

Research Article

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Does Ego Depletion Elicit Stronger Cues of Deception?

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Abstract: Lying is cognitively demanding and presumably requires self-regulation. According to ego depletion theory, a task that requires self-regulation should therefore impair an individual's ability to tell a convincing lie in a later task. Consequently, it was hypothesized that a manipulation of ego depletion would enhance behavioral differences between liars and truth-tellers. To manipulate ego depletion, participants worked (vs. did not work) on a task in which they had to suppress dominant responses while copying a text. Subsequently, they talked in a simulated job interview about a job they had previously held (vs. not held). In the sample of 164 participants, there was no evidence to support the hypothesis; the expected Ego Depletion x Veracity interaction was not significant for any of the 15 behavioral cues coded in the videotaped interviews. Although the main effect of ego depletion was significant at the multivariate level for the first of two parts of the interview, none of the univariate main effects reached the significance level corrected for multiple testing. Bayesian analyses rendered moderate to strong evidence in favor of the null hypothesis. Possible implications of the results are discussed, also those related to ego depletion theory.

Keywords: self-regulation; ego depletion; behavioral cues; deception; lying.

1 Introduction

Deception occurs in many areas of daily life and in many cases, it is crucial to find out when someone is not telling the truth (e.g., Ekman, 2009; Vrij, 2008). For example, lie detection is often necessary to identify the person responsible for a criminal act in the forensic field. In job interviews, interviewers try to determine whether the applicant is honest and has the claimed qualifications. In everyday social situations, people may want to detect lies to find out if others are honest and can be trusted. Problematically, however, humans cannot reliably detect lies in such ad hoc veracity judgments; a meta-analysis suggests that humans are correct only about 54% of the time (Bond & DePaulo, 2006).

Trying to determine the reasons for the lack of accuracy in lie detection, a meta-analysis suggested that behavioral differences between liars and truth-tellers are, if at all, only small (Hartwig & Bond, 2011). Research on the cognitive load approach showed that accuracy can be increased when behavioral differences are enhanced using an additional task that taxes senders' cognitive resources (Vrij et al., 2008; for a meta-analysis, see Vrij et al., 2017). The underlying theoretical idea is that lying is cognitively demanding; an additional challenging task leads to a decrease in lying performance because fewer resources are available for lying (e.g., Vrij et al., 2011; Vrij, 2015). In this article, we focus specifically on the self-regulation resources of senders. Ego depletion theory (e.g., Baumeister et al., 1998; Baumeister et al., 2007) suggests that a task requiring self-regulation reduces subsequent performance on another self-regulation task. Because lying requires self-regulation (e.g., DePaulo et al., 2003; Vrij et al., 2006), behavioral differences between liars and truth-tellers should be enhanced if liars had worked on a task requiring self-regulation prior to lying.

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1.1 Ego Depletion

Self-regulation is a dynamic process of setting a goal and working toward that goal while monitoring one's progress toward it; self-regulation, therefore, involves executive control processes such as inhibiting thoughts, emotions, habits, or impulses (see e.g., Inzlicht et al., 2021). Ego depletion theory (e.g., Baumeister et al., 1998; Baumeister et al., 2007; Muraven et al., 1998; Vohs et al., 2005) assumes a limited cognitive resource that is needed to exert self-regulation, similar to energy. Because this cognitive resource is limited, individuals cannot perform self-regulation on a permanent basis. Accordingly, ego depletion theory postulates that practicing self-regulation on one task can lead to impaired performance on a subsequent task that also requires self-regulation (see Carter et al., 2015; Dang, 2018; Friese et al., 2018; Hagger et al., 2010, for reviews and meta-analyses). The effects of depleting self-regulatory resources were evident in many domains, such as controlling dominant responses like emotions (e.g., Muraven et al., 1998), thoughts (e.g., Muraven & Slessareva, 2003; Wegner et al., 1987), impulses (e.g., Baumeister et al., 1998), habits (e.g., Neal et al., 2013), or in initiating actions (e.g., Baumeister et al., 1998). Moreover, self-regulatory resources also played a role in complex thought processes and intellectual performance (e.g., Janssen et al., 2008; Schmeichel et al., 2003; Schmeichel, 2007).

