

## Drawing on Liars' Lack of Cognitive Flexibility: Detecting Deception Through Varying Report Modes

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*Summary:* The present experiment examined the role of cognitive flexibility in the consistency of truth tellers' and liars' reports. We expected liars to be less flexible (less able to report an experience in different ways) and hence less consistent than truth tellers when asked to describe an event in different ways (e.g. verbally and pictorially). In the experiment, truth tellers entered a room and performed several tasks, whereas liars did not enter the room or perform the tasks but attempted to convince an interviewer that they did. Truth tellers and liars were interviewed twice about the room and tasks, and were asked to express their answers either the same way on both interviews (e.g. verbally then again verbally) or in different ways (e.g. verbally then pictorially). In support of the cognitive flexibility hypothesis, liars' reports were less consistent than truth tellers' reports, particularly when reporting in different ways across interviews. Theoretical and practical implications are discussed. Copyright © 2012 John Wiley & Sons, Ltd.

The methods most often used to detect deception are based on anxiety (Vrij, 2008). These methods rely on cues or observable measures of physiological responses (e.g. gaze aversion or fidgeting) that are thought to manifest when a liar knows the truth to be different from what he or she is reporting. This situation ostensibly creates dissonance. Upon experiencing dissonance, a liar's discomfort may leak through in noticeable behavior patterns (Zuckerman, DePaulo, & Rosenthal, 1981). However, discomfort and corresponding anxiety may not necessarily be indicative of deception, because signs of discomfort and anxiety may also be found among truth tellers. For instance, the experience of the interview itself may be sufficient to elicit anxiety cues from truth tellers (Bond & Fahey, 1987). Hence, truth tellers' heightened anxiety may be falsely attributed to mendacity resulting in misdiagnoses of deception (Vrij, 2008; for a critical review of anxiety-based deception using polygraph, see National Research Council, 2003).

One alternative to the anxiety-based approach is the cognitive approach (Vrij, Fisher, Mann, & Leal, 2006, 2008, 2010). Cognitive methods of detecting deception are based on the inherent differences in thought processes that occur when telling the truth versus lying. The cognitive approach, rather than relying on fleeting, physiological, or behavioral cues, uses the output of cognitive processes to differentiate between liars and truth tellers.

Several cognitive cues to deception have been identified recently, with promising results (Vrij, 2008). For example, because lying can be more cognitively demanding than telling the truth, when reporting a narrative in a reverse order (also a cognitively demanding task), liars tend to include fewer auditory details and make more speech hesitations than do truth tellers (Vrij et al., 2008; for more on cognitive demand and deception, see Mann, Vrij, & Bull, 2002; & Vrij, Semin, & Bull, 1996). Liars may also take longer to respond and offer shorter responses than truth tellers (DePaulo, Lindsay,

Malone, Muhlenbruck, Charlton, & Cooper, 2003). And, pairs of liars have been found to be less consistent with each other than pairs of truth tellers across multiple reports when asked unanticipated questions (Vrij et al., 2009).

Those findings were extended recently to show that liars are also less consistent than truth tellers when they are asked to output their responses pictorially on one report and verbally on the other (Leins, Fisher, Vrij, Leal, & Mann, 2011). The present study dissected the Leins et al. finding to examine two mechanisms that possibly account for the results: Were liars disrupted merely by having to output their stories pictorially, or were they disrupted by having to respond in different modalities across reports?

Some researchers have suggested that reporting events pictorially (e.g. by drawing a sketch) is inherently difficult for liars because they do not anticipate such a non-verbal output and hence are not prepared to display their knowledge non-verbally (Vrij et al., 2010). A related explanation is that when liars fabricate a cover story to account for their actions, they think primarily in terms of actions and people (e.g. I went to a basketball game with my friends), but they do not consider the spatial details of the event (e.g. where I was sitting in relation to my friends; Vrij et al., 2009). Consequently, when asked to draw a highly detailed sketch of the scene, liars have to make an *ad hoc* decision about where to place the various characters in the sketch: Shall I place myself to the left of my friends, to the right, or in the middle? By comparison, giving a verbal response provides some protection to liars in that they can describe the people and actions without specifying location: I went to the basketball game with my friends. Indeed, when asked to both draw a highly detailed sketch of a location and verbally describe the same location, liars and truth tellers in one study differed from one another to a greater extent across sketches than across verbal reports (Vrij, Mann, Leal, & Fisher, 2011).

A second possible explanation of the Leins et al. (2011) findings is that truth tellers, who actually experienced an event, are cognitively more flexible than liars, who merely imagined an event. Experiencing an event should allow various perceptual qualities (e.g. sights and sounds) to be encoded along with other, salient, apperceptive qualities (e.g. emotions

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and duration) into a single memory trace (Johnson & Raye, 1981). This memory trace can then be tapped when reporting about the experienced event. It allows experienced events to be reported in various ways because, regardless of the report process, all reported event details can be retrieved from that source. By contrast, *imagined* events are not often experienced perceptually; rather, they are experienced conceptually, without the benefit of sights and sounds, and so on (Johnson, Foley, Suengas, & Raye, 1988). Therefore, a memory trace for a conceptual experience will lack perceptual details; and as a result, perceptual qualities will not be available when recalling imagined events. Differences in the availability of perceptual details may then yield differences in cognitive flexibility.

