

The Effects of a Secondary Task on True and False Opinion Statements

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Abstract

Background: In this experiment, we examined the effect of carrying out a secondary task on the arguments truth tellers and lie tellers put forward when discussing their opinions about societal issues. There is evidence to suggest that lying is more cognitively demanding than truth telling. Investigators can take advantage of the additional cognitive load imposed on lie tellers by imposing additional cognitive load, which should be particularly debilitating for lie tellers.

Method: In the experiment, participants told the truth or lied about some societal issues. Two-thirds of participants were asked to also remember and recall a car registration number during the interview. For one third of participants this secondary task was made important (secondary task and incentive). The pre-registered hypothesis we tested was that the most pronounced differences between truth tellers and lie tellers would occur in this secondary task and incentive condition, followed by the control condition (no secondary task) followed by the secondary task without an incentive condition. The dependent variables were the number of words uttered and number of arguments reported and the plausibility, immediacy, directness and clarity of the statement.

Results: The differences between conditions were small but followed the predicted pattern of results. The effects were most pronounced for the variables plausibility, immediacy, directness and clarity.

Conclusion: The pattern of results suggests that the introduction of secondary tasks in interview could facilitate lie detection but such tasks need to be introduced carefully. It seems that a secondary task will only be effective if lie tellers do not neglect it. This can be achieved by either telling interviewees that the secondary task is important (as we did in the present experiment) or by introducing a secondary task that interviewees cannot neglect (such as gripping an object; holding an object into the air; or driving a car simulator). Secondary tasks that do not fulfill these criteria are unlikely to facilitate distinguishing between truth tellers and lie tellers.

Introduction

The verbal and nonverbal cues lie tellers display are typically weak and unreliable [1,2]. As a result, researchers have started to design interview protocols that aim to enhance such cues [3]. One such approach is called 'imposing cognitive load' [4]. The rationale of this approach is that in interview settings lying is more cognitively demanding than telling the truth. If cognitive load is increased in an interview through specific interventions (e.g., imposing cognitive load), this should impair lie tellers more than truth tellers because lie tellers will have fewer cognitive resources left over. In this experiment, we examined the effect of one imposing cognitive load intervention - carrying out a secondary task- on the arguments truth tellers and lie tellers put forward when discussing their opinions about societal issues.

Reasons why Lying is More Mentally Taxing than Truth Telling

Numerous scholars have presented reasons as to why, in interview settings, lying is typically more cognitively demanding than truth telling. See Blandón-Gitlin et al. [5], Gombos [6], Sporer and Schwandt [7], Vrij [8,9], Vrij et al. [10] and Walczyk et al. [11,12] for elaborate discussions of those issues. Here we provide a summary of the main reasons. First, formulating the lie may be cognitively demanding, particularly when the lie has not been planned in advance [1,7]. Lie tellers need to fabricate details that should sound plausible and should not provide leads to investigators. Second, they also should remember what they have said to maintain consistency in case they are asked about the event again [13]. Third, lie tellers are less likely than truth

tellers to take their credibility for granted [14]. Lie tellers therefore are more inclined than truth tellers to control their demeanour to appear honest to the investigator. Fourth, another consequence of not taking their credibility for granted is that lie tellers will monitor the reactions from the investigator to assess whether they appear convincing [15]. Fifth, lie tellers are often preoccupied with the task of reminding themselves to continue lying [1]. Sixth, deception requires a justification and lie tellers need to decide for each question that is asked whether or not to lie [16]. Sixth, when a question is asked the truth will be activated automatically. Lie tellers therefore have to suppress the truth first before telling a lie [17,11].

Lying and Mental Effort: The Evidence

Various sources indicate that in interview settings lying is more cognitively demanding than truth telling, see also Vrij [8,9]. First, when participants-after being interviewed- were asked how mentally taxing these interviews were, lie tellers reported to have experienced more cognitive load than truth tellers [8-20]. Second, a meta-analysis of fMRI deception research revealed that deception is

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Citation: Vrij A, Deeb H, Leal S, Fisher RP (2022) The Effects of a Secondary Task on True and False Opinion Statements. Int J Psychol Behav Anal 8: 190. doi: <https://doi.org/10.15344/2455-3867/2022/185>

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associated with higher brain activity than truth telling, particularly in prefrontal regions, which are associated with executive processes such as working memory, inhibitory control, and task switching [21]. Third, analyses of police interviews with real-life suspects revealed that suspects particularly displayed signs of cognitive load when lying (increase in pauses, decrease in blinking and decrease in hand and finger movements; Mann et al. [22], Vrij & Mann [23]). Fourth, when police officers saw a selection of these police interviews (without being told when the suspects were lying or truth telling) they thought that that the suspects appeared to be thinking harder when they lied than when they told the truth [24].

Secondary Tasks

Investigators can take advantage of the additional cognitive load imposed on lie tellers by imposing additional cognitive load, which should be particularly debilitating for lie tellers. One possible way to impose additional cognitive load in interviews is by asking interviewees to carry out a secondary task at the same time as recalling their stories. Carrying out two tasks at the same time (i.e., story-telling and an additional task) is cognitively more difficult than carrying out just one task (story-telling) because when conducting two tasks simultaneously interviewees must divide their attention between the two tasks [25,26]. Three experiments supported this assumption, all measuring reaction times [27-29]. In these experiments various secondary tasks were introduced such as squeezing a spring-loaded hand grip for as long as possible; pressing a key once or twice depending on whether the answers were written in bold or italics; or using a driving simulator. Carrying out such tasks increased lie tellers' reaction times more than truth tellers' reaction times.