At this point, however, we do not want to omit recent criticism of ego depletion theory (research) due to replication problems as well as non-significant effects in meta-analyses (e.g., Carter et al., 2015; Dang, 2016b; Hagger et al., 2016; Lurquin et al., 2016; Vohs et al., 2021; Xu et al., 2014). Whereas a first meta-analysis of 83 published studies yielded a medium-to-large effect size of $d = 0.62$ (Hagger et al., 2010), a re-analysis of it suggested a publication bias in the analyzed literature and gave rise to the assumption that the ego depletion effect may not differ from zero (Carter & McCullough, 2014). A meta-analysis that included also unpublished studies (Carter et al., 2015) raised further doubt about the robustness and existence of the ego depletion effect and so did a large multilab registered replication report ($k = 23$ labs, $N = 2,141$ participants) which did not result in a significant ego depletion effect ($d = 0.04$, 95% CI $[-0.07, 0.15]$). Doubt has been raised about the manipulation used in this replication report (see e.g., Baumeister & Vohs, 2016; Dang, 2016a; Drummond & Philipp, 2017); however, another multilab registered replication report ($k = 36$ labs, $N = 3,531$ participants) which addressed the criticism did also not result in a significant effect (Vohs et al., 2021). Another replication project (Dang et al., 2021) found a significant, yet much smaller effect size than the meta-analysis by Hagger et al. (2010) originally had suggested. To conclude, there has been much discussion on whether or not an ego depletion effect exists in the theorized form (see Friese et al., 2018, for an overview of the arguments); the last years of research suggest that the ego depletion effect is likely, if at all, not as robust and as large as previously thought.

1.2 The Cognitive Demands of Lying

Lying is cognitively demanding and is assumed to require self-regulation (e.g., Debey et al., 2012; DePaulo et al., 2003; Granhag & Hartwig, 2008; Vrij et al., 2006; Vrij et al., 2011; Zuckerman, DePaulo, & Rosenthal, 1981). To tell a convincing story, liars must come up with details and make sure that the story is plausible and not self-contradictory (Buller & Burgoon, 1996; Vrij et al., 2011; Zuckerman, DePaulo, & Rosenthal, 1981). Liars must prevent information from different sources from contradicting each other or information they have previously given themselves from contradicting their current narrative. Yet, liars do not quite succeed in meeting these requirements; lies are overall less detailed, less plausible, less elaborate, and less complex than truths (e.g., DePaulo et al., 2003; Hauch et al., 2015).

Because liars try to appear as credible as possible, they attempt to control or adapt behaviors that they believe may appear deceptive (e.g., DePaulo et al., 2003; Zuckerman, DePaulo, & Rosenthal, 1981). In all of this, liars must suppress the truth (Gombos, 2006). Liars' cognitive resources are further strained as they monitor not only their own behavior but also the reaction of others to determine if their lie is successful or if they need to adjust their behavior (Buller & Burgoon, 1996; Sporer & Schwandt, 2006; Vrij et al., 2011). Because monitoring and controlling one's behavior places cognitive demands on individuals, individuals must have cognitive resources to manage their paraverbal, verbal, and nonverbal behavior in ways that they believe will leave the most credible impression possible (see also Vohs et al., 2005).

1.3 Ego Depletion and Lying

Effects of ego depletion have previously been examined in the field of lie detection; depleted compared to non-depleted individuals achieved lower accuracy scores when discriminating between truth and deception (Reinhard et al., 2013). Also effects of ego depletion on the decision of whether to lie or cheat have been researched in several studies (see e.g., Bereby-Meyer & Shalvi, 2015; Köbis et al., 2019, for reviews and meta-analysis). Depleted individuals undeservingly over-benefited themselves, cheated, or lied more often in various contexts (e.g., Fan et al., 2021; Gino et al., 2011; Keller & Kiss, 2021; Kouchaki & Smith, 2014; Mead et al., 2009; Muraven et al., 2006; Wang et al., 2017), but so far, there is little research on depleted vs. non-depleted individuals' behaviors when they tell truthful vs. deceptive messages. Only two experiments (Debey et al., 2012) investigated the effect of ego depletion on lying using the Sheffield lie test (Spence et al., 2001; Verschuere et al., 2011) in which participants lie by pressing a specific key on the keyboard in response to a displayed statement. While the ego depletion manipulation likely did not work in Experiment 1 of Debey et al. (2012), Experiment 2 using a different manipulation also showed no effect on lying as measured by participants' mean response times and error rates. However, because individuals do not “tell lies” in the Sheffield lie test, the study at hand study is to our knowledge the first to investigate the effect of ego depletion on verbal, nonverbal, and paraverbal behaviors when lying vs. telling the truth.

Because lying requires self-regulation, we expected that a task demanding self-regulation subsequently diminishes individuals' ability to lie. Because self-regulation is generally considered effortful, we assume that individuals are less able to make further efforts after having made an initial effort. Hence, their self-presentation should be less effective when individuals had worked on a self-regulation manipulation before lying. Thereby, behavioral differences between liars and truth-tellers should be increased. Not only should liars' resources to control their nonverbal behavior be reduced, but also their cognitive resources to develop a detailed, plausible, and comprehensive story. By contrast, truth-tellers should be less affected by a preceding task requiring self-regulation because their (cognitive) resources are less taxed when telling the truth.

