. In cases where data on task duration were missing but a standardized depleting task was used (e.g., modified Stroop task), the task duration was inferred using the average duration for that task across studies reporting duration data.

Interim period. As few studies reported the precise time period between the two tasks in the dual-task paradigm, we aimed to test whether the type of inter-task interim activity moderated the ego-depletion effect. Studies were therefore classified on the basis of the activities performed during the interim period. Studies were classified as those that reported no activities during the interim period, those that required participants to complete questionnaires (e.g., mood scales, manipulation check items), and those that required participants to engage in a filler task or reported a rest period between tasks. According to the recovery hypothesis, we predicted that studies reporting no interim period would provide less opportunity for participants to recover their self-control resources leading to a larger ego-depletion effect. In contrast, participants required to complete questionnaires or filler tasks or were prescribed a period of rest between tasks were expected to have greater chance for recovery and a comparatively smaller ego-depletion effect.

Experiment presentation. We also tested whether presenting tasks in the dual-task paradigm as single or separate experiments or by the same or different experimenters moderated the overall ego-depletion effect. Studies making an explicit statement that the tasks were presented as separate experiments were coded as one moderator group while those that made no explicit distinction were assumed to have presented the tasks as a single experiment and formed the other moderator group. In addition, studies that reported using different experimenters to administer the self-control tasks formed one moderator group and studies using the same experimenter were allocated to the other moderator group.

Type of dependent task. We conducted a moderator analysis to evaluate whether non-behavioral or judgment dependent self-control measures in the dual-task paradigm were as vulnerable to the ego-depletion effect as behavioral measures. Studies were therefore coded according to whether they used a behavioral measure such as performance of a self-control task or used a non-behavioral or judgment measure that was indicative of self-control effort. Examples of non-behavioral or judgment dependent measures included subjective ratings of a target person with responses analyzed for prejudiced or aggressive responses (e.g., Muraven, 2008b; Stucke & Baumeister, 2006) or self-reported evaluations that require suppression of well-learned tendencies such as being modest and self-effacing rather than narcissistic or exaggerating of ability (e.g., Fischer et al., 2007; Vohs et al., 2005, Study 8).

Matched depleting and dependent tasks. Studies were coded according to whether the depleting and dependent self-control tasks in the dual-task paradigm were from the same or different spheres according to the previously-cited criteria for specific and global spheres of self-control. We therefore developed two moderator groups. Studies that adopted depleting and dependent tasks from the same specific (controlling emotions, thoughts, impulses, and attention, choice and volition, cognitive processing, and social processing) or global (affective, cognitive, or combined affective and cognitive) sphere were coded as ‘matched’ and those adopting tasks from different spheres were coded ‘unmatched’.

Control condition. We coded studies according to the type of control condition that was adopted in the dual-task paradigm. The majority of studies used modified, easier versions of the depleting task which did not require the overriding of an impulsive or well-learned response. Some studies used an alternative task that was ostensibly easier and required less self-control resources relative to the depleting task. For example, Muraven et al. (1998, Study 3) used Wegner et al.’s (1987) ‘white bear’ thought control paradigm to deplete self-control resources and compared this with a control group that solved math problems. Muraven et al.

argued that the active suppression of unwanted thoughts demanded more self-control resources than math problems as the latter did not require the active suppression of a dominant response. It is, nevertheless, possible that the math problems still required some degree of self-control to resist the urge to quit. The adoption of such tasks in the control condition may require a degree of self-control but less so than the depleting tasks in the experimental condition. This may serve to moderate the ego-depletion effect so we coded studies into moderator categories according to their use of easier versions and alternative tasks in the control condition. We also coded studies that used the same initial task but included an individual difference variable to evoke depletion. For example, Gordijn and coworkers (2004) segregated their sample into individuals scoring low and high on a motivation to respond without prejudice measure and participants in both groups were then asked to describe a person from a minority group while suppressing stereotypes. Consistent with predictions, the low-motivation group exhibited greater ego depletion on the second task relative to the high-motivation group. Some studies adopted a design in which the initial task was absent for control participants (Baumeister et al., 1998, Study 3; Burkley, 2008, Study 2). However, too few studies (k = 2) were available to include this as a moderator category.

Task complexity. Although self-control tasks share a similar domain or sphere, they are quite variable in their specific features making it difficult to evaluate whether these features may be more demanding of self-control resources than others. For example, it is difficult to establish whether resisting tempting foods in an ostensible taste test is more demanding or effortful than resisting the discomfort in the forearm muscles while holding a handgrip apparatus. However, some tasks in the cognitive processing domain with clear common features have been classified as more or less demanding due to their complexity and type of processing required. Schmeichel's (2007) experiments on the resource depleting effect of tasks requiring executive functioning identified tasks that varied in the extent and number of

processes required and proposed that the level of complexity was proportional to the degree of ego depletion evoked. For example, executive functioning tasks such as recalling a set of digits in the order in which they were presented were considered less effortful and required less self-control resources than tasks that required the recall of digits in reverse order. This is because maintaining figures in memory as in the forward span task does not require other control processes such as updating and ignoring or inhibiting competing information like the reverse span task. Similarly, Wright et al. (2008) suggest that simple math calculations involving single arithmetic operations (e.g., multiplication) require less effort and place less burden on self-control resources than mixed-operation calculations as they do not require the need to suppress competing processes: "A single operation challenge… obviates the need to inhibit one operational impulse (e.g., that to add) in favor of another (e.g., that to divide) and, thus, eliminates a source of regulatory demand" (Wright et al., 2008, p. 130).

A substantial subset of the present sample of studies (k = 36) adopted dependent self-control tasks which varied in their complexity and could be categorized accordingly. These could then be used as moderator groups to test the hypothesis that simple tasks require less self-control resources than complex tasks. This is consistent with the strength model which suggests that dependent tasks with greater regulatory demand would lead to increased performance impairment and therefore more ego depletion after working on a depleting task. Studies that adopted tasks requiring rote memory, recall, or single arithmetic operations were classified as simple self-control tasks. These included rote memory (e.g., Gailliot, Schmeichel, & Baumeister, 2006, Study 7), adding and multiplication (e.g., Mead, Baumeister, Gino, Schweitzer, & Ariely, 2009, Study 1; Stewart et al., 2009; Vohs et al., 2005, Study 1), and forward span recall (e.g., Schmeichel, 2007, Study 2) tasks. Tasks that required multiple cognitive processes such as encoding, memory maintenance and updating, and multiple arithmetic operations were classified as complex. These included solvable anagram (e.g.,

Gailliot, Baumeister et al., 2007, Study 8; Gordijn et al., 2004, Study 5), reading, sentence and reverse span memory (e.g., Johns et al., 2008, Studies 1 & 4; Schmeichel, 2007, Studies 1 & 2), Graduate Record Examination reasoning (e.g., Fennis et al., 2009, Study 2; Finkel et al., 2006, Studies 2 & 3; Gailliot et al., 2006, Study 7), and mixed-operation arithmetic calculation (Wright et al., 2008) tasks. We again used an expert judge to corroborate our classification and inter-rater reliability for the classifications was very high (Kappa =.89, $p < .001$). There were insufficient numbers of studies ($k = 9$) in the cognitive processing sphere to conduct a meta-analysis with depleting task complexity as a moderator.

Source laboratory. The strength model was developed and extensively-tested by Baumeister and colleagues (Baumeister et al., 1998; Muraven et al., 1998) and comprise the largest number of tests of the ego-depletion effect emanating from a single research group in the present sample of studies. We therefore considered it prudent to include source laboratory as a moderator variable to detect any potential variation in the effect in studies originating in the laboratories of Baumeister and his known collaborators (DeWall, Gailliot, Muraven, Schmeichel, and Vohs) and studies from other investigators' laboratories. Studies were coded if they emanated from the Baumeister laboratory or those of his collaborators ($k = 98$) or another laboratory ($k = 99$) according to co-authorship and known prior affiliation.

Moderator Analysis

Analytic strategy. The influence of categorical moderator variables on the ego-depletion effect was evaluated by segregating studies on the basis of the moderator and conducting separate meta-analyses in each moderator group. The moderator was considered effective if the average corrected effect sizes calculated in each moderator group were significantly different as evidenced by no overlap in the CI_{95}. Moderation was further supported if the moderator resulted in a narrowing of the CI_{95}, an increase in the variance accounted for by sampling error variability, and a decrease in the I^2 statistic. One of the moderator variables was continuous

(depleting task duration) and we tested its effect on the ego-depletion effect size using linear regression.

Relations between moderators. We also examined relations between the significant moderator variables to identify potential confounding effects among the moderators of the ego-depletion effect (DeCoster, 2004; Lipsey, 2003). As the majority of the moderators in the present study were categorical, we conducted chi-square analyses on two-way categorical tables to evaluate the strength of the relationships between the variables. Relations between the one continuous moderator (depleting task duration) and the categorical moderators were evaluated by calculating the average values for the continuous moderator at each level of the categorical variable followed by a one-way ANOVA to test the strength of the relationship. A statistically non-significant chi-square or *F*-ratio indicates that the effect of one moderator variable on the dependent variable (ego depletion) is likely to be independent of the other moderator variable. We used a conservative *p* value of .01 to evaluate the significance of the relations. In the event of a significant association between moderators, we examined the categorical tables to identify the source of the variation. Where appropriate, we conducted follow-up meta-analyses of the ego-depletion effect in groups of studies determined by the crossing of the related moderator variables.

Additional Dependent Variables and Alternative Hypotheses

Studies measuring additional dependent variables alongside measures of task performance in ego-depletion studies adopting the dual-task paradigm were also subjected to meta-analytic synthesis. Specifically, studies including self-report measures of effort, positive and negative affect, perceived difficulty, subjective fatigue, self-efficacy, and blood glucose for experimental (ego-depleted) and control (non-depleted) groups were identified and effect sizes calculated. These additional variables were not measured in all studies or were unavailable in

some cases, so the samples for these analyses were invariably subsets of the sample used to calculate the overall ego-depletion effect.

Positive and negative affect were tapped using previously-validated (e.g., BMIS, Mayer & Gaschke, 1988; PANAS, Watson, Clark, & Tellegen, 1988) and author-developed measures of mood and affect. Subjective fatigue and perceived difficulty were invariably measured on self-report scales developed by study authors. Measures of self-efficacy included standardized measures (e.g., Generalized Self-Efficacy Scale, Schwarzer & Jerusalem, 1995) as well as those developed by study authors. A content analysis of the items used in the self-efficacy instruments revealed considerable commonality in content with measures focusing on perceived competency and expectations of success in performing the target task. A judge was employed to independently code the dependent measures and demonstrated strong agreement with our classification (Kappa = .95, p <.001). Discrepancies were resolved using the same method we used previously. Studies measuring the effect of ego depletion on blood glucose levels used commercially-available electronic blood glucose analyzers.

Testing Strength Model Hypotheses

Conservation. Studies testing the conservation hypothesis were required to provide sufficient data to calculate a standardized difference in post-depletion performance on the second self-control task for participants told to expect an additional self-control task and control participants not informed of an additional task. Larger effect sizes reflected greater levels of ego depletion in participants anticipating future self-control. We also tested the effect of strategies to increase motivation on the ego-depletion effect across studies. We therefore meta-analyzed the second-task performance of ego-depleted participants provided with either a motivational intervention or no intervention in the dual-task paradigm. Motivational interventions included providing monetary incentives to complete the second task (Muraven & Slessareva, 2003), framing the second task as important or meaningful (Muraven & Slessareva,

2003), or presenting the second task in an autonomy-supportive manner to facilitate intrinsic motivation (Moller, Deci, & Ryan, 2006; Muraven, Gagne, & Rosman, 2008). Larger effect sizes indicated that motivation was effective in promoting better performance on self-control tasks.

Training. The criterion for studies eligible for the training hypothesis analysis was the inclusion of an experimental manipulation that required participants to engage in a period of practice with self-control tasks prior to being subjected to an ego-depletion manipulation using the dual-task paradigm. A diverse range of tasks were used to train self-control such as speech modification (e.g., using “yes” and “no” only and no colloquialisms, Gailliot, Plant et al., 2007), use of the non-dominant hand (Finkel, DeWall, Slotter, Oaten, & Foshee, 2009), maintaining posture, mood regulation, monitoring eating habits (Muraven et al., 1999), impulse control tasks like the Stroop test or an aversive mouth rinse (Hui et al., 2009), physical exercise (Oaten & Cheng, 2006b), financial self-management (Oaten & Cheng, 2007), and academic study (Oaten & Cheng, 2006a). Studies reporting differences in second self-control task performance between trained depleted participants and untrained depleted controls were included. Larger effect sizes represented superior performance on self-control tasks as a result of training.

Recovery. We aimed to test the variation of the ego-depletion effect in studies that manipulated the duration of the inter-task rest or relaxation period in the dual-task paradigm. However, we could only locate two studies ($k = 4$) that tested this effect (Oaten et al., 2008; Tyler & Burns, 2008). This was considered insufficient to conduct a moderator analysis. An indirect test of the recovery hypothesis was offered through our analysis of inter-task interim activities reported in the previous section.

Glucose supplementation. Studies that administered glucose-containing solutions to participants prior to the experiment or in the interim period between self-control tasks were

subjected to a meta-analysis. The effect size was calculated as the difference in second task performance for participants assigned to either a group that received a glucose solution or a control group that received a sweet placebo. Larger effect sizes were indicative of better performance on self-control tasks as a result of glucose supplementation.

Results

The literature search identified 83 experimental studies that satisfied inclusion criteria with 198 independent tests of the ego-depletion effect. Effect sizes for the ego-depletion effect and the effect of depletion on additional dependent variables (effort, positive and negative affect, perceived difficulty, subjective fatigue, and self-efficacy) are reported in Appendix B[5] (see Footnote 4). The table also includes moderator coding, a precise description of how the effect size was extracted in each study, and details of the methods adopted to measure additional dependent variables. Effect sizes and characteristics of studies included in the analyses of the conservation (anticipate future self-control task, motivation) and training hypotheses of the strength model are provided in Table 1. Analysis of outliers using Grubbs' (1950) statistic identified five cases. Three outliers were detected in the data set for the overall ego-depletion effect, two on the right hand side of the distribution (d = 3.02, Muraven et al., 2008, Study 1; d = 2.60, Tyler & Burns, 2009, Study 2, sample 2) and one on the left (d = -0.57, Wright et al., 2007, Study 2, sample 2). These were replaced with their nearest neighboring values, d = 1.90 and d = -0.11, respectively, and retained in subsequent analyses. In the analyses for additional dependent variables, one outlier was detected for the negative affect (d = 1.40, Ciarocco et al., 2001, Study 2) variable and was also set to its closest neighboring value (d = 0.99). In the analyses of additional hypotheses, one outlier was identified for the conservation hypothesis, expect future task analysis (d = 2.61, Tyler & Burns, 2009) and replaced with its nearest neighbor (d = 1.70).

Overall Ego-Depletion Effect

Results of the meta-analysis of the overall ego-depletion effect are presented in Table 2. The averaged corrected standardized mean difference for ego depletion on self-control dependent measures was $d^{+} = 0.62$ ($CI_{95} = 0.57, 0.67$, $Q(197) = 301.79$, $p < .001$). This represents a medium-to-large effect size (Cohen, 1987). All but two of the effect sizes in the data set were positive in valence. The *Q*-statistic, percentage of variance accounted for by sampling error variance (65.61%), and an I^2 statistic exceeding 25% (34.72%) indicated a substantial degree of heterogeneity in the effect size across the studies indicating the likelihood of extraneous moderators of the effect (Higgins & Thompson, 2002). The confidence intervals did not include zero leading to a rejection of the null hypothesis. The 'fail safe' sample size (N_{FS}) exceeded Rosenberg's (2005) cutoff value indicating that the likelihood of sufficient studies with null effects existing to reduce the ego-depletion effect to a trivial value was highly improbable.

Additional Dependent Variables

Average corrected effect size statistics for the effect of ego depletion on other dependent variables are given in Table 2. Each effect represents the standardized mean difference in the target dependent variable for ego-depleted participants and non-depleted controls. Effect sizes for effort ($d^{+} = 0.64$, $CI_{95} = 0.47, 0.80$, $Q(30) = 95.04$, $p < .001$), perceived difficulty ($d^{+} = 0.94$, $CI_{95} = 0.73, 1.14$, $Q(57) = 456.57$, $p < .001$), subjective fatigue ($d^{+} = 0.44$, $CI_{95} = 0.26, 0.63$, $Q(25) = 97.61$, $p < .001$), and blood glucose levels ($d^{+} = -0.87$, $CI_{95} = -1.20, -0.54$, $Q(4) = 2.83$, $p = .59$) were significantly different from zero and medium-to-large in magnitude. Effect sizes for positive affect ($d^{+} = -0.03$, $CI_{95} = -0.12, 0.05$, $Q(66) = 146.09$, $p < .01$), negative affect ($d^{+} = 0.14$, $CI_{95} = 0.06, 0.22$, $Q(35) = 45.73$, $p = .11$), and self-efficacy ($d^{+} = 0.16$, $CI_{95} = -0.19, 0.51$, $Q(4) = 8.10$, $p = .09$) were substantially smaller. The confidence intervals for the positive affect and self-efficacy effect sizes included the value of zero. With the exception of

effect sizes for negative affect and blood glucose, all effect sizes exhibited significant heterogeneity.

Moderator Analyses

Averaged corrected standardized-difference effect sizes and associated statistics for each moderator group are provided in Table 3.

Sphere of depleting task. We tested the specific and general spheres of depleting task as moderators of the overall ego-depletion effect. Medium-to-large effect sizes were observed for moderator groups defined according to the specific sphere of depleting task adopted: controlling emotions (d^+ = 0.62; CI_{95} = 0.50, 0.74, $Q(23) = 33.67$, $p = .07$), thoughts (d^+ = 0.63; CI_{95} = 0.53, 0.75, $Q(24) = 18.16$, $p = .80$), impulses (d^+ = 0.55; CI_{95} = 0.46, 0.64, $Q(60) = 128.26$, $p < .001$), and attention (d^+ = 0.65; CI_{95} = 0.50, 0.81, $Q(20) = 10.68$, $p = .95$), choice and volition (d^+ = 0.82; CI_{95} = 0.62, 1.00, $Q(11) = 8.87$, $p = .63$), and cognitive (d^+ = 0.54; CI_{95} = 0.29, 0.80, $Q(12) = 30.64$, $p < .01$) and social (d^+ = 0.75; CI_{95} = 0.65, 0.84, $Q(37) = 30.69$, $p = .76$) processing tasks. Five of these effects were homogenous. Confidence intervals revealed that the ego-depletion effect size for the controlling impulse task moderator group was significantly smaller than the effect for the social processing task moderator group. There were no other significant differences. Moderator analysis of experiments adopting affective (d^+ = 0.57; CI_{95} = 0.49, 0.64, $Q(87) = 163.59$, $p < .001$), cognitive (d^+ = 0.65; CI_{95} = 0.57, 0.73, $Q(70) = 95.23$, $p < .05$), and combined affective and cognitive (d^+ = 0.73; CI_{95} = 0.64, 0.83, $Q(38) = 32.56$, $p = .67$) depleting tasks produced effect sizes of similar magnitude. There were no significant differences in effect sizes across the moderator groups. Only the effect size for studies classified as combined affective and cognitive was homogenous.

Frequently-used depleting tasks. We also tested whether the average ego-depletion effect size varied across studies adopting frequently-used depleting tasks. Analyses for crossing-out-letters (d^+ = 0.77, CI_{95} = 0.65, 0.90, $Q(19) = 25.68$, $p = .14$), Wegner's white-bear

paradigm (d^+ = 0.65, CI_{95} = 0.52, 0.78, $Q(18)$ = 16.72, p = .54), video-watching affect regulation (d^+ = 0.55, CI_{95} = 0.42, 0.68, $Q(18)$ = 18.83, p = .40), and video-watching attention control (d^+ = 0.61, CI_{95} = 0.48, 0.74, $Q(18)$ = 23.89, p = .16) tasks revealed medium-to-large average effect sizes with no significant differences across moderator groups. The effect size for the modified Stroop task was smaller in magnitude (d^+ = 0.40, CI_{95} = 0.26, 0.55, $Q(12)$ = 23.01, $p < .05$) and significantly smaller than the effect size for the crossing-out-letters task. With the exception of the Stroop task group, all of the moderator analyses yielded homogenous effect sizes[6].

Duration of depleting task. Depleting task duration in minutes was treated as a continuous moderator of the ego-depletion effect. The majority of studies (k = 148) reported task duration data and this was converted into minutes. We conducted a linear regression analysis with the ego-depletion effect size as the dependent variable and task duration as an independent predictor weighted by the inverse variance of each effect size (Hedges & Olkin, 1983; Sánchez-Meca & Marín-Martínez, 1998). The analysis yielded a marginally-significant effect for task duration on ego depletion, but the effect size was small (β = .11, z = 1.79, p = .07).

Interim period. We conducted an analysis examining the effect of the type of interim activity on ego depletion in the dual-task paradigm. The averaged effect size did not vary across moderator groups for studies in which participants completed questionnaires during the interim period (d^+ = 0.71, CI_{95} = 0.65, 0.77, $Q(118)$ = 161.96, $p < .01$) and those who completed a filler task or had a break between the tasks (d^+ = 0.72, CI_{95} = 0.60, 0.85, $Q(23)$ = 22.30, p = .50), but the effect for studies that reported no interim period was significantly smaller by comparison (d^+ = 0.47, CI_{95} = 0.39, 0.55, $Q(54)$ = 83.19, $p < .01$). The analysis for the filler task or break group was homogenous while the remaining effects exhibited substantial heterogeneity.

Experiment presentation. The ego-depletion effect for studies presenting the two tasks as single (d^+ = 0.58; CI_{95} = 0.53, 0.64, Q(133) = 195.91, p < .001) or separate (d^+ = 0.71; CI_{95} = 0.63, 0.80, Q(63) = 96.80, p < .001) experiments were not significantly different. However, the effect size for tasks administered by the same experimenter (d^+ = 0.61; CI_{95} = 0.56, 0.66, Q(182) = 283.55, p < .001) was significantly smaller than that for tasks administered by a different experimenter (d^+ = 0.86; CI_{95} = 0.69, 1.01, Q(14) = 9.76, p = .78). Effect sizes were medium-to-large in all cases and all effects exhibited substantial heterogeneity with the exception of the effect for tasks administered by different experimenters.

Sphere of dependent task. We tested whether groups of effect sizes defined according to the specific features of the criterion self-control tasks would moderate the ego-depletion effect. Three of moderator groups (controlling attention, controlling emotion, and controlling thoughts) contained fewer than five effect sizes and were deemed insufficient for meta-analytic synthesis. Analyses of the four remaining moderator groups revealed no significant differences in effect sizes for tasks in the controlling impulses (d^+ = 0.71; CI_{95} = 0.64, 0.78, Q(103) = 151.07, p < .01), cognitive processing (d^+ = 0.60; CI_{95} = 0.52, 0.67, Q(46) = 43.03, p = .60), and social processing (d^+ = 0.69; CI_{95} = 0.60, 0.79, Q(32) = 29.11, p = .61) spheres. However, confidence intervals indicated that the ego-depletion effect was significantly smaller in experiments adopting choice and volition tasks (d^+ = 0.22; CI_{95} = 0.11, 0.33, Q(7) = 4.19, p = .76) than the effect in all other groups. All of the effect sizes were homogenous with the exception of the effect in the controlling impulses tasks group. For the moderator analysis in which dependent self-control tasks were classified in accordance with their global features, effect sizes for affective (d^+ = 0.71; CI_{95} = 0.64, 0.78, Q(106) = 155.70, p < .01) and combined affective and cognitive (d^+ = 0.69; CI_{95} = 0.60, 0.79, Q(32) = 29.11, p = .61) tasks were significantly larger relative to the effect for cognitive tasks (d^+ = 0.48; CI_{95} = 0.40, 0.55, Q(57)

= 85.73, $p < .01$). Only the effect size for the combined affective and cognitive group was homogenous.

