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Delta plots do not reveal response inhibition in lying

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A B S T R A C T

The role of response inhibition in lying is debated. By using the delta-plot method applied to the Sheffield Lie Test, Debey, Ridderinkhof, De Houwer, De Schryver, and Verschuere (2015) provided evidence supporting the role of inhibition in lying. In the study of Debey et al., inhibitory skill was measured in terms of the size of the lie effect. However, to provide convincing evidence that delta plots highlight the role of response inhibition in lying, inhibitory ability must be evaluated independently from the size of the lie effect. After replicating original findings, this article shows that a delta plot analysis does not differentiate individuals with different inhibitory abilities, when inhibitory skill is measured by means of the Stop Signal Task, instead of the size of the lie effect. This suggests that researchers should be cautious when making conclusions about cognitive mechanisms based on the sole analysis of delta plots.

1. Introduction

The intentional misrepresentation of reality is an important part of social behavior and daily communication (ten Brinke, Vohs, & Carney, 2016). From an evolutionary perspective, the ability to detect deception may seem a necessary condition to establish interpersonal trust, which is a basic requirement for social interaction. Nevertheless, deception detection is a very difficult task. For example, a meta-analysis based on data from over 24,000 judges reports an overall accuracy of only 54%, with individuals correctly classifying 61% of truths as nondeceptive but only 47% of lies as deceptive (Bond & DePaulo, 2006). Therefore, deception detection is difficult to study,[1] because distinguishing lies from honest responses is simply something that people are unable to do with any degree of accuracy.[2] However, beside deception detection, deception research also examines deception production. In this regard, there is one result that has been replicated over and over: Response latencies are longer when people lie than when they tell the truth (Johnson, Barnhardt, & Zhu, 2004; Seymour, Seifert, Shafto, & Mosmann, 2000; Suchotzki, Verschuere, Van Bockstaele, Ben-Shakhar, & Crombez, 2017; Zuckerman, DePaulo, & Rosenthal, 1981).

Such result is consistent with one of the most important predictions of the cognitive approach to deception. The cognitive approach holds that lying is a complex behavior, cognitively more demanding than truth telling; therefore, lying takes more time than telling the truth. Zuckerman et al. (1981) were among the first to describe the cognitive processes involved with deception. Their Four-Factors theory of deception hypothesized a greater arousal when lying, the presence of guilty feelings, a greater complexity of

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[1] A modern technique more promising than the polygraph is fMRI-based lie detection, which relies on the assumption that it may be possible to discriminate between the brain activities associated to truthfully and untruthfully responding. The accuracy of this procedure, however, is debated (for a recent review, see Farah, Hutchinson, Phelps, & Wagner, 2014).

[2] Recently, it has been proposed that people might be better at detecting deception at nonconscious levels than at conscious level (*e.g.*, ten Brinke, Stimson, & Carney, 2014), although the evidences supporting such claim are rather unconvincing (Franz & von Luxburg, 2015).

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cognitive processing when lying, and the attempt to control verbal and nonverbal behavior in order to avoid from being caught. All the successive cognitive theories have strongly empathized the role of executive functions in the production of deceptive behaviors (see Gombos, 2006; Walczyk, Igou, Dixon, & Tcholakian, 2013). The Interpersonal Deception Theory (Buller & Burgoon, 1996) focuses on the executive processes of metacognitive regulation and executive attention; the Preoccupation Model of Secrecy (Lane & Wegner, 1995) suggests that thought suppression, that is, inhibition, is the strategy most often used by liars; the Self-Presentation model (DePaulo, 1992) provides a theory of non-verbal deception which posits the processes of monitoring, control, and inhibition of non-verbal behaviors (such as the expression of facial emotions or the tone of one's voice); the Working-Memory Model of Deception (Sporer & Schwandt, 2006, 2007) highlights the greater cognitive load required by deception as compared to truth-telling, specifically with reference to the processes of retrieval from memory and reconstruction; finally, the Activation-Dections-Construction model (Walczyk, Roper, Seemann, & Humphrey, 2003; Walczyk, Harris, Duck, & Mulay, 2014) analyzes the deception act into three components: the retrieval from memory of the truthful information, its inhibition, and the construction of a context-appropriate lie. Moreover, Christ, Van Essen, Watson, Brubaker, and McDermott (2008) have proposed that task switching (*i.e.*, the ability to switch between tasks or mental sets) may be another executive function involved in deceptive behavior: task switching, in fact, is required for shifting between truthful and deceptive responses.