Reaction time as a dependent variable is problematic because it cannot be used in real life interviews. We are not aware of an applied setting where interviewees' reaction times are measured or where it would be suitable to do so in the future. The results of secondary tasks experiments would be more ecologically valid if adding a second task also affects speech content. Two experiments introduced secondary tasks and measured speech content [28,30]. However, in both experiments, speech content was measured only when the secondary task was present; there was no comparisons with a control condition (secondary task absent condition).

In the present experiment we manipulated the secondary task factor when measuring speech content. Truth tellers and lie tellers discussed their opinions about various societal issues. Truth tellers expressed their true opinions whereas lie tellers expressed opinions opposite to their true opinion. In the secondary task conditions, the interviewees were asked -in addition to story-telling- to remember and recall a 7-digit car registration number. Recalling lists has been tested extensively in the memory literature and has been shown to be demanding on cognitive resources and working memory [31,32]. We chose a 7-digit number because lists of up to seven items can be remembered (magic number seven) by truth tellers without exhausting their cognitive resources [33]. The dependent variables were the number of words spoken, the number of arguments mentioned in support of the opinion they conveyed and against the opinion they conveyed, and the plausibility, immediacy, directness and clarity of the statement. These measures reflect the cognitive resources available to truth tellers and lie tellers. Truth tellers' scores are typically higher than lie tellers' scores regarding these variables [1].

A secondary task should affect only the story-telling of lie tellers more than that of truth tellers if interviewees actually pay attention

to the secondary task. Interviewees, may not, however, always pay attention to the secondary task. Interviewees may think that of the two tasks (story-telling and secondary task), the story-telling task matters more in making a convincing impression on interviewers. Since lie tellers are less likely to take their credibility for granted than truth tellers, 'neglecting' the secondary task may occur particularly for lie tellers. This was found by Lancaster et al. [30]. We therefore introduced two secondary tasks conditions, whereby in the 'secondary task with an incentive' condition the interviewees were told explicitly that their performance on the secondary task would count towards making a credible impression. Such an instruction was not given in the 'secondary task without an incentive' condition.

In this pre-registered experiment (pre-registration: osf.io/5tz2f/; registration: osf.io/dfnrs/), we tested the following three pre-registered hypotheses:

Truth tellers will provide more words, more pro-arguments and fewer anti-arguments and more plausible, immediate, direct, and clear statements than lie tellers (Veracity main effect, Hypothesis 1).

Participants in the secondary task conditions will provide fewer words and fewer arguments and less plausible, immediate, direct, and clear statements than participants in the secondary task absent condition (Secondary task main effect, Hypothesis 2).

The most profound differences between truth tellers and lie tellers on opinion statements will be evident in the secondary task and incentive condition and the least profound differences will be evident in the secondary task absent condition (Veracity X Secondary Task interaction effect, Hypothesis 3).

As a manipulation check we measured participants' accuracy in mentioning the car registration number. We expected (1) truth tellers to be more accurate when recalling the car registration number than lie tellers; (2) participants in the secondary task and incentive condition to be more accurate when recalling the car registration number than participants in the secondary task and no incentive condition; and (3) truth tellers to be more accurate on the secondary task than lie tellers, particularly in the secondary task and incentive condition.

Method

Participants

Sample size was determined using G*Power software. To obtain 95% power, a medium to large effect size of $f^2 = 0.09$, and $\alpha = 0.05$, at least 158 participants were needed. Originally, 165 participants took part, but one participant did not follow the instructions in the secondary task condition by writing down the car registration number they were supposed to remember. This participant was deleted from the sample. Therefore, a total of 164 participants took part, of whom 49 were male and 115 were female. Their average age was $M = 26.90$ ($SD = 9.83$). Participants described themselves as White British ($n = 39$), Asian ($n = 32$), White ($n = 29$), White European ($n = 18$), British ($n = 10$), Black African ($n = 9$), mixed ($n = 8$), Arab ($n = 5$), Black British ($n = 4$), Hispanic ($n = 3$), Black ($n = 3$), and other ($n = 4$).

Procedure

Participants were recruited via online advertisements and the university staff and student portals. The experiment was carried out online and participants were given £10 for taking part.

Participants first completed a 20-item opinion questionnaire (via Qualtrics) in which they gave their opinion about various societal topics that were in the news at the time of the experiment on a 7-point rating scale (1 = *totally disagree* to 7 = *totally agree*). Appendix 1 shows the full list of topics. For each participant, the experimenter selected the three topics with the strongest support (scale points 6-7) or strongest opposition (scale points 1-2) and gave these three topics to the interviewer to discuss in the interview. Since each participant produced three statements, a total of 492 statements (3 * 164) were produced in the experiment. For the vast majority of these statements (454 out of 492, 92%), participants ticked the extreme score '1' or '7'. The remaining 8% were '2' or '6'. The 492 statements given by the participants in the interviews covered all twenty topics.

Participants were then randomly allocated to the Veracity and Secondary Task conditions. A total of 82 participants were allocated to the truth condition and 82 participants to the lie condition. In each veracity condition, a total of 29 participants did not receive a secondary task, and the remaining participants received a secondary task without ($n = 27$) or with ($n = 26$) an incentive.

