New Ideas in Psychology 41 (2016) 8–17

Contents lists available at ScienceDirect

New Ideas in Psychology

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

# The dual component theory of inhibition regulation: A new model of self-control

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ARTICLE INFO

*Article history:*
Received 7 June 2015
Received in revised form
15 December 2015
Accepted 17 December 2015
Available online 30 December 2015

*Keywords:*
Self-control
Inhibition
Modularity
Self-regulation
Inhibitory Control

ABSTRACT

Self-control is one of the most extensively studied topics in psychology and the resource or ego depletion model is one of the most popular. Although evidence supports some aspects of this model, other evidence is problematic for the notion that self-control is a limited resource. Herein, a new theory is proposed: the Dual Component Theory of Inhibition Regulation (DCTIR). The following paper will highlight key issues in self-control, describe the DCTIR, demonstrate how the DCTIR can account for the existing body of findings concerning limits to self-control, and provide novel predictions and avenues for further research.



## 1. Introduction

Self-control is the ability to inhibit, override, or otherwise circumvent responses motivated by short-term rewards in order to pursue more long-term benefits (Fujita, 2011; Hofmann, Friese, & Friese, 2009; Mischel, Shoda, & Rodriguez, 1989; Vohs & Heatherton, 2000). Although there are a number of strategies that one can use to accomplish self-control (see Fujita, 2011), here we are concerned specifically with the ability to inhibit prepotent or impulsive responses, which is at the heart of self-control. One of the more popular theories concerning this type of self-control is the resource or ego depletion model. The central tenet of this model is that self-control is a limited resource that can be depleted through use (Baumeister & Heatherton, 1996; Heatherton & Baumeister, 1996; Vohs & Heatherton, 2000). That is, engaging in a self-control task results in depletion of the willpower resource, leading to decreased performance on subsequent self-control tasks. This effect is referred to as *ego depletion*.

In a classic demonstration of the ego depletion effect, Baumeister, Bratslavsky, Muraven, and Tice (1998) presented hungry participants with cookies, candies, and radishes on a table. The experimental group was instructed to eat the radishes, but not the cookies or candies. The control group was asked to eat some of the cookies or candies. Participants in the experimental group thus had to resist the temptation to eat the more desirable food items (i.e., apply self-control), whereas the control group (minus the occasional radish lover) did not have such a temptation and thus did not need to apply self-control. Participants were then given an unsolvable geometry task as an assessment of subsequent self-control. Supporting the ego depletion model, participants in the experimental group gave up sooner on the unsolvable task.

Subsequent research has investigated the ego depletion effect across a host of domains, including emotion regulation and aggression (DeWall, Baumeister, Stillman, & Galliot, 2007), dieting/eating (Vohs & Heatherton, 2000), and cheating behavior (Mead, Baumeister, Gino, Schweitzer, & Ariely, 2009).

However, there are also problems with the ego depletion model. First, the model relies heavily on metaphor. The model does not specify the nature of the mechanism underlying the ego depletion effect. Glucose was offered as a candidate for the resource that was being depleted, potentially providing a more mechanistic account (Gailliot et al., 2007). However, this explanation has subsequently been shown to be a poor one (see Beedie & Lane, 2012; Molden et al., 2012; Kurzban, 2010a).

Second, multiple studies call into question basic premises of the model. For example, motivating participants (Muraven & Slessareva, 2003) or convincing participants that they have willpower resources remaining (Clarkson, Hirt, Jia, & Alexander, 2010)

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http://dx.doi.org/10.1016/j.newideapsych.2015.12.001
0732-118X/

is enough to eliminate the depletion effect. Moderating effects like these (see also Magen & Gross, 2007; Job, Dweck, & Walton, 2010) are inconsistent with the notion that self-control is energetically limited.

Third, there has been disagreement about the strength of the depletion effect. Hagger, Wood, Stiff, and Chatzisarantis (2010) found in their meta-analysis that the depletion effect was robust ($d$ = .62). However, Carter and McCullough (2014), employing statistical techniques to correct for small-study effects and publication bias, concluded that the depletion effect is much smaller and may not exist. It should be noted that the bias-correcting procedures employed by Carter and McCullough (2014) have themselves come under criticism. In particular, these procedures appear to perform quite poorly and suggest that effects are smaller than they really are when publication bias and heterogeneous effects are present in the literature (see Moreno et al., 2009; Reed, Florax, & Poot, 2015). Given that these conditions are likely to exist in the ego depletion literature, Inzlicht and Berkman (2015) have argued that Carter and McCullough's (2014) conclusions are premature. We would add that these discussions highlight the need for more consistent conceptual and operational definitions of self-control. For example, the same tasks have alternatively been employed as depletion tasks and control tasks (see for example the three-digit by three-digit multiplication task, Muraven, Tice, & Baumeister, 1998; Stillman, Tice, Fincham, & Lambert, 2009). A more clear and consistent conceptual view would aid in understanding when to expect or not expect a depletion effect.