Replicating previous research, we expected a main effect of veracity; liars should be less forthcoming, less pleasant, tenser, and their statements should be less compelling (see DePaulo et al., 2003). More importantly, we predicted an interaction effect between the ego depletion condition and veracity. The predicted behavioral differences between liars and truth-tellers should be larger in the ego depletion condition than in the control condition. To test these assumptions, we manipulated ego depletion and veracity. After participants performed (vs. did not perform) a task that required to inhibit a dominant response, participants were videotaped in a simulated job interview talking about a job they actually had held (vs. not held). Deception cues were coded for the recorded videos to inform about behavioral differences.

2 Method

2.1 Participants and Study Design

One hundred ninety-five individuals participated in the study “Study on the behavior of applicants in job interviews”. The study employed a 2 (Ego Depletion: ego depletion vs. control) x 2 (Veracity: lie vs. truth) between-subjects design. All participants were students and were required to have completed an internship or work-study experience lasting several months before participating in the study. This was necessary so that participants could talk truthfully about their job experiences when being assigned to the truth condition. Participants were informed that they would get up to €18 for their participation and that they could take their video home to analyze their behavior if interested. They were further asked to dress as if they would have an actual employment interview. Each participant was invited to the laboratory individually.

Out of the 195 recorded videos, 164 were considered usable. Eleven videos had to be excluded due to technical issues (e.g., the picture was blurry), eleven videos because the participants had misunderstood the instructions (e.g., they selected a job they had listed as a previous job despite having to make up a different job in the lie condition), five videos because the experimenter could not ask all interview questions (e.g., the recording had to be stopped prematurely due to a malfunction), two videos because the participants were nonnative speakers and indicated they had not fully

understood the instructions, and another two videos because the respective participants had participated twice in the study (the videos from their first participation were kept). The participants from the final 164 videos were on average 23.99 years old ($SD = 2.79$; 82 women, 82 men).

2.2 Procedure

Upon entering the laboratory, the experimenter randomly drew an envelope containing the study instructions for the participant. The instructions also included the assignment to the lie vs. truth condition, for which the experimenter was blind. In the ego depletion condition, the study began with the manipulation presented in a supposedly unrelated study called “Concentration and Fatigue.” To manipulate ego depletion, we used a method by Reinhard et al. (2013), which was a modified version of the manipulation used by Muraven et al. (2006). The participants were asked to copy a text about the history of Stuttgart for 15 minutes while following a series of rules. They had to omit the letters “e” and “n,” which are among the most common letters in the German language. In addition, the participants had to omit the letter “a,” but only if it came before an “l” or “m” in the respective word. To follow these rules, participants had to suppress their natural reaction of simply copying a text. Similar tasks have been used previously as manipulations of ego depletion (e.g., Schmeichel, 2007, Experiment 2). The participants were given time to familiarize themselves with the rules and told the experimenter when they were ready to begin. After the 15min, the experimenter told the participants to stop copying the text and start working on the instructions from the envelope for the “Study on the behavior of applicants in job interviews.” In the control condition, we adapted the procedure used by Reinhard et al. (2013); instead of copying the text without following specific rules, participants immediately began to work on the instructions in the envelope. In doing so, we created a naturalistic baseline behavior in the control condition without any additional influences.

Participants received a generic job posting for a trainee position that was open to all types of college degrees. They were asked to read the job posting thoroughly and then list all jobs and internships they had done previously that could be considered relevant experience for the advertised position. Next, participants should imagine having a job interview where they describe an internship or a work-study activity that is relevant to the advertised trainee position. In the truth condition, participants were asked to select and write down one of the previously listed jobs for the upcoming interview. In the lie condition, participants were asked to write down a job for the upcoming interview that they had not listed and that they had not previously held. In both conditions, participants were told that they would receive €5 if they successfully convinced the interviewer that they had actually done the selected job. For participating in the study (including the transfer of the audio and visual rights of their video to the researchers), they should receive €13 in any case.

The interview consisted of two parts. The first part contained biographically oriented questions that typically occur in a similar form in job interviews (see e.g., Schuler, 2013). Since these questions can be expected in job interviews, candidates can prepare answers for such questions in advance, especially if they are faking work experience. Accordingly, participants had 5min to prepare for this part of the interview. For preparation, they were given guiding questions to answer at the beginning of the interview (“When, where and for whom did you work?”, “What exactly did you do in your internship/working student activity?”, “What did you like/dislike about your internship/working student activity?”). Participants could take notes on the questions but were not allowed to keep them during the interview. The second part of the interview contained competency-based questions (see e.g., Raisová, 2012). Since competency-based questions can refer to different competencies, anticipating them is more difficult than biographically oriented questions. Accordingly, participants did not receive any information about this second part of the interview before the recording of the interview, and they could not prepare for it.