Frequently-used dependent tasks. Five dependent self-control tasks were used on 10 or more occasions. Averaged effect sizes for handgrip ($d^+ = 0.64$, $CI_{95} = 0.45, 0.83$, $Q(17) = 33.85$, $p < .01$), modified Stroop ($d^+ = 0.76$, $CI_{95} = 0.59, 0.94$, $Q(14) = 18.55$, $p = .18$), food taste test ($d^+ = 0.50$, $CI_{95} = 0.33, 0.68$, $Q(9) = 13.21$, $p = .20$), math or mental arithmetic ($d^+ = 0.50$, $CI_{95} = 0.31, 0.69$, $Q(9) = 7.80$, $p = .55$), and solvable anagram ($d^+ = 0.60$, $CI_{95} = 0.44, 0.76$, $Q(9) = 10.94$, $p = .28$) tasks were medium-to-large in size and were not significantly different across tasks. With the exception of the handgrip task, all of the moderator analyses resulted in homogenous effect sizes.

Matched depleting and dependent tasks. The ego-depletion effect size for studies that adopted depleting and dependent tasks that were matched on task sphere (specific classification, $d^+ = 0.59$; $CI_{95} = 0.48, 0.71$, $Q(39) = 62.90$, $p < .01$; global classification, $d^+ = 0.61$; $CI_{95} = 0.52, 0.70$, $Q(67) = 100.12$, $p < .001$) did not differ from the effect size for studies adopting tasks unmatched on sphere (specific classification, $d^+ = 0.63$; $CI_{95} = 0.58, 0.68$, $Q(157) = 238.49$, $p < .001$; global classification, $d^+ = 0.63$; $CI_{95} = 0.57, 0.69$, $Q(129) = 201.52$, $p < .001$)[7]. Only the moderator group in which the tasks were matched according to specific sphere classification was homogenous.

Type of dependent task. Tests of the ego-depletion effect for studies employing a behavioral ($d^+ = 0.62$; $CI_{95} = 0.56, 0.67$, $Q(169) = 274.61$, $p < .001$) or a non-behavioral or judgment ($d^+ = 0.66$; $CI_{95} = 0.56, 0.76$, $Q(27) = 26.44$, $p = .49$) dependent measure revealed medium-to-large effect sizes in each moderator group with no significant differences. The effect size for behavioral measures exhibited substantial heterogeneity, while the effect size for non-behavioral or judgment measures was homogenous.

Control condition task. Meta-analyses of studies using an easier version of the depleting task (d^+ = 0.62; CI_{95} = 0.56, 0.67, $Q(169) = 283.19$, $p < .001$), an alternative task (d^+ = 0.53; CI_{95} = 0.29, 0.77, $Q(4) = 0.23$, $p = .99$), and the same task with an individual difference characteristic to evoke depletion (d^+ = 0.66; CI_{95} = 0.54, 0.78, $Q(20) = 11.37$, $p = .94$) revealed no differences in effect size. The effect size for studies using an easy version of the depleting task exhibited substantial heterogeneity while the effect sizes for the alternative task and same task with individual differences groups were homogenous.

Task complexity. Ego-depletion effect sizes were larger for the subset of studies adopting complex dependent tasks (d^+ = 0.65; CI_{95} = 0.54, 0.75, $Q(26) = 26.44$, $p = .44$) compared to those adopting less complex or simple tasks (d^+ = 0.35; CI_{95} = 0.15, 0.55, $Q(8) = 5.93$, $p = .66$), a difference that was borderline significant. In both cases the averaged effect size was homogenous.

Source laboratory. There were no significant differences in the average effect size for studies originating from the labs of Baumeister and collaborators (d^+ = 0.60; CI_{95} = 0.53, 0.66, $Q(97) = 158.08$, $p <.001$) and other laboratories (d^+ = 0.66; CI_{95} = 0.59, 0.72, $Q(99) = 141.43$, $p < .01$). Both effects exhibited substantial heterogeneity.

Individual differences. Several studies ($k = 9$) measured trait self-control concurrent with ego depletion in dual-task paradigm experiments (DeWall et al., 2007, Study 4; Dvorak & Simons, 2009; Finkel & Campbell, 2001, Study 2; Gailliot & Baumeister, 2007b, Studies 1 & 2; Gailliot, Schmeichel et al., 2007, Studies 1 & 2; Muraven, Pogarsky, & Shmueli, 2006; Stillman et al., 2009, Study 2). However, the studies did not provide sufficient data to test individual differences in self-control as a moderator of the ego-depletion effect in our meta-analysis. Specifically, effect size data for the ego-depletion effect in high and low trait-self-control groups were not available. No other individual difference or personality constructs

were measured with sufficient regularity to offer a cumulative analysis of their effects on ego depletion.

Relations between moderators. Pairwise tests of relations between significant moderator variables are presented in Appendix C (see Footnote 4). The variables included in the analysis were sphere of depleting task (specific classification), frequently used depleting task, experiment presentation (same vs. different experimenters), interim period, sphere of depleting task (specific and global classifications), and task complexity. The analysis yielded relatively few significant relations among the variables suggesting that our selection of moderators and coding procedures were largely effective in identifying unique moderator variables that were not confounded with others (Lipsey, 2003).

There were significant associations between sphere of depleting task (specific classification) and frequently-used depleting task moderator variables ($\chi^2(12) = 270.00$, $p < .001$) and between sphere of dependent task, specific and global classifications ($\chi^2(10) = 396.00$, $p < .001$). These findings were unsurprising as the variables involved represented nested versions of the same analysis according to our moderator coding. For example, the sphere of dependent task moderator variables, classified according to specific and global features, were strongly associated because specific domains of depleting task (e.g., controlling impulses or controlling emotions) were exclusive to categories of depleting tasks in the global domain (e.g., affective tasks). Conducting follow-up analyses on the basis of these relations was not warranted as such analyses would fail to explain additional variance in the ego-depletion effect across moderator groups.

We found significant relations between the interim period and sphere of depleting task (specific classification) moderators ($\chi^2(12) = 36.39$, $p < .001$). Examination of the classification tables identified that the relationship was due to a disproportionate number of cases in the ‘no interim reported’ category that adopted social processing and controlling

impulses tasks relative to the other categories. As our moderator analysis revealed that studies adopting no interim period between tasks exhibited a significantly smaller ego-depletion effect compared to studies that included an interim period/filler task or had participants complete questionnaires, we conducted follow-up analyses to investigate whether task sphere explained this variance. Specifically, we conducted separate meta-analyses in moderator groups defined by depleting task sphere (social processing vs. controlling impulses vs. other spheres) and interim period (interim period/filler task/completed questionnaires vs. no interim reported). Results indicated that the ego-depletion effect was significantly larger in the social processing tasks-interim period ($d^+ = 0.79$; $CI_{95} = 0.68, 0.92$, $Q(23) = 19.51$, $p < .67$), social processing tasks-no interim reported ($d^+ = 0.68$; $CI_{95} = 0.54, 0.82$, $Q(13) = 9.71$, $p = .72$), controlling impulses-interim period ($d^+ = 0.67$; $CI_{95} = 0.56, 0.78$, $Q(45) = 77.40$, $p < .01$), and other spheres-interim period ($d^+ = 0.71$; $CI_{95} = 0.63, 0.78$, $Q(70) = 73.30$, $p = .37$) moderator groups relative to the effect in the tasks from the controlling impulses-no interim reported moderator group ($d^+ = 0.37$; $CI_{95} = 0.23, 0.52$, $Q(14) = 30.53$, $p < .01$). Furthermore, the effect size in the other studies-no interim reported moderator group ($d^+ = 0.49$; $CI_{95} = 0.34, 0.65$, $Q(23) = 46.48$, $p < .01$) exhibited significant overlap in confidence intervals with effect sizes in the other moderator groups with the exception of the social processing tasks-interim period group. These results suggest that the inclusion of studies adopting controlling impulses depleting tasks led to the significant attenuation of the ego-depletion effect in the no interim reported moderator group. However, as the confidence intervals for the other studies-no interim reported moderator group straddled those of the controlling impulses-no interim reported moderator group and those from other moderator groups, and it is likely that the association among these moderators did not fully account for the variation in the ego-depletion effect size due to interim period.

The presentation of tasks by the same or different experimenters significantly moderated the ego-depletion effect. This moderator variable was also significantly related to sphere of depleting task (specific classification), $\chi^2(6) = 20.40$, $p < .01$. We therefore investigated

whether depleting task sphere confounded this effect. An examination of the classification tables for these variables revealed that a disproportionately larger proportion of studies adopting depleting tasks in the social processing sphere also used different experimenters. For many of the studies adopting depleting tasks in the social processing sphere, the use of different experimenters was an integral part of the depletion paradigm (e.g., experiments requiring an interracial interaction, Richeson & Shelton, 2003; Richeson & Trawalter, 2005; Richeson et al., 2005; Trawalter & Richeson, 2006). A follow-up moderator analysis by depleting task sphere (social processing vs. other spheres) and experiment presentation (same vs. different experimenters) revealed that studies adopting depleting tasks in the social processing sphere and used different experimenters exhibited a larger ego-depletion effect (d^+ = 1.00; CI_{95} = 0.75, 1.24, $Q(7) = 3.93$, $p = .79$) than studies adopting social processing tasks and used the same experimenter (d^+ = 0.71; CI_{95} = 0.60, 0.80, $Q(29) = 22.08$, $p = .82$). Similarly, studies adopting tasks from other spheres and used different experimenters exhibited a larger ego-depletion effect (d^+ = 0.76; CI_{95} = 0.56, 0.97, $Q(6) = 6.09$, $p = .41$) compared with studies adopting tasks from other spheres using the same experimenter (d^+ = 0.59; CI_{95} = 0.53, 0.65, $Q(148) = 253.18$, $p < .001$). The ego-depletion effect was significantly larger in the social processing tasks-different experimenter moderator group relative to the other tasks-same experimenter moderator group. However, within the spheres of task moderator groups, there were no significant differences in the effect sizes and the same pattern of findings to the main moderator analysis for experiment presentation was observed.

Testing Strength-Model Hypotheses

Averaged corrected standardized-difference effect sizes and associated statistics for the meta-analyses of additional strength model hypotheses are provided in Table 2.

Conservation. We meta-analyzed studies in which participants were informed they were required to engage in a third self-control task after the second task in the dual-task paradigm.

Two studies were included in the analysis with seven separate tests of the effect (Muraven, Shmueli et al., 2006; Tyler & Burns, 2009). The effect size was large, significant, and homogenous (d^+ = 1.04; CI_{95} = 0.78, 1.30, $Q(6)$ = 8.41, p = .21), such that expecting future self-control performance led to higher levels of ego depletion among depleted samples.

We also tested the moderation of the ego-depletion effect by motivational strategies. Three studies were included in the analysis offering 10 independent tests of the effect (Moller et al., 2006; Muraven et al., 2008; Muraven & Slessareva, 2003). The analysis produced a large effect size (d^+ = 1.05; CI_{95} = 0.49, 1.61, $Q(9)$ = 56.12, $p < .001$), supporting the hypothesis that introducing motivational strategies results in better performance on dependent self-control tasks among ego-depleted people. The effect exhibited significant heterogeneity.

Training. Seven studies provided nine tests of the training hypothesis (Finkel et al., 2009; Gailliot, Plant et al., 2007; Hui et al., 2009; Muraven et al., 1999; Oaten & Cheng, 2006a, 2006b, 2007). The effect size was large and significant indicating that participants receiving training performed better on the self-control task and were less ego-depleted than untrained participants (d^+ = 1.07; CI_{95} = 0.10, 2.03, $Q(8)$ = 138.98, $p < .001$). It is important to note that none of the individual effects included in the analysis were small or negative in valence and the high degree of heterogeneity in the effect reflected the very large range in effect sizes (d = 0.10 to 8.59).

Glucose supplementation. We tested the effect of administering glucose (as opposed to placebo) on the ego-depletion effect. Four studies reporting five separate effect sizes were included in the analysis (DeWall et al., 2008; Gailliot, Baumeister et al., 2007; Gailliot et al., 2009; Masicampo & Baumeister, 2008). Study characteristics are reported in Table 1. Results revealed a large homogenous effect size (d^+ = 0.75, CI_{95} = 0.48, 1.03, $Q(4)$ = 3.36, p = .50) indicating that supplementing people with glucose is associated with significantly better performance on self-control tasks among depleted people relative to controls provided with a sweet placebo.

Discussion

The main aim of present study was to conduct a meta-analytic synthesis of the ego-depletion effect in experimental studies adopting the dual-task paradigm. Additional aims were to test (a) the effect of ego depletion on other dependent variables (effort, perceived difficulty, subjective fatigue, negative and positive affect, self-efficacy, and blood glucose), (b) the effect of theoretically-salient moderators on ego depletion, (c) alternative explanations for the ego-depletion effect, and (d) key additional hypotheses derived the strength model of self-control. A literature search identified 83 studies that met inclusion criteria providing 198 independent tests of the ego-depletion effect. The meta-analysis of the overall ego-depletion effect produced a medium-to-large average effect size. The effect was significantly different from zero but displayed substantial heterogeneity. Significant effects were found for ego depletion on effort, perceived difficulty, negative affect, subjective fatigue, and blood glucose, reflecting the effortful, aversive nature of self-control tasks. The effect of ego depletion on positive affect and self-efficacy was trivial and non-significant. Moderator analyses revealed that the ego-depletion effect was generally consistent across sphere of depleting and dependent task. The effect size for depleting tasks in the controlling impulses sphere and for the modified Stroop task was smaller relative to a minority of other spheres and tasks. The effect was significantly smaller for studies adopting dependent tasks in the cognitive and choice and volition spheres. The effect was also smaller for simple as opposed to complex dependent tasks, a difference that was borderline significant, for tasks administered by the same experimenter compared to those administered by different experimenters, and for studies that reported no inter-task interim period. Presentation of the tasks as separate experiments, whether depleting and dependent tasks were matched on sphere, use of behavioral or non-behavioral dependent measures, type of control condition, and source laboratory did not moderate the effect. Tests of the additional hypotheses of the strength model revealed that motivational incentives, training on self-control tasks, and glucose supplementation resulted in significantly superior second task performance

relative to controls among ego-depleted groups. In contrast, studies in which participants anticipated a future self-control task exhibited a significantly larger ego-depletion effect relative to those that did not expect a future task in ego-depleted groups.

Implications for the Strength Model

The significant overall effect for the ego-depletion effect provides confirmatory evidence for the acute decrements in self-control task performance observed in experiments adopting the strength model and the dual-task paradigm. Moderator analyses examining the effect for both depleting and dependent tasks in different spheres of self-control also supported the presence of the effect. As predicted, any variation in the effect across spheres was due to differences in the magnitude rather than whether the effect was present or absent. Furthermore, the effect did not vary across studies in which the depleting or dependent tasks were from identical or different spheres of self-control, providing further evidence to support the generality of the effect. Findings are consistent with a resource depletion model which predicts that performance decrements carry across different spheres of self-control. It also corroborates the view that self-control draws from a single, global resource and depletion is not an artefact of specific spheres or tasks. The present synthesis therefore contributes to knowledge by demonstrating that the ego-depletion effect exists, its associated confidence intervals do not include trivial values, and it is generalizable across spheres of self-control.

The analysis of sphere of task as a moderator provided important information on whether certain spheres of ego-depleting task were more demanding of self-control resources than others. Introducing sphere as a moderator was effective in resolving some of the heterogeneity in the overall ego-depletion effect in some moderator groups. The majority of the spheres exhibited homogenous ego-depletion effects and did not differ significantly from each other. The general pattern of these results suggests that most tasks are equally taxing of self-control resources. However, there were some variations. Studies that adopted depleting tasks in the

controlling impulses sphere and dependent tasks in the cognitive sphere exhibited smaller ego-depletion effect sizes than the effects in a minority of other spheres. These moderator groups also exhibited high levels of heterogeneity. In some cases, the heterogeneity associated with the effects in these spheres was resolved when moderator groups were formed from individual, frequently-used depleting (e.g., crossing-out-letters) and dependent (e.g., modified Stroop, food taste test) controlling-impulse tasks. Some individual tasks also displayed significant heterogeneity and lower ego-depletion effects (e.g., modified Stroop as a depleting task), but excluding studies adopting this task in the moderator analyses for task sphere (e.g., controlling impulses, affective) did not produce homogenous effects. The lower size and heterogeneity of the effect in these spheres do not appear to be attributable to one particular task.

Studies adopting choice and volition tasks as a dependent variable exhibited much lower levels of depletion than studies using tasks in other specific spheres of self-control. A possible reason for this variation is that making choices may not place as many demands on depleted individuals' self-control resources than tasks in other spheres, but this does not appear to be the case when such tasks are used as depleting tasks. On closer inspection, the effect was based on a small sample with the majority of effects derived from studies using a particular type of consumer-choice task (Masicampo & Baumeister, 2008; Pocheptsova, Amir, Dhar, & Baumeister, 2009). These tasks focus on ego-depleted individuals' failure to select a compromise option in a buying scenario, likely due to the use of simple rather than deep-level processing. The strength of the effect may be reduced for these tasks because a substantial proportion of people are still able make correct decisions even when depleted. This individual task may therefore be one that is less effective in measuring self-control resource depletion, but appears to be an exception rather than the rule.

An inconsistency in the ego-depletion literature is whether the ego-depletion effect is exclusively the result of engaging in tasks that require suppressing impulses or overriding

dominant responses or whether difficult or challenging tasks also have the propensity to evoke ego depletion. We hypothesized that difficult tasks vary in complexity and, therefore, the extent to which they deplete self-control resources. Although classifying such tasks according to their complexity proved challenging due to their diversity, cognitive processing tasks that varied in the number of processes required provided an opportunity to test the effect of task complexity on ego depletion. Complex tasks required a greater number of cognitive processes such as mixed-arithmetic operations or memory updating than tasks that required relatively few such as rote memory (Schmeichel, 2007). Consistent with expectations, dependent tasks classified as complex led to a larger ego-depletion effect than tasks classified as simple. Although the difference was borderline significant, these results provide preliminary evidence that the degree of ego depletion evoked by cognitive processing tasks is dependent on task complexity. Findings indicate that the depletion of self-control resources is not exclusively confined to tasks that require overriding impulses or habitual responses, but also applies to difficult or challenging tasks that demand complex cognitive processing.

It was also important to test whether the type of control condition task with which the depleting self-control task was compared affected the ego-depletion effect. We tested this by including the type of control condition task used in dual-task paradigm experiments as a moderator variable. Most experiments used a modified ‘easier version’ of the depleting self-control task for the control condition task such as a congruent Stroop task or eating a tempting food in an ostensible taste test. A common feature of these tasks is that individuals are required to act in accordance with, rather than override, habitual or dominant responses. However, some experiments used individual differences and alternative tasks (e.g., math problems) as the control condition. The average ego-depletion effect in the present meta-analysis did not differ regardless of the type of control condition adopted. Although the selection of an appropriate control condition is an important feature of the dual-task paradigm in order to effectively

induce ego depletion, the extent of resource depletion does not depend on the types of control task identified in this analysis. The implication of these findings is that there is some flexibility within the dual-task paradigm in terms of the means to deplete resources as well as the control conditions with which the depleting task is compared. However, researchers must exercise caution when selecting tasks so that the features that define them as depleting or non-depleting are clearly identifiable and can be justified theoretically. Our classification of tasks based on complexity of the processing required may provide a useful guide in this regard.

Another feature of depleting self-control tasks likely to affect ego depletion is the length of time spent on the task. Consistent with the conceptualization of self-control as a limited resource, it was proposed that spending longer on the initial self-control task in the dual-task paradigm would consume more of the resource. Our meta-analysis revealed a marginally-significant relationship between duration of depleting task and ego depletion in the hypothesized direction. The small effect size indicates that task duration accounted for relatively little variance in the ego-depletion effect. Task duration should therefore be a minor consideration when designing and evaluating ego-depletion experiments. It is important to note that the task duration range of the studies used in the present analysis was relatively narrow; many of the tasks were relatively brief in duration. This is consistent with the heavy focus on short-term self-control failure in experimental tests of ego depletion. The relatively brief task duration means that it was unlikely there would be an observable deterioration in performance on the initial self-control task itself in these studies. The identification of a decline in performance on the initial task would be a useful additional index of resource depletion and consistent with the long-term task performance decrements observed in the mental fatigue and vigilance literature (Parasuraman, 1979; See et al., 1995). Furthermore, no study has manipulated initial task duration in a dual-task paradigm and examined its effects on

performance of both initial and second tasks. The present analysis provides the impetus for future research to examine extended task duration as a moderator of ego depletion.

We conducted analyses to test relations between significant moderator variables in order to provide a critical evaluation of potential confounding effects due to interrelationships among moderators. In general, our analysis revealed few significant relations providing evidence that the moderators identified were unique and the analyses were not confounded. We found two instances in which a relationship between moderators had a demonstrable effect on the moderator analyses. We found that experiments that did not report an interim period between tasks exhibited weaker ego-depletion effects than those that reported an interim period or the completion of questionnaires between tasks. This finding was contrary to the recovery hypothesis which suggests that an interim period between tasks would permit partial recovery of self-control resources and lead to better performance on the second task. Our analysis of relations between moderators suggested that this effect may have been confounded by a significant relationship between the interim period and task sphere moderators. The analysis revealed that the inclusion of studies adopting depleting tasks in the controlling impulses sphere that did not report an interim period may have biased the ego-depletion effect size downwards. Reasons why researchers controlling impulses depleting tasks were less likely to report an interim period are unclear and cannot be ascertained from the current analysis. However, there was evidence that this did not account for all the variation in the ego-depletion effect across interim period. An important consideration when interpreting these findings is that our coding of the ‘no interim period reported’ category for this moderator was relatively crude. For example, it was possible that studies coded as reporting no interim period may have included an interim period or filler task between tasks in their experiment but failed to mention doing so. Full reporting of the duration and experimental requirements (e.g., filler tasks,

questionnaire completion) between tasks is advocated to provide more robust data to evaluate whether inter-task period moderates the ego-depletion effect.

We also found that presenting tasks in the dual-task paradigm by the same or different experimenters moderated the ego-depletion effect. Contrary to predictions and the experimenter-demand account, the ego-depletion effect size was larger among studies in which the tasks were administered by different experimenters. Analyzing relations between moderator variables suggested that a significant association between the experiment presentation and sphere of depleting task moderators may have confounded the effect. We found that studies adopting social processing depleting tasks were more likely to use different experimenters than studies adopting tasks in other spheres. Our analysis revealed that inclusion of studies adopting social processing depleting tasks tended to bias the ego-depletion effect size for different experimenters upwards. This indicated that the association between these moderators was a result of a methodological artefact of particular studies rather than a systematic variation between studies. However, it must be stressed that the pattern of the differences was identical for the task presentation moderator analyses within the social processing and other tasks moderator groups. This means that the inclusion of these particular tasks was not exclusively responsible for the significantly larger ego-depletion effect among studies using different experimenters. Furthermore, the analyses including different experimenters comprised comparatively small samples of studies and should be interpreted with caution. On the basis of this analysis, researchers adopting the dual-task paradigm should include additional checks to ascertain the extent of participants' perceived fulfilment of experimenter demands. Although participants in the present sample of studies were typically probed for suspicion regarding links between the two tasks, few studies reported whether participants thought they had satisfied the experimenter's demands after the initial task. In addition, few studies reported effort exerted on

both the initial and second tasks. This would provide useful information to complement the use of different experimenters as a means to evaluate the experimenter-demand hypothesis.

Alternative Explanations

Our analysis also examined motivation, fatigue, self-efficacy, and affect as alternative explanations for the ego-depletion effect and how these explanations compared with the limited-resource account offered by the strength model. Present findings provide clear evidence that the impairment of task performance observed in ego-depletion experiments coincides with increased perceptions of fatigue, difficulty, and effort. Such perceptions substantiate the greater demand that self-control tasks place on individuals' resources relative to control condition tasks and are often used as manipulation checks in the dual-task paradigm (Baumeister et al., 1998; Govorun & Payne, 2006). These findings also corroborate research in related fields. For example, significant relations have been found between cognitive performance and other indices of fatigue like sleep deprivation (Barber, Munz, Bagsby, & Powell, 2009; Drummond et al., 2005) and mental fatigue (Ackerman & Kanter, 2009). Fatigue therefore serves as an indicator of the increased demands that self-control tasks place on individuals. This is not inconsistent with a limited resource account for self-control failure. Self-regulation requires considerable effort, placing increased demands on self-control resources. The depletion of resources is likely to lead to subjective fatigue and a reason why subsequent attempts at self-control fail. The prospect of future tasks will also be perceived as more daunting when fatigued, so future self-control tasks appear more difficult. Fatigue is expected to serve as a mediating factor in the effect of self-control resource depletion on task performance (Muraven et al., 1998), but there have been no formal tests of this effect.