Given these problems, we argue that a theory more specifically describing the functional nature of the self-control mechanism is needed. With a well-specified model of the self-control mechanism comes the ability to explain how we identify tempting situations to inhibit, how we inhibit, why we stop inhibiting, when and when not to expect a depletion-like effect, and why certain variables like motivation would affect self-control. Although there have been other recent attempts to conceptualize self-control (e.g., Inzlicht & Schmeichel, 2012; Hofmann, Baumeister, Förster, & Vohs, 2012), we argue that none of them completely solve these issues. To address this vital need for a strong theory of self-control, we propose the Dual Component Theory of Inhibition Regulation (DCTIR). We discuss key features of the model as well as the meta-theory from which the model is derived. We then present a description of the DCTIR, discuss how it explains existing findings in the literature, and outline future directions for testing the model.

## 2. Dual component theory of inhibition regulation

### 2.1. Key features of self-control

Any theory that seeks to provide a functional mechanism for applying self-control should address certain fundamental issues. First, we assume that it is functional to apply self-control in certain situations, in order to regulate impulsive behaviors. The theory therefore ought to explain when it is appropriate to use, or not use, self-control. Moreover, the theory ought to provide a mechanism that could accomplish the identification of these situations. In other words, the theory should explain how and when we identify the need to inhibit a prepotent behavior.

Second, we assume that it is undesirable for self-control to be applied indefinitely. That is, self-control must eventually come to a halt. Thus, a functional theory must also explain when it would be beneficial to stop (or not stop) using self-control. The theory should provide a mechanism capable of making this determination. It is worth noting that this assumption challenges some common ways of thinking about self-control. Much self-control research has been pervaded by the ideology that stopping self-control necessarily represents a failure. That is, impulsive responses are equated with bad decision making, whereas using self-control is equated with good decision making. However, there could be advantages to both exerting inhibition and eventually stopping it. For example, even people on a diet need to eventually eat. Calling the cessation of inhibition a "failure" of self-control is thus misleading, as it would depend on the situational context.

A third feature of self-control is that there is variation across contexts. That is, people may show high self-control performance for one behavior, but low self-control performance for another (Cohen & Lieberman, 2010; Cortes, Kammrath, Scholer, & Peetz, 2014). Someone may control their emotions well, but have difficulty sticking to a diet. Even for the same behavior, individuals do not exhibit high or low self-control in every situation. Yet, there seems to be a common mechanism responsible for inhibiting these different behaviors. Accounting for this variation in self-control across situational contexts is of key importance.

In summary, we assume that the functional application of self-control requires knowing when to apply self-control, knowing when to stop applying it, and involves a common processing mechanism. These fundamental assumptions should guide the basic design features of a proposed self-control mechanism. A more computational approach can be used to meet these assumptions and generate specific predictions concerning the application of inhibitory self-control.

### 2.2. Meta-theory of the DCTIR

The meta-theory of the DCTIR is based primarily in modularity. Modularity was first used in the arena of artificial intelligence. A module was described as a mechanism designed to carry out a specific function (Ermer, Cosmides, & Tooby, 2007). This functional specialization is the conceptualization of modularity that evolutionary psychologists follow (Ermer et al., 2007; Kurzban, 2010b; Pinker, 1997). According to this view, the mind is composed of information processing mechanisms designed to solve particular problems. This conceptualization of modularity is used here (as opposed to the information encapsulation definition most associated with Fodor, 1983). Unlike the resource model, which assumes mostly general purpose mechanisms, the DCTIR assumes there are many domain-specific, content-dependent mechanisms. With the theoretical foundations of our theory detailed, we now present our modular theory of self-control.

### 2.3. The DCTIR

The DCTIR proposes that there are numerous, domain-specific modules working to carry out certain behaviors. Some of these are short-term or "impulsive" modules that are focused on the here and now. These modules motivate immediate behavior. The purpose of self-control is to regulate these impulsive modules. Specifically, the DCTIR proposes that these impulsive modules are regulated by a computational inhibition module, composed of a monitor and a threshold component. By computation, it is meant, "the organized causation of patterned information input–output relations" (Tooby & Cosmides, 2008, p. 115). By inhibiting particular modules, an individual is better able to regulate multiple systems, some of which have conflicting outcomes. For example, impulsive "short-term" modules to aggress may conflict with more long-term systems to manage interpersonal relationships. By inhibiting the impulsive modules, the long-term system is given priority. Thus, although there is no monitoring of goal conflict, the conflict is resolved by inhibiting one of these mutually exclusive behaviors (e.g., you can eat or not eat, but not both). The inhibition module proposed is conceptualized as an algorithm. That is, it is a step-by-