After the 5min of preparation time for the first part of the interview, the experimenter started the recording. Participants sat at a table opposite the camera and the experimenter. Only part of the table and the participant’s upper body were visible in the video, but not the experimenter. The experimenter began the recording by saying, “You stated in your application that you have already done an internship/working student activity in *name of selected job*. When, where, and for whom did you work, and what exactly did you do there?”. After participants had answered these questions, the experimenter asked, “What did you like or dislike about it?”. After participants had also responded to this question, the experimenter introduced the second part of the interview by saying, “Thank you very much for your explanations; I would like to ask you a few more questions.”

The questions of the second part of the interview were divided into two blocks of three questions each; the experimenter asked the next question once the participant had answered the previous one. The first block of questions was: (1) “Please describe the biggest challenge in your internship/working student activity in *name of selected job*.”, (2) “How did you go about solving the challenge?”, (3) “What was the result?”. The second block of questions was identical to the previous one except for the first question: “Please describe a situation during your internship/working student activity where you had to use your communication skills to get an important point across to others.”

After all questions were answered, the experimenter ended the recording and told all participants they had convinced her that they had done the described job and would receive the additional €5. Last, participants provided some demographic data, agreed to the further use of their video, and received €18.

2.3 Coding of Cues

Fifteen cues were coded because we expected that the ego depletion manipulation could influence them and because they were either identified as valid cues to deception in a meta-analysis (DePaulo et al., 2003) or because they had been named as beliefs about cues to deception (e.g., Akehurst et al., 1996; Global Deception Research Team, 2006; Granhag et al., 2005; Ulatowska, 2017; Zuckerman, Koestner, & Driver, 1981). Note that recent work has questioned whether truths and lies differ reliably on such cues; effect sizes reported in DePaulo et al. (2003) are likely smaller than assumed, averting gaze these effects exist at all (see Luke, 2019). However, we anticipated that even small effects might be enhanced by the manipulation, or that effects unobservable in a non-depleted state might manifest as a result of the manipulation. For example, although gaze aversion is unrelated to deception according to the meta-analysis (DePaulo et al., 2003), it is assumed to be used to manage cognitive load (see e.g., Doherty-Sneddon et al., 2002; Doherty-Sneddon & Phelps, 2005; Glenberg et al., 1998). Accordingly, instructions to maintain gaze have previously been used as a manipulation of cognitive load to increase behavioral differences between liars and truth-tellers (Vrij et al., 2010). If depleted senders have fewer cognitive resources to control their behavior, and also to maintain gaze, differences between liars and truth-tellers might occur when individuals’ cognitive resources are strained through the ego depletion manipulation.¹

Independent raters coded the following cues for each of the 164 usable videos: Plausibility; Logical structure; Discrepant, ambivalent; Verbal and vocal involvement; Verbal and vocal immediacy (impressions); Verbal and vocal uncertainty (impressions); Word and phrase repetitions; Gaze aversion; Illustrators; Negative statements and complaints; Nervous, tense (overall); Fidgeting (undifferentiated); Talking time; Details; Cognitive complexity. A list of the cues with descriptions and rating scales used can be found in Appendix A. Two raters from a pool of eight trained raters were assigned to each cue; one of these raters coded the cue for all videos in random order, and the other rater coded a random selection of 34 videos (20% of all videos). Raters were blind to the experimental conditions and hypotheses of the study and had no time pressure to finish the coding to avoid that they would rush through the coding. All raters were psychology students who had completed courses on empirical research methods. The first author further explained to the raters how to proceed with the coding, what was particularly important, and went through the definition of the cues with them. Raters discussed with the first author if they were unsure about a rating. Whenever necessary, information about these discussions was shared with the second rater for the cue (e.g., when refining the definition of a cue to include or exclude a particular behavior).

Each rater gave two ratings per video for a cue, one rating for the first interview part and one rating for the second interview part. For all cues rated on seven-point scales, differences larger than or equal to four points were resolved by the first author using a consensus approach; hence, the first author decided which of the two ratings most appropriately reflected the case. The reliability scores of the cues can be found in Table 1 (1st part) and Table 2 (2nd part). For the cues “Verbal and vocal involvement” and “Verbal and vocal immediacy (impressions),” more than one-third of the ratings had discrepancies equal to or greater than four points. Because this large number of discrepancies suggested that these cues had not been coded successfully, we decided not to use them in the analyses. For transparency and for interested readers, these cues are nevertheless included in the dataset uploaded on OSF <https://osf.io/cuwvg/>.

¹ Note, that we also ran the analyses without gaze aversion and cognitive complexity, which are not valid cues to deception according to DePaulo et al. (2003). Removing these cues from the analyses did not change the conclusions.

3 Results

We ran two separate MANOVAs, one for the ratings of the first part of the interview and one for the ratings of the second part of the interview. We entered the ratings for the coded cues of the respective interview part as dependent variables. Veracity and the ego depletion condition were the independent variables. Means and standard deviations of the coded cues for deceptive and true messages in the control and the ego depletion condition can be found in Table 1 (1st part) and Table 2 (2nd part).