Reduced motivation has been proposed as a further alternative explanation for self-regulatory failure and fatigue may play an important supporting role. According to a motivation-only explanation, performing difficult and effortful tasks leads to a state of mental

fatigue and reduces the perceived importance of subsequent task goals relative to the expected effort required. This results in decreased motivation to perform subsequent tasks that are perceived to be difficult, effortful, and fatiguing. Analogously, providing incentives or emphasizing the importance of task goals increases motivation to engage in such tasks by providing reasons to overcome fatigue and invest effort in attaining task goals. Consistent with this theory, present findings indicate that incentives or raising the importance of task goals reduced the deleterious effect of ego depletion on self-control task performance. Motivation therefore provides a viable explanation for the decrements in task performance observed in ego-depletion experiments.

According to the strength model, the limited resource and motivational explanations for ego depletion are not irreconcilable. The depletion of a limited self-control resource may be involved in inducing perceptions of fatigue which, in turn, results in decreased motivation to exert future self-control and regulatory failure on subsequent tasks. There are two reasons for this effect from the strength model perspective. First, depletion of self-control resources leads to comparatively higher perceptions of the effort required to engage in future acts of self-control because doing so is relatively costly when resources are scarce compared to when they are plentiful. Second, engaging in self-control tasks reduces the availability of resources. This leads to increased motivation to conserve resources for times of need and reduced willingness to allocate further resources on tasks perceived to be unimportant. In contrast, providing incentives or increasing the importance of a task may result in increased motivation to commit further self-control resources to reach task goals in spite of the relatively high cost. Individuals are therefore more inclined to allocate their precious reserves because the task goal is perceived to be well worth the effort. However, while this integrated motivation and limited resource account may offer a solution in drawing together these competing explanations, the present synthesis does not provide unequivocal support for this model. The evidence presented here

suggests that a motivation-only account of self-regulatory failure in the dual-task paradigm holds as a viable alternative explanation to the strength model.

The problem is that self-control capacity as a limited resource has only ever been measured indirectly, meaning the ego-depletion effect has been exclusively inferred from post-depletion performance on self-control tasks. Current data, therefore, cannot verify whether the motivation-only and strength models provide exclusive explanations for the performance decrements observed on self-control tasks in ego-depletion experiments. Both models suggest that engaging in debilitating tasks is a source of fatigue and results in reduced motivation to engage in subsequent tasks. The motivation-only account suggests that the fatigue leads to a perceived imbalance between the effort required to achieve the goal and its value. The strength model suggests that this imbalance is due to reduced capacity to allocate depleted self-control resources to the task and increased motivation to conserve those resources. Until an objective measure of resource depletion has been identified, evidence to reconcile these competing explanations for the ego-depletion effect is likely to remain elusive.

Self-efficacy has also been proposed as an alternative explanation for ego depletion. People may have sufficient outcome expectancies regarding self-control tasks, but their perceived capacity to exert the necessary effort to attain task goals is diminished when in an ego-depleted state. The present analysis did not find a significant effect of self-efficacy on ego depletion. Furthermore, one study that attempted to change self-efficacy beliefs by providing bogus feedback regarding task performance found no significant effects (H. M. Wallace & Baumeister, 2002). Although the limited number of tests does not unequivocally rule out self-efficacy as a potential mediator of ego depletion, there is little support for it based on the evidence presented in the literature and in the current analysis.

A further alternative explanation for a decrease in performance across tasks may be due to negative affect. Present results revealed that negative affect is significantly related to ego

depletion, with a small, homogenous effect size. It seems that engaging in self-control tasks may induce negative affect, regardless as to whether the task itself requires affect regulation, which is consistent with expectations given their aversive nature (Tice & Bratslavsky, 2000). This would point to an explanation in which ego depletion was the result of coping with a negative affective state. Recent research has suggested that process behind the link between negative affective states and self-control failure is due to the depleting nature of active mood regulation. People are not able to commit resources to the second self-control task because attempts to regulate the negative affect induced by the initial task drains self-control resources (Bruyneel et al., 2009). Few studies in the present sample, however, reported relations between negative affect and task performance. This negated a formal test of mediation of the effect of ego depletion on task performance by negative affect. Although there are tests of this mediation effect in the in the ego-depletion literature (e.g., Gailliot et al., 2006), they are relatively uncommon and researchers are encouraged to investigate the mediating role of negative affect in future ego-depletion studies.

Engaging in effortful, aversive tasks in ego-depletion experiments was not related to positive affect. Ego depletion does not undermine positive mood in the same way that it appears to induce negative affect. However, research has found that inducing positive affect is effective in overcoming the deleterious effects of self-control resource depletion (Tice, Baumeister, Shmueli, & Muraven, 2007). Positive affect may lead to renewed vigor toward tasks such that individuals increase their efforts and motivation to expend self-control resources in their pursuit. Alternatively, the induction of a positive mood may obviate the need to commit self-control resources to overcome the negative affect induced by the self-control tasks. In contrast, there is evidence that inducing a positive mood does not promote better self-control (Schmeichel & Vohs, 2009). Tests of positive affect induction as means to overcome

ego depletion are relatively scarce and additional empirical investigation is warranted to resolve the inconsistency.

Additional Strength-Model Hypotheses

The present analysis also tested additional hypotheses that have emerged from the strength model. These hypotheses aim to provide a more complete explanation of self-regulatory failure from a resource depletion perspective and assist in developing an understanding of the mechanisms that underpin the ego-depletion effect. In this section we evaluate the extent to which these hypotheses are supported by the present meta-analysis and the implications for the strength model.

Conservation. The strength model proposes that people attempt to conserve self-control resources when they are aware of forthcoming demands on their reserves. The depletion of self-control in the strength model is viewed as temporary and may be due to either the complete depletion of finite self-control reserves or, alternatively, the result of partial depletion with people conserving their reserves for future exertions (Baumeister & Heatherton, 1996; Muraven & Baumeister, 2000). Present results support the partial-depletion model. Individuals tend to modulate the application of self-control resources when faced with the prospect of future demand. This is clearly adaptive from a limited resource perspective as it maximizes the application of self-control resources and produces economy of effort. It is also consistent with an integrated motivational and limited resource account for ego depletion. Just as incentives can increase motivation to invest increased effort and allocate further self-control reserves post-depletion, future expectation motivates the conservation of resources particularly when those reserves are depleted. This is because, when depleted, even a small outlay of resources is considered relatively costly. The sample of the effect sizes testing this hypothesis is comparatively small and from two studies (Muraven, Shmueli et al., 2006; Tyler & Burns,

2009), so it is important that this effect is replicated in a more diverse range of self-control tasks.

Training. According to the strength model, regular training on tasks requiring self-control will improve a person's capacity to exert self-control just as training a muscle increases its strength and endurance (Baumeister & Heatherton, 1996; Baumeister et al., 2000). As expected, our analysis indicated that regular training resulted in significantly superior post-depletion self-control performance relative to untrained controls. Importantly, a diverse range of training techniques to improve self-control was identified. This is important as it not only supports the training hypothesis, but provides further support for the premise that self-control draws from a common, global resource. Just as tasks from different spheres can deplete self-control strength, so regular training on self-control tasks in different spheres can help increase the capacity to exert self-control.

The mechanism that underlies the training hypothesis remains elusive. As yet, it is unclear whether training improves efficiency in the application of finite self-control resources to self-control tasks, perhaps through the development of self-control 'skills', or whether the pool is just extended such that more of the self-control resource is available. Future tests may examine the effect of training on repeated self-control tasks which may address the efficiency versus 'extended pool' question. This may also shed light on whether self-control is akin to a skill rather than a limited resource. Research may also examine whether ceasing training results in self-control capacity returning to baseline. This will provide useful further information on the processes by which training affects ego depletion and the longevity of the effect. Finally, future studies should seek to investigate whether the increase in self-control capacity as a result of training is linearly proportional to the duration of the training period. Preliminary evidence has been provided by Oaten and Cheng (2006b, 2007) who found steadily decreasing levels of ego depletion within trained participants at multiple time points during an extended training

intervention. Additional multi-cohort within-participants training studies may provide further data to support this hypothesis.

Recovery. In the original conceptualization of the strength model, Baumeister and colleagues (Baumeister & Heatherton, 1996; Muraven & Baumeister, 2000) proposed that sufficient recovery is necessary after resource depletion for self-regulatory capacity to be restored. We investigated this in present analysis by coding studies as those that required the completion of questionnaires between tasks, equivalent to a brief rest, a filler task or rest period between self-control tasks, and those that reported no interim period. Ego depletion did not vary across the questionnaire completion and filler task groups while, contrary to hypotheses, the no reported interim group had lower levels of ego depletion. These results seem to suggest that immediate engagement in tasks results in less resource depletion, which is inconsistent with the recovery hypothesis. As we emphasized earlier, our coding of inter-task duration was relatively crude as there is likely to be considerable inter-individual variation in questionnaire and filler task completion time. Furthermore, the non-reporting of an interim period is not equivalent to the absence of an interim period. A more effective means to test the role of recovery on ego depletion would be the inclusion of recovery or relaxation manipulations in the dual-task paradigm. Studies have demonstrated reduced ego depletion among participants receiving recovery manipulations (Oaten et al., 2008; Tyler & Burns, 2008), but there were insufficient effects for a meta-analysis. There is clearly a need for additional studies testing the role of recovery and relaxation. There is also a need to examine the effect of chronic lack of recovery on self-control capacity. For example, Baumeister and Heatherton (1996) suggested that sleep may assist in recovery from self-control resource depletion, while sleep deprivation may lead to failure to recover and lead to a chronic state of ego depletion (C. Anderson, 2009; Barber et al., 2009; Wright, 2009).

Glucose and glucose supplementation. A recent avenue of inquiry in the pursuit of the mechanisms that govern ego depletion has been the identification of physiological mediators and moderators. Most prominent is the proposed role of blood glucose as a mediator of the effect of ego depletion on self-control task performance in the dual-task paradigm (Dvorak & Simons, 2009). Gailliot and Baumeister (2007a) have suggested that as self-control tasks require increased cerebral functioning, they may cause a concomitant rise in the demand for glucose in the brain (Benton, Parker, & Donohoe, 1996; Green, Elliman, & Rogers, 1997). They propose that changes in blood glucose levels as a consequence of engaging in self-control tasks in dual-task paradigm experiments may serve as a proxy measure of this demand. Results of the present meta-analysis indicate that blood glucose levels were significantly associated with ego depletion. However, there are two caveats to bear in mind when interpreting these findings. First, the data are from a limited number of effect sizes ($k = 5$) and only two studies (Dvorak & Simons, 2009; Gailliot, Baumeister et al., 2007), albeit from separate laboratories. Second, the studies did not measure glucose consumption in the brain which would be necessary to validate the proposed mechanism. Conclusions based on these data should not, therefore, be treated as unequivocally supportive of glucose as a physiological indicator of the ego-depletion effect.

An additional finding in the present analysis was that glucose supplementation allayed the effects of ego depletion on self-control task performance. This also provides limited evidence for glucose as a control mechanism for self-regulatory resource depletion. Nevertheless, there may be number of plausible alternative explanations for this effect. For example, the consumption of beverages rich in sugar is associated with increased positive affect (Benton, 2002) and may have resulted in a concomitant increase in motivation to perform subsequent tasks. Similarly, researchers have also proposed that it is the perception of glucose in the mouth cavity, as opposed to ingestion and substrate use, that leads to increased exertion on tasks (Pottier, Bouckaert, Gilis, Roels, & Derave, 2010). In summary, while

present results provide preliminary evidence that blood glucose and glucose supplementation are implicated in the effect of ego-depletion on self-control task performance, the aforementioned caveats and alternative explanations mean that these findings should be regarded as tentative and not indicative of direct evidence for role of glucose as a mechanism for the ego-depletion effect.

Limitations and Future Directions

A limitation of the present analysis is that some of the effect sizes reported were based on relatively small sample sizes. As simulation studies have demonstrated that meta-analyses based on small samples of studies tend to bias the effect size upwards (Reynolds & Day, 1984), caution should be exercised in interpreting the size of the effects in some of the sub-analyses in the present research. In particular, analyses of the conservation, training, and glucose supplementation moderator groups were based on sets of studies numbering as few as five. Although these effects were corrected for statistical artefacts, the potential for one or two effects to alter the size and distribution of the averaged effect size remains. Replication of these effects in different spheres of self-control should be a priority for future investigation.

The present meta-analysis has assisted in identifying gaps in the ego depletion literature and priorities for future research. An outstanding issue is the longevity of the ego-depletion effect and need to reconcile the long- and short-term effects of self-control resource depletion. Baumeister and coworkers (Baumeister et al., 1998; Muraven et al., 1998) explicitly align the strength model with short-term depletion of self-control resources. It is clear that the dual-task paradigm and experimental tests of the theory have been geared toward testing such a model by adopting tasks typically less than 10 minutes in duration (Vohs et al., 2008). However, it is unclear what effects chronic self-control efforts have on ego depletion. It is difficult to distinguish between conditions that lead to the observation of a training effect and improvements in self-control and those that lead to long-term fatigue and decrements in self-

control performance. For example, Vohs and Heatherton (2000) proposed that “repeated attempts at inhibition render a person especially vulnerable to situational temptations” (p. 249). They surmised that long-term dieters were compelled to engage in the chronic inhibition of the impulse to eat and would therefore be more vulnerable to depletion. In contrast, the training hypothesis proposes that long-term practice on self-control increases resistance to the deleterious effects of self-control exertion on task performance (Muraven et al., 1999; Oaten & Cheng, 2006a, 2006b, 2007). If the latter is the case, would dieters not be expected to be more effective in controlling their desire to eat if they have had long-term experience with resisting temptation? A possible reason for this inconsistency may be differences in the relative frequency and success of the long-term inhibitory experiences. Training effects have usually been observed after a series of relatively discrete and planned acts of self-control with sufficient recovery allowing for gradual improvement. Furthermore, in training studies participants are invariably successful in the self-control tasks they perform. The self-control acts are therefore experienced as finite quanta of successful self-regulation with sufficient time for recovery before the next act. In contrast, long-term acts of self-control in real-world contexts like dieting are likely lead to frequent and unplanned attempts to resist temptations throughout the day. Furthermore, there is likely to be greater variation in the frequency of success and dieters may experience long-term failed attempts to self regulate with little opportunity to recover. In strength model vernacular, this may be the equivalent of ‘overtraining’ resulting in a chronically-depleted state. Empirical support for these proposed mechanisms is necessary to resolve this inconsistency.

Further research is also required to identify the conditions that lead to the attenuating effect of motivation on ego depletion. If motivation compels individuals to tap further into their finite self-control reserves, as suggested by the findings of the present analysis, it is unlikely that they will be able to stave off the depleting effects of self-control tasks indefinitely.

Evidence for this comes from research demonstrating that performance on vigilance tasks steadily declines over time (See et al., 1995). The effect of motivation on repeated bouts of self-control exertion needs to be tested to delineate the boundary conditions of motivation as a strategy to allay ego depletion. It is also important that the conservation of self-control resources is studied in conjunction with motivation. For example, will people anticipating a future self-control task still conserve their self-control resources if they are provided with an incentive to perform the second task? Or will they forego the tendency to conserve resources and expend more of their reserves because they have increased motivation to perform the task?

The present analysis did not include individual differences in self-control as a moderator of the ego-depletion effect due to the limited number of tests of the effect. Research suggests that dispositional self-control may moderate the deleterious effects of situationally-induced self-control resource depletion on subsequent task performance (Dvorak & Simons, 2009; Friese & Hofmann, 2009; Gailliot & Baumeister, 2007b; Gailliot, Schmeichel et al., 2007). This is consistent with a limited capacity model of self-control. Dispositional self-control likely reflects the extent of an individual's self-control reserves and therefore determines the potential resources available for allocation to self-control tasks. This trait-level capacity has also been related to long-term self-regulatory efforts (Tangney et al., 2004). Future research needs to provide further tests of the interaction between ego depletion and trait self-control on task performance using the dual-task paradigm. This will assist in further integrating dispositional and situational influences on self-control performance.

The strength model may provide only a partial explanation for self-control failure. Current data support a limited resource account for short-term self-control depletion, but do not unequivocally support or falsify alternative explanations such as motivation-only and coping with negative affect. Integrating the strength model with other theories may provide more comprehensive explanations of self-regulation. For example, theorists have recently proposed

the integration of the strength model and dual-process models of behavioral decision making (Dvorak & Simons, 2009; Hagger, Wood, Stiff, & Chatzisarantis, 2009; Masicampo & Baumeister, 2008; Pocheptsova et al., 2009). In such models, behavior is viewed as a function of effortful, intentional decisions that require deliberation and information processing (reflective route) and reactive responses that are spontaneous, unplanned and rely on heuristic processing (impulsive route) (Hofmann, Friese, & Strack, 2009; Hofmann, Friese, & Wiers, 2008; Strack & Deutsch, 2004). Self-control is conceptualized as a deliberate and intentional attempt to override and gain control over impulsive responses driven by situational cues and immediate rewards. Engaging in behaviors that require overcoming dominant responses and focused commitment on long-term goal attainment is therefore most effectively controlled by the reflective route requiring motivation and effort. Resource depletion may be a mechanism that determines whether actions are determined by reflective rather than impulsive routes to behavior. A lack of self-control resources decreases the propensity of the reflective pathway to override the influence of the impulsive pathway on behavior. This is likely to result in behavior becoming increasingly determined my the impulsive route and reduced persistence on long-term, planned behaviors (Dvorak & Simons, 2009). These developments are the beginnings of endeavors to unify theories of self-control to resolve inconsistencies and provide complementary explanations of behavior.

Conclusion

The present meta-analysis provides evidence to suggest that the strength model is a useful explanatory system to understand self-control, but further refinements may be necessary, particularly when it comes to the identification of mechanisms. For example, the present analysis could not unequivocally rule out other explanations for ego depletion such as motivation-only and negative affect. These alternatives are not necessarily inconsistent with a resource depletion account and may provide insight into the possible processes that underpin

ego depletion. It is also important to note that support for self-control as a limited resource has only ever been inferred indirectly from performance decrements on self-control tasks (Schmeichel, Demaree, Robinson, & Pu, 2006). Identifying physiological analogs for ego depletion may offer a potential solution. The finding that blood glucose varies with ego depletion, for example, provides preliminary evidence linking self-control strength to a physical resource (Dvorak & Simons, 2009; Gailliot, Baumeister et al., 2007). These results have been complemented by research that has linked physiological analogs for effort including electromyographic activity (Bray et al., 2008), cardiovascular response (Segerstrom & Nes, 2007; Wright et al., 2008), and galvanic skin response (Sheppes, Catran, & Meiran, 2009) with ego depletion. Such evidence is consistent with Baumeister and coworkers' (1998) prediction that it is "implausible that ego depletion would have no physiological aspect or correlates at all" (p. 1263). Practically, these explanations and mechanisms may provide insight into strategies that can be used to overcome ego depletion. Intervention techniques to increase motivation and promote regular practice on self-control tasks are means that have been suggested to improve self-control capacity (Hagger et al., 2009; Hui et al., 2009; Muraven & Slessareva, 2003). The strength model offers promise in identifying strategies to minimize short-term decrements in self-control and assist in developing interventions that foster better self-regulation.

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Footnotes

[1]Self-control is defined as the individual's capacity to alter, modify, change, or override his or her impulses, desires, and habitual responses (Baumeister & Heatherton, 1996). Quite literally, it is the ability of the self to exert control over the self. Other terms often considered synonymous with self-control include *willpower*, *self-discipline*, and *self-regulation* (Duckworth & Seligman, 2005; Henden, 2008; Mischel, 1996). Self-control and self-regulation, in particular, are often used interchangeably in the literature (Baumeister et al., 2007; Hofmann et al., 2007). Self-control can be viewed as a specific case of self-regulation in which the person exerts deliberate and conscious effort to control the self, while self-regulation is a global term that also encompasses reflexive and non-conscious regulatory processes such as homeostasis (Baumeister et al., 2007). For the purpose of this article we will confine our definition of self-control as the individual's effortful capacity to regulate their emotions, thoughts, impulses, or other well-learned or automatic behavioral responses (Vohs, 2006).

[2]We also conducted our meta-analyses using a fixed-effects meta-analytic method (Hedges & Olkin, 1985). Effect-sizes and confidence intervals computed for the overall ego-depletion effect and the moderator group, additional variables, and strength model hypotheses analyses were not appreciably different from those produced using a random effects model. Data for the fixed-effects analyses are available on request from the first author.

[3]We would like to thank an anonymous reviewer for this suggestion.

[4]Appendices A, B, and C are made available as online supplementary materials [URL to be reported here].

[5]Five effect sizes were included in the analysis testing the effect of ego depletion on blood glucose. The effect sizes are not reported in Appendix B as few of the studies involved in the blood glucose analysis were included in the meta-analysis of the overall ego-depletion effect. The effect sizes were from studies 3 (d = 1.64, n = 16), 4 (d = 1.23, n = 12), 5 (d = 0.96,

n = 23), and 6 (d = 0.89, n = 17) in Gailliot et al.'s (2007) article and Dvorak and Simons' (2009) study (d = 0.69, n = 90).

[6]The modified Stroop task was the only specific self-control depleting task that exhibited significant heterogeneity with a mean effect size significantly lower than those in the other depleting task moderator groups. This pattern mirrored the pattern of effect sizes for tasks in the controlling impulse and affective groups in the spheres of depleting task moderator analysis. We therefore tested whether studies adopting the Stroop task were responsible for the heterogeneity and significantly lower averaged effect sizes observed in these spheres by omitting studies adopting the Stroop task (k = 13) from the controlling impulse and affective moderator analyses. Re-estimating the meta-analysis revealed that omitting these tasks did not lead to a substantive change in the averaged effect size or an appreciable narrowing of the confidence intervals for the controlling impulses (d^+ = 0.62, CI_{95} = 0.51, 0.74, $Q(47) = 95.16$, $p < .001$) and affective (d^+ = 0.62, CI_{95} = 0.54, 0.70, $Q(74) = 129.47$, $p < .001$) spheres of depleting task. The substantial heterogeneity remained.

[7]We also examined relations among the specific and global task sphere and frequently-used tasks moderator variables across depleting and dependent task types. This was to evaluate whether there was a tendency for experimenters to adopt tasks from the same sphere for the depleting and dependent tasks in the dual-task paradigm. We found no association for any combination of these variables pointing to the independence of these moderators. This was consistent with the null finding in the moderator analysis in which depleting and dependent tasks were coded as matched on task sphere. Taken together, these results indicate that experimenters in the present sample of studies tended to adopt depleting and dependent tasks from different spheres of self-control and demonstrate their utility in testing the generality of the ego-depletion effect.

[8]A list of references included in the meta-analysis is available as online supplementary materials [URL to be reported here].