Participants were informed about which three topics they would be interviewed. Truth tellers were asked to express their opinions truthfully about the three topics, whereas lie tellers were asked to pretend that they have the opposite opinions. Participants were told that it is important to come across as convincing during the interview. If the interviewer believed them, they would be entered in a prize draw worth £50, £100 and £150. If the interviewer did not believe them, they would not be entered in the prize draw. In reality, all participants were entered in the draw.

Participants were given the opportunity to prepare for the interview for as long as they needed. When participants indicated to have finished their preparation, they completed a pre-interview questionnaire

via Qualtrics. Apart from completing a background characteristics section (gender, age, ethnic background), participants were asked to rate their thoroughness of preparation via three items: 1 (*shallow*) to 7 (*thorough*); 1 (*insufficient*) to 7 (*sufficient*); and 1 (*poor*) to 7 (*good*). The answers to the three questions were averaged (Cronbach's alpha = .92) and the variable is called 'preparation thoroughness'. Participants were also asked whether they thought they were given enough time to prepare themselves with the following question: 'Do you think the amount of time you were given to prepare was: 1 (*insufficient*) to 7 (*sufficient*). Finally, participants were asked how motivated they were to perform well during the interview on a 5-point scale ranging from 1 (*not at all motivated*) to 5 (*very motivated*).

The interview started when the participants said they were ready. Participants in all conditions were asked to remove all notes and pens next to them. In the secondary task conditions, participants were asked to show both their hands on camera (to ensure they do not write the car registration number). They were then read the following instructions: "You will now be shown a car registration number. It is very important that you recall this number as you have to report it back to the interviewer. We will test your memory while you express your opinions. Thus, try to recall the registration number in full. You are asked not to write down this number. Since the experimenter and interviewer can see your hands, they will check that you do not cheat. The number will be displayed for five seconds only. You cannot view the number more than once, so please click the arrow to the next page only once you are ready." The five seconds was based on previous memory research in which correct recall has been shown to increase and false recall to decrease between 1s to 5s [32]. The next page then showed the following 7-digits car registration number: WBY35Z1.

Participants in the secondary task and incentive condition received as additional instructions that if they cannot remember the car registration number during the interview, they may be asked to write

1	Women should have the right to an abortion
2	Capital punishment should be a legal option in judicial systems for very serious crimes
3	The UK immigration laws should be much tougher for anyone wanting to live in the UK
4	The smoking ban in public places is a good thing
5	Obese people should pay for their own healthcare
6	Couples should cohabit before they marry
7	You support the Labour Party
8	Arranged marriages should be allowed
9	You generally agreed with Donald Trump's remarks
10	Governments should allow the use of cannabis for personal use
11	You are happy that the Brexit campaign succeeded
12	The furlough scheme was well-implemented by the UK Government during the pandemic
13	The UK Government has handled the Covid pandemic very well
14	The proposed 1% salary increase for nurses is sufficient
15	Regarding lockdown restrictions, health is more important than economy
16	Boris Johnson is a good Prime Minister
17	Global warming is a serious threat
18	You believe in anti-natalism
19	Animal farming is very cruel
20	The Government should employ COVID passports in pubs and other public places

Appendix 1: List of opinion statements.

down their opinions. In reality, none of the participants was asked to prepare a written statement.

The interviewer, blind to the veracity conditions, asked the following question for each opinion topic: "I understood from the experimenter that you are strongly in favour of/opposed to the following statement (statement read out). Could you please give me all the reasons that come to mind why you support/oppose this statement?". Participants in the secondary task conditions were then asked: "I understood from the experimenter that you have a car registration number to remember. Please recall that number?" The interviewer repeated these questions for the next two topics.

After the interview, all participants completed a post-interview questionnaire via Qualtrics. It measured rapport with the interviewer, because rapport is an important motivator for a productive interview [34]. It was measured via the nine-item Interaction Questionnaire [35]. Participants rated the interviewer on nine characteristics such as smooth, bored, engrossed and involved, using 7-point scales ranging from 1 (*not at all*) to 7 (*extremely*), Cronbach's alpha = .82. Participants also rated what they thought the likelihood was of having to write a statement using a 7-point Likert scale ranging from 1 (*not at all*) to 7 (*very much*). All participants were asked whether they cheated on the story-telling part of the interview (by consulting their notes) and participants in the secondary task conditions were asked whether or not they had cheated on the secondary task (by writing down the registration number). No participant said to have cheated on the story-telling part of the interview and one participant said to have cheated on the secondary task by writing down the car registration number (this participant was not included in the analysis). After completing the post-interview questionnaire, participants were given the debrief form. They were told by the experimenter that they were believed by the interviewer and therefore were entered into the draw as thanks for their contribution. They were also given details how to receive the £10 payment.

The interviews were video- and audio recorded and transcribed.

Coding

The numbers of words uttered by the participant in answering the three questions were counted through the Word software 'count' option. For the remaining variables, two coders were used who rated the transcripts independently from each other. Each coder rated all 164 transcripts. The ratings occurred per question, so we obtained three ratings for each variable per participant. The number of arguments was calculated as the total number of arguments mentioned in the three statements. For the other ratings, which were measured on 7-point Likert scales, the three ratings were averaged.