For the first part of the interview, using Pillai's trace, the effect of the ego depletion condition was significant, $V = 0.16$, $F(13, 148) = 2.19$, $p = .013$. Contrary to the predictions, neither the effect of veracity, $V = 0.13$, $F(13, 148) = 1.65$, $p = .078$, nor the Ego Depletion x Veracity interaction, $V = 0.10$, $F(13, 148) = 1.25$, $p = .250$, were significant.

For the second part of the interview, also no effects were significant. Neither the ego depletion condition, $V = 0.11$, $F(13, 148) = 1.45$, $p = .143$, nor veracity, $V = 0.07$, $F(13, 148) = 0.84$, $p = .619$, nor the Ego Depletion x Veracity interaction, $V = 0.08$, $F(13, 148) = 0.97$, $p = .482$, reached the level of significance.

The results for the univariate ANOVAs are displayed in Table 1 for the first part of the interview and in Table 2 for the second part of the interview. Due to the large number of statistical tests, we used a Bonferroni-corrected significance level of .002. For none of the cues did the predicted interaction reach the corrected significance level; only in the case of the cue "nervous, tense" did the interaction even reach the conventional significance level of .05 for the second interview part, $F(1, 160) = 5.83$, $p = .017$, $\eta^2 = .035$. Similarly, none of the main effects reached the corrected level of significance.

To also account for the dependency between the two interview parts in the analyses while determining whether the data supported the null hypothesis or was just inconclusive, we calculated additional Bayesian mixed factors ANOVAs. For each cue, the ANOVA calculated in JASP (JASP Team, 2022) includes the interview part as a within-subjects factor and veracity and ego depletion as between-subjects factors. Table 3 contains the Bayes factors relevant to the hypotheses; the Bayes factors across models for the inclusion of the main effect of Veracity and the Ego Depletion x Veracity interaction are displayed including an interpretation of the evidence they provide. The last column shows the Bayes factor for the model which includes the main effects of ego depletion and veracity and their interaction in comparison to the null model. The full results of the models are uploaded in OSF.

For the main effect of veracity, only the cue details rendered moderate evidence ($BF_{incl} = 6.582$) in favor of the alternative hypothesis; truths were overall more detailed than lies. For nine cues, there was moderate evidence in favor of the null hypothesis, three cues rendered strong evidence, and one cue anecdotal evidence for the null hypothesis. For the Ego Depletion x Veracity interaction, none of the cues rendered evidence for the alternative hypothesis. Contrary to the predictions, for eight cues the analysis rendered strong evidence for the null hypothesis concerning the Ego Depletion x Veracity interaction, four cues moderate evidence, and one cue anecdotal evidence in favor of the null hypothesis.

4 Discussion

The study tested whether ego depletion enhances behavioral differences between liars and truth-tellers. When cognitive resources for self-regulation are drawn upon in an initial task, liars should subsequently lack the self-regulatory resources required for telling a convincing lie. This lack of self-regulatory resources was expected to magnify the behavioral differences between liars and truth-tellers. We found no evidence to support this assumption; differences between liars and truth-tellers in the coded cues were not significantly larger when senders worked on a task requiring self-regulation before the interview. Additional Bayesian analyses also revealed no evidence in favor of the hypothesis. On the contrary, the Bayesian analyses rendered moderate to strong evidence in favor of the null hypothesis, depending on the cue. This result is consistent with recent nonsignificant findings on ego depletion (e.g., Carter et al., 2015; Dang, 2016b; Hagger et al., 2016; Lurquin et al., 2016; Vohs et al., 2021; Xu et al., 2014). Also aligning with recent research (e.g., Luke, 2019), most of the coded cues were not related to the veracity status of the message; only the cue details showed moderate evidence of being a valid indicator of deception.

As outlined above, ego depletion theory is currently the subject of critical debate (see e.g., Friese et al., 2018, for a synthesis of arguments). Some argue that ego depletion theory should be abandoned. In contrast, others believe it

Table 1: Descriptive statistics and ANOVA results at the univariate level of the coded cues in the first part of the interview.

