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Lying and executive control: An experimental investigation using ego depletion and goal neglect

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ABSTRACT

This study investigated whether lying requires executive control using a reaction-time based lie test. We hypothesized that (1) goal neglect induced by a long response-stimulus interval (RSI; 5–8 s) would make lying harder relative to a short RSI (.2 s) that promoted attentional focus, and (2) participants whose executive control resources were depleted by an initial executive control task would experience more difficulty to lie than control participants who performed a task that required little executive control. Across two experiments, the ego depletion manipulation did not reliably affect lying. Both experiments revealed that the cognitive cost associated with lying was larger for the long compared to the short RSI. This finding supports the idea that lying requires more executive control than truth telling. The manipulation of RSI may provide a simple, yet effective means to improve lie detection accuracy.

1. Introduction

Lying is a complex cognitive activity. Liars have to deal with the coordination of one or more of following tasks: to make the decision to deceive, to suppress the truth and activate a lie, to infer what others already know, to keep their story straight, to monitor their own behavior as well as the reactions of the listener, and if necessary to adjust the lie to make it more believable. Zuckerman, DePaulo, and Rosenthal (1981) were among the first to recognize the mentally taxing properties of lying. They introduced a cognitive view on deception, which essentially holds that lying is cognitively more demanding than telling the truth.

A number of studies have found support for the cognitive view on deception. First, lying is accompanied by behaviors that are also typically observed in cognitively taxing tasks (Ekman & Friesen, 1972; Goldman-Eisler, 1968; Veltman & Gaillard, 1998), such as less hand and arm movements, reduced eye blinking and more pauses when speaking (DePaulo et al., 2003; Leal & Vrij, 2008, 2010; Sporer & Schwandt, 2007). Second, in deception studies participants report that lying requires more mental effort compared to truth telling (Vrij, Semin, & Bull, 1996). Third, police officers who see interviews from a high realistic forensic setting judge that their suspects think harder when they lie than when they tell the truth (Mann & Vrij, 2006). Fourth, lying is associated with more errors and increased response latencies compared to truth telling, which is assumed to reflect increased cognitive effort (Seymour & Kerlin, 2008; Sheridan & Flowers, 2010; Spence et al., 2001; Verschuere, Crombez, Degroote, & Rosseel, 2009; Verschuere, Spruyt, Meijer, & Otgaar, 2011). Finally, a growing number of brain imaging studies have found stronger activation of frontal regions for deception compared to truth telling — regions that are typically linked with cognitive, or executive, control (for recent reviews see Christ, Van Essen, Watson, Brubaker, & McDermott, 2009; Gamer, 2011). Miyake et al. (2000) differentiated three major components of executive control: working memory, task switching, and response inhibition. All three components are likely to play a role in deception. Working memory may enable to keep the truth active while constructing the lie, response inhibition may be required to inhibit the truth response from leaking, and task switching may allow to switch between being honest and being

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deceptive (Johnson et al., 2004; Spence et al., 2004; Visu-Petra, Miclea, & Visu-Petra, 2012). The meta-analysis by Christ and colleagues indeed showed that ten of the thirteen brain regions activated during lying have also been associated with executive functions such as working memory, inhibitory control, and/or task switching. In sum, research has indicated that lying requires more cognitive effort and executive control than truth telling. However, most of the studies conducted so far are observational or correlational. Here we test the hypothesis that lying requires executive control by experimentally manipulating executive control. We selected two manipulations that are known to undermine executive control: (1) goal neglect and (2) ego depletion.

