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Response Inhibition and Interference Suppression in Restrained Eating☆

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Compared to unrestrained eaters (URE), restrained eaters (RE) more often show self-control deficits in their responses to food cues. Deficits in inhibition processes for RE may contribute to negative food intake control outcomes for RE compared to URE. Previous research has focused on response inhibition differences between the two groups, but not interference suppression differences. This study examined specific inhibition processes in RE and URE using three computerized behavioral tasks – Food Stroop task, Stroop task, and Simon task. Significant group differences were found on the Stroop task, but not on the Food Stroop task or Simon task. Compared to URE, RE have inhibition deficits in response inhibition, but no deficits in interference suppression. These findings clarify specific inhibition processes that differentially affect dietary intake for RE and URE, and more generally contribute to our knowledge of the role of cognitive processes in health behaviors.

Keywords: Response inhibition, Interference suppression, Dietary restraint, Stroop task, Simon task

Obesity and overweight are two salient health problems in industrialized countries (Katz et al., 2005). Weight status has multiple causes (e.g. environmental, social, and person-level factors), and individual differences in inhibition ability are thought to affect eating behavior and contribute to variations in weight loss treatment outcomes (Allom, Mullan, & Hagger, 2015; Hofmann, Rauch, & Gawronski, 2007; Jansen et al., 2009). Although inhibitory control is recognized as an important factor in dietary intake, inhibition is a complex construct that is currently being refined by researchers. Inhibition is defined broadly as an executive function that terminates or reduces a response to a perceptual or behavioral cue (Jurado & Rosseli, 2007). Recent approaches to inhibition have defined the construct as an attentional control process that limits what environmental stimuli can affect goal oriented behaviors (Hasher, Lustig, & Zacks, 2007) or the ability to control reactions in order to complete behaviors relevant to long term goals (Allom et al., 2015).

Another concept related to control of eating behaviors, impulsivity, is defined broadly as a failure to control behaviors (Jansen et al., 2009; Nederkoorn, Van Eijs, & Jansen, 2004). Like inhibition, impulsivity is a complex construct currently being refined by researchers. Multiple impulsivity scales exist that vary in their factor structure of the construct as a whole (Stanford et al., 2009). In addition, impulsive behaviors have been associated with failures in multiple specific inhibition processes including response inhibition, response interference, and motivational/decisional impulsiveness (Cyders & Coskunpinar, 2012; Stahl et al., 2014).

Researchers studying control of dietary intake developed the concept of dietary restraint as a way to address individual differences in eating behavior patterns. Dietary restraint scales act as a proxy measure of individual differences in inhibition and attention that were predicted to underlie patterns of eating behaviors. Studies using dietary restraint scales categorize people between two extremes: highly restrained eaters (RE) and unrestrained eaters (URE) (Herman & Polivy, 1980; Laessle, Tuschl,

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Kotthaus, & Pirke, 1989; Williamson et al., 2007).[1] As measured with the Revised Restraint Scale, RE are more likely than URE to report a history of dieting, to display attentional biases toward food cues, and to display disinhibited eating in the presence of palatable food. Herman and Polivy (1980) proposed that RE and URE differ in their ability to self-regulate behaviors after multiple instances of inhibiting responses to food cues. Specifically, RE are proposed to have more attention for food cues, and therefore must inhibit their response to these cues to control eating behavior more often than do URE; these repeated instances of inhibition responses to food cues are predicted to contribute to later disinhibited eating behavior (Herman & Polivy, 1980).