Cue	Reliability				Control				Ego Depletion				Univariate ANOVA					
	1 st part		Lie		Truth		Lie		Truth		Veracity Effect		Ego depletion Effect		Interaction Effect			
	M	SD	M	SD	M	SD	M	SD	M	SD	F	p	η ²	F	p	η ²	F	p
Talking time	>.99	135.10	65.36	139.25	64.68	103.17	45.89	129.90	66.78	2.61	.108	.016	4.66 [†]	.032	.028	1.40	.239	.009
Details	.45	4.28	1.24	4.93	1.37	4.02	1.35	4.69	1.57	9.20 [†]	.003	.054	1.25	.265	.008	0.00	.969	<.001
Cognitive complexity	.50	5.38	1.55	5.50	1.34	5.71	1.35	5.76	1.23	0.16	.687	.001	1.98	.162	.012	0.03	.857	<.001
Plausibility	.62	5.48	0.91	5.88	0.88	5.45	1.02	5.81	0.77	7.27 [†]	.008	.043	0.10	.754	.001	0.02	.879	<.001
Logical structure	.47	6.10	1.14	6.33	0.97	6.50	0.74	6.26	1.01	0.00	.968	<.001	1.04	.310	.006	1.96	.163	.012
Discrepant, ambivalent	.06	6.80	0.46	6.65	0.58	6.43	0.89	6.60	0.63	0.01	.936	<.001	4.26 [†]	.041	.026	2.35	.127	.014
Verbal & vocal uncertainty	.14	1.83	0.87	1.78	0.70	1.60	0.70	1.79	0.90	0.32	.574	.002	0.77	.381	.005	0.93	.336	.006
Word & phrase repetitions	.90	2.00	5.43	1.78	2.28	1.05	1.50	1.17	1.91	0.01	.915	<.001	2.50	.116	.015	0.12	.728	.001
Illustrators	.95	9.75	11.25	8.38	10.05	6.26	7.57	6.12	6.92	0.29	.593	.002	4.10 [†]	.045	.025	0.19	.665	.001
Negative statements	.61	1.45	0.68	1.45	0.75	1.29	0.74	1.43	1.02	0.32	.573	.002	0.54	.463	.003	0.32	.573	.002
Nervous, tense	.53	1.83	0.75	1.90	0.98	2.36	1.19	1.90	1.01	1.47	.227	.009	2.98	.086	.018	2.87	.092	.018
Fidgeting	.56	1.55	1.11	1.43	0.64	1.60	1.04	1.64	1.14	0.06	.806	<.001	0.70	.403	.004	0.30	.583	.002
Gaze aversion	.43	1.98	0.83	2.25	1.45	2.00	0.96	1.93	0.92	0.37	.541	.002	0.79	.374	.005	1.09	.299	.007

Note. [†] Effect would be significant in case of uncorrected p-values.

Table 2: Descriptive statistics and ANOVA results at the univariate level of the coded cues in the second part of the interview.

Cue	Reliability 2 nd part	Control		Ego Depletion				Univariate ANOVA										
		Lie		Truth		Lie		Truth		Veracity Effect		Ego depletion Effect		Interaction Effect				
		M	SD	M	SD	M	SD	M	SD	F	p	η^2	F	p	η^2	F	p	η^2
Talking time	>.99	215.68	95.13	223.00	105.26	189.00	73.06	202.52	114.35	0.46	.497	.003	2.37	.126	.015	0.04	.840	<.001
Details	.63	3.95	1.15	4.28	1.13	3.62	1.03	4.17	1.32	5.74†	.018	.035	1.45	.230	.009	0.37	.542	.002
Cognitive complexity	.45	5.70	1.09	5.75	0.95	5.45	1.31	5.55	1.21	0.16	.687	.001	1.56	.213	.010	0.02	.900	.000
Plausibility	.43	5.88	0.91	5.75	0.98	5.60	0.99	5.74	1.01	0.00	.953	<.001	0.92	.340	.006	0.77	.381	.005
Logical structure	.34	6.32	1.02	6.50	0.78	6.52	0.63	6.57	0.63	0.83	.363	.005	1.23	.270	.008	0.27	.602	.002
Discrepant, ambivalent	.02	6.83	0.38	6.68	0.53	6.55	0.67	6.62	0.62	0.20	.656	.001	3.58	.060	.022	1.58	.211	.010
Verbal & vocal uncertainty	.39	1.90	0.93	1.83	0.75	1.81	0.92	1.95	0.88	0.06	.804	<.001	0.02	.892	<.001	0.64	.425	.004
Word & phrase repetitions	.91	3.88	8.16	3.95	4.78	2.52	2.73	2.83	4.48	0.05	.819	<.001	2.16	.143	.013	0.02	.889	<.001
Illustrators	.92	15.23	17.99	14.60	14.07	13.52	13.97	13.10	20.31	0.04	.841	<.001	0.37	.543	.002	0.00	.970	<.001
Negative statements	-.07	1.50	0.75	1.55	0.64	1.45	0.80	1.33	0.65	0.10	.757	.001	1.40	.238	.009	0.57	.450	.004
Nervous, tense	.26	1.80	0.72	2.03	0.92	2.50	1.13	2.00	1.01	0.84	.361	.005	5.05†	.026	.031	5.83†	.017	.035
Fidgeting	.25	1.50	0.68	1.58	0.90	1.76	1.12	1.48	0.80	0.57	.452	.004	0.34	.560	.002	1.67	.198	.010
Gaze aversion	.47	2.13	0.97	2.40	1.52	2.24	1.19	2.14	1.18	0.22	.640	.001	0.14	.708	.001	0.93	.335	.006

Note. †Effect would be significant in case of uncorrected p-values.