The coders counted the *number of arguments given in favour* of their opinion and the *numbers of arguments given that go against* their opinion. Examples are "A lot of people can't necessarily help being obese", "I don't think we should have been given the (Brexit) vote because as a nation I think we're ignorant to the consequences of the decision that we've made" and "People obviously can breathe a lot easier now that smoking in pubs has been abandoned".

Plausibility was defined as "Does the answer sound reasonable and genuine and was there enough of an answer to sound convincing"; *Immediacy* was defined as "Personal and not distanced"; *Directness* was defined as "To the point and not repetitive or waffle" and *Clarity*

was defined as "How clearly does the reader understand what the participant was saying by the end of the answer" All four items were measured on 7-point Likert scales ranging from 1 (*not at all*) to 7 (*very much*). These definitions were derived from DePaulo et al. [1].

The following statement was considered high in plausibility, immediacy, directness and clarity:

So I oppose this statement that the UK immigration laws should be tougher and the reason why is that people who come, say to the UK and they come from abroad and either seek asylum so they're here for some kind of new life and I think that it would be wrong in terms of human rights to neglect them from that chance. Because, if you're born in the UK, you were just lucky enough to be born in the UK and you won't have any suffering. Whereas, if you're born abroad, that shouldn't be a reason why you're not allowed to have a new life in somewhere like the UK for example. I think it also brings a lot of culture and I don't think without immigration we'd have really good takeaway systems, all the Chinese food, Indian food, you wouldn't really have that if it wasn't for people who migrated to the UK. I also think in terms of skilling, in terms of skills and jobs there's a lot who say people from abroad come into the UK for work steal all the jobs. But I don't agree with that because I think there's a lot of jobs, it's just that people in the UK prefer to have a certain type of job. Whereas, if you come from another country and you're desperate to start a new life, you're more than willing to start any job regardless of how good or bad it is because ultimately you just need money to survive, so I don't think they're taking our jobs.

This statement was considered plausible (a score of 6 was given) because the person mentioned several reasons while elaborating on them. The statement is also of good length. The statement was considered immediate (a score of 5 was given) because the statement was reasonably personal. The statement was considered direct (a score of 6 was given) because it was concise and not repetitive. The statement was considered clear (a score of 6 was given) because the statement was clearly understandable.

The following statement was considered low in plausibility, immediacy, directness and clarity:

When I saw the statement, it kinda triggered a few thoughts that I've already been having recently in terms of why especially in this current time with Covid, why it was given such attention when let's say for example pandemic, epidemic like Ebola, swine flu and previously back in the day the plagues and all that thing. I think what we see from history is that humans can survive certain health implications. Unfortunately, it does come at a cost of a big number of people and it does result in death but I think what we see is a bit like 'survival of the fittest' and I think for the favour for the human race, we do need to be able to withstand whatever health may come to that. You know, those with the genes and those with the ability to withstand such viruses can continue and pass that on later on. Again, unfortunately, it is at the cost of people's lives but I think for the sake of future generations and all those things, we have to continue as we should which is why the economy being at risk is actually more detrimental than health. Because history has taught us health can be overcome at a cost yes but with economy like when economy of the nation crashes that has long term detrimental effects. It's very hard to recover from that. So, I disagree that health is more important, the economy is more of value because it has a larger impact on the nation and also how it (inaudible) in the future and it will affect future generations compared to health.

Would health (inaudible) genes? The economy you're passing on recession and you're passing on like low fees and things like that so yeah.

The statement was considered implausible (a score of 2 was given) because the person argued against him/herself "comes at the cost of a large number of people" and the thought of "survival of the fittest" seems inappropriate in this context. The statement was considered average (score of 4) in terms of immediacy. The statement was considered low in directness (score of 2 was given) because it had a slow start (the first argument "humans can survive certain health implications" appears on line 4) and it is repetitive. The person said several times that health implications come at cost and also at the end repeats the argument that the economy is more important than health ("why the economy being at risk is actually more detrimental than health" is followed by "I disagree that health is more important, the economy is more of value"). The statement was considered somewhat unclear (a score of 3 was given) because the person appeared to struggle to formulate his/her thoughts.

Inter-rater reliability between the two coders, using the two-way random effects model measuring consistency, was sufficient for all variables: pro-arguments (Average Measures ICC = .72), anti-arguments, (Average Measures ICC = .63), plausibility (Average Measures ICC = .74), immediacy (Average Measures ICC = .60), directness (Average Measures ICC = .64) and clarity (Average Measures ICC = .73). We averaged the scores of the two coders and used these average scores in the analyses.

Regarding the car registration number, one point was given for each correct digit and another point if the digit was mentioned at the correct location (1st, 2nd, 3rd etc). The maximum score for recalling the car registration number was therefore 42 (3 X 14). A computer programmer developed an algorithm and coding therefore occurred automatically.

Results

Motivation, preparation thoroughness, preparation time and rapport

Four ANOVAs using a 2 (Veracity: true vs lie) X 3 (Secondary task: no task, task without an incentive, task with an incentive) factorial design were carried out with motivation, preparation thoroughness, preparation time and rapport as dependent variables. The analysis with motivation as a dependent variable revealed a significant Secondary Task main effect, $F(2, 158) = 4.49, p = .013, \eta_p^2 = .05$. Tukey post hoc tests showed that participants in the secondary task with incentive condition ($M = 4.52, SD = 0.70, 95\% CI [4.33, 4.71]$) were significantly more motivated ($p = .014$) than participants in the secondary task without an incentive condition ($M = 4.13, SD = 0.75, 95\% CI [3.94, 4.32]$). The motivation levels from participants in the control condition ($M = 4.51, SD = 0.70, 95\% CI [4.25, 4.61]$) did not differ from those two other conditions.