Table 1

Characteristics of Studies Used in Meta-Analyses Testing Additional Hypotheses

Hypothesis	Author	Study	N	d^a
Conservation				
Future self-control	Muraven, Shmueli & Burkley (2006)	1	46	0.91
		2	34	1.04[b]
		3	31	0.66[b]
		4	38	0.61[c]
	Tyler & Burns (2009)	1	41	2.53[b]
		2	30	1.70[d]
		3	40	1.00[e]
Motivation	Moller, Deci & Ryan (2006)	1	24	1.05[f]
		2	24	3.75[f]
		3	30	3.84[f]
	Muraven, Gagne & Rosman (2008)	1	16	4.59[f]
		2	44	0.65[f]
		3	48	0.78[g]
	Muraven & Slessareva (2003)	1	43	0.60[h]
		2	41	0.92[h]
		3	24	0.89[h]
	Stewart, Wright, Hui & Simmons (2009)		42	0.72[i]
Training	Finkel et al. (2009)	5	40	0.82[j]
	Gailliot, Plant, Butz & Baumeister (2007)	1	20	0.99[k]
		2	22	0.91[k]
		4	52	0.50[k]
	Hui, Wright, Simmons, Eaton & Nolte (2009)		42	0.48[l]
	Muraven, Baumeister & Tice (1999)		69	0.57[k]
	Oaten & Cheng (2006a)		45	8.59[m]
	Oaten & Cheng (2006b)		24	3.13[n]
	Oaten & Cheng (2007)		49	5.97[o]
Glucose supplementation	Dewall, Baumiester, Gailliot & Maner (2008)	2	30	0.96[p]
	Gailliot et al. (2007)	8	73	0.55[q]
		9	18	1.57[r]
	Gailliot, Peruche, Plant & Baumeister (2009)		51	0.69[s]
	Masicampo & Baumeister (2008)		57	0.77[t]

Note. [a]Ego-depletion effect from dual-task paradigm for depleted participant group in the presence and absence of moderator (future self-control, motivation, training, and glucose supplementation). [b]Expect future self-control task vs. expect no future self-control task conditions. [c]Expect future self-control task vs. expect future hard task conditions. [d]Average effect size for 3-minute and 10-minute actual task duration vs. 20-minute actual task duration. [e]Experiment finished vs. experiment unfinished conditions. [f]Autonomy vs. controlled motivational conditions. [g]Pressure vs. no pressure conditions. [h]Motivation vs. no motivation condition, motivational manipulations included increasing interest in the final task, highlighting the benefits of practice, and provision of monetary incentives. [i]High expectancy of reward vs. low expectancy of reward conditions. [j]Effect size is overall effect of regulation training between self-control exercise vs. control groups, self-control training required participants to engage in either verbal (avoid colloquialisms, slang, abbreviated, and shorthand terms) or physical regulation (use of non-dominant hand for everyday tasks) over a

period of two weeks. [k]Self-control exercise vs. no exercise condition, self-control exercises required modification of speech, modification of posture, control of emotions, monitoring eating habits, and avoiding use of colloquialisms over a period of two weeks. [l]Effect size is average across crossing-out-letter and cold-pressor dependent tasks between the strong training vs. no training groups, self-control exercises required participants to engage in an incongruent Stroop task and rinse their mouth with Listerine for 30 seconds twice a day over a period of two weeks**.** [m]Self-control exercise (cohort 1) vs. no exercise (cohort 2) groups, self-control exercises required participants to engage in a regular program of study including self-imposed deadlines, a study schedule, and use of a study register and diary to enhance self-monitoring over a period of two months. [n]Self-control exercise (cohort 1) vs. no exercise (cohorts 2 & 3) groups, self-control exercises required participants to engage in a regular tailored program of physical activity prescribed by a gym instructor over a period of two months. [o]Self-control exercise (cohort 1) vs. no exercise (cohort 2) groups, self-control exercises required participants to engage in a personal financial management program including spending diaries and program logs over a period of four months. [p]Effect size is average effect of supplementation (glucose vs. placebo) condition on word fragments task performance for participants in the high depletion (mortality salience) condition. [q]Effect size is average effect of supplementation (glucose vs. placebo) condition on self-reported willingness to help after participants had completed an examination as part of their psychology course. [r]Effect size is average effect of supplementation (glucose vs. placebo) condition on number of voluntary helping hours given for participants in the high depletion (attention control) condition. [s]Effect size is average effect of supplementation (glucose vs. placebo) condition on number of prejudiced statements given for participants high in prejudiced attitudes. [t]Effect size is average effect of supplementation (glucose vs. placebo) condition on choice of apartment (attraction effect) for participants in the high depletion (attention control) condition.

Table 2

Results of Meta-Analysis of Ego-Depletion

Effect	*k*	N	d^+	d^+ CI_{95}		SD	SE	N_{FS}	Var[a]	*Q*	I^2	I^2 CI_{95}	
				LL	*UL*							*LL*	*UL*
Overall ego-depletion effect	198	10782	0.62	0.57	0.67	0.20	0.02	50445	65.61	301.79***	34.72	22.14	45.27
Other dependent variables													
Effort	31	1835	0.64	0.47	0.80	0.39	0.09	1383	32.62	95.04***	69.49	55.69	78.99
Positive Affect	67	4033	-0.03	-0.12	0.05	0.28	0.05	0	45.86	146.09**	54.82	40.48	65.71
Negative Affect	36	2237	0.14	0.06	0.22	0.13	0.04	55	78.72	45.73	23.46	0.00	49.56
Perceived difficulty	58	3597	0.94	0.73	1.14	0.72	0.10	12994	12.70	456.57***	87.52	84.62	89.86
Subjective fatigue	26	1809	0.44	0.26	0.63	0.41	0.09	554	26.64	97.61***	74.39	62.44	82.54
Self-efficacy	5	210	0.16	-0.19	0.51	0.25	0.18	0	61.76	8.10	50.62	0.00	81.88
Blood glucose	5	158	-0.87	-1.20	-0.54	0.00	0.17	28	100.00	2.83	0.00	–	–
Strength model hypotheses													
Conservation hypothesis													
Future self-control	7	260	1.04	0.78	1.30	0.15	0.13	106	83.28	8.41	28.66	0.00	69.31
Motivation	10	336	1.05	0.49	1.61	0.83	0.29	301	17.82	56.12***	83.96	72.08	90.79
Training hypothesis	9	363	1.07	0.10	2.03	1.43	0.49	567	6.48	138.98***	94.24	91.09	96.28
Glucose supplementation	5	229	0.75	0.48	1.03	0.00	0.14	32	100.00	3.36	0.00	–	–

Note. [a]Percent variance attributed to sampling error variability; *k* = Number of effect sizes in meta-analysis; N = total sample size in meta-analysis; d^+ = averaged corrected standardized difference effect size; CI_{95} = 95% confidence intervals; *LL* = Lower limit of confidence interval; *UL* = Upper limit of confidence interval; SD = Residual standard deviation of d^+; SE = Standard error of d^+; N_{FS} = Fail safe N; *Q* = Cochran's (1952) *Q* Statistic; I^2 = Higgins and Thompson's (2002) I^2 statistic.

* $p < .05$ ** $p < .01$ *** $p < .001$

Table 3

Results of Moderator Analyses

Moderator	*k*	N	d^+	d^+ CI_{95}		SD	SE	N_{FS}	Var[a]	*Q*	I^2	I^2 CI_{95}	
				LL	*UL*							*LL*	*UL*
Sphere of depleting task													
Specific task classification[b]													
Controlling emotions	24	1146	0.62	0.50	0.74	0.19	0.06	636	71.28	33.67	34.69	0.00	58.51
Controlling thoughts	25	1212	0.63	0.53	0.75	0.00	0.06	708	100.00	18.16	0.00	–	–
Controlling impulses	61	3956	0.55	0.46	0.64	0.27	0.05	4434	47.56	128.26***	53.22	37.39	65.05
Controlling attention	21	1078	0.65	0.50	0.81	0.22	0.08	569	63.80	10.68	0.00	–	–
Choice and volition	12	475	0.82	0.62	1.00	0.00	0.10	213	100.00	8.87	0.00	–	–
Cognitive processing	13	615	0.54	0.29	0.80	0.35	0.13	136	42.42	30.64**	60.84	28.21	78.63
Social processing	38	1966	0.75	0.65	0.84	0.00	0.05	1471	100.00	30.69	0.00	–	–
Global classification[c]													
Affective	88	5351	0.57	0.49	0.64	0.24	0.04	9086	53.79	163.59***	46.82	31.66	58.61
Cognitive	71	3380	0.65	0.57	0.73	0.18	0.04	6237	74.56	95.23*	26.49	0.78	45.55
Affective and cognitive	39	2051	0.73	0.64	0.83	0.00	0.05	2512	100.00	32.56	0.00	–	–
Frequently used depleting tasks													
Crossing-out-letters	20	1101	0.77	0.65	0.90	0.15	0.06	760	77.88	25.68	26.01	0.00	57.09
White bear paradigm	19	932	0.65	0.52	0.78	0.00	0.07	432	100.00	16.72	0.00	–	–
Video-watching affect regulation[d]	19	963	0.55	0.42	0.68	0.00	0.07	315	100.00	18.83	0.00	–	–
Video-watching attention control[e]	19	1006	0.61	0.48	0.74	0.14	0.06	411	79.54	23.89	24.65	0.00	56.83
Modified Stroop	13	1322	0.40	0.26	0.55	0.18	0.07	160	56.50	23.01*	47.85	72.55	0.91
Interim period													
Completed questionnaires	119	5726	0.71	0.65	0.77	0.18	0.03	20948	73.47	161.96**	27.14	8.06	42.26
Filler task and/or break between tasks	24	1115	0.72	0.60	0.85	0.00	0.06	6662	100.00	22.30	0.00	–	–
No interim period reported	55	3941	0.47	0.39	0.55	0.17	0.04	2876	66.11	83.19**	35.08	9.57	53.40
Experiment presentation													
Presented as single experiment	134	7413	0.58	0.53	0.64	0.19	0.03	20455	68.40	195.91***	32.11	15.75	45.30

Presented as separate experiment	64	3369	0.71	0.63	0.80	0.21	0.04	6627	66.12	96.80***	34.92	11.45	52.17
Administered by same experimenter	183	10133	0.61	0.56	0.66	0.21	0.03	41876	64.54	283.55***	35.81	22.96	46.52
Administered by different experimenters	15	649	0.86	0.69	1.01	0.00	0.07	404	100.00	9.76	0.00	–	–
Sphere of dependent task													
Specific classification[f]													
Controlling impulses	104	4836	0.71	0.64	0.78	0.21	0.03	15427	68.84	151.07**	31.82	12.89	46.63
Choice and volition	8	1300	0.22	0.11	0.33	0.00	0.06	23	100.00	4.19	0.00	–	–
Cognitive processing	47	2505	0.60	0.52	0.67	0.00	0.04	2470	100.00	43.03	0.00	–	–
Social processing	33	1934	0.69	0.60	0.78	0.00	0.05	1797	100.00	29.11	0.00	–	–
Global classification													
Affective	107	4945	0.71	0.64	0.78	0.21	0.04	16366	68.72	155.70**	31.92	13.33	46.53
Cognitive	58	3903	0.48	0.40	0.55	0.17	0.04	3106	67.66	85.73**	33.51	8.01	51.94
Affective and cognitive	33	1934	0.69	0.60	0.78	0.00	0.05	1797	100.00	29.11	0.00	–	–
Frequently used dependent tasks													
Handgrip	18	872	0.64	0.45	0.83	0.28	0.10	407	53.18	33.85**	49.78	13.52	70.84
Modified Stroop	15	633	0.76	0.59	0.94	0.16	0.09	306	80.88	18.55	24.53	0.00	59.25
Food taste test	10	527	0.50	0.33	0.68	0.16	0.09	71	75.71	13.21	31.87	0.00	67.48
Math or mental arithmetic	10	447	0.50	0.31	0.69	0.00	0.10	55	100.00	7.80	0.00	–	–
Solvable anagram	10	670	0.60	0.44	0.76	0.08	0.08	128	91.43	10.94	17.73	0.00	58.74
Matched depleting and dependent tasks													
Specific classification													
Matched	40	1881	0.59	0.48	0.71	0.23	0.06	1565	63.60	62.90**	38.00	8.99	57.76
Unmatched	158	8901	0.63	0.58	0.68	0.20	0.03	33925	66.25	238.49***	34.17	19.79	45.97
Global classification													
Matched	68	3226	0.61	0.52	0.70	0.21	0.04	5067	67.92	100.12**	33.08	9.60	50.46
Unmatched	130	7556	0.63	0.57	0.69	0.20	0.03	23300	64.51	201.52***	35.99	20.54	48.43
Type of dependent task													
Behavioral self-control measure	170	9096	0.62	0.56	0.67	0.22	0.03	35689	61.91	274.61***	38.46	25.77	48.97
Non-behavioral judgment measure	28	1686	0.66	0.56	0.76	0.00	0.05	1231	100.00	26.44	0.00	–	–
Control condition task[g]													
Easier version	170	9272	0.62	0.56	0.67	0.23	0.03	36526	60.03	283.19***	40.32	28.13	50.44

Individual difference	21	1194	0.66	0.54	0.78	0.00	0.06	618	100.00	11.37	0.00	–	–
Alternative	5	274	0.53	0.29	0.77	0.00	0.12	16	100.00	0.23	0.00	–	–
Task complexity													
Complex	27	1495	0.65	0.54	0.75	0.00	0.05	972	100.00	26.44	0.00	–	–
Simple	9	407	0.35	0.15	0.55	0.00	0.10	16	100.00	5.93	0.00	–	–
Source laboratory													
Baumeister	98	5906	0.60	0.53	0.66	0.21	0.03	12425	61.99	158.08***	38.64	21.51	52.02
Other	100	4876	0.66	0.59	0.72	0.19	0.04	12758	70.71	141.43**	30.00	10.01	45.55

Note. [a]Percent variance attributed to sampling error variability. [b]Two studies (k = 4) were omitted from the specific classification analysis because two depleting self-control tasks in different spheres were used concurrently (Fischer et al., 2007, Studies 1, 2, and 4; Ostafin, Marlatt, & Greenwald, 2008). [c]The studies that used depleting tasks in two spheres were classified into the affective (Fischer et al., 2007, Studies 1, 2, & 4) or combined affective and cognitive (Ostafin et al., 2008) moderator groups for the global classification analysis. [d]One study (k = 3) was omitted from this analysis because the emotion regulation tasks were used in conjunction with tasks in another sphere (Fischer et al., 2007, Studies 1, 2, & 4). [e]One study (k = 3) was omitted from this analysis because the attention control task was used in conjunction with a task in another sphere (Fischer et al., 2007, Studies 1, 2, and 4). [f]Three moderator groups had four or fewer effect sizes and were deemed unsuitable to be included in the analysis: Controlling emotions (k = 3; Muraven et al., 1998, Study 3; Schmeichel, 2007, Study 3; Vohs et al., 2005, Study 3), controlling attention (k = 3; Muraven et al., 2008, Studies 1 & 3; Muraven, Shmueli et al., 2006, Study 2), and controlling thoughts (k = 0). [g]Only two effect sizes were available for the moderator group in which participants allocated to the control condition did not engage in any task (Baumeister et al., 1998, Study 2; Burkley, 2008, Study 2), so this moderator group was omitted from the analysis. k = Number of effect sizes in meta-analysis; N = total sample size in meta-analysis; d^+ = averaged corrected standardized difference effect size; CI_{95} = 95% confidence intervals; *LL* = Lower limit of confidence interval; *UL* = Upper limit of confidence interval; SD = Residual standard deviation of d^+; SE = Standard error of d^+; N_{FS} = Fail safe N; Q = Cochran's (1952) Q Statistic; I^2 = Higgins and Thompson's (2002) I^2 statistic.

* $p < .05$ ** $p < .01$ *** $p < .001$

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Appendix A

Taxonomy of Depleting and Dependent Self-Control Tasks for the Dual-Task Paradigm Experiments Included in the Meta-Analysis

Task sphere						
Affective		Cognitive				Affective and cognitive
CE	CI	CA	CP	CT	CV	SP
Depleting task						
Regulate affect while presented with emotive video or pictures[a,b] (Baumeister, Bratslavsky, Muraven, & Tice, 1998, Study 3; Finkel & Campbell, 2001, Study 2; Fischer, Greitemeyer, & Frey, 2007, Studies 1, 2 & 4; 2008, Study 4; Friese, Hofmann, & Wanke, 2008, Studies 2 & 3; Hofmann, Rauch, & Gawronski,	Crossing-out-letters task[a] (Baumeister et al., 1998, Study 4; DeWall, Baumeister, Gailliot, & Maner, 2008, Studies 1 & 3; DeWall, Baumeister, Stillman, & Gailliot, 2007, Study 4; Fennis, Janssen, & Vohs, 2009, Study 4; Fischer et al., 2007, Study 3; 2008, Study 3; Gailliot & Baumeister, 2007, Study 2; Legault, Green-Demers, & Eadie, 2009, Study 2; Muraven, 2008, Study 1; Tice, Baumeister, Shmueli, & Muraven, 2007, Study 2; Tyler, 2008, Study 3; Tyler & Burns, 2009, Studies 2S1, 2S2 & 2S3; Wan & Sternthal, 2008, Studies 1, 2, 3 & 4; Wheeler, Brinol, & Hermann, 2007) (20)	Focusing attention on subject and not displayed words while watching a video (DeWall et al., 2008, Study 2; DeWall et al., 2007, Study 2; Finkel, DeWall, Slotter, Oaten, & Foshee, 2009, Study 4; Fischer et al., 2007, Studies 1, 2 & 4; 2008, Study 1; Gailliot & Baumeister, 2007, Study 3; Gailliot, Baumeister et al., 2007, Study 7;	Paced forward (low fatigue)/backward (high fatigue) counting task (Wright et al., 2007, Studies 1S1, 1S2, 2S1 & 2S2; Wright, Martin, & Bland, 2003, S1 & S2) (6)	Suppressing thoughts of a 'white bear' (Burkley, 2008, Studies 3 & 4; Fischer et al., 2007, Study 5; 2008, Study 2; Gailliot et al., 2006, Study 2; Muraven, Collins, & Nienhaus, 2002; Muraven, Shmueli, & Burkley, 2006, Study 1; Muraven & Slessareva, 2003, Study 1; Muraven et al., 1998, Studies 2 & 3; Seeley &	Making product choices (Bruyneel, Dewitte, Vohs, & Warlop, 2006, Studies, 1, 2 & 3; Vohs et al., 2008, Studies 1a, 1b, 2 & 6) (7)	Suppressing stereotypical thoughts of prejudiced groups (e.g. homosexuals, obese, old people, foreigners) (Gailliot, Plant, Butz, & Baumeister, 2007, Studies 1, 2 & 3; Gordijn, Hindriks, Koomen, Dijksterhuis, & Van Knippenberg, 2004, Studies 2 & 4; Oikawa, 2005, Studies 1 & 2) (7)

2007; Inzlicht & Gutsell, 2007; Joireman, Balliet, Sprott, Spangenberg, & Schultz, 2008, Study 3; Martijn, Tenbult, Merckelbach, Dreezens, & de Vries, 2002; Muraven, 2008, Study 2; Muraven & Slessareva, 2003, Study 3; Muraven, Tice, & Baumeister, 1998, Study 1; Ostafin, Marlatt, & Greenwald, 2008; Schmeichel, 2007, Study 4; Schmeichel, Demaree, Robinson, & Pu, 2006; Schmeichel, Vohs, & Baumeister, 2003, Study 2; Shamosh & Gray, 2007; Vohs, Gailliot, Schmeichel, & Baumeister, 2006, Study 3; Janssen, Fennis, Pruyn, & Vohs, 2008, Study 2; Masicampo & Baumeister, 2008; Pocheptsova, Amir, Dhar, & Baumeister, 2009, Studies 3 & 4; Schmeichel, 2007, Studies 1S1 & 1S2; Schmeichel & Vohs, 2009, Study 2; Schmeichel et al., 2003, Studies 1 & 3; Stillman, Tice, Fincham, & Lambert, 2009, Study 3; Vohs et al., 2005, Study 8; Vohs & Faber, 2007, Study 1) (22)

Gardner, 2003, Studies 1 & 2; Stillman et al., 2009, Study 1; Tyler, 2008, Study 4; Tyler & Burns, 2008, Study 2; 2009, Study 3; Vohs et al., 2005, Study 5; Vohs & Faber, 2007, Study 2; Vohs & Schmeichel, 2003, Study 4) (19)

Baumeister, & Ciarocco, 2005, Study 6; Vohs & Heatherton, 2000, Study 3; Zyphur, Warren, Landis, & Thoresen, 2007, Study 2) (23)						
Reading book passage aloud in emotionally expressive fashion (Gailliot, Schmeichel, & Maner, 2007, Study 1; Vohs & Faber, 2007, Study 3; Vohs & Schmeichel, 2003, Study 3) (3)	Modified Stroop task performance[c] (Bray, Ginis, Hicks, & Woodgate, 2008; Bruyneel, Dewitte, Franses, & Dekimpe, 2009, Study 2; DeWall et al., 2007, Study 3; Gailliot & Baumeister, 2007, Study 1; Govorun & Payne, 2006; Mead, Baumeister, Gino, Schweitzer, & Ariely, 2009, Study 2; Muraven, Rosman, & Gagne, 2007, Study 3; Neshat-Doost, Dalgleish, & Golden, 2008; Pocheptsova et al., 2009, Studies 1 & 2; Vohs et al., 2005, Study 7; Wallace & Baumeister, 2002; Webb & Sheeran, 2003, Study 1) (13)	Arithmetic task with/without auditory interference (Alberts, Martijn, Greb, Merckelbach, & de Vries, 2007, Study 2; Geeraert & Yzerbyt, 2007, Study 2b) (2)	Easy/difficult labyrinths task (Alberts et al., 2007, Study 1; Martijn et al., 2007) (2)	Suppressing thoughts of death (Gailliot, Baumeister et al., 2007, Study 8; Gailliot et al., 2006, Studies 6, 7S1, 7S2, 8 & 9) (6)	Forced-choice essay task (Baumeister et al., 1998, Study 2; Moller, Deci, & Ryan, 2006, Study 1) (2)	High-maintenance social interaction tasks (Finkel et al., 2006, Studies 1, 2, 3, 4, & 5; Zyphur et al., 2007, Study 1) (6)
Regulating negative affect when describing a situation (Bruyneel et al.,	Appetizing/unappetizing food taste perception task (Baumeister et al., 1998, Study 1; DeWall et al., 2007, Study 1; Geeraert & Yzerbyt, 2007, Study		Performing arithmetic calculations while standing on one leg (Tyler &	Suppressing thoughts of previously-viewed emotive video (Ostafin et	Making choices about psychology course (Vohs et al., 2008, Study	Other-race/same-race social interaction task (Richeson & Shelton, 2003; Richeson & Trawalter, 2005, Studies,

2009, Studies 3 & 4) (2)	1b; Muraven, Gagne, & Rosman, 2008, Study 1; Segerstrom & Nes, 2007; Shmueli & Prochaska, 2009; Stucke & Baumeister, 2006, Study 1) (7)	Burns, 2008, Study 1; Webb & Sheeran, 2003, Study 2) (2)	al., 2008)[b] (1)	4a & 4b) (2)	1, 2 & 3; Richeson, Trawalter, & Shelton, 2005; Trawalter & Richeson, 2006) (6)
	Writing an essay excluding specified letters (Mead et al., 2009, Study 1; Pocheptsova et al., 2009, Study 5; Schmeichel, 2007, Studies 2S1 & 2S2; Schmeichel & Vohs, 2009, Study 1) (5)	Geometric figure tracing task using non-dominant hand and in mirror (Fennis et al., 2009, Study 5) (1)		Choosing university courses to satisfy general education requirements (Vohs et al., 2008, Study 3) (1)	Interpersonal interaction task requiring control over self-presentational attributes (e.g., modesty, gender favourability, sceptical audience, tokenism) (Fennis et al., 2009, Study 2a; Vohs et al., 2005, Studies 1, 2, 3, & 4) (5)
	Paced letter-circling task for 'special case'/consecutive letters (Stewart, Wright, Hui, & Simmons, 2009; Wright, Stewart, & Barnett, 2008, S1 & S2) (3)	Difficult solvable anagram/word fragments task (Park, Glaser, & Knowles, 2008) (1)			Managing stygmatizing thoughts using stereotype threat procedure (Inzlicht, McKay, & Aronson, 2006, Studies 2 & 3; Johns, Inzlicht, & Schmader, 2008, Studies 1, 3 & 4) (5)
	Typing task omitting 'e's (Muraven et al., 2008, Study 3; Muraven et al., 2006, Studies 2 & 4) (3)	Performance on working memory task (operation span) (Schmeichel, 2007, Study 3) (1)			'Foot-in-the-door' compliance-gaining persuasive technique (Fennis et al., 2009, Studies 1, 2 & 3) (3)
	Avoiding body movements, emotional displays or facial expressions while watching a				Computer game producing a brief episode of ostracism (Oaten,

	boring film (Stucke & Baumeister, 2006, Studies 2 & 3) (2) High (vs. low) availability/proximity of tempting food (Vohs & Heatherton, 2000, Studies 1 & 2) (2) Remaining silent and resisting temptation to interact (Ciarocco, Sommer, & Baumeister, 2001, Studies 1 & 2) (2) Avoiding using speech fillers in speech control task (Muraven & Slessareva, 2003, Study 2) (1) Cue exposure task smelling alcohol or water (Muraven & Shmueli, 2006) (1) Embedded figures task (Tyler & Burns, 2009, Study 1) (1) Handgrip task (Burkley, 2008, Study 2) (1)				Williams, Jones, & Zadro, 2008, Studies 1 & 2) (2) Relational value monitoring paradigm requiring monitoring of social cues (Tyler, 2008, Studies 1 & 2) (2) Intergroup conflict during interactive visual perception task (Kahan, Polivy, & Herman, 2003) (1) Resisting a personally-relevant persuasive message (Burkley, 2008, Study 1) (1)	