Table 3: Bayes factors from mixed factors Bayesian ANOVAs for the inclusion of the hypothesized effects (full results in OSF).

Cue	Veracity			Ego Depletion x Veracity			BF ₁₀ of the “Ego Depletion + Veracity + Ego Depletion x Veracity model” compared to the null model
	BF _{incl} across models	Evidence	in favor of	BF _{incl} across models	Evidence	in favor of	
Talking time	0.180	Moderate	H0	0.117	Moderate	H0	0.065
Details	6.582	Moderate	H1	0.284	Moderate	H0	1.730
Cognitive complexity	0.094	Strong	H0	0.036	Strong	H0	0.015
Plausibility	0.283	Moderate	H0	0.050	Strong	H0	0.035
Logical structure	0.133	Moderate	H0	0.091	Strong	H0	0.055
Discrepant, ambivalent	0.146	Moderate	H0	0.238	Moderate	H0	0.372
Verbal and vocal uncertainty (impressions)	0.137	Moderate	H0	0.075	Strong	H0	0.043
Word and phrase repetitions	0.122	Moderate	H0	0.086	Strong	H0	0.049
Gaze aversion	0.167	Moderate	H0	0.109	Moderate	H0	0.067

is too early to discard it and therefore emphasize the need to investigate potential moderators and suggest structural improvements at the theoretical and empirical levels (e.g., Dang & Hagger, 2019; Inzlicht & Friese, 2019; Lin et al., 2020; Lurquin & Miyake, 2017). Further research is needed to more thoroughly investigate why we did not find an effect of ego depletion here. If a study that addresses the limitations of the current work (see below for details) also fails to find the predicted effect, it seems conceivable that the depleted self-regulatory resources do not have a central function in lying. This would then explain why we did not observe the expected amplification of behavioral differences between liars and truth tellers. However, given replication problems and the likely influence of publication bias on the ego depletion literature, it is possible that the ego depletion effect does not exist as postulated (see also Friese et al., 2018). Lying may require self-regulation, but ego depletion may not reduce lie performance because it does not strain the senders' self-regulation resources to impair subsequent performance.

In line with Luke (2019), most of the coded cues were not valid indicators of deception, even though most of them were identified as valid indicators in the meta-analysis by DePaulo et al. (2003). Only for the cue details, did we find moderate evidence for it being an indicator. Despite strong efforts to reliably code the cues, multiple cues had insufficient interrater reliability scores. We coded 15 cues for 164 videos which had a mean length of 421.85 seconds ($SD = 142.94$, $Min = 196$, $Max = 1036$). Although cues should have been coded independent of length, the overall length might still have had an influence. There is likely higher ambiguity when raters give a single rating for messages that last multiple minutes than when messages are shorter. For instance, it may be less clear how to weight single incidences of behavior in the overall rating when messages are long. It could therefore be beneficial for future research to employ quantitative, countable cues whenever possible instead of cues that are more subjectively coded using rating scales. In addition, when large samples of messages and/or long messages are coded, closer coordination between raters may be important because calibration may be lost over a long time period of coding.

4.1 Limitations

Neither the frequentist nor the Bayesian analyses supported the predicted increase in behavioral differences between liars and truth-tellers under ego depletion. One reason for this might have been the sample being too small as recent research suggests that the ego depletion effect may not be as large and as robust as the meta-analysis by Hagger et al. (2010) suggested (see also Carter & McCullough, 2013, 2014; Dang et al., 2021; Friese et al., 2018; Vohs et al., 2021).

Because interrater reliability was relatively low for some of the cues, it could be argued that the expected effects were not observable due to inadequate measurement of the dependent variables. However, a closer look at the results shows that the expected outcome did not occur even for the cues with high interrater reliability such as talking time, illustrators, or repetitions.

Here we employed a previously used ego depletion manipulation in the experimental condition, in which participants had to inhibit dominant responses when copying a text. However, we adapted the procedure in the control condition; unlike in previous studies (e.g., Muraven et al., 2006; Reinhard et al., 2013), individuals in the control condition did not work on a task but began with the procedure for the lie/truth production immediately. Although this adaptation has implications for the conclusions that can be drawn from the study, we wanted to generate a naturalistic baseline behavior in the control condition, paralleling research on the cognitive load approach in which there are usually no specific instructions for the control conditions (e.g., Vrij et al., 2008; Vrij et al., 2010). We assumed that the adapted procedure should show similar or maybe even stronger effects than the original procedure because cognitive resources of participants in the control condition were not taxed at all.