For preparation thoroughness, preparation time and rapport the Veracity and Secondary Task main effects and the Veracity X Secondary Task interaction effect were not significant, all $F's < 3.72$, all $p's > .056$. The mean scores showed that participants found their preparation thorough ($M = 4.87, SD = 1.33$), their preparation time very sufficient ($M = 6.09, SD = 1.20$) and their rapport with the interviewer good ($M = 5.60, SD = 0.92$).

Manipulation checks for the secondary task

Two 2 (Veracity: true vs lie) X 2 (Secondary task: task without an incentive vs task with an incentive) ANOVAs were carried out with 'effort to remember the car registration number' and 'correct memory' of that number as dependent variables. The two main effects and the interaction effect were not significant, all $F's < 0.61$, all $p's > .438$. Participants reported to have put considerable effort to remember the car registration number ($M = 6.01 [SD = 1.09]$ on a 7-point scale). Their memory of the car registration number was good ($M = 31.55 [SD = 8.84]$ on a 42-point scale).

Hypotheses testing

A 2 (Veracity: true vs lie) X 3 (Secondary task: no task, task without an incentive, task with an incentive) MANOVA was carried out with the seven variables listed in Table 1 as dependent variables. At a multivariate level the analysis revealed a significant main effect for Veracity, $F(7, 152) = 5.92, p < .001, \eta_p^2 = .21$. The Secondary Task main effect, $F(14, 306) = 0.51, p = .927, \eta_p^2 = .02$, and the Veracity X Secondary Task interaction effect, $F(14, 306) = 0.91, p = .551, \eta_p^2 = .04$, were not significant.

Table 1 shows that truth tellers reported fewer anti-arguments than lie tellers and that truth tellers' answers sounded more plausible, immediate, direct and clearer than lie tellers' answers. This supports Hypothesis 1. The absent of a Secondary Task main effect means that Hypothesis 2 was not supported.

The interaction effect was not significant. However, the p-value represents all possible patterns of simple main effects and not just the effect we hypothesised. A better way to test Hypothesis 3 is to carry out three MANOVAs with Veracity as factor for each of the three Secondary Task conditions separately. See Nahariand Ben-Shakhar [36] and Vrij et al. [37] for a similar approach. We expected to find the most pronounced differences between truth tellers and lie tellers in the 'secondary task with incentive' condition and the least pronounced differences between truth tellers and lie tellers in the 'secondary task without an incentive' condition.

The MANOVA for the control (no secondary task) condition revealed a significant multivariate Veracity effect, $F(7, 50) = 2.29, p = .042, \eta_p^2 = .24$. Truth tellers' statements sounded more plausible, immediate, direct and clearer than lie tellers' statements, see Table 1.

The Veracity effect in the MANOVA for the secondary task without incentive condition was not significant, $F(7, 46) = 2.17, p = .054, \eta_p^2 = .25$. None of the univariate effects were significant either, see Table 1.

The MANOVA for the secondary task with incentive condition revealed a significant multivariate Veracity effect, $F(7, 44) = 3.11, p = .009, \eta_p^2 = .33$. Truth tellers reported fewer anti-arguments than lie tellers and truth tellers' statements sounded more plausible, immediate, direct and clearer than lie tellers' statements, see Table 1.

Comparing the results of the two conditions with significant results (control condition and secondary task with incentive condition) showed the most diagnostic differences between truth tellers and lie tellers in the secondary task with incentive condition. First, more effects were significant in that condition ($n = 5$) than in the control condition ($n = 4$). Second, the effect sizes (d) and Bayes Factors (BF_{10}) were considerably larger for the plausibility and clarity variables in the

secondary task with incentive condition than in the control condition (and more similar in both conditions for immediacy and directness). In other words, the most pronounced differences were found in the secondary task with incentive condition and the least pronounced differences in the secondary task without incentive condition. This supports Hypothesis 3.

Discussion

We examined the effect of introducing a secondary task on truth tellers' and lie tellers' story-telling performance. We predicted that the largest Veracity differences would emerge in the secondary task with incentive condition. This was indeed the case. The comparison between the two secondary tasks conditions showed a clear advantage of the secondary task with incentive condition: Five significant Veracity differences emerged in that condition versus no significant

differences in the secondary task without an incentive condition. Also, the comparison between the secondary task with incentive condition with the control condition showed an advantage of the secondary task with incentive condition, because the Veracity differences in plausibility and clarity were more pronounced in this condition than in the control condition. For most other variables, however, the Veracity differences between these two conditions did not differ. There are good reasons to explain this. Word count and number of pro-arguments did not reveal Veracity effects in either condition. There is perhaps no reason as to why variables that are unrelated to deception would show more pronounced effects when a secondary task is introduced (i.e., floor effect). The variables immediacy and directness revealed strong Veracity effects in both conditions. If an effect is already strong in the control condition, it would be difficult to improve upon it in the secondary task condition (i.e., ceiling effect).