Affective		Cognitive				Affective and cognitive
CE	CI	CA	CP	CT	CV	SP
			Dependent task			
Regulate affect while presented	Handgrip task[d] (Alberts et al., 2007, Study 1; Bray et al., 2008;	Computerized vigilance task	Performance on math/mental		Consumer decision task	Self-reports of positive illusions e.g. cognitive

with emotive video or pictures (Muraven et al., 1998, Study 3; Schmeichel, 2007, Study 3; Vohs et al., 2005, Study 3) (3)	Ciarocco et al., 2001, Study 2; Finkel et al., 2006, Study 4; Inzlicht et al., 2006, Study 3; Martijn et al., 2007; Martijn et al., 2002; Muraven & Shmueli, 2006; Muraven et al., 1998, Study 1; Seeley & Gardner, 2003, Studies 1 & 2; Tyler, 2008, Study 2; Tyler & Burns, 2008, Study 1; 2009, Studies 2S1, 2S2, 2S3 & 3; Vohs et al., 2005, Study 2) (18)	(Muraven et al., 2008, Studies 1 & 3; Muraven et al., 2006, Study 2) (3)	arithmetic task (Johns et al., 2008, Study 3; Stewart et al., 2009; Tyler & Burns, 2008, Study 2; Vohs et al., 2005, Study 1; Vohs et al., 2008, Study 4b; Wright et al., 2007, Studies 1S2 & 2S2; Wright et al., 2003, S1 & S2; Wright et al., 2008, S2) (10)	(e.g., compromise, reference-dependent, and attraction effects) (Masicampo & Baumeister, 2008; Pocheptsova et al., 2009, Studies 1, 2, 3, 4, & 5) (6)	abilities, control over chance, event, optimistic view of future, self-relevant attributes, positive future illusions[e] (Fischer et al., 2007, Studies 1, 2, 3, 4 & 5) (5)
	Modified Stroop task (Fennis et al., 2009, Study 3; Gailliot, Baumeister et al., 2007, Study 7; Gailliot et al., 2006, Study 6; Inzlicht & Gutsell, 2007; Inzlicht et al., 2006, Study 2; Muraven et al., 2006, Study 4; Richeson & Shelton, 2003; Richeson & Trawalter, 2005, Studies, 1, 2 & 3; Richeson et al., 2005; Shamosh & Gray, 2007; Trawalter & Richeson, 2006; Webb & Sheeran, 2003, Study 2; Wright et al., 2008, S1) (15)		Performance on solvable anagram/word fragments task (Baumeister et al., 1998, Study 3; Gailliot, Baumeister et al., 2007, Study 8; Gailliot, Plant et al., 2007, Studies 1, 2 & 3; Gailliot et al., 2006, Studies 8 & 9; Gordijn et al., 2004, Study 2;	Choosing to solve a challenging or easy anagram task[c] (Finkel et al., 2006, Study 1) (1)	Self-reported willingness to volunteer[e] (DeWall et al., 2008, Study 2; Fennis et al., 2009, Studies 4 & 5) (3)

	Oikawa, 2005, Study 2; Vohs et al., 2008, Study 6) (10)		
Amount of tempting food or drink consumed in ostensible taste test[f] (Friese et al., 2008, Studies 2 & 3; Hofmann et al., 2007; Kahan et al., 2003; Muraven et al., 2002; Oaten et al., 2008, Study 1; Ostafin et al., 2008; Stillman et al., 2009, Study 3; Vohs & Heatherton, 2000, Studies 1 & 3; Zyphur et al., 2007, Study 1) (11)	Performance on working memory task (e.g., reading span, operation span, sentence span, digit span, rote memory) (Gailliot et al., 2006, Study 7S2; Johns et al., 2008, Studies 1 & 4; Schmeichel, 2007, Studies 1S1, 1S2, 2S1, 2S2 & 4) (8)	Temporal discounting measure representing value of immediate vs. delayed rewards (Joireman et al., 2008, Study 3) (1)	Measures of death thoughts e.g. word search tasks, ambiguous drawing task, death words in participant-generated stories[e] (Gailliot et al., 2006, Studies 2 & 3; Gailliot, Schmeichel et al., 2007, Study 1) (3)
Unsolveable geometric figure-tracing task (Baumeister et al., 1998, Studies 1 & 2; Fennis et al., 2009, Study 2a; Geeraert & Yzerbyt, 2007, Study 1b; Moller et al., 2006, Study 1; Muraven & Slessareva, 2003, Study 1; Vohs et al., 2008, Study 4a; Wallace & Baumeister, 2002; Webb & Sheeran, 2003, Study 1) (9)	Analytical reasoning GRE problems (Fennis et al., 2009, Study 2; Finkel et al., 2006, Studies 2 & 3; Gailliot et al., 2006, Study 7S1; Schmeichel et al., 2003, Studies 1 & 3) (6)		Accuracy of recognising simple and complex relational cues in relational cue identification task (Tyler, 2008, Studies 3 & 4) (2)
Indices of aggression e.g. administration of ‘hot	Index of conformation bias		Attitudes toward persuasive argument[e]

sauce'/white noise/painful yoga poses to partner or negative evaluation of perpetrator or experimenter (DeWall et al., 2007, Studies 1, 2, & 3; Finkel et al., 2009, Study 4; Stucke & Baumeister, 2006, Studies 1, 2 & 3) (7)	after evaluating information about argument credibility (Fischer et al., 2008, Studies 1, 2, 3 & 4) (4)	(Burkley, 2008, Studies 2 & 3) (2)
Persistence on unsolvable anagram task (Burkley, 2008, Study 1; Ciarocco et al., 2001, Study 1; Muraven et al., 1998, Study 2; Segerstrom & Nes, 2007; Tyler, 2008, Study 1; Tyler & Burns, 2009, Study 1) (5)	Favorable and unfavorable thoughts listed in response to counterattitudinal message (Burkley, 2008, Study 4; Wheeler et al., 2007l) (2)	Self-reported desire to disclose intimate information to stranger[e] (Vohs et al., 2005, Studies 6 & 7) (2)
Regulating amount of money spent on purchases/lottery tickets (Bruyneel et al., 2009, Studies 2, 3 & 4; Vohs & Faber, 2007, Studies 2 & 3) (5)	Cognitive control estimates from stereotyping 'weapons identification' task (Govorun & Payne, 2006) (1)	Self-reported likelihood/willingness of helping[e] (DeWall et al., 2008, Studies 1 & 3) (2)
Amount of unpleasant-tasting substance consumed (Muraven & Slessareva, 2003, Study 3; Oaten et al., 2008, Study 2; Vohs et al., 2008, Studies 1a & 1b) (4)	Cognitive Elaboration Test (CET) and General Mental Abilities Test (GMAT) measures of reasoning and	Test of stereotyping and prejudice based on ratings of target[e] (Muraven, 2008, Studies 1 & 2) (2)

	elaboration (Schmeichel et al., 2003, Study 2) (1)	
Persistence on unsolvable math puzzle (Wan & Sternthal, 2008, Studies 1, 2, 3 & 4) (4)	Failures on 'Operation' children's board game (Finkel et al., 2006, Study 5) (1)	Compliance with authoritative source with respect to money donated to leading charity[e] (Janssen et al., 2008, Study 2) (1)
Amount of affectively-appealing product chosen/purchased in simulated shop (Bruyneel et al., 2006, Studies 1, 2 & 3) (3)	Performance on complex decision-making task using Navel combat simulator (Zyphur et al., 2007, Study 2) (1)	Impression formation task test of stereotyping (Oikawa, 2005, Study 1) (1)
Persistence on cold pressor task (Muraven et al., 2006, Study 1; Schmeichel & Vohs, 2009, Study 1; Vohs et al., 2008, Study 2) (3)	Performance on verbal and figural fluency tests (Schmeichel et al., 2006) (1)	Number of counter-arguments given to a personally-held opinion[e] (Fennis et al., 2009, Study 1) (1)
Persistence on embedded figures task (Schmeichel & Vohs, 2009, Study 2; Vohs et al., 2005, Study 4; Vohs & Heatherton, 2000, Study 2) (3)	Processing of racial stereotype information using Implicit Association Test (Legault et al., 2009, Study 2) (1)	Number stereotypes used in description of target[e] (Gordijn et al., 2004, Study 4) (1)
Number of attempts on letter-circling task (Wright et al., 2007, Studies 1S1 & 2S1) (2)	Working memory capacity tested by specific memories	Perceived likelihood of engaging in sexual infidelity[e] (Gailliot &

	recalled on autobiographical memory test (Neshat-Doost et al., 2008) (1)	Baumeister, 2007, Study 2) (1)
Persistence on frustrating maze/ball manipulation game (Muraven & Slessareva, 2003, Study 2; Tice et al., 2007, Study 2) (2)		Self-allocated amount of money (quarters)[e] (Mead et al., 2009, Study 1) (1)
Persistence on weight holding task (Alberts et al., 2007, Study 2; Geeraert & Yzerbyt, 2007, Study 2b) (2)		Self-reported accommodation tendencies for close relationships (Finkel & Campbell, 2001, Study 2) (1)
Breath-holding task performance (Vohs & Schmeichel, 2003, Study 4) (1)		Self-reported intention to aggress[e] (DeWall et al., 2007, Study 4) (1)
Number of intimate behaviours shown in 'physical intimacy' task (Gailliot & Baumeister, 2007, Study 3) (1)		Self-reported narcissistic self-descriptions[e] (Vohs et al., 2005, Study 8) (1)
Number of 'sexual words' produced in word search task (Gailliot & Baumeister, 2007, Study 1) (1)		Self-reported responses to scenarios of underregulated verbosity[e] (Vohs et al., 2005, Study 5) (1)
Persistence on reading aloud task (Vohs & Schmeichel, 2003, Study 3) (1)		'Shooter bias' task measuring unintended racial discriminatory[e] behavior (Park et al., 2008) (1)

	Resisting temptation to cheat on quiz task (Mead et al., 2009, Study 2) (1)	Willingness to pay money in price assignment task[e] (Vohs & Faber, 2007, Study 1) (1)
	Persistence in watching a boring movie (Baumeister et al., 1998, Study 4) (1)	
	Persistence on word production task on a given set of letters (Stillman et al., 2009, Study 1) (1)	
	Resisting temptation to smoke (Shmueli & Prochaska, 2009) (1)	
	'Self-stopping' or stop-signal task performance (Muraven et al., 2007, Study 3) (1)	
	Time spent on math problems rather than playing video games or reading magazines (Vohs et al., 2008, Study 3) (1)	
	Time spent on unsolvable 'block' puzzle[f] (Zyphur et al., 2007, Study 1) (1)	

Note. An accompanying list of references is available as an online supplemental document. CA = Controlling attention; CE = Controlling emotions; CI = Controlling impulses; CP = Cognitive performance; CV = Choice and volition; SP = Social processing. Tasks arranged in order of frequency of use in each column. Parenthesized numbers in each cell indicate frequency of use of each self-control task. [a]Fischer et al. (2007, Studies 1, 2, & 4) presented participants with either a video-watching affect regulation task or a crossing-out letters task as the depleting task and therefore appears in both the controlling emotion and controlling attention columns. These studies were omitted from moderator analyses for specific sphere and frequently-used depleting tasks and classified as affective for the global sphere moderator analysis. [b]Ostafin et al. (2008) presented participants with a video-watching affect regulation task and a thought suppression task as depleting tasks and therefore appears in both the controlling emotion and controlling thoughts columns. This study was omitted from moderator analyses for specific sphere and

frequently-used depleting tasks and classified as combined cognitive and affective for the global sphere moderator analysis. [c]Nashat-Doost et al. (2008) administered an incongruent Stroop task to participants assigned to the ego-deletion condition with control (non-depletion) participants assigned to either a congruent Stroop or a no Stroop condition. [d]In all but one study (Seeley & Gardner, 2003), baseline handgrip measures were taken and controlled for in dependent variable analyses. [e]Non-behavioural judgement measures indicative of ego-depletion but likely to be inappropriate for use as a depleting task in the two-task paradigm. [f]Zypher et al. (2007, Study 1) presented an ostensible food taste test and an unsolvable block puzzle as dependent self-control tasks and therefore appears twice in the controlling impulses column. This study was omitted from moderator analyses for frequently-used dependent tasks and classified as controlling impulses for the specific sphere moderator analysis and affective for the global sphere moderator analysis

Appendix B

Characteristics of Studies Included in Meta-Analyses

Author	Study	N	*d*[a]	Depleting task				Task Presentation		Interim[d]	Dependent task				Matched		Control cond[e]	Task complexity[f]	Lab[g]	Additional dependent variables
				Sphere	AFF/COG	Freq[b]	Time[c]	SIN/SEP	DXP/SXP		Sphere	AFF/COG	Freq[b]	BEH/NBJ	Sphere	AFF/COG				
Alberts, Martijn, Greb, Merckelbach, & Vries (2007)	1	40	0.88[h]	CP	COG	NF	10	SEP	SXP	FT	CI	AFF	HGR	BEH	UMD	UMD	EV	NC	OTH	Positive affect[i] (*d* = -.15)
	2	40	1.62[j]	CA	COG	NF	8	SEP	SXP	FT	CI	AFF	NF	BEH	UMD	UMD	EV	NC	OTH	Positive affect[i] (*d* = -0.42) Fatigue[k] (*d* = -0.43)
Baumeister, Bratslavsky, Muraven & Tice (1998)	1	44	1.79[l]	CI	AFF	NF	5	SEP	SXP	CQ	CI	AFF	NF	BEH	UMD	MTD	EV	NC	RFB	Positive affect[i] (*d* = 0.49) Fatigue[m] (*d* = 0.61) Effort[n] (*d* = 0.98) Difficulty[o] (*d* = 0.45)
	2	20	1.90[p]	CV	COG	NF	ND	SIN	SXP	CQ	CI	AFF	NF	BEH	UMD	UMD	AB	NC	RFB	
	3	30	0.76[q]	CE	AFF	VAR	10	SEP	SXP	CQ	CP	COG	ANG	BEH	UMD	UMD	EV	CLX	RFB	Difficulty[o] (*d* = 0.81) Effort[n] (*d* = 1.05)
	4	84	0.59[r]	CI	AFF	COL	ND	SEP	SXP	CQ	CI	AFF	NF	BEH	UMD	UMD	EV	NC	RFB	Fatigue[m] (*d* = 0.61) Effort[s] (*d* = 0.50)
Bray, Ginis,		49	0.56[t]	CI	AFF	MST	3.67	SIN	SXP	CQ	CI	AFF	HGR	BEH	MTD	MTD	EV	NC	OTH	Positive affect[i]

Hicks & Woodgate (2008)																			(*d* = -0.37) Fatigue[u](*d* = 0.35) Effort[n] (*d* = 0.36)
Bruyneel, Dewitte, Franses, & Dekimpe (2009)	2	68	0.53[v]	CI	AFF	MST	6	SIN	SXP	CQ	CI	AFF	NF	BEH	MTD	MTD	EV	NC	OTH	Negative affect[w] (*d* = 0.21)
	3	27	0.95[x]	CE	AFF	NF	ND	SIN	SXP	CQ	CI	AFF	NF	BEH	UMD	MTD	EV	NC	OTH	Negative affect[w] (*d* = -0.42)
	4	44	0.59[y]	CE	AFF	NF	ND	SIN	SXP	CQ	CI	AFF	NF	BEH	UMD	MTD	EV	NC	OTH	Negative affect[w] (*d* = -0.24) Positive affect[w] (*d* = -0.44)
Bruyneel, Dewitte, Vohs & Warlop (2006)	1	89	0.55[z]	CV	COG	NF	1.02[aa]	SEP	SXP	NI	CI	AFF	NF	BEH	UMD	UMD	EV	NC	OTH	Positive affect[w] (*d* = 0.09) Negative affect[w] (*d* = 0.05)
	2	44	0.64[ab]	CV	COG	NF	ND	SEP	SXP	NI	CI	AFF	NF	BEH	UMD	UMD	EV	NC	OTH	
	3	42	0.61[ac]	CV	COG	NF	ND	SEP	SXP	NI	CI	AFF	NF	BEH	UMD	UMD	EV	NC	OTH	
Burkley (2008)	1	72	0.47[ad]	SP	C&A	NF	ND	SEP	SXP	CQ	CI	AFF	NF	BEH	UMD	UMD	EV	NC	OTH	
	2	22	0.91[ae]	CI	AFF	NF	ND	SEP	SXP	NI	SP	C&A	NF	NBJ	UMD	UMD	AB	NC	OTH	
	3	78	0.45[af]	CT	COG	WBP	5	SEP	DXP	CQ	SP	C&A	NF	NBJ	UMD	UMD	AT	NC	OTH	Effort[n] (*d* = 0.55)
	4	60	0.59[ag]	CT	COG	WBP	5	SEP	SXP	CQ	CP	COG	NF	NBJ	UMD	UMD	EV	NC	OTH	Effort[n] (*d* = 0.37)
Ciarocco,	1	37	0.73[ah]	CI	AFF	NF	6	SEP	SXP	CQ	CI	AFF	NF	BEH	MTD	MTD	EV	NC	RFB	Difficulty[o] (*d*

Sommer & Baumeister (2001)																		= 1.87)
	2	24	0.94[ai]	CI	AFF	NF	6	SEP	SXP	CQ	CI	AFF	HGR	BEH	MTD	MTD	EV	NC	RFB	Difficulty[o] (*d* = 2.52) Negative affect[w] (*d* = 1.40)
DeWall, Baumeister, Gailliot, & Maner (2008)	1	28	1.12[aj]	CI	AFF	COL	ND	SIN	SXP	CQ	SP	C&A	NF	NBJ	UMD	UMD	EV	NC	RFB	
	2	30	0.96[ak]	CA	COG	NF	6	SIN	DXP	CQ	SP	C&A	NF	BEH	UMD	UMD	EV	NC	RFB	
	3	146	0.37[al]	CI	AFF	COL	ND	SIN	SXP	CQ	SP	C&A	NF	NBJ	UMD	UMD	EV	NC	RFB	Positive affect[i] (*d* = 0.12)
DeWall, Baumeister, Stillman & Gailliot (2007)	1	33	0.66[am]	CI	AFF	NF	5	SIN	SXP	CQ	CI	AFF	NF	BEH	MTD	MTD	EV	NC	RFB	Negative affect[an] (*d* = -0.25)
	2	53	0.67[ao]	CA	COG	VAT	6	SIN	SXP	CQ	CI	AFF	NF	BEH	UMD	UMD	EV	NC	RFB	Positive affect[w] (*d* = -0.53) Negative affect[w] (*d* = 0.17) Difficulty[o] (*d* = 0.62)
	3	51	0.92[ap]	CI	AFF	MST	5	SIN	SXP	CQ	CI	AFF	NF	BEH	MTD	MTD	EV	NC	RFB	Positive affect[w] (*d* = 0.27) Negative affect[w] (*d* = 0.32)
	4	97	0.52[aq]	CI	AFF	COL	ND	SIN	SXP	CQ	SP	C&A	NF	NBJ	UMD	UMD	EV	NC	RFB	Difficulty[o] (*d* = 1.15)
Fennis, Janssen, &	1	39	0.68[ar]	SP	C&A	NF	ND	SIN	SXP	CQ	SP	C&A	NF	BEH	MTD	UMD	EV	NC	RFB	

Vohs (2009)	2	60	0.59[as]	SP	C&A	NF	ND	SIN	SXP	CQ	CP	COG	NF	BEH	UMD	UMD	EV	CLX	RFB	
	2a	46	1.18[at]	SP	C&A	NF	2.5	SIN	SXP	CQ	CI	AFF	NF	BEH	UMD	UMD	EV	NC	RFB	
	3	37	0.77[au]	SP	C&A	NF	ND	SIN	SXP	CQ	CI	AFF	MST	BEH	UMD	UMD	EV	NC	RFB	Effort[n] (*d* = 1.06)
	4	108	1.16[av]	CI	AFF	COL	ND	SEP	SXP	CQ	SP	C&A	NF	NBJ	UMD	UMD	EV	NC	RFB	
	5	100	0.57[aw]	CP	COG	NF	4	SIN	SXP	CQ	SP	C&A	NF	NBJ	UMD	UMD	EV	NC	RFB	
Finkel & Campbell (2001)	2	46	0.38[ax]	CE	AFF	VAR	7	SIN	SXP	CQ	SP	C&A	NF	NBJ	UMD	UMD	EV	NC	OTH	Effort[ay] (*d* = 1.37)
Finkel, Campbell, Brunell, Dalton, Scarbeck & Chartrand (2006)	1	26	0.91[az]	SP	C&A	NF	3	SIN	SXP	CQ	CV	COG	NF	BEH	UMD	UMD	EV	NC	OTH	Fatigue[ba] (*d* = 0.04)
	2	54	0.81[bb]	SP	C&A	NF	10	SIN	SXP	NI	CP	COG	NF	BEH	UMD	UMD	EV	CLX	OTH	Positive affect[bc] (*d* = 0.54) Fatigue[ba] (*d* = 0.12) Self-efficacy[bd] (*d* = 0.42)
	3	46	0.79[be]	SP	C&A	NF	10	SIN	SXP	NI	CP	COG	NF	BEH	UMD	UMD	EV	CLX	OTH	Positive affect[bf] (*d* = 0.67) Fatigue[ba] (*d* = 0.74) Self-efficacy[bd] (*d* = -0.15)
	4	32	0.66[bg]	SP	C&A	NF	6	SIN	SXP	CQ	CI	AFF	HGR	BEH	UMD	UMD	EV	NC	OTH	Positive affect[bf] (*d* = -0.36) Fatigue[ba] (*d* = 0.72)

																		Self-efficacy[bd] (d = -0.41)
	5	29	0.90[bh]	SP	C&A	NF	30	SIN	SXP	CQ	CP	COG	NF	BEH	UMD	UMD	EV	NC	OTH	
Finkel, DeWall, Slotter, Oaten, & Foshee (2009)	4	16	1.41[bi]	CA	COG	VAT	6	SIN	SXP	CQ	CI	AFF	NF	BEH	UMD	MTD	EV	NC	OTH	
Fischer, Greitemeyer & Frey (2007)	1	100	0.65[bj]	X	AFF	NF	5	SIN	SXP	NI	SP	C&A	NF	NBJ	UMD	UMD	EV	NC	OTH	
	2	97	0.46[bk]	X	AFF	NF	5	SEP	SXP	NI	SP	C&A	NF	NBJ	UMD	UMD	EV	NC	OTH	
	3	56	0.62[bk]	CI	AFF	COL	12.5[bl]	SIN	SXP	CQ	SP	C&A	NF	NBJ	UMD	UMD	EV	NC	OTH	Positive affect[w] (d = 0.17) Negative affect[w] (d = 0.35)
	4	52	0.62[bm]	X	AFF	NF	5	SIN	SXP	NI	SP	C&A	NF	NBJ	UMD	UMD	EV	NC	OTH	
	5	30	0.77[bn]	CT	COG	WBP	ND	SIN	SXP	NI	SP	C&A	NF	NBJ	UMD	UMD	EV	NC	OTH	Positive affect[w] (d = -0.07) Negative affect[w] (d = 0.41) Self-efficacy[bo] (d = 0.88)
Fischer, Greitemeyer & Frey (2008)	1	49	0.62[bp]	CA	COG	VAT	5	SEP	SXP	CQ	CP	COG	NF	BEH	UMD	MTD	EV	NC	OTH	
	2	56	0.65[bq]	CT	COG	WBP	ND	SEP	SXP	CQ	CP	COG	NF	BEH	UMD	MTD	EV	NC	OTH	Negative affect[br] (d = 0.41)