Our first manipulation was based on Duncan's goal neglect theory (Duncan, 1995; Duncan, Emslie, Williams, Johnson, & Freer, 1996; for similar views see e.g., De Jong, Berendsen, & Cools, 1999; Engle & Kane, 2004; Kane & Engle, 2003). Duncan has argued that human behavior is goal-directed and therefore, task goals need to be formed that guide the selection of responses. Keeping task goals active (goal maintenance) is accomplished by means of an attentional goal-weighting process that relies on prefrontal cortex function. This implies that responses will be fast and accurate when attention is sharply focused on the task goal. When, however, attention to the task goal is loose, lapses of attention will occur and lead to goal neglect, i.e. "disregard of a task requirement even though it has been understood and remembered" (Duncan, 1995, p. 257). Goal maintenance is important in executive control tasks such as the Stroop task (Stroop, 1935), in which the required response is opposite to the prepotent response. In the Stroop task, the task goal entails naming the ink color in which color words are printed, while inhibiting the prepotent response of saying the word. The Stroop effect refers to the cost in response latency and accuracy on incongruent trials (e.g., RED in blue ink) compared to congruent trials (e.g., RED in red ink). Because on incongruent trials the prepotent response conflicts with the task goal, situations that promote goal neglect should result in more prepotency based behavior, and hence larger Stroop effects. To verify this prediction, De Jong et al. (1999) asked participants to perform a Stroop task either with a short (200 ms) or long (2000 ms) response–stimulus interval (RSI; the period between the response and the appearance of the next stimulus). The authors argued that the fast pace, induced by the short RSI, would help participants to remain focused on the task and hence effectively inhibit the word's meaning. A long RSI, on the other hand, would lead to attentional lapses and a failure to fully deploy the ability to inhibit. Their results indeed showed that the Stroop effect was affected by the RSI. With a long RSI, the Stroop effect was significant (47 ms), whereas the effect was small and non-significant (11 ms) when the RSI was short. Here, we manipulated the RSI to induce goal neglect in a deception task. Our second manipulation is grounded in the self-control and ego depletion literature. Self-control can be defined as "the overriding or inhibiting of automatic, habitual, or innate behaviors, urges, emotions, or desires that would otherwise interfere with goal directed-behavior" (Muraven, Shmueli, & Burkley, 2006, p. 524). Ego depletion is the well-studied phenomenon that the performance on a self-control task is significantly worse when another self-control task was executed before. This finding is usually explained by the limited resource model of Baumeister and colleagues (Baumeister, Bratslavsky, Muraven, & Tice, 1998; Baumeister, Gailliot, DeWall, & Oaten, 2006). According to this model, self-control depends on a limited resource that can be temporarily depleted, thereby hampering the efficacy of a subsequent self-control attempt. In a prototypical ego depletion study, hungry participants were asked to eat radishes while a plate of freshly baked cookies was placed in front of them (Baumeister et al., 1998). Afterwards, they were asked to solve a puzzle that unbeknownst to them was actually not solvable. It was found that participants who previously had to resist eating the cookies, quit earlier than the control group who had been allowed to eat cookies. Apparently, resisting the cookies depleted self-control resources that could no longer be used in the subsequent puzzle task. Recent work on ego depletion tried to connect the limited resource view of self-control to executive functioning. Conceptually, self-control has a large degree of overlap with executive control: in order to succeed in self-controlled behavior, one has to keep the goal active in working memory, refrain from any goal-irrelevant behavior, and switch goals if needed (Ilkowska & Engle, 2010; Robinson, Schmeichel, & Inzlicht, 2010). In a series of studies, Schmeichel (2007) showed that participants who initially engaged in executive control tasks (e.g., inhibiting predominant writing tendencies) performed worse in subsequent executive control tasks (e.g., reverse digit span task), relative to a control group that performed initial tasks that did not require executive control. Other support for the effects of ego depletion of executive control comes from a study with the Autobiographic Memory Task (AMT; Neshat-Doost, Dalgleish, & Golden, 2008). In this study, participants were asked to recall specific autobiographical memories (e.g., "I remember the day we went to Disneyland") in response to word cues (e.g., "holiday"). Most of the times a word primes over-general, prepotent memories (e.g., "I enjoyed all of my holidays as a teenager"). Therefore, working memory capacity is needed to set these unspecific memories aside and maintain the search through the autobiographic knowledge base (Conway & Pleydell-Pearce, 2000). Neshat-Doost et al. showed that the depletion of working memory resources through a color Stroop task that consisted of only incongruent trials led to reduced autobiographic memory specificity in comparison to a control Stroop that required naming color names printed in black. Here, we implemented an ego depletion manipulation before participants engaged into the deception task.

Goal neglect and ego depletion were manipulated in the Sheffield lie test (Spence et al., 2001), a well-established variant of the Differentiation-of-Deception Paradigm (Furedy, Davis, & Gurevich, 1988). In the Sheffield lie test, participants were required to give speeded *yes* or *no* responses to questions about simple daily activities (e.g., "Drunk coffee?"). Depending on the color of the response labels that appeared under the questions, they were instructed to answer truthfully in the presence of one color, whereas the other color indicated to lie. Using this paradigm, it has been repeatedly shown that lying leads to greater response times – sometimes accompanied by more errors – than truth telling (i.e., *lie effects*; Spence et al., 2001; Spence, Kaylor-Hughes, Farrow, & Wilkinson, 2008; Verschuere et al., 2011). In the present study, the RSI was manipulated within subjects. A long RSI preceded the questions on half of the trials, whereas the RSI was short on the other half of the trials. We hypothesized that a long RSI would disturb the ability for goal maintenance, which would have the strongest effect on trials that require most executive control (i.e., lie trials). This would result in larger lie effects on long RSI trials compared to trials with a short RSI. Prior to the Sheffield lie test, ego depletion was manipulated between subjects using the *e*-hunting task (Baumeister et al., 1998; DeWall et al., 2008). A meta-analysis on ego depletion showed that this task produces the largest effect size (Hagger et al., 2010). In the *e*-hunting task, participants first form the habit of crossing out every instance of the letter *e* in a text. Whereas the control group afterwards applies the same rules in a second text, the depletion group receives additional rules that prohibit crossing out every *e*. These rules may bring along a state of ego depletion, as participants have to override their acquired habit. Following the idea that executive control is crucially involved in lying, we predicted that the depletion group would have difficulties to efficiently suppress the truth in the Sheffield lie test, as expressed in larger lie effects compared to the control group.

In order to maximize the effect of ego depletion, several other manipulations from the meta-analysis of Hagger et al. (2010) were implemented in our design: (1) as previous studies have shown that motivation can diminish ego depletion effects (Stewart et al., 2009), the experiment was not announced as a lie detection study, thereby trying to prevent that participants would spare resources for the Sheffield lie test, (2) we presented the *e*-hunting task and the lie test as two independent experiments, (3) developed by different experimenters, (4) we used an interim period between the self-control tasks by letting participants fill out questionnaires, including the Self-Monitoring Scale (SMS; Snyder, 1974)