	Truth			Lie			F	p	d	BF ₁₀
	M	(SD)	95% CI	M	(SD)	95% CI				
Total sample										
Number of words	468.87	(248.08)	408.96,530.53	474.66	(304.82)	417.52,538.30	00.10	.920	0.02 (-.29,0.33)	0.17
Pro-arguments	7.22	(2.77)	6.68,7.78	6.79	(2.28)	6.26,7.36	01.19	.277	0.17 (-.14,0.47)	0.29
Anti-arguments	0.50	(0.66)	0.27,0.72	1.01	(1.29)	0.78,1.23	09.93	.002	0.50 (0.18,0.80)	15.46
Plausibility	4.63	(1.09)	4.39,4.87	3.88	(1.07)	3.67,4.14	19.60	<.001	0.69 (0.37,1.00)	939.54
Immediacy	5.16	(0.83)	4.96,5.35	4.49	(0.96)	4.32,4.71	21.90	<.001	0.75 (0.42,1.05)	3013.19
Directness	4.79	(0.79)	4.61,4.97	4.24	(0.83)	4.08,4.43	18.60	<.001	0.68 (0.36,0.98)	649.63
Clarity	4.85	(0.93)	4.64,5.06	4.13	(1.00)	3.93,4.35	23.27	<.001	0.75 (0.42,1.05)	3970.90
No secondary task										
Number of words	468.41	(259.90)	373.07,563.76	483.52	(252.67)	388.17,578.86	00.05	.823	0.06 (-.46,0.57)	0.27
Pro-arguments	7.14	(3.23)	6.15,8.13	6.57	(1.93)	5.58,7.56	00.66	.419	0.21 (-.31,0.73)	0.35
Anti-arguments	0.59	(0.66)	0.19,0.99	1.05	(1.37)	0.65,1.45	02.72	.105	0.43 (-.10,0.94)	0.82
Plausibility	4.53	(1.13)	4.14,4.91	3.84	(0.93)	3.46,4.23	06.35	.015	0.67 (0.13,1.19)	3.51
Immediacy	5.21	(0.85)	4.87,5.55	4.31	(0.97)	3.97,4.65	14.21	<.001	0.99 (0.43,1.52)	67.79
Directness	4.72	(0.84)	4.42,5.03	4.05	(0.80)	3.75,4.36	09.66	.003	0.82 (0.27,1.34)	12.60
Clarity	4.73	(1.07)	4.36,5.10	4.04	(0.91)	3.67,4.41	07.02	.010	0.69 (0.15,1.21)	4.57
Secondary task without an incentive										
Number of words	401.89	(183.83)	284.59,519.19	491.30	(388.27)	374.00,608.59	01.17	.284	0.29 (-.25,0.83)	0.44
Pro-arguments	6.74	(2.14)	5.89,7.60	7.24	(2.28)	6.39,8.10	00.69	.410	0.23 (-.31,0.76)	0.37
Anti-arguments	0.33	(0.50)	-.05,0.71	0.81	(1.29)	0.44,1.19	03.25	.077	0.48 (-.06,1.02)	1.04
Plausibility	4.51	(1.13)	4.08,4.95	4.07	(1.12)	3.64,4.51	02.04	.159	0.39 (-.15,0.92)	0.64
Immediacy	4.98	(0.85)	4.66,5.30	4.71	(0.80)	4.39,5.03	01.46	.233	0.33 (-.21,0.86)	0.50
Directness	4.72	(0.82)	4.41,5.02	4.48	(0.77)	4.17,4.79	01.17	.284	0.30 (-.24,0.83)	0.45
Clarity	4.79	(0.80)	4.48,5.11	4.40	(0.84)	4.09,4.72	03.06	.086	0.48 (-.07,1.01)	0.96
Secondary task with an incentive										
Number of words	538.92	(280.45)	430.76,647.09	447.50	(267.67)	339.52,555.48	01.45	.235	0.33 (-.22,0.88)	0.50
Pro-arguments	7.81	(2.79)	6.75,8.87	6.58	(2.63)	5.51,7.65	02.68	.108	0.45 (-.10,1.00)	0.83
Anti-arguments	0.58	(0.80)	0.18,0.98	1.15	(1.22)	0.75,1.56	04.06	.049	0.55 (-.01,1.10)	1.44
Plausibility	4.85	(1.02)	4.41,5.29	3.72	(1.17)	3.29,5.16	13.82	<.001	1.03 (.44,1.59)	54.93
Immediacy	5.28	(0.79)	4.89,5.65	4.47	(1.10)	4.10,4.85	09.10	.004	0.85 (.27,1.40)	9.94
Directness	4.93	(0.72)	4.61,5.25	4.20	(0.89)	3.88,4.52	10.64	.002	0.90 (.32,1.46)	17.56
Clarity	5.03	(0.90)	4.61,5.45	3.94	(1.20)	3.52,4.35	13.86	<.001	1.03 (.43,1.59)	55.68

Table 1: Statistical Results as a Function of Veracity.