	3	36	0.84[bs]	CI	AFF	COL	ND	SEP	SXP	CQ	CP	COG	NF	BEH	UMD	UMD	EV	NC	OTH	Positive affect[w] (*d* = -0.03) Negative affect[w] (*d* = -0.46)
	4	48	0.86[bt]	CE	AFF	VAR	5	SEP	SXP	CQ	CP	COG	NF	BEH	UMD	UMD	EV	NC	OTH	
Friese, Hofmann & Wanke (2008)	2	69	0.34[bu]	CE	AFF	VAR	7	SEP	SXP	CQ	CI	AFF	FTT	BEH	UMD	MTD	EV	NC	OTH	Negative affect[w] (*d* = 0.15) Fatigue[m] (*d* = 1.20) Effort[s] (*d* = 1.17)
	3	48	0.31[bv]	CE	AFF	VAR	9.5	SEP	SXP	CQ	CI	AFF	FTT	BEH	UMD	MTD	EV	NC	OTH	Negative affect[w] (*d* = 0.35) Fatigue[m] (*d* = 1.67) Effort[s] (*d* = 1.58)
Gailliot & Baumeister (2007)	1	32	0.37[bw]	CI	AFF	MST	4	SIN	SXP	CQ	CI	AFF	NF	NBJ	MTD	MTD	EV	NC	RFB	Difficulty[o] (*d* = 2.13)
	2	27	0.99[bx]	CI	AFF	COL	ND	SIN	SXP	CQ	SP	C&A	NF	NBJ	UMD	UMD	EV	NC	RFB	Difficulty[o] (*d* = 1.31)
	3	21	0.92[by]	CA	COG	VAT	6	SIN	SXP	CQ	CI	AFF	NF	BEH	UMD	UMD	EV	NC	RFB	
Gailliot et al. (2007)	7	62	0.73[bz]	CA	COG	VAT	6	SIN	SXP	CQ	CI	AFF	MST	BEH	UMD	UMD	EV	NC	RFB	
	8	73	0.46[ca]	CT	COG	NF	ND	SIN	SXP	(6)	CP	COG	ANG	BEH	UMD	MTD	EV	CLX	RFB	
Gailliot, Plant, Butz & Baumeister (2007)	1	40	0.89[cb]	SP	C&A	NF	5	SIN	SXP	NI	CP	COG	ANG	BEH	UMD	UMD	ID	CLX	RFB	
	2	98	0.40[cc]	SP	C&A	NF	5	SIN	SXP	NI	CP	COG	ANG	BEH	UMD	UMD	ID	CLX	RFB	

	3	172	0.38[cd]	SP	C&A	NF	5	SIN	SXP	NI	CP	COG	ANG	BEH	UMD	UMD	ID	CLX	RFB	
Gailliot, Schmeichel & Baumeister (2006)	2	19	0.99[ce]	CT	COG	WBP	5	SIN	SXP	CQFT (4)	SP	C&A	NF	NBJ	UMD	UMD	EV	NC	RFB	Difficulty[o] (*d* = 0.86)
	3	67	0.49[cf]	CA	COG	VAT	6	SIN	SXP	CQFT (4)	SP	C&A	NF	NBJ	UMD	UMD	EV	NC	RFB	
	6	57	0.59[cg]	CT	COG	NF	6	SIN	SXP	CQFT (4)	CI	AFF	MST	BEH	UMD	UMD	EV	NC	RFB	Positive affect[i] (*d* = 0.26)
	7S1	19	0.83[ch]	CT	COG	NF	ND	SIN	SXP	CQFT (5)	CP	COG	NF	BEH	UMD	MTD	EV	CLX	RFB	
	7S2	19	0.28[ci]	CT	COG	NF	ND	SIN	SXP	CQFT (5)	CP	COG	NF	BEH	UMD	MTD	EV	SIM	RFB	
	8	57	0.62[cj]	CT	COG	NF	5	SIN	SXP	CQFT (5)	CP	COG	ANG	BEH	UMD	MTD	EV	CLX	RFB	
	9	55	0.70[ck]	CT	COG	NF	ND	SIN	SXP	CQFT (5)	CP	COG	ANG	BEH	UMD	MTD	EV	CLX	RFB	
Gailliot, Schmeichel, & Maner (2007)	1	24	1.83[cl]	CE	AFF	NF	5	SIN	SXP	CQ	SP	C&A	NF	NBJ	UMD	UMD	EV	NC	OTH	
Geeraert & Yzerbyt (2007)	1b	46	0.52[cm]	CI	AFF	NF	4	SIN	SXP	CQ(20)	CI	AFF	NF	BEH	MTD	MTD	EV	NC	OTH	
	2b	32	1.12[cn]	CA	COG	NF	8	SIN	SXP	CQ	CI	AFF	NF	BEH	UMD	UMD	EV	NC	OTH	
Gordijin, Hindricks, Koomen, Dijksterhuis & Knippenberg (2004)	2	42	0.66[co]	SP	C&A	NF	5	SEP	SXP	CQ(5)	CP	COG	ANG	BEH	UMD	UMD	ID	CLX	OTH	
	4	66	0.73[cp]	SP	C&A	NF	5	SEP	SXP	NI	SP	C&A	NF	BEH	MTD	UMD	ID	NC	OTH	
Govorun & Payne (2006)		72	0.46[cq]	CI	AFF	MST	15	SEP	SXP	NI	CP	COG	NF	BEH	UMD	UMD	EV	NC	OTH	Fatigue[m] (*d* = 1.10) Difficulty[o] (*d*

																		= 0.35)
Hofmann, Rauch & Gawronski (2007)		50	0.12[cr]	CE	AFF	VAR	7	SIN	SXP	CQ	CI	AFF	FTT	BEH	UMD	MTD	EV	NC	OTH	Negative affect[cs] (*d* = 0.36) Difficulty[ct] (*d* = 1.26)
Inzlicht & Gutsell (2007)		33	1.68[cu]	CE	AFF	VAR	10	SEP	SXP	CQ	CI	AFF	MST	BEH	UMD	MTD	EV	NC	OTH	
Inzlicht, McKay & Aronson (2006)	2	42	0.84[cv]	SP	C&A	NF	ND	SEP	SXP	CQ+(4)	CI	AFF	MST	BEH	UMD	UMD	ID	NC	OTH	
	3	61	0.66[cw]	SP	C&A	NF	ND	SIN	SXP	CQ+(4)	CI	AFF	HGR	BEH	UMD	UMD	ID	NC	OTH	
Janssen, Fennis, Pruyn & Vohs (2008)	2	107	0.94[cx]	CA	COG	VAT	4	SEP	SXP	NI	SP	C&A	NF	BEH	UMD	UMD	EV	NC	OTH	
Johns, Inzlicht, & Schmader (2008)	1	81	0.69[cy]	SP	C&A	NF	ND	SEP	SXP	NI	CP	COG	NF	BEH	UMD	UMD	ID	CLX	OTH	
	3	39	0.55[cz]	SP	C&A	NF	ND	SEP	SXP	FT	CP	COG	MAT	BEH	UMD	UMD	ID	CLX	OTH	
	4	37	1.00[da]	SP	C&A	NF	ND	SEP	SXP	FT	CP	COG	NF	BEH	UMD	UMD	ID	CLX	OTH	
Joireman, Balliet, Sprott, Spangenberg & Schultz (2008)	3	99	0.18[db]	CE	AFF	VAR	ND	SIN	SXP	NI	CV	COG	NF	BEH	UMD	UMD	EV	NC	OTH	Difficulty[o] (*d* = 0.85)
Kahan, Polivy & Herman (2003)		59	0.53[dc]	SP	C&A	NF	ND	SIN	SXP	CQ	CI	AFF	FTT	BEH	UMD	UMD	ID	NC	OTH	
Legault, Green-Demers, &	2	68	0.58[dd]	CI	AFF	COL	2	SIN	SXP	CQ	CP	COG	NF	NBJ	UMD	UMD	ID	NC	OTH	Positive affect[i] (*d* = 0.24) Fatigue[ba] (*d* =

Eadie (2009)																		1.31)
Martijn, Alberts, Merckelbach, Havermans, Huijts & de Vries (2007)		37	0.70[de]	CP	COG	NF	10	SEP	SXP	FT	CI	AFF	HGR	BEH	UMD	UMD	EV	NC	OTH	Positive affect[i] (*d* = -0.51) Fatigue[df] (*d* = 0.56)
Martijn, Tenbult, Merckelbach, Dreezens & de Vries (2002)		33	0.72[dg]	CE	AFF	VAR	3	SIN	SXP	CQFT	CI	AFF	HGR	BEH	UMD	UMD	EV	NC	OTH	Positive affect[i] (*d* = 0.59) Difficulty[dh] (*d* = 0.76)
Masicampo & Baumeister (2008)		59	0.42[di]	CA	COG	VAT	6	SIN	SXP	(10)	CV	COG	NF	BEH	UMD	MTD	EV	NC	RFB	Positive affect[i] (*d* = 0.11)
Mead, Baumeister, Gino, Schweitzer, & Ariely (2009)	1	84	0.58[dj]	CI	AFF	NF	6	SEP	SXP	CQ	SP	C&A	NF	BEH	UMD	UMD	EV	NC	RFB	
	2	78	0.90[dk]	CI	AFF	MST	ND	SEP	DXP	CQ	CI	AFF	NF	BEH	MTD	MTD	EV	NC	RFB	
Moller, Deci, & Ryan (2006)	1	25	0.71[dl]	CV	COG	NF	1.5[ab]	SIN	SXP	NI	CI	AFF	NF	BEH	UMD	UMD	EV	NC	OTH	Positive affect[i] (*d* = 0.13)
Muraven (2008)	1	56	0.85[dm]	CI	AFF	COL	ND	SIN	SXP	NI	SP	C&A	NF	BEH	UMD	UMD	ID	NC	RFB	
	2	41	0.66[dn]	CE	AFF	VAR	8	SIN	SXP	CQ	SP	C&A	NF	BEH	UMD	UMD	ID	NC	RFB	
Muraven, Collins & Nienhaus (2002)		58	0.53[do]	CT	COG	WBP	5	SIN	SXP	CQ	CI	AFF	FTT	BEH	UMD	UMD	AT	NC	RFB	Positive affect[i] (*d* = 0.24) Negative affect[dp] (*d* = 0.21) Effort[n] (*d* = -0.39) Difficulty[o] (*d*

																		= 0.24)
Muraven, Gagne & Rosman (2008)	1	16	3.02[dq]	CI	AFF	NF	5	SIN	SXP	CQ	CA	COG	NF	BEH	UMD	UMD	EV	NC	RFB	Positive affect[i] (*d* = -0.03)
	3	48	1.14[dr]	CI	AFF	NF	ND	SIN	SXP	CQ	CA	COG	NF	BEH	UMD	UMD	EV	NC	RFB	Positive affect[i] (*d* = 0.11) Self-efficacy[ds] (*d* = 0.13)
Muraven, Rosman & Gagne (2007)	3	30	0.60[dt]	CI	AFF	MST	6	SIN	SXP	CQ	CI	AFF	NF	BEH	MTD	MTD	EV	NC	RFB	Positive affect[i] (*d* = -0.17)
Muraven & Shmueli (2006)		160	0.11[du]	CI	AFF	NF	4	SIN	SXP	CQ	CI	AFF	HGR	BEH	MTD	MTD	EV	NC	RFB	
Muraven, Shmueli & Burkley (2006)	1	46	0.59[dv]	CT	COG	WBP	5	SIN	SXP	CQFT	CI	AFF	NF	BEH	UMD	UMD	AT	NC	RFB	Effort[n] (*d* = 0.12)
	2	34	0.47[dw]	CI	AFF	NF	ND	SIN	SXP	CQFT	CA	COG	NF	BEH	UMD	UMD	EV	NC	RFB	Positive affect[i] (*d* = -0.06) Effort[dx] (*d* = 0.68)
	4	38	0.70[dy]	CI	AFF	NF	ND	SIN	SXP	CQFT	CI	AFF	MST	BEH	MTD	MTD	EV	NC	RFB	Positive affect[i] (*d* = -0.28) Effort[dx] (*d* = -0.35)
Muraven & Slessareva (2003)	1	43	0.60[dz]	CT	COG	WBP	5	SIN	SXP	CQ	CI	AFF	NF	BEH	UMD	UMD	AT	NC	RFB	Positive affect[i] (*d* = 0.17) Effort[dx] (*d* = 0.43) Difficulty[o] (*d* = 0.19)
	2	41	0.62[ea]	CI	AFF	NF	ND	SIN	SXP	CQ	CI	AFF	NF	BEH	MTD	MTD	EV	NC	RFB	Effort[n] (*d* = 0.14) Difficulty[o] (*d* = 0.18)
	3	24	0.59[eb]	CE	AFF	VAR	5	SIN	SXP	CQ	CI	AFF	NF	BEH	UMD	MTD	EV	NC	RFB	Effort[n] (*d* =

																		0.46)
Muraven, Tice & Baumeister (1998)	1	60	0.64[ec]	CE	AFF	VAR	3	SIN	SXP	CQ	CI	AFF	HGR	BEH	UMD	MTD	EV	NC	RFB	Fatigue[m] (*d* = 0.51) Effort[n] (*d* = 0.98)
	2	34	0.75[ed]	CT	COG	WBP	6	SIN	SXP	CQ	CI	AFF	NF	BEH	UMD	UMD	EV	NC	RFB	Difficulty[o] (*d* = 1.15)
	3	49	0.57[ee]	CT	COG	WBP	5	SIN	SXP	CQ	CE	AFF	NF	BEH	UMD	UMD	AT	NC	RFB	Positive affect[i] (*d* = 0.18) Difficulty[o] (*d* = 0.54)
Neshat-Doost, Dagleish & Golden (2008)		32	0.84[ef]	CI	AFF	MST	6.5	SIN	SXP	CQ	CP	COG	NF	BEH	UMD	UMD	EV	CLX	OTH	Positive affect[eg] (*d* = -0.13) Negative affect[eh] (*d* = 0.15) Fatigue[ei] (*d* = 0.52) Difficulty[o] (*d* = 1.19)
Oaten, Williams, Jones & Zadro (2008)	1	71	1.08[ej]	SP	C&A	NF	5	SEP	SXP	CQ	CI	AFF	FTT	BEH	UMD	UMD	EV	NC	OTH	
	2	73	0.59[ek]	SP	C&A	NF	5	SEP	SXP	CQ	CI	AFF	NF	BEH	UMD	UMD	EV	NC	OTH	
Oikawa (2005)	1	38	0.98[el]	SP	C&A	NF	ND	SIN	DXP	CQ	SP	C&A	NF	BEH	MTD	UMD	EV	NC	OTH	Fatigue[ei] (*d* = 0.91)
	2	40	1.53[em]	SP	C&A	NF	ND	SIN	DXP	CQ	CP	COG	ANG	BEH	UMD	UMD	EV	CLX	OTH	Fatigue[ei] (*d* = 1.28)
Ostafin, Marlatt & Greenwald (2008)		85	0.44[en]	X	C&A	NF	4	SIN	SXP	CQ	CI	AFF	FTT	BEH	UMD	UMD	EV	NC	OTH	Positive affect[eo] (*d* = -0.49) Effort[n] (*d* = 0.52)
Park, Glaser		57	0.56[ep]	CP	COG	NF	ND	SIN	DXP	CQ	SP	C&A	NF	BEH	UMD	UMD	ID	NC	OTH	Effort[n] (*d* =

& Knowles (2008)																		0.06) Difficulty[o] (*d* = 0.11)
Pocheptsova, Amir, Dhar & Baumeister (2009)	1	284	0.29[eq]	CI	AFF	MST	6	SIN	SXP	NI	CV	COG	NF	BEH	UMD	UMD	EV	NC	RFB	
	2	501	0.18[er]	CI	AFF	MST	6	SIN	SXP	NI	CV	COG	NF	BEH	UMD	UMD	EV	NC	RFB	Positive affect[w] (*d* = -0.54) Negative affect[w] (*d* = -0.04) Fatigue[u] (*d* = 0.15) Difficulty[o] (*d* = 0.55)
	3	105	0.36[es]	CA	COG	VAT	3.67	SEP	SXP	NI	CV	COG	NF	BEH	UMD	MTD	EV	NC	RFB	
	4	64	0.25[et]	CA	COG	VAT	3.67	SEP	SXP	NI	CV	COG	NF	BEH	UMD	MTD	EV	NC	RFB	Positive affect[eu] (*d* = .36)
	5	162	0.15[ev]	CI	AFF	NF	ND	SEP	SXP	NI	CV	COG	NF	BEH	UMD	UMD	EV	NC	RFB	
Richeson & Shelton (2003)		22	1.42[ew]	SP	C&A	NF	5	SIN	DXP	NI	CI	AFF	MST	BEH	UMD	UMD	ID	NC	OTH	
Richeson & Trawalter (2005)	1	60	0.79[ex]	SP	C&A	NF	8	SEP	DXP	NI	CI	AFF	MST	BEH	UMD	UMD	ID	NC	OTH	
	2	32	0.93[ey]	SP	C&A	NF	8	SEP	DXP	NI	CI	AFF	MST	BEH	UMD	UMD	ID	NC	OTH	
	3	34	0.91[ez]	SP	C&A	NF	8	SEP	DXP	NI	CI	AFF	MST	BEH	UMD	UMD	ID	NC	OTH	
Richeson, Trawalter & Shelton (2005)		30	0.95[fa]	SP	C&A	NF	6	SEP	DXP	NI	CI	AFF	MST	BEH	UMD	UMD	ID	NC	OTH	
Schmeichel	1S1	79	0.45[fb]	CA	COG	VAT	6	SIN	SXP	CQ	CP	COG	NF	BEH	UMD	MTD	EV	CLX	RFB	Positive affect[i]

(2007)																		(*d* = -0.34) Difficulty[o] (*d* = 1.22)
	1S2	62	0.52[fc]	CA	COG	VAT	6	SIN	SXP	CQ	CP	COG	NF	BEH	UMD	MTD	EV	CLX	RFB	
	2S1	61	0.51[fd]	CI	AFF	NF	6	SIN	SXP	CQ	CP	COG	NF	BEH	UMD	UMD	EV	SIM	RFB	Positive affect[i] (*d* = -0.40) Difficulty[o] (*d* = 3.93)
	2S2	61	0.08[fe]	CI	AFF	NF	6	SIN	SXP	CQ	CP	COG	NF	BEH	UMD	UMD	EV	CLX	RFB	
	3	30	0.68[ff]	CP	COG	NF	2	SIN	SXP	NI	CE	AFF	NF	BEH	UMD	UMD	EV	NC	RFB	Negative affect[fg] (*d* = -0.15) Difficulty[o] (*d* = 2.70)
	4	65	0.53[fh]	CE	AFF	VAR	4	SIN	SXP	NI	CP	COG	NF	BEH	UMD	UMD	EV	CLX	RFB	Positive affect[i] (*d* = -0.30) Difficulty[o] (*d* = 0.44)
Schmeichel, Demaree, Robinson & Pu (2006)		50	0.85[fi]	CE	AFF	VAR	2	SIN	SXP	CQ(7)	CP	COG	NF	BEH	UMD	UMD	EV	CLX	RFB	Negative affect[eo] (*d* = -0.16) Difficulty[o] (*d* = 0.35)
Schmeichel & Vohs (2009)	1	59	0.61[fj]	CI	AFF	NF	5	SIN	SXP	CQ	CI	AFF	NF	BEH	MTD	MTD	EV	NC	RFB	Positive affect[i] (*d* = 0.26) Effort[n] (*d* = 0.62)
	2	72	0.75[fk]	CA	COG	VAT	5	SIN	SXP	CQ	CI	AFF	NF	BEH	UMD	UMD	EV	NC	RFB	Negative affect[w] (*d* = 0.24) Difficulty[o] (*d* = 2.58)
Schmeichel, Vohs & Baumeister (2003)	1	24	1.61[fl]	CA	COG	VAT	6	SIN	SXP	CQ	CP	COG	NF	BEH	UMD	MTD	EV	CLX	RFB	Positive affect[w] (*d* = 0.06) Negative

																			affect[w] (*d* = 0.32) Difficulty[o] (*d* = 1.53)
	2	37	0.43[fm]	CE	AFF	VAR	10	SIN	SXP	CQ	CP	COG	NF	BEH	UMD	UMD	EV	X	RFB	Positive affect[w] (*d* = 0.31) Negative affect[w] (*d* = 0.23) Difficulty[o] (*d* = 0.64)
	3	36	0.90[fl]	CA	COG	VAT	6	SIN	SXP	CQ	CP	COG	NF	BEH	UMD	MTD	EV	CLX	RFB	Positive affect[w] (*d* = 0.04) Negative affect[w] (*d* = 0.43) Difficulty[o] (*d* = 1.25)
Seeley & Gardner (2003)	1	73	0.41[fn]	CT	COG	WBP	5	SEP	SXP	NI	CI	AFF	HGR	BEH	UMD	UMD	EV	NC	OTH	
	2	55	0.47[fo]	CT	COG	WBP	5	SEP	SXP	NI	CI	AFF	HGR	BEH	UMD	UMD	EV	NC	OTH	
Segerstrom & Nes (2007)		83	0.65[fp]	CI	AFF	NF	5	SIN	SXP	CQ	CI	AFF	NF	BEH	MTD	MTD	EV	NC	OTH	Positive affect[w] (*d* = -0.19) Negative affect[w] (*d* = -0.20) Fatigue[fq] (*d* = 0.14) Effort[fr] (*d* = 0.63)
Shamosh & Gray (2007)		57	0.67[fs]	CE	AFF	VAR	6	SIN	SXP	CQ	CI	AFF	MST	BEH	UMD	MTD	EV	NC	OTH	Positive affect[i] (*d* = 0.14) Effort[n] (*d* = 0.79)
Shmueli &		101	0.19[ft]	CI	AFF	NF	5	SIN	SXP	CQ	CI	AFF	NF	BEH	MTD	MTD	EV	NC	OTH	Difficulty[o] (*d*

Prochaska (2009)																		= 0.15) Effort[fu] (*d* = .65)
Stewart, Wright, Hui & Simmons (2009)		40	0.47[fv]	CI	AFF	NF	8.5	SEP	SXP	NI	CP	COG	MAT	BEH	UMD	UMD	EV	SIM	OTH	Negative affect[fw] (*d* = 0.99) Fatigue[ei] (*d* = 1.55) Difficulty[o] (*d* = 3.28)
Stillman, Tice, Fincham & Lambert (2009)	1	40	0.02[fx]	CT	COG	WBP	6	SIN	SXP	CQ	CI	AFF	NF	BEH	UMD	UMD	EV	NC	OTH	
	3	33	0.04[fy]	CA	COG	VAT	6	SIN	SXP	NI	CI	AFF	FTT	BEH	UMD	UMD	EV	NC	OTH	
Stucke & Baumeister (2006)	1	60	0.82[fz]	CI	AFF	NF	5	SIN	SXP	NI	CI	AFF	NF	NBJ	MTD	MTD	EV	NC	RFB	
	2	62	0.60[ga]	CI	AFF	NF	10	SIN	SXP	NI	CI	AFF	NF	NBJ	MTD	MTD	EV	NC	RFB	
	3	45	1.20[ga]	CI	AFF	NF	10	SIN	SXP	CQ	CI	AFF	NF	NBJ	MTD	MTD	EV	NC	RFB	Effort[gb] (*d* =1.89)
Tice, Baumeister, Shmueli & Muraven (2007)	2	93	0.61[gc]	CI	AFF	COL	ND	SIN	SXP	FT	CI	AFF	NF	BEH	MTD	MTD	EV	NC	RFB	Positive affect[eu] (*d* = 0.81)
Trawalter & Richeson (2006)		45	0.83[gd]	SP	C&A	NF	7	SEP	DXP	NI	CI	AFF	MST	BEH	UMD	UMD	EV	NC	OTH	
Tyler (2008)	1	33	1.07[ge]	SP	C&A	NF	4	SIN	SXP	CQ	CI	AFF	NF	BEH	UMD	UMD	EV	NC	OTH	Positive affect[gf] (*d* = 0.35) Difficulty[o] (*d* = -0.31)
	2	30	0.97[gg]	SP	C&A	NF	4	SEP	SXP	CQ	CI	AFF	HGR	BEH	UMD	UMD	EV	NC	OTH	Positive affect[gf] (*d* = 0.49)