The study did not include a manipulation check that could have provided information on the effectiveness of the manipulation because we were not aware of any procedure that thoroughly assesses whether individuals had exerted sufficient self-regulation to impair their subsequent behaviors. As discussed by Friese et al. (2018) in more detail, ego depletion theory suggests that individuals may suffer from depletion effects at the behavioral level (functional level) without necessarily feeling consciously depleted (cognitive level). Manipulation checks are therefore difficult to design because they are likely of limited use when they address only the cognitive level (see Friese et al., 2018; Houwer, 2011). Although the employed procedure in the experimental condition resulted in significant effects in earlier studies (e.g., Muraven et al., 2006; Reinhard et al., 2013), we cannot say for sure whether the 15-minute copying of the text was enough to exhaust self-regulatory resources sufficiently.

5 Conclusion

Here we combined two fields of research that seem to suffer from publication bias, namely the field of research on cues to deception (see e.g., Luke, 2019) and the field of ego depletion research (see e.g., Carter et al., 2015; Carter & McCullough, 2014; Friese et al., 2018). We are aware that the reported research suffers from methodological flaws which we have reported transparently hoping that other researchers can benefit from this transparency. As stated by various researchers examining ego depletion and cues to deception (e.g., Friese et al., 2018; Inzlicht & Friese, 2019; Luke, 2019; Vadillo et al., 2018), we need to be more transparent in reporting research to keep the file drawer problem as small as possible. Only by reporting null results and being honest about what we have done (e.g., not concealing that there were unreliably coded or invalid cues) can science be self-correcting and we can truly advance the field. To address the limitations of this study, further work in this area should focus on solid manipulations of ego depletion with a large sample and ensure appropriate procedures to code the behavioral cues reliably. Even if the problems of this study are addressed in further work, based on the current results and ongoing replication issues, it is still questionable whether ego depletion would then elicit stronger cues of deception.

Data and Material Availability: The datasets generated and analyzed during the current study, additional analyses, and the experimental materials are available in the OSF repository: <https://osf.io/cuwvg/>

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Appendix A

Coding scheme

Cue	Cue Description (based on DePaulo et al., 2003)	Medium for coding	Scale
Talking time	Total time of the interaction that the speaker spends talking or seems talkative	Video	Talking time of the participant in the respective question block (in seconds)
Details	Degree to which the message includes details such as descriptions of people, places, actions, objects, events, and the timing of events; degree to which the message seemed complete, concrete, striking, or rich in details	Transcript	little detailed 1-2-3-4-5-6-7 very detailed
Cognitive complexity	Use of longer sentences (as indexed by mean length of the sentences), more syntactically complex sentences (those with more subordinate clauses, prepositional phrases, etc.), or sentences that includes more words that precede the verb (mean preverb length); use of the words but or yet; use of descriptions of people that are differentiating and dispositional	Transcript	little complex 1-2-3-4-5-6-7 very complex
Plausibility	Degree to which the message seems plausible, likely, or believable	Transcript	not at all plausible 1-2-3-4-5-6-7 very plausible
Logical structure	“Consistency and coherence of statements; collection of different and independent details that form a coherent account of a sequence of events” (Zaparniuk, Yuille, & Taylor, 1995, p. 344)	Transcript	not logical at all 1-2-3-4-5-6-7 very logical
Discrepant, ambivalent	Speakers’ communications seem internally inconsistent or discrepant; information from different sources (e.g., face vs. voice) seems contradictory; speaker seems to be ambivalent	Video	inconsistent 1-2-3-4-5-6-7 consistent
Verbal and vocal involvement	Speakers describe personal experiences, or they describe events in a personal and revealing way; speakers seems vocally expressive and involved	Audio	not involved at all 1-2-3-4-5-6-7 very involved
Verbal and vocal immediacy (impressions)	Speakers respond in ways that seem direct, relevant, clear, and personal rather than indirect, distancing, evasive, irrelevant, unclear, or impersonal	Audio	indirect 1-2-3-4-5-6-7 direct
Verbal and vocal uncertainty (impressions)	Speakers seem uncertain, insecure, or not very dominant, assertive, or emphatic; speakers seem to have difficulty answering the question	Audio	not at all unsure 1-2-3-4-5-6-7 very unsure
Word and phrase repetitions	Subcategory of non-ah speech disturbances in which words or phrases are repeated with no intervening pauses or speech errors	Transcript	Number of word and sentence repetitions
Gaze aversion	Speakers look away or avert their gaze	Video only (no audio)	little avoidant 1 - 2 - 3 - 4 - 5 - 6 - 7 strongly avoidant
Illustrators	Hand movements that accompany speech and illustrate it	Video	Number of illustrative hand movements
Negative statements and complaints	Degree to which the message seems negative or includes negative comments or complaints	Transcript	not at all negative 1-2-3-4-5-6-7 very negative
Nervous, tense (overall)	Speaker seems nervous, tense; speaker makes body movements that seem nervous	Video	not nervous at all 1-2-3-4-5-6-7 very nervous
Fidgeting (undifferentiated)	Object fidgeting and/or self-fidgeting and/or facial fidgeting (undifferentiated)	Video only (no audio)	not fidgety at all 1-2-3-4-5-6-7 very fidgety