The worst results in terms of Veracity effects was obtained in the secondary task without incentive condition, as we had predicted. In fact, the secondary task without an incentive condition did not reveal any Veracity differences. We argued that lie tellers may be inclined to focus less on the secondary task than truth tellers in this 'no incentive' condition, because lie tellers would prefer to focus on the story-telling part. If so, truth tellers have divided their attention more between the two tasks (secondary task and story-telling) than lie tellers. This would impair the story-telling task more in truth tellers than in lie tellers which could explain the absence of Veracity effects in story-telling performance. However, following this reasoning someone would think that lie tellers would have reported to have paid less attention to the secondary task than truth tellers and should have performed worse than truth tellers on the secondary task. We found no evidence for this. The self-reports revealed no Veracity differences in paying attention to the secondary task and the actual performance on that task was equal for truth tellers and lie tellers. This means that either our theoretical reasoning to explain the results in the secondary task without incentive condition is inadequate or our manipulation checks were ineffective. The fact that the results of the experiment supported our pre-registered interaction hypothesis makes us believe that our theoretical rationale was adequate.

The absence of Veracity effects in the secondary tasks without an incentive condition reveals that secondary tasks should be introduced carefully in interviews. We argued in the Introduction a secondary task will only be effective if lie tellers do not neglect it. This can be achieved by either telling interviewees that the secondary task is important (as we did) or by introducing a secondary task that interviewees cannot neglect (such as gripping an object; holding an object into the air; or driving a car simulator). Secondary tasks that do not fulfill these criteria are unlikely to facilitate distinguishing between truth tellers and lie tellers.

The Veracity main effects revealed that lie tellers reported more anti-arguments than truth tellers. Since these anti-arguments represent lie tellers' real opinion, this finding thus shows that lie tellers revealed their real opinions through reporting anti-arguments. However, also truth tellers reported anti-arguments so the presence of anti-arguments do not necessarily indicate deceit.

The most diagnostic differences between truth tellers and lie tellers occurred in plausibility, immediacy, directness and clarity. Someone could argue that these variables reflect the quality of the arguments more than the other variables (number of words, number of arguments) which are more quantitative variables. This could mean that it is more the quality than the quantity of lie tellers' statements that gave their lies away. This may reflect cognitive load experienced by lie tellers. It is perhaps easier for lie tellers to add quantity to their statements than quality when discussing opinions. Note that this quantity / quality argument does apply to a lesser extent to lying about activities. In that research 'total details' - a quantitative measure - discriminates well between truth tellers and lie tellers [38,39]. When discussing activities lie tellers are often reluctant to add details to their statements because they are concerned that these details give leads to investigators [40]. This concern may apply less to discussing opinions because statements about opinions may be less likely to result in leads than statements about past activities. The idea whether the quality of statements is more diagnostic about deceit than the quantity of statements when people discuss their opinions is worth examining in future research.

Competing Interests

The authors declare that they have no competing interests.

Authors' contributions

Aldert Vrij designed the experiment, analysed the data and wrote the first draft of the article.

Haneen Deeb carried out the experiment, helped with analysing the data and made comments on the initial draft.

Sharon Leal helped with designing the experiment and made comments on the initial draft.

Ronald P. Fisher made comments on the original draft.

Ethical Approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee [Science and Health Faculty Ethics Committee University of Portsmouth, UK, SHFEC 20210043] and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent

Informed consent was obtained from all individual participants included in the study.

References

1. DePaulo BM, Lindsay JL, Malone BE, Muhlenbruck L, Charlton K, et al. (2003) Cues to deception. *Psychol Bull* 129: 74-118.
2. DePaulo BM, Morris WL (2004) Discerning lies from truths: Behavioural cues to deception and the indirect pathway of intuition. *Deception detection in forensic contexts*. Cambridge University Press.
3. Vrij A, Granhag PA (2012) Eliciting cues to deception and truth: What matters are the questions asked. *Journal of Applied Research in Memory and Cognition* 1: 110-117.
4. Vrij A, Leal S, Mann S, Dalton G, Jo E, et al. (2017) Using the Model Statement to elicit information and cues to deceit in interpreter-based interviews. *Acta Psychol* 177: 44-53.
5. Blandón-Gitlin I, Fenn E, Masip J, Yoo AH (2014) Cognitive-load approaches to detect deception: searching for cognitive mechanisms. *Trends Cogn Sci* 18: 441-444.
6. Gombos VA (2006) The cognition of deception: The role of executive processes in producing lies. *Genet Soc Gen Psychol Monogr* 132: 197-214.
7. Sporer SL, Schwandt B (2006) Paraverbal indicators of deception: A meta-analytic synthesis. *Applied Cognitive Psychology* 20: 421-446.
8. Vrij A (2014) Interviewing to detect deception. *European Psychologist* 19: 184-195.
9. Vrij A (2015) A cognitive approach to lie detection. *Deception detection: Current challenges and new approaches*. Wiley.
10. Vrij A, Mann S, Fisher R, Leal S, Milne B, et al. (2008) Increasing cognitive load to facilitate lie detection: The benefit of recalling an event in reverse order. *Law Hum Behav* 32: 253-265.
11. Walczyk JJ, Roper KS, Seemann E, Humphrey AM (2003) Cognitive mechanisms underlying lying to questions: Response time as a cue to deception. *Applied Cognitive Psychology* 17: 755-774.
12. Walczyk JJ, Igou FP, Dixon AP, Tcholokian T (2013) Advancing lie detection by inducing cognitive load on liars: A review of relevant theories and techniques guided by lessons from polygraph-based approaches. *Front Psychol* 4: 14.
13. Granhag PA, Strömwall LA (1999) Repeated interrogations-Stretching the deception detection paradigm. *Expert Evidence* 7: 163-174.