	3	30	1.36[gh]	CI	AFF	COL	10	SIN	SXP	CQ	SP	C&A	NF	BEH	UMD	UMD	EV	NC	OTH	Difficulty[o] (*d* = -0.20) Positive affect[gf] (*d* = -0.12) Fatigue[gi] (*d* = 0.41) Difficulty[o] (*d* = 1.36)
	4	60	0.58[gj]	CT	COG	WBP	6	SEP	SXP	CQ	SP	C&A	NF	BEH	UMD	UMD	EV	NC	OTH	Positive affect[gf] (*d* = 0.30) Fatigue[gi] (*d* = -0.06) Difficulty[o] (*d* = 0.76)
Tyler & Burns (2008)	1	60	1.56[gk]	CP	COG	NF	6	SIN	SXP	(1)	CI	AFF	HGR	BEH	UMD	UMD	EV	NC	OTH	Positive affect[gf] (*d* = -0.21) Difficulty[o] (*d* = 1.66)
	2	40	0.99[gl]	CT	COG	WBP	6	SIN	SXP	(3)	CP	COG	MAT	BEH	UMD	UMD	EV	CLX	OTH	Positive affect[gf] (*d* = -0.16) Difficulty[o] (*d* = 1.38)
Tyler & Burns (2009)	1	20	1.36[gm]	CI	AFF	NF	10	SEP	SXP	CQ	CI	AFF	NF	BEH	MTD	MTD	EV	NC	OTH	Positive affect[gf] (*d* = -0.39) Difficulty[o] (*d* = 2.94)
	2S1	20	1.22[gn]	CI	AFF	COL	3	SEP	SXP	CQ	CI	AFF	HGR	BEH	MTD	MTD	EV	NC	OTH	Positive affect[gf] (*d* = -0.27) Difficulty[o] (*d* = 2.92)
	2S2	20	2.60[go]	CI	AFF	COL	10	SEP	SXP	CQ	CI	AFF	HGR	BEH	MTD	MTD	EV	NC	OTH	
	2S3	20	0.44[gp]	CI	AFF	COL	20	SEP	SXP	CQ	CI	AFF	HGR	BEH	MTD	MTD	EV	NC	OTH	

	3	40	1.19[gq]	CT	COG	WBP	6	SEP	SXP	CQ	CI	AFF	HGR	BEH	UMD	UMD	EV	NC	OTH	Positive affect[gf] (*d* = -0.24) Difficulty[o] (*d* = 2.80)
Vohs, Baumeister & Ciarocco (2005)	1	68	0.58[gr]	SP	C&A	NF	ND	SIN	SXP	CQ	CP	COG	MAT	BEH	UMD	UMD	EV	SIM	RFB	
	2	58	0.64[gs]	SP	C&A	NF	ND	SIN	SXP	NI	CI	AFF	HGR	BEH	UMD	UMD	ID	NC	RFB	
	3	30	1.59[gt]	SP	C&A	NF	6	SEP	SXP	CQ	CE	AFF	NF	BEH	UMD	UMD	EV	NC	RFB	Difficulty[o] (*d* = 1.17)
	4	60	1.06[gu]	SP	C&A	NF	4	SIN	SXP	CQ	CI	AFF	NF	BEH	UMD	UMD	EV	NC	RFB	Difficulty[o] (*d* = 0.70)
	5	34	0.80[gv]	CT	COG	WBP	6	SIN	SXP	CQ	SP	C&A	NF	NBJ	UMD	UMD	EV	NC	RFB	Positive affect[w] (*d* = 0.34) Negative affect[w] (*d* = 0.48)
	6	57	0.63[gw]	CE	AFF	VAR	9	SIN	SXP	CQ	SP	C&A	NF	NBJ	UMD	UMD	EV	NC	RFB	Difficulty[o] (*d* = 2.09)
	7	71	0.70[gx]	CI	AFF	MST	6	SIN	SXP	NI	SP	C&A	NF	NBJ	UMD	UMD	EV	NC	RFB	Difficulty[o] (*d* = 1.33)
	8	32	0.79[gy]	CA	COG	VAT	7	SIN	SXP	CQ	SP	C&A	NF	NBJ	UMD	UMD	EV	NC	RFB	Difficulty[o] (*d* = 2.03)
Vohs, Baumeister, Schmeichel, Twenge, Nelson & Tice (2008)	1a	30	1.34[gz]	CV	COG	NF	3.5	SIN	SXP	CQ	CI	AFF	NF	BEH	UMD	UMD	EV	NC	RFB	
	1b	30	1.01[gz]	CV	COG	NF	3.5	SIN	SXP	CQ	CI	AFF	NF	BEH	UMD	UMD	EV	NC	RFB	
	2	25	0.98[ha]	CV	COG	NF	3.5	SEP	DXP	CQ	CI	AFF	NF	BEH	UMD	UMD	EV	NC	RFB	
	3	26	0.99[hb]	CV	COG	NF	8	SIN	SXP	CQ	CI	AFF	NF	BEH	UMD	UMD	EV	NC	RFB	Positive affect[w] (*d* = 0.40)

																			Negative affect[w] (*d* = 0.39)
	4a	40	0.84[hc]	CV	COG	NF	ND	SEP	DXP	CQ	CI	AFF	NF	BEH	UMD	UMD	EV	NC	RFB	
	4b	40	0.93[hd]	CV	COG	NF	12	SEP	DXP	CQ	CP	COG	MAT	BEH	UMD	MTD	EV	CLX	RFB	
	6	64	0.73[he]	CV	COG	NF	4.5	SIN	SXP	NI	CP	COG	ANG	BEH	UMD	MTD	EV	CLX	RFB	
Vohs & Faber (2007)	1	35	0.96[hf]	CA	COG	VAT	6	SEP	SXP	CQ	SP	C&A	NF	BEH	UMD	UMD	EV	NC	RFB	Difficulty[o] (*d* = 1.99)
	2	70	1.27[hg]	CT	COG	WBP	6	SEP	SXP	CQ	CI	AFF	NF	BEH	UMD	UMD	EV	NC	RFB	Difficulty[o] (*d* = 0.88)
	3	40	1.38[hh]	CE	AFF	NF	6	SEP	SXP	CQ	CI	AFF	NF	BEH	UMD	MTD	EV	NC	RFB	Difficulty[o] (*d* = 0.66)
Vohs & Heatherton (2000)	1	18	1.40[hi]	CI	AFF	NF	10	SIN	SXP	CQ	CI	AFF	FTT	BEH	MTD	MTD	EV	NC	RFB	
	2	28	0.77[hj]	CI	AFF	NF	10	SIN	SXP	CQ	CI	AFF	NF	BEH	MTD	MTD	EV	NC	RFB	Positive affect[hk] (*d* = 0.45) Negative affect[hl] (*d* = 0.55)
	3	36	0.76[hm]	CE	AFF	VAR	11	SIN	SXP	CQ	CI	AFF	FTT	BEH	UMD	MTD	EV	NC	RFB	Positive affect[hk] (*d* = 0.35) Negative affect[hl] (*d* = 0.36)
Vohs & Schmeichel (2003)	3	48	1.07[hn]	CE	AFF	NF	4.38	SIN	SXP	CQ	CI	AFF	NF	BEH	UMD	MTD	EV	NC	RFB	Positive affect[w] (*d* = 0.06) Negative affect[w] (*d* = -0.37) Difficulty[o] (*d* = 0.62)
	4	47	0.76[ho]	CT	COG	WBP	6	SEP	SXP	CQ	CI	AFF	NF	BEH	UMD	UMD	EV	NC	RFB	Positive affect[w] (*d* =

																			0.50) Negative affect[w] (*d* = 0.13) Difficulty[o] (*d* = 0.78)
Wallace & Baumeister (2002)		23	1.13[hp]	CI	AFF	MST	6	SEP	SXP	NI	CI	AFF	NF	BEH	MTD	MTD	EV	NC	RFB	
Wan & Sternthal (2008)	1	25	1.25[hq]	CI	AFF	COL	ND	SIN	SXP	CQ	CI	AFF	NF	BEH	MTD	MTD	EV	NC	OTH	Positive affect[hr] (*d* = -0.35) Negative affect[hs] (*d* = 0.57) Effort[n] (*d* =0.98)
	2	27	1.27[hq]	CI	AFF	COL	ND	SIN	SXP	CQ	CI	AFF	NF	BEH	MTD	MTD	EV	NC	OTH	Positive affect[hr] (*d* = 0.34) Negative affect[hs] (*d* = 0.53) Effort[n] (*d* = 0.50)
	3	50	0.77[ht]	CI	AFF	COL	ND	SIN	SXP	CQ	CI	AFF	NF	BEH	MTD	MTD	EV	NC	OTH	Positive affect[hr] (*d* = -1.03) Negative affect[hs] (*d* = 0.45) Effort[n] (*d* = 1.43)
	4	42	1.11[hu]	CI	AFF	COL	ND	SIN	SXP	CQ	CI	AFF	NF	BEH	MTD	MTD	EV	NC	OTH	Positive affect[hr] (*d* = 0.39) Negative affect[hs] (*d* = 0.43) Effort[n] (*d* =

																			1.18)
Webb & Sheeran (2003)	1	31	0.95[hv]	CI	AFF	MST	10	SEP	SXP	NI	CI	AFF	MST	BEH	MTD	MTD	EV	NC	OTH	Positive affect[i] (*d* = 0.23) Effort[n] (*d* = 1.79) Fatigue[m] (*d* = 0.48) Difficulty[o] (*d* = 1.98)
	2	28	1.73[hw]	CP	COG	NF	ND	SIN	SXP	NI	CI	AFF	NF	BEH	UMD	UMD	EV	NC	OTH	Positive affect[i] (*d* = -0.55) Fatigue[m] (*d* = 0.78) Difficulty[o] (*d* = 1.81)
Wheeler, Brinol & Hermann (2007)		68	0.90[hx]	CI	AFF	COL	5	SIN	SXP	NI	CP	COG	NF	NBJ	UMD	UMD	EV	NC	OTH	Effort[n] (*d* = 0.44) Fatigue[m] (*d* = 0.44) Difficulty[o] (*d* = 0.03)
Wright et al. (2007)	1S1	48	0.30[hy]	CP	COG	NF	5	SIN	SXP	NI	CI	AFF	MAT	BEH	UMD	UMD	EV	NC	OTH	Positive affect[eu] (*d* = 0.46) Difficulty[o] (*d* = 0.58)
	1S2	46	0.13[hz]	CP	COG	NF	5	SIN	SXP	NI	CP	COG	MAT	BEH	MTD	MTD	EV	SIM	OTH	
	2S1	49	0.34[hy]	CP	COG	NF	5	SIN	SXP	NI	CI	AFF	NF	BEH	UMD	UMD	EV	NC	OTH	Positive affect[eu] (*d* = -0.08) Difficulty[o] (*d* = 1.09)
	2S2	47	-0.57[hz]	CP	COG	NF	5	SIN	SXP	NI	CP	COG	NF	BEH	MTD	MTD	EV	SIM	OTH	
Wright, Martin & Bland (2003)	S1	36	0.21[ia]	CP	COG	NF	5	SIN	SXP	NI	CP	COG	MAT	BEH	MTD	MTD	EV	SIM	OTH	Fatigue[m] (*d* = -0.16) Difficulty[o] (*d* = 1.66)
	S2	37	0.21[ib]	CP	COG	NF	5	SIN	SXP	NI	CP	COG	MAT	BEH	MTD	MTD	EV	SIM	OTH	
Wright ,	S1	53	-0.11[ic]	CI	AFF	NF	5	SIN	SXP	NI	CI	AFF	MST	BEH	MTD	UMD	EV	NC	OTH	Difficulty[o] (*d*

Stewart & Barnett (2008)																			= 0.35)
	S2	53	0.65[id]	CI	AFF	NF	5	SIN	SXP	NI	CP	COG	MAT	BEH	UMD	MTD	EV	SIM	OTH	
Zyphur, Warren, Landis & Thoresen (2007)	1	65	0.65[ie]	SP	C&A	NF	ND	SIN	SXP	CQ	CI	AFF	NF	BEH	UMD	MTD	EV	NC	OTH	Positive affect[w] (d = 0.67)
	2	80	0.56[if]	CE	AFF	VAR	10	SIN	SXP	NI	CP	COG	NF	BEH	UMD	UMD	EV	NC	OTH	

Note. S = Sample; CA = Controlling attention; CE = Controlling emotions; CI = Controlling impulses; CP = Cognitive processing; CT = Controlling thoughts; CV = Choice and volition; SP = Social processing; X = Studies using a combination of two spheres of task and excluded from the specific sphere of task moderator analysis (Fischer et al., 2007, Studies 1, 2, and 4; Ostafin et al., 2008); COG = Cognitive self-control tasks; AFF = Affective self-control tasks; C&A = Cognitive and affective self-control tasks; NF = Task not frequently used as a depleting task; VAR = Video-watching affect regulation task; COL = Crossing-out-letters task; MST = Modified Stroop task; WBP = Wegner et al.'s (1987) white bear paradigm; VAT = Video-watching attention control task; ND = No task duration reported; SIN = Tasks presented as single experiment; SEP = Tasks presented as separate experiments; SXP = Tasks administered by a same experimenter; DXP= Tasks administered by different experimenters; FT = Completed filler task; CQ = Completed questionnaires; CQFT = Completed questionnaires and filler task; NI = No interim period reported; HGR = Handgrip task; ANG = Solvable anagrams task; FTT = Food taste task; MAT = Math or mental arithmetic task; BEH = Studies employing a behavioral dependent measure of a self-control; NBJ = Studies employing a non-behavioral or self-reported judgment dependent measure of self-control; UMD = Depleting and dependent tasks unmatched on sphere; MTD = Depleting and dependent tasks matched on sphere; EV = Control condition is easier/less demanding version of depleting task; AB = Task absent – control participants sit passively and do not engage in any task; AT = Control participants engage in alternative task in control condition; ID = Individual difference variable defines control condition; NC = Study not classified as complex or simple; CLX = Complex cognitive processing task; SIM = Simple cognitive processing task; OTH = Data from other laboratories; RFB = Data from Roy F. Baumeister and collaborators' laboratories.

[a]Overall ego-depletion effect from two-task paradigm. Effect sizes for studies using an individual difference characteristic or manipulation to evoke the ego-depletion effect were calculated from the depleted and non-depleted groups within the relevant individual difference category that evoked the depletion effect. Effect sizes for studies employing factorial designs to examine the effect of other independent variables on ego-depletion were calculated for the depletion vs. no depletion comparison in the absence of the moderator. [b]Most frequently used (k > 10) depleting/dependent tasks. [c]Duration of depleting task. [d]Interim period between depleting and dependent task in two-task paradigm. Few studies stated a precise time so studies are coded according to the task (if any) participants completed in the interim period. Numbers in parentheses refer to time (in minutes) of the interim period if given. Numbers preceded by a '+' sign indicate an interim period of the duration shown in minutes in addition to completing questionnaires/filler task. [e]Type of control condition. [f]Used cognitive processing task (e.g., memory span) that was 'complex' (as opposed to 'simple')

to evoke depletion. [g]Source laboratory. [h]Differences in handgrip task performance in the hard (depletion) vs. easy (no depletion) labyrinths task groups in the neutral prime condition. [i]Brief Mood Introspection Scale (BMIS) valence score. [j]Differences in weight-holding task for the distraction (depletion) vs. no distraction (no depletion) attention control task in the neutral prime condition. [k]Six-item 'energy and tiredness' scale. [l]Differences in persistence on unsolvable figure-tracing task for the radishes (depletion) vs. chocolate (no depletion) food taste task groups. [m]'Tiredness' item from BMIS. [n]Single-item measure of effort. [o]Single-item measure of perceived difficulty. [p]Effect size is average effect of high choice counterattitudinal (depletion) and high-choice proattitudinal (depletion) essay task conditions vs. no choice (no depletion) essay task conditions on persistence on unsolvable figure-tracing task. [q]Differences in number of anagrams solved for the emotion suppression (depletion) vs. no suppression (no depletion) video-watching task groups. [r]Differences in time spent watching a boring movie for the impulse suppression (depletion) vs. no suppression (no depletion) crossing-out-letters task groups. [s]Single-item measure of concentration on task. [t]Differences in handgrip performance for the incongruent (depletion) vs. congruent (no depletion) Stroop task groups. [u]Single-item measure of tiredness/exhaustion. [v]Differences in lottery expenditures for the incongruent (depletion) vs. congruent (no depletion) Stroop task groups for the positive affect condition only. [w]Positive and Negative Affect Schedule (PANAS). [x]Differences in lottery expenditures for negative affect regulation (depletion) vs. helped affect regulation (no depletion) groups. [y]Differences in lottery expenditures for negative affect regulation (depletion) vs. no affect regulation (no depletion) groups. [z]Differences in tendency of participants to choose affectively-appealing product in simulated shop for choice (depletion) vs. no-choice (no depletion) groups. [aa]Median value of task duration in choice and no choice conditions. [ab]Differences in amount of affectively-appealing product purchased in simulated shop for choice (depletion) vs. no-choice (no depletion) groups. [ac]Differences in amount of candy purchased for choice (depletion) vs. no-choice (no depletion) groups in the 'very attractive candy' condition. [ad]Differences in persistence on unsolvable anagrams for personally-relevant (depletion) vs. not relevant (no depletion) persuasive message groups. [ae]Differences in attitudes toward persuasive argument for task present (depletion) vs. task absent (no depletion) handgrip task groups. [af]Differences in attitudes toward persuasive argument for thought suppression using 'white bear' paradigm (depletion) vs. math problems (no depletion) groups. [ag]Differences in positive and negative thoughts computed for thought suppression (depletion) vs. no suppression (no depletion) 'white bear' paradigm groups in the 'strong arguments' (high persuasion) condition. [ah]Differences in persistence on unsolvable anagrams for ostracizing task (depletion) vs. no ostracizing task (no depletion) groups independent of task feedback condition. [ai]Differences in handgrip task persistence for ostracizing task (depletion) vs. no ostracizing task (no depletion) groups. [aj]Differences in helping behaviour for the impulse suppression (depletion) vs. no suppression (no depletion) crossing-out-letters task groups. [ak]Differences in helping behaviour for the attention control (depletion) vs. no attention control (no depletion) video-watching task groups in the placebo condition. [al]Differences in willingness to help for the impulse suppression (depletion) vs. no suppression (no depletion) crossing-out-letters task groups in the 'stranger' condition. [am]Differences in aggressive behaviour (quantity of 'hot sauce' given) for resist donut (depletion) vs. resist radish (no depletion) food taste task groups. [an]Three-item anger feelings index comprising items of 'cruelty', 'threatening', and 'anger'. [ao]Differences in aggressive behaviour (application of 'white noise' punishment) for attention control (depletion) vs. no attention control (no depletion) video-watching task groups in the 'high provocation' condition. [ap]Differences in negative evaluation of job candidate for the incongruent (depletion) vs. congruent (no depletion) Stroop task groups in the 'high provocation' condition. [aq]Differences in aggressive intentions for the impulse suppression (depletion) vs. no suppression (no depletion) crossing-out-letters task groups independent of trait self-control scores. [ar]Differences in number of counter arguments made to counterattitudinal message for the 'foot-in-the-door' initial request (depletion) vs. no initial request (no depletion) groups. [as]Differences in performance on analytical problems for the 'foot-in-the-door' questions on cognitively-demanding topic (depletion) vs. no initial request (no depletion) groups. [at]Differences in performance on unsolvable

figure-tracing task for the impression management (depletion) vs. no impression management (no depletion) open-ended question groups. [au]Differences in Stroop task performance for the 'foot-in-the-door' questions on cognitively-demanding topic (depletion) vs. cognitively-undemanding topic (no depletion) groups. [av]Differences in willingness to volunteer for the impulse suppression (depletion) vs. no suppression (no depletion) crossing-out-letters task groups for the high reciprocity condition. [aw]Differences in willingness to volunteer for the impulse suppression (depletion) vs. no suppression (no depletion) unsolvable figure-tracing task groups. [ax]Effect size is average of effect of emotion suppression (depletion) vs. emotion expression (no depletion) video-watching task conditions on self-reported accommodation components. [ay]Five-item measure of effort. [az]Differences in preference for easy or difficult anagrams for the high-maintenance (depletion) vs. low-maintenance (no depletion) interaction conditions of the maze task. [ba]Multi-item subjective-depletion measure using items referring to 'drained' and 'tired'. [bb]Differences in number of Graduate Record Exam (GRE) problems solved for the high-maintenance (depletion) vs. low-maintenance (no depletion) interaction conditions of the data-entry task excluding 'no coordination' group. [bc]Two-item measure of mood. [bd]Two-item measure of self-efficacy. [be]Differences in number of GRE problems solved for the high-maintenance (depletion) vs. low-maintenance (no depletion) interaction conditions of the maze task. [bf]Seven-item measure of mood. [bg]Differences in handgrip performance for the high-maintenance (depletion) vs. low-maintenance (no depletion) conditions of the co-operative problem-solving task. [bh]Differences in 'Operation' game performance for the high-maintenance, misalignment (depletion) vs. low-maintenance, mimicry (no depletion) conditions of the behavioral mimicry task. [bi]Differences in index of aggression (time assigned to partner for uncomfortable yoga poses) for the attention control (depletion) vs. no attention control (no depletion) video-watching task groups. [bj]Effect size is average of effect of attention control/emotion suppression (depletion) vs. no suppression (no depletion) video-watching task conditions on reported self-presentational components. [bk]Effect size is average of effect of impulse suppression (depletion) vs. no suppression (no depletion) crossing-out-letters task conditions on reported probabilities of positive and negative events. [bl]A range was specified so the median value for task duration is used. [bm]Effect size is average of effect of attention control/emotion suppression (depletion) vs. no suppression (no depletion) video-watching task conditions on reported positive self-attributes. [bn]Differences in overall reported positive future illusions for the thought suppression (depletion) vs. no suppression (no depletion) 'white bear' paradigm groups. [bo]Generalized Self-Efficacy Scale (GSES). [bp]Differences in confirmatory information processing for attention control (depletion) vs. no attention control (no depletion) video-watching task groups. [bq]Differences in confirmatory information processing for thought suppression (depletion) vs. no suppression (no depletion) 'white bear' paradigm groups excluding 'ego threat' group. [br]Four-item measure of negative emotions. [bs]Differences in confirmatory information processing for impulse suppression (depletion) vs. no suppression (no depletion) crossing-out-letters task groups excluding 'ego threat' and 'cognitive load' groups. [bt]Differences in confirmatory information processing for the emotion suppression (depletion) vs. no suppression (no depletion) video-watching task groups. [bu]Differences in amount of tempting food eaten (potato chips) for the emotion suppression (depletion) vs. no suppression (no depletion) video-watching task groups independent of implicit attitudes. [bv]Differences in amount of tempting drink consumed (beer) for the emotion suppression (depletion) vs. no suppression (no depletion) video-watching task groups independent of restraint standards. [bw]Differences in number of sexual words in word search task for impulse suppression (depletion) vs. no suppression (no depletion) modified Stroop task groups. [bx]Differences in likelihood of performing sexual infidelity for impulse suppression (depletion) vs. no suppression (no depletion) crossing-out-letters task groups for males. [by]Differences on extent of sexual behaviour for the attention control (depletion) vs. no attention control (no depletion) video-watching task groups for sexually experienced couples. [bz]Differences in errors on the Stroop task for the attention control (depletion) vs. no attention control (no depletion) video-watching task groups in the placebo condition. [ca]Differences in unsolved word fragments for the death (depletion) vs. dental pain (no depletion) writing task groups in the placebo condition. [cb]Differences in number of