With reference to the central role of the executive functions (in particular inhibition) in the production of deception, Debey, Ridderinkhof, De Houwer, De Schryver, and Verschuere (2015) tested the hypothesis that participants with stronger inhibitory control are also better liars, as postulated by cognitive models. Lying ability was measured by means of the Sheffield Lie Test (Spence et al., 2001), that is, by asking participants to provide yes/no-answers to questions presented on the computer screen. Depending on the color in which the words appeared, participants were instructed to lie or to tell the truth. The typical result of the Sheffield Lie Test is a lower accuracy and longer and more variable response latencies when participants lie versus when they tell the truth. This result is consistent with the cognitive approach to deception described above, which posits that lying is cognitively more demanding than truth-telling.

The original contribution of Debey et al. (2015) is the use of a delta plot analysis (De Jong, Liang, & Lauber, 1994) for examining the relation between inhibitory control and lying proficiency. A delta plot analysis of the Sheffield Lie Test data describes the time course of the slowing down of the response latencies when participants are required to lie. If $Q_X(p)$ and $Q_Y(p)$ are the quantile functions for the distributions of response latencies in the lie (*Y*) and truth (*X*) trials, then a delta plot is a graph of $Q_Y(p)-Q_X(p)$ against the average of the quantiles $[Q_X(p) + Q_Y(p)]/2$.

In general, if in an experimental condition (*e.g.*, the "lie" condition of the Sheffield Lie Test) participants slow down with respect to a control condition (*e.g.*, the "truth" condition of the Sheffield Lie Test), then both the means *and* the variances of their RT distributions will increase. In such circumstances, the delta plot assumes a positive slope (Speckman, Rouder, Morey, & Pratte, 2008). Not all delta plots, however, show positive slopes. In the Simon task,[3] for example, the Simon effect ($RT_{incompatible}-RT_{compatible}$) tends to decrease for slower responses (*e.g.*, Burle, Possamaï, Vidal, Bonnet, & Hasbroucq, 2002).

In order to relate the delta plot analysis to the Sheffield Lie Test, Debey et al. (2015) reasoned as follows. Individuals with better inhibitory control should be able to suppress the dominant truth response more efficiently than individual with worse inhibitory control, if enough time is provided for the activation of their control mechanisms. For individuals with better inhibitory control, therefore, the RT lie effect ($RT_{lie}-RT_{truth}$) should be smaller in correspondence of longer (as compared to shorter) average response latencies and, as a consequence, the delta plot should have a smaller (or negative) slope than for individuals with worse inhibitory control. To test their hypothesis, Debey et al. (2015) divided participants into two groups according to the size of the lie effect, on the assumption that a smaller lie effect implies lower inhibitory control. By defining group membership in this manner, Debey et al. (2015) concluded that participants with better inhibition abilities produce delta plots with null or negative slopes, whereas participants with worse inhibition abilities produce positive sloped delta plots. This result is interesting because it implies that the slope of the delta plot derived from the Sheffield Lie Test may be informative about the individual differences in the participants' ability to inhibit the truthful response.

An anonymous Reviewer cited in the manuscript, however, suggested that the results obtained with a median split of the sample based on the size of the lie effect might be a statistical artefact, given that the dependent measure (*i.e.*, the lie effect) was used to determine group membership which, in turn, was used to explain the dependent variable. Debey et al. (2015) recognised the arbitrariness of a group classification based on a median split of the lie effect, but they countered this criticism by proposing a number of statistical analyses which, apparently, neutralized such an alternative explanation.

Given the importance of elucidating the cognitive mechanisms underlying deception, and the importance of the contribution of Debey et al. (2015), in the present study we set out to test whether the slope of a delta plot can really inform us about the inhibitory abilities of the individuals who completed a Sheffield Lie Test. In order to classify participants as having good or bad inhibitory abilities, inhibitory control was assessed with another task, without considering the size of the lie effect.

Inhibition is not an unitary construct. Most accounts distinguish among three different inhibition functions (Friedman & Miyake, 2004; see also Hasher & Zacks, 1988): inhibition of prepotent responses, resistance to distractor interference, and resistance to proactive interference (*i.e.*, the ability to resist memory intrusions from previously relevant information). In the context of deception, the most important dimension of inhibition is the suppression of a prepotent response. According to the cognitive approach, in fact, the production of a lie requires the previous inhibition of a prepotent truthful response (Sip, Roepstorff, McGregor, & Frith, 2008).

[3] In the Simon task, participants are instructed to indicate the feature of a lateralized stimulus. Although the location of the stimulus is task irrelevant, it interferes in the decision process: Responses are slower and less accurate when stimulus location is contralateral to the required response (incompatible trial) than when it is ipsilateral to the correct response (compatible trial), a phenomenon known as the "Simon effect" (Simon & Small, 1969).