14. Kassin SM, Appleby SC, Torkildson-Perillo J (2010) Interviewing suspects: Practice, science, and future directions. *Legal and Criminological Psychology* 15: 39-56.
15. Buller DB, Burgoon JK (1996) Interpersonal Deception Theory. *Communication Theory* 6: 203-242.
16. Levine TR, Kim RK, Hamel LM (2010) People lie for a reason: Three experiments documenting the principle of veracity. *Communication Research Reports* 27: 271-285.
17. Spence SA, Farrow TFD, Herford AE, Wilkinson ID, Zheng Y, et al. (2001) Behavioural and functional anatomical correlates of deception in humans. *Neuroreport: For Rapid Communication of Neuroscience Research* 12: 2849-2853.
18. Caso L, Gnisci A, Vrij A, Mann S (2005) Processes underlying deception: An empirical analysis of truths and lies when manipulating the stakes. *Journal of Interviewing and Offender Profiling* 2: 195-202.
19. Hartwig M, Granhag PA, Strömwall L, Kronkvist O (2006) Strategic use of evidence during police interrogations: When training to detect deception works. *Law Hum Behav* 30: 603-619.
20. Vrij A, Mann S, Fisher R (2006) Information-gathering vs accusatory interview style: Individual differences in respondents' experiences. *Personality and Individual Differences* 41: 589-599.
21. Christ SE, Van Essen DC, Watson JM, Brubaker LE, McDermott KB, et al. (2009) The Contributions of Prefrontal Cortex and Executive Control to Deception: Evidence from Activation Likelihood Estimate Meta-analyses. *Cerebral Cortex* 19: 1557-1566.
22. Mann S, Vrij A, Bull R (2002) Suspects, lies and videotape: An analysis of authentic high-stakes liars. *Law Hum Behav* 26: 365-376.
23. Vrij A, Mann S (2003) Deceptive Responses and Detecting Deceit. Halligan PW, Bass C, and Oakley D (eds.), *Malingering and Illness Deception: Clinical and Theoretical Perspectives*. Oxford: University Press, 67-88.
24. Mann S, Vrij A (2006) Police officers' judgements of veracity, tenseness, cognitive load and attempted behavioural control in real life police interviews. *Psychology Crime Law* 12: 307-319.
25. Johnston WA, Greenberg SN, Fisher RP, Martin DW (1970) Divided attention: A vehicle for monitoring memory processes. *J Exp Psychol* 83: 164-171.
26. Smith MC (1969) Effect of varying channel capacity on stimulus detection and discrimination. *J Exp Psychol* 82: 520-526.
27. Debey E, Verschuere B, Crombez G (2012) Lying and executive control: An experimental investigation using ego depletion and goal neglect. *Acta Psychol* 140: 133-141.
28. Gawrylowicz J, Fairlamb S, Tantot E, Qureshi Z, Redha A, et al. (2016) Does practice make the perfect liar? The effect of rehearsal and increased cognitive load on cues to deception. *Applied Cognitive Psychology* 30: 250-269.
29. Visu-Petra G, Varga M, Miclea M, Visu-Petra L (2013) When interference helps: increasing executive load to facilitate deception detection in the concealed information test. *Frontiers in Psychology* 4: 146.
30. Lancaster GLJ, Vrij A, Hope L, Waller B (2013) Sorting the liars from the truth tellers: The benefits of asking unanticipated questions. *Applied Cognitive Psychology* 27: 107-114.
31. Chabris C, Simons D (2010) *The invisible gorilla and other ways our intuition deceives us*. HarperCollins Publishers.
32. McDermott KB, Watson JM (2001) The rise and fall of false recall: The impact of presentation duration. *Journal of Memory and Language* 45: 160-176.
33. Miller GA (1956) The magical number seven, plus or minus two: Some limits on our capacity for processing information. *Psychological review* 63: 81-97.
34. Brimbal L, Dianiska RE, Swanner JK, Meissner CA (2019) Enhancing cooperation and disclosure by manipulating affiliation and developing rapport in investigative interviews. *Psychology Public Policy and Law* 25: 107-115.
35. Vallano JP, Schreiber Compo N (2011) A comfortable witness is a good witness: Rapport-building and susceptibility to mis-information in an investigative mock-crime interview. *Applied Cognitive Psychology* 25: 960-970.
36. Nahari G, Ben-Shakhar G (2011) Psychophysiological and behavioural measures for detecting concealed information: The role of memory for crime details. *Psychophysiology* 48: 733-744.
37. Vrij A, Fisher R, Blank H (2017) A cognitive approach to lie detection: A meta-analysis. *Legal and Criminological Psychology* 22: 1-21.
38. Amado BG, Arce R, Fariña F, Vilarino M (2016) Criteria-Based Content Analysis (CBCA) reality criteria in adults: A meta-analytic review. *International Journal* 16: 201-210.
39. Gancedo Y, Fariña F, Seijo D, Vilariño M, Arce R, et al. (2021) Reality monitoring: A meta-analytical review for forensic practice. *The European Journal of Psychology Applied to Legal Context* 13: 99-110.
40. Nahari G, Vrij A, Fisher RP (2014) Exploiting liars' verbal strategies by examining the verifiability of details. *Legal and Criminological Psychology* 19: 227-239.