Because inhibition behaviors are enacted using multiple subtypes of control processes, it is likely that differences in control of eating behaviors are driven by differences in multiple types of inhibition. Two specific types of inhibition processes that may be involved in controlling eating behavior are *response inhibition* and *interference suppression* (Bunge, Dudukovic, Thomason, Vaidya, & Gabrieli, 2002). Multiple lines of research suggest that these are two distinct inhibition processes. Neuroimaging research suggests different brain areas of a broader self-control network are differentially activated for tasks corresponding to each of these types of inhibition (Blasi et al., 2006; Heatherton & Wagner, 2011; Hwang, Velanova, & Luna, 2010; Murray et al., 2014). Cognitive behavioral research also suggests that response inhibition and interference suppression represent separate control functions. For example, Nigg (2000) identified that response inhibition tasks such as Stroop tasks require participants to control distracting internal or external stimuli to complete a primary response. Other researchers state that Stoop tasks involve inhibiting habitual responses to cues to create a correct response (Simon & Berbaum, 1990; Liu, Banich, Jacobson, & Tanabe, 2004). In comparison, interference suppression tasks such as the Simon task involve inhibition of aspects of neutral stimuli that compete with current task goals (Simon & Berbaum, 1990; Mullane, Corkum, Klein, & McLaughlin, 2009). Simon tasks are not influenced by habituated responses to attentional cues; instead, the interference effect is driven by a stimulus–response conflict where individuals must identify the correct spatial response required for the task while inhibiting new spatial coding information about where the stimulus item is presently located (Hommel, 2011; MacLeod & MacDonald, 2000; Martin-Rhee & Bialystok, 2008).

Although response inhibition and interference suppression represent different types of inhibition, researchers in the health domain have only recently begun to focus on the role that interference suppression may play in determining eating behaviors in RE and URE (see Forestell, Lau, Gyurovski, Dickter, & Haque, 2012; Meule, Vögele, & Kübler, 2012). The theoretical explanations regarding inhibition differences between RE and URE have most often been studied using response inhibition tasks, including Stroop tasks and modified Emotional Food Stroop tasks (Brooks, Prince, Stahl, Campbell, & Treasure, 2011; Dobson & Dozois, 2004). Food Stroop tasks use neutral and food related words as stimuli, and participants with attentional biases toward food cues have slower reaction times when they name colors of food related words than neutral words (MacLeod & MacDonald, 2000; Pothos, Calitri, Tapper, Brunstrom, & Rogers, 2009). Two meta-analyses examining response inhibition in RE and URE reported that (a) RE exhibit more disinhibited eating behavior than URE in food cue reactivity tasks, (b) significant inhibition deficits in RE are not reliably found in responses to Food Stroop tasks (no significant Food Stroop effects or a small effect size), and (c) significant inhibition deficits in RE are reliably found in general Stroop tasks (Brooks et al., 2011; Dobson & Dozois, 2004).

Despite the amount of research examining inhibition deficits in RE, there is still a need to clarify how specific types of inhibition processes involved in eating behaviors interact with levels of dietary restraint. Recent research emphasizes that people with deficits in one type of inhibition often have deficits in other types of inhibition (Lustig, Hasher, & Zacks, 2007), and diverse clinical populations defined by maladaptive behavioral control have distinctive patterns of inhibition deficits. Examining multiple types of inhibition within the same sample of RE and URE would clarify the relative importance of specific inhibition processes in controlling dietary intake behaviors and would also help explain some of the problems with translating basic research findings into applied health interventions. For example, past interventions for improving self-control of dietary intake targeted general response inhibition skills but recent studies have found that training cue specific response inhibition skills may be more effective at a behavioral level (Allom et al., 2015; Lawrence, Verbruggen, Morrison, Adams, & Chambers, 2015).

This study assessed if the self-reported differences in inhibition of eating behaviors between RE and URE are associated with deficits in general response inhibition alone or deficits in interference suppression as well. Our study assessed how RE and URE differ in response inhibition and interference suppression using three specific tasks: a Food Stroop task (cue specific response inhibition), a Stroop task (general response inhibition), and a Simon task (interference suppression). Comparing interference effects between RE and URE on these tasks contributes to current knowledge of inhibition, and identifies the inhibition processes that are involved in behavioral control of eating behaviors.

Methods

Participants

English-speaking women between 18 and 35 years of age attending college or graduate school in the Los Angeles area were recruited in 2014 and 2015 (mean age = 22.26 years, range = 18–32). Participation was restricted to women to control potential gender effects and due to the reported higher prevalence of restrained eating among women (Rand & Kuldau, 1991). A total of 257 participants completed a composite health survey. URE and RE were then defined using an extreme groups design

[1] Multiple dietary restraint scales exist (Allison et al., 1992); the Revised Restraint Scale was used due to its predictions of inhibition and attention processes involved in the definition of dietary restraint.

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