anagrams solved for the low external motivation to respond without prejudice (depletion) vs. high external motivation to respond without prejudice (no depletion) participants after describing a homosexual target while avoiding stereotypes and for the non-exercise condition. [cc]Differences in number of anagrams solved for the low internal and external motivation to respond without prejudice (depletion) vs. high internal and external motivation to respond without prejudice (no depletion) participants after describing a homosexual/fat target while avoiding stereotypes and for the non-exercise condition. [cd]Differences in number of anagrams solved for the low motivation to respond without prejudice (depletion) vs. high motivation to respond without prejudice (no depletion) participants after describing a homosexual target while avoiding stereotypes and independent of recent exercise in self-control. [ce]Differences in number of death thoughts reported in word-search task for the thought suppression (depletion) vs. no suppression (no depletion) 'white bear' paradigm groups. [cf]Differences in number of death thoughts reported in ambiguous drawing task for the attention control (depletion) vs. no attention control (no depletion) video-watching task groups. [cg]Differences in Stroop task performance for the suppress thoughts of death (depletion) vs. no suppression (no depletion) writing task groups. [ch]Differences in analytical problems solved for the suppress thoughts of death (depletion) vs. no suppression (no depletion) writing task groups. [ci]Differences in rote memory problems solved for the suppress thoughts of death (depletion) vs. no suppression (no depletion) writing task groups. [cj]Differences in number of anagrams solved for the death (depletion) vs. dental pain (no depletion) writing task groups. [ck]Differences in word fragments solved for the death (depletion) vs. dental pain (no depletion) writing task groups. [cl]Differences in death words reported in personal story for the exaggerate emotion (depletion) vs. no exaggeration (no depletion) reading task groups. [cm]Differences in persistence on unsolvable figure-tracing task for the no chocolates (depletion) vs. no radishes (no depletion) food taste task groups. [cn]Differences in persistence on weight-holding task for the distraction (depletion) vs. no distraction (no depletion) attention control task groups. [co]Differences in number of anagrams solved for the suppress stereotypes (depletion) vs. do not suppress stereotype (no depletion) task in low motivation to respond without prejudice participants. [cp]Differences in the degree to which participant descriptions of a target were stereotypical for the suppress stereotypes (depletion) vs. do not suppress stereotype (no depletion) task in low motivation to respond without prejudice participants. [cq]Differences in cognitive control for the incongruent (depletion) vs. congruent (no depletion) Stroop task groups. [cr]Differences in candy consumption in food taste task for the emotion suppression (depletion) vs. no suppression (no depletion) video-watching task groups. [cs]Negative mood scale derived from Gollwitzer [Gollwitzer, M. (2005). *Ist gerächt gleich gerecht? Eine Analyse von Racheaktionen und rachebezogenen Reahtionen unter gerechtigkeitpsychologischen Aspekten [Is vengeance a justice-related reaction?]*. Berlin: WVB]. [ct]Single-item measure of ease of suppression. [cu]Differences in Stroop task (incongruent trials) performance for the emotion suppression (depletion) vs. no suppression (no depletion) video-watching task groups. [cv]Differences in response times on the Stroop task for the stereotype threat (depletion) vs. no threat (no depletion) conditions in the black participant group. [cw]Differences in handgrip performance for the stereotype threat (depletion) vs. no threat (no depletion) condition in the group of participants told to expect a math test. [cx]Differences in compliance (money donated) for the attention control (depletion) vs. no attention control (no depletion) video-watching task groups for participants informed the target charity was highly authoritative. [cy]Differences in performance on reading span task for the stereotype threat (depletion) vs. no stereotype threat (no depletion) task groups for participants in the 'informed' anxiety condition. [cz]Effect size is average effect of stereotype threat (depletion) vs. no stereotype threat (no depletion) conditions on working memory and math test performance. [da]Differences in working memory test performance for the stereotype threat (Latino) (depletion) vs. no threat (Caucasian) (no depletion) groups in the threat-only condition. [db]Differences on temporal discounting measure for the emotion suppression (depletion) vs. no suppression (no depletion) video-watching task groups independent of Consideration of Future Consequences. [dc]Differences in cookie consumption for the conflict (depletion) vs. no conflict (no depletion) visual perception task groups for restrained eaters. [dd]Differences in implicit prejudice scores for the impulse

suppression (depletion) vs. no suppression (no depletion) crossing-out-letters task in the low self-determined motivation to regulate prejudice participants. [de]Differences in handgrip performance for the difficult (depletion) vs. easy (no depletion) labyrinths task groups for participants in the neutral prime condition. [df]Eight-item measure of fatigue. [dg]Differences in handgrip performance for the emotion suppression (depletion) vs. no suppression (no depletion) video-watching task omitting the expectancy challenge condition. [dh]Two-item measure of difficulty in suppressing emotions. [di]Differences in choice of apartment (attraction effect) for the attention control (depletion) vs. no attention control (no depletion) video-watching task groups in the placebo condition. [dj]Differences in self-allocated amount of money (quarters) for the impulse suppression (depletion) vs. no suppression (no depletion) essay-writing task excluding words containing specified letters for participants in the self-scored (cheating possible) condition. [dk]Differences in number of questions scored 'correct' for the incongruent (depletion) vs. congruent (no depletion) Stroop task groups for participants choosing the pre-marked sheet. [dl]Differences in persistence on unsolvable puzzles for the controlled choice (depletion) vs. no choice (no depletion) speech preparation task. [dm]Differences on test of stereotyping for the impulse suppression (depletion) vs. no suppression (no depletion) crossing-out-letters task in the high motivation to control prejudiced reaction participants. [dn]Differences on test of stereotyping for the emotion suppression (depletion) vs. no suppression (no depletion) video-watching task in the high motivation to control prejudiced reaction participants. [do]Differences amount of tempting (liked) drink consumed (beer) for the thought suppression using 'white bear' paradigm (depletion) vs. simple arithmetic (no depletion) task independent of trait temptation to drink. [dp]Six-item measure of irritation. [dq]Differences in errors on computerized vigilance task for the no cookies (depletion) vs. no radishes (no depletion) food taste task groups in the 'non-contingent reward' condition. [dr]Differences in errors on computerized vigilance task for the impulse suppression (depletion) vs. no suppression (no depletion) typing paragraph without 'e's task groups in the 'no pressure' condition. [ds]Two-item measure of 'planned effort' and confidence in 'doing well'. [dt]Differences in stop signal task performance for the incongruent (depletion) vs. congruent (no depletion) Stroop task groups in the 'non-contingent reward' condition. [du]Differences in handgrip performance for the sniff alcohol (depletion) vs. sniff water (no depletion) video-watching task groups independent of trait temptation to drink. [dv]Differences in cold pressor task performance for the thought suppression (depletion) vs. no suppression (no depletion) 'white bear' paradigm in the 'anticipate no self-control' condition. [dw]Differences in hits on concentration task for the impulse suppression (depletion) vs. no suppression (no depletion) typing paragraph without 'e's task in the 'anticipate no self-control' condition. [dx]Single-item measure of 'fighting against urge…' [dy]Differences in incongruent Stroop response times for the impulse suppression (depletion) vs. no suppression (no depletion) typing paragraph without 'e's task in the 'anticipate hard future task' condition. [dz]Differences in persistence on unsolvable figure-tracing task for the thought suppression (depletion) vs. no suppression (no depletion) 'white bear' paradigm in the 'not important' condition. [ea]Differences in persistence on the frustrating game for the impulse suppression (depletion) vs. no suppression (no depletion) speech control task in the 'low pay' condition. [eb]Differences in amount of aversive-tasting drink consumed for the emotion suppression (depletion) vs. no suppression (no depletion) video-watching task in the 'low pay', 'sour beverage' condition. [ec]Differences in handgrip performance for the emotion suppression (depletion) vs. no suppression (no depletion) video-watching task groups. [ed]Differences in persistence on unsolvable anagrams for the thought suppression (depletion) vs. no suppression (no depletion) 'white bear' paradigm groups. [ee]Differences in emotional expressivity while watching emotive video for the thought suppression using 'white bear' paradigm (depletion) vs. math problems (no depletion) groups. [ef]Differences in autobiographical memory task performance for the color (congruent) Stroop (depletion) vs. control (incongruent) Stroop (no depletion) conditions. [eg]Average effect of ego-depletion on single-item measures of 'calmness' and 'happiness'. [eh]Average effect of ego-depletion on single-item measures of 'anger' and 'sadness'. [ei]Single-item measure of fatigue. [ej]Differences in amount of tempting food (cookies) eaten for the ostracism (depletion) vs. inclusion (no depletion) computerized game groups. [ek]Differences in amount

of aversive-tasting drink consumed for the ostracism (depletion) vs. inclusion (no depletion) computerized game groups. [el]Differences in number of stereotypes used for the stereotype suppression (depletion) vs. non suppression (no depletion) writing task groups for conscious suppression participants. [em]Differences in number of anagrams solved for the stereotype suppression (depletion) vs. non suppression (no depletion) writing task groups for conscious suppression participants. [en]Differences in amount of tempting drink (beer) consumed for the emotion and thought suppression (depletion) vs. no suppression (no depletion) conditions of the video-watching and thought-listing suppression tasks. [eo]Self-Assessment Manikin (SAM). [ep]Differences on 'Shooter bias' measure of unintended racial discriminatory behavior for the difficult (depletion) vs. easy (no depletion) anagrams task in the low implicit motivation to control prejudice participants. [eq]Differences in reference-dependent choice for the incongruent (depletion) vs. congruent (no depletion) Stroop task groups across both reference point groups. [er]Differences in compromise effect for the incongruent (depletion) vs. congruent (no depletion) Stroop task groups across both choice sets. [es]Differences in attraction effect for the attention control (depletion) vs. no attention control (no depletion) video-watching task groups across both choice sets. [et]Differences in attraction effect for the attention control (depletion) vs. no attention control (no depletion) video-watching task groups across both choice sets. [eu]Single-item measure of 'happiness'. [ev]Differences in attraction effect for the impulse suppression (depletion) vs. no suppression (no depletion) essay-writing task excluding words containing specified letters groups across both choice sets. [ew]Differences in response times on the Stroop task for the black (depletion) vs. white (no depletion) confederate interaction task. [ex]Differences in response times on the Stroop task for the interracial (depletion) vs. same-race (no depletion) confederate interaction task groups overall independent of performance and prejudice concern feedback conditions. [ey]Differences in response times on the Stroop task for the inter-racial (depletion) vs. same-race (no depletion) confederate interaction task groups for the 'no script' condition. [ez]Differences in response times on the Stroop task for the inter-racial (depletion) vs. same-race (no depletion) confederate interaction task groups for the 'no anxiety attribution' (control) condition. [fa]Differences in response times on the Stroop task for the interracial (depletion) vs. same-race (no depletion) confederate interaction task groups for participants high in implicit in-group favouritism. [fb]Differences in memory span test performance for the attention control (depletion) vs. no attention control (no depletion) video-watching task groups for participants allocated to the operation span test. [fc]Differences in memory span test performance for the attention control (depletion) vs. no attention control (no depletion) video-watching task for participants allocated to the sentence span test. [fd]Differences in digit span test performance for the impulse suppression (depletion) vs. no suppression (no depletion) essay-writing task excluding words containing specified letters for participants completing the reverse (difficult) span test. [fe]Differences in digit span test performance for the impulse suppression (depletion) vs. no suppression (no depletion) essay-writing task excluding words containing specified letters for participants completing the forward (easy) span test. [ff]Effect size is average effect of short term memory (2-word) and short term memory (6-word) (depletion) vs. working memory (no depletion) test performance on emotion expression in video-watching task. [fg]Five-item negative affect scale. [fh]Effect size is average effect of the exaggerate (depletion) vs. express (no depletion) video-watching task on operation span tests for sets recalled, longest set, words in correct sets, and total recall measures. [fi]Effect size is average effect of the exaggerate (depletion) vs. normal viewing (no depletion) video-watching task on verbal and figural fluency tests. [fj]Differences in time spent on cold pressor task for the impulse suppression (depletion) vs. no suppression (no depletion) essay-writing task excluding words containing specified letters for participants in the no-affirmation condition. [fk]Differences in persistence on math puzzle for the attention control (depletion) vs. no attention control (no depletion) video-watching task groups for participants in the no-affirmation condition. [fl]Differences in number of correct problems from the GRE test for the attention control (depletion) vs. no attention control (no depletion) video-watching task groups. [fm]Effect size is average effect of the attention control (depletion) vs. no attention control (no depletion) video-watching task conditions on number of correct problems, number of attempts at problems, and proportion of

problems correct in the General Mental Abilities Test. [fn]Differences in hand grip performance for the thought suppression (depletion) vs. no suppression (no depletion) 'white bear' paradigm groups for 'US citizenship' participants. [fo]Differences in hand grip performance for the thought suppression (depletion) vs. no suppression (no depletion) 'white bear' paradigm groups independent of self-monitoring scores. [fp]Differences in persistence on first unsolvable anagram for the eat carrots (depletion) vs. eat cookies and candy (no depletion) food taste task groups in the high self-consciousness participants. [fq]Fatigued affect from PANAS – Expanded form (PANAS-X). [fr]Six-item measure of effort. [fs]Differences in modified Stroop task performance for the emotion suppression (depletion) vs. no suppression (no depletion) video-watching task for all participants independent of fluid intelligence test scores. [ft]Differences in number of cigarettes smoked for resist cookies (depletion) vs. resist vegetables (no depletion) food taste task groups. [fu]Single-item measure of temptation. [fv]Differences in persistence on mental arithmetic task for the high fatigue (depletion) vs. low fatigue (no depletion) letter-cancelling task for the low expectancy condition. [fw]Single-item measure of nervousness. [fx]Differences in persistence on word production task for the thought suppression (depletion) vs. no suppression (no depletion) 'white bear' paradigm for the neutral-primed participants. [fy]Differences in amount of food eaten in food taste task for the attention control (depletion) vs. no attention control (no depletion) video-watching task groups for the no-prime control participants. [fz]Differences in evaluation of experimenter for the no cookies (depletion) vs. help yourself (no depletion) groups. [ga]Differences in evaluation of experimenter for the control expressions and movements (depletion) vs. watch only (no depletion) video-watching task groups. [gb]Two-item measure of effort and tiresomeness. [gc]Differences in persistence on frustrating game for the impulse suppression (depletion) vs. no suppression (no depletion) crossing-out-letters task groups. [gd]Effect size is average effect of promotion (depletion) vs. prevention and control (no depletion) instructions in interracial interaction task on Stroop task response time. [ge]Differences in persistence on unsolvable anagrams in the relational (depletion) vs. non-self (no depletion) self-monitoring task groups. [gf]Four-item mood scale based on BMIS items. [gg]Differences in handgrip performance in the relational (depletion) vs. non-self (no depletion) self-monitoring task groups. [gh]Differences in relational-value identification task performance in the impulse suppression (depletion) vs. no suppression (no depletion) crossing-out-letters task groups for complex interaction cues only. [gi]Four-item fatigue scale based on BMIS items. [gj]Differences in relational-value cue identification task performance in the thought suppression (depletion) vs. no suppression (no depletion) 'white bear' paradigm. [gk]Effect size is effect of difficult (depletion) vs. easy (no depletion) arithmetic calculations task on handgrip performance for the 1-minute inter-task interval group. [gl]Effect size is effect of thought suppression (depletion) vs. no suppression (no depletion) 'white-bear' paradigm on persistence on math problem task for the control (no relaxation) group. [gm]Effect size is effect of complex (depletion) vs. simple (no depletion) embedded-figures task on persistence on anagrams task for the control (did not expect future self-control) group. [gn]Effect size is effect of impulse suppression (depletion) vs. no suppression (no depletion) crossing-out-letters task on handgrip performance for the 3-min task duration group. [go]Effect size is effect of impulse suppression (depletion) vs. no suppression (no depletion) crossing-out-letters task on handgrip performance for the 10-min task duration group. [gp]Effect size is effect of impulse suppression (depletion) vs. no suppression (no depletion) crossing-out-letters task on handgrip performance for the 20-min task duration group. [gq]Effect size is average of effect of thought suppression (depletion) vs. no suppression (no depletion) 'white bear' paradigm conditions on handgrip performance in the 'not finished' condition only. [gr]Effect size is average of effect of modest self-presentation (depletion) vs. self-enhancing presentation (no depletion) on persistence on math problems for participants in the 'strangers' condition and effect of self-enhancing presentation (depletion) vs. modest self-presentation (no depletion) on persistence on math problems for participants in the 'friends' condition. [gs]Effect size is average of effect of competent (depletion) vs. interpersonal (no depletion) self-presentation on handgrip performance for female participants and effect of interpersonal (depletion) vs. competent (no depletion) self-presentation on handgrip performance for male participants. [gt]Differences in facial expressiveness for the 'be competent and likeable'

(depletion) vs. ‘be yourself’ (no depletion) self-presentation task for the sceptical audience condition. [gu]Differences in persistence on embedded-figures task for the token (depletion) vs. non token (no depletion) self-presentation task independent of topic condition. [gv]Differences on self-reports of underregulated verbosity for the suppression (depletion) vs. no suppression (no depletion) ‘white bear’ paradigm groups. [gw]Effect size is average effect of suppress/exaggerate (depletion) vs. no regulation (no depletion) emotion regulation task conditions on disclosure preference for ambivalent and avoidant attachment style participants. [gx]Effect size is average of effect of incongruent (depletion) vs. congruent (no depletion) Stroop task manipulations on disclosure preference for ambivalent attachment style and avoidant attachment style participants. [gy]Effect size is effect of attention control (depletion) vs. no attention control (no depletion) video-watching task conditions on self-reported narcissistic tendencies. [gz]Differences in amount of aversive-tasting drink consumed for the choice (depletion) vs. no-choice (no depletion) consumer product rating task groups. [ha]Differences in time spent on cold pressor task for the choice (depletion) vs. no-choice (no depletion) consumer product rating task groups. [hb]Differences in time spent on math problems rather than other tasks for the choice (depletion) vs. no-choice (no depletion) general university course choice task groups. [hc]Differences in persistence on unsolvable figure-tracing task for the choice (depletion) vs. no-choice (no depletion) psychology course choices task groups. [hd]Differences in persistence on solvable anagram task for the choice (depletion) vs. no-choice (no depletion) psychology course choices task groups. [he]Effect size is average effect of choice (depletion) vs. nonchoice deliberate and nonchoice implement (no depletion) product choice conditions on persistence on solvable anagrams. [hf]Differences in willingness to pay for the attention control (depletion) vs. no attention control (no depletion) video-watching task groups. [hg]Differences in amount of money spent on purchases for the suppression (depletion) vs. no suppression (no depletion) ‘white bear’ paradigm groups. [hh]Differences in amount of money spent on purchases for the emotionally-expressive (depletion) vs. emotionally-neutral (no depletion) reading task groups. [hi]Differences in amount of tempting food (ice-cream) eaten for the high temptation (depletion) vs. low temptation (no depletion) food availability/proximity groups for chronic dieters in the ‘help yourself’ condition. [hj]Differences in time spent on embedded-figures task for the high temptation (depletion) vs. low temptation (no depletion) food availability/proximity groups. [hk]Ten-item positive affect scale based on Heatherton and Vohs [Heatherton, T. F., & Vohs, K. D. (2000). Interpersonal evaluations following threats to self: Role of self-esteem. *Journal of Personality and Social Psychology*, *78*, 725-736]. [hl]Four-item dysphoria scale based on Heatherton and Vohs (2000). [hm]Differences in amount of tempting food (ice-cream) eaten for the emotion suppression (depletion) vs. no suppression (no depletion) video-watching task groups. [hn]Differences in behavioural continuance (reading aloud task) for the emotionally-expressive (depletion) vs. emotionally-neutral (no depletion) reading task groups. [ho]Differences in breath-holding task performance for the suppression (depletion) vs. no suppression (no depletion) ‘white bear’ paradigm groups. [hp]Differences in persistence on unsolvable figure-tracing task for the incongruent (depletion) vs. congruent (no depletion) Stroop task for the no feedback condition. [hq]Differences in persistence on unsolvable math puzzle for the impulse suppression (depletion) vs. no suppression (no depletion) crossing-out-letters task for the no clock condition. [hr]Eight-item positive mood scale from BMIS. [hs]Eight-item negative mood scale from BMIS. [ht]Differences in persistence on unsolvable math puzzle for the impulse suppression (depletion) vs. no suppression (no depletion) crossing-out-letters task for the overall sample independent of self-monitoring scores. [hu]Differences in persistence on unsolvable math puzzle for the impulse suppression (depletion) vs. no suppression (no depletion) crossing-out-letters task groups for the no clock condition and independent of self-monitoring scores. [hv]Effect size is effect of incongruent (depletion) vs. congruent (no depletion) Stroop task manipulations on persistence on unsolvable tracing puzzle in the no implementation intention condition. [hw]Effect size is average effect of difficult (depletion) vs. easy (no depletion) arithmetic calculations task manipulations on Stroop task completion time and error rate in the no implementation intention condition. [hx]Differences in favourability index from the thought listing task for the impulse suppression (depletion) vs. no suppression (no depletion) crossing-out-letters task groups for the weak arguments

condition. [hy]Differences in number of attempts in letter-circling task for the high fatigue (depletion) vs. low fatigue (no depletion) paced counting task groups for the low relevance condition. [hz]Differences in performance on the mental arithmetic task for the high fatigue (depletion) vs. low fatigue (no depletion) paced counting task groups for the high relevance condition. [ia]Differences in performance on mental arithmetic task (easy standard) for the high fatigue (depletion) vs. low fatigue (no depletion) paced letter-circling task groups. [ib]Differences in performance on mental arithmetic task (difficult standard) for the high fatigue (depletion) vs. low fatigue (no depletion) paced letter-circling task groups for easy task standard. [ic]Differences in performance on modified Stroop task for the high fatigue (depletion) vs. low fatigue (no depletion) paced letter-circling task for difficult task standard. [id]Differences in performance on mental arithmetic task for the high fatigue (depletion) vs. low fatigue (no depletion) paced letter-circling task groups. [ie]Effect size is average effect of high maintenance 'negative' (depletion) vs. low maintenance 'positive' (no depletion) interaction task groups on persistence on unsolvable puzzle and amount of food eaten in food taste task. [if]Differences in performance on Naval combat simulator complex decision-making task for the emotion suppression (depletion) vs. no suppression (no depletion) video-watching task groups.

Appendix C

Relations Between Moderators

Moderator variable	1	2	3	4	5	6
1. Sphere of depleting task – specific	–					
2. Frequently used depleting task	**χ^2(12) = 270.00, p < .001, N = 90**	–				
3. Duration of depleting task	F(6,137) = 1.09, p = .36, N = 144	F(4,68) = 2.73, p = .04, N = 73	–			
4. Experiment presentation – same/different experimenters	**χ^2(6) = 20.40, p < .01, N = 194**	χ^2(4) = 2.55, p = .64, N = 90	F(1,146) = 0.35, p = .55, N = 148	–		
5. Interim period	**χ^2(12) = 36.39, p < .001, N = 194**	χ^2(8) = 9.56, p = .30, N = 90	F(2,145) = 0.79, p = .46, N = 148	χ^2(2) = 2.84 p = .24, N = 198	–	
6. Sphere of dependent task – specific	χ^2(30) = 33.90, p = .29, N = 194	χ^2(16) = 18.10, p = .32, N = 90	F(5,142) = 0.96, p = .45, N = 148	χ^2(5) = 3.03, p = .70, N = 198	χ^2(10) = 19.49, p = .04, N = 198	–
7. Sphere of dependent task - global	χ^2(12) = 10.38, p = .58, N = 194	χ^2(8) = 10.27, p = .25, N = 90	F(2,145) = 0.49, p = .62, N = 148	χ^2(2) = 2.49, p = .29, N = 198	χ^2(4) = 9.06, p = .06, N = 198	**χ^2(10) = 396.00, p < .001, N = 198**

Note. Emboldened statistics indicate relations significant at the p < .01 level.