A memory trace richly encoded with a variety of perceptual details will allow individuals (in this case, truth tellers) to report those details in different ways (e.g. *saying* an object's location and then *drawing* the object's location), demonstrating cognitive flexibility. By contrast, a memory trace lacking perceptual details will make reporting in different ways difficult (in this case, for liars), demonstrating constrained cognitive flexibility. Thus, when truth tellers report about events they have experienced, and liars report about events they have imagined, the two should differ in cognitive flexibility, particularly with respect to perceptual qualities of an event.

The Leins *et al.* (2011) study, unfortunately, cannot distinguish between the two explanations (modality and cognitive flexibility) of why liars were less consistent than truth tellers, because the two factors were confounded. In that design, all participants were asked to draw a sketch of the event on one of the two interviews, and all participants were asked to convey their answers differently on the two interviews: once verbally and once pictorially. The solution, which we implement in the present study, is to manipulate in a complete factorial design both the mode of reporting (verbal versus pictorial) and the similarity of the report mode across interviews (two of the same mode of reporting versus two different modes of reporting). If modality is the critical mechanism, then liars should be least consistent when they recall pictorially on both interviews; they should be most consistent when they recall verbally on both interviews; and they should be at an intermediate level of consistency when reporting pictorially one time and verbally the other time (or vice versa). However, we do not predict that outcome. Rather, we favor the cognitive flexibility explanation for liars' inconsistency. If cognitive flexibility is in fact responsible for liars' inconsistency in this experiment, then similarity between the output modalities of the two interviews should be critical, with liars being most consistent when reporting in the same modality on both interviews (pictorial/pictorial and verbal/verbal) and least consistent when reporting in different modalities (verbal/pictorial and pictorial/verbal). As for truth tellers, their consistency should not be affected appreciably by either the mode of report or the similarity between modes of reporting. Truth tellers should remain consistent—more consistent than liars across all conditions—as they should be reporting from a strong memory, which will allow them to recall critical spatial details and report those details consistently across verbal and pictorial modes of reporting.

We suspect that liars and truth tellers might also use different report strategies to accomplish their goals. Specifically, in the interest of appearing consistent, liars may opt to repeat their earlier statements (a *repeat* strategy), whereas truth tellers, who may be less concerned with appearance, may opt simply to reconstruct their critical experience from memory (a *reconstruct* strategy; for more on *repeat* versus *reconstruct* strategies, see Granhag & Stromwall, 1999). Hence, we also explored the strategies of liars and truth tellers in the present experiment.

## METHOD

### Design

A 2 (veracity: truth teller versus liar)  $\times$  2 (report mode at Interview 1: verbal versus pictorial)  $\times$  2 (report mode at Interview 2: verbal versus pictorial) between-subjects design tested the differential effects of report mode and cognitive flexibility on report consistency.

### Participants

Undergraduate psychology students ( $N=96$ , 66 women and 30 men; mean age = 22 years) were recruited from Florida International University via an online recruitment system and in-class solicitation. Students received course credit in exchange for their participation.

### Procedure

Participants were greeted in the interview room and tested individually. They were informed that they were participating in a study of memory and that they may be asked to lie. After consenting to participate, they were given a copy of the participant instructions to preview. The participant instructions served a number of purposes. They outlined the procedure that participants followed after leaving the interview room. They included a list of items located in a windowless task room—the only way to perceive the interior of the room was to gain access through an unlocked, windowless door. And they explained that (i) if the task room door was unlocked when they arrived, participants should enter the room and complete the tasks; however, if the task room door was locked, participants should wait 5 minutes and then return to the interview room; (ii) participants should convince the interviewers that they completed the tasks; and (iii) if the interviewers did not believe them, participants would have to write a report describing the experimental tasks. Participants were told that they may keep and refer to the instructions until Interview 1 began. After an opportunity to clarify the instructions, participants were told to go to the task room and perform a series of five tasks: (i) turn on a stereo; (ii) organize blocks to resemble a pattern; (iii) sign and date a log book; (iv) put together a puzzle; and (v) turn off the stereo. The task room was located in a different corridor than the interview room.

Truth-telling participants entered the task room and completed the five tasks. In previous testing, participants took approximately 5 minutes to complete the tasks. Therefore, 5 minutes were allotted for task completion. Participants were told to return to the interview room after completing the tasks.

Lying participants did not enter the task room because when they arrived there, it was locked. Instead, they were instructed to wait 5 minutes before returning to the interview room to report that they had just completed the tasks in the task room. This procedure mirrors a context in which a suspect/interviewee may report a fabricated alibi: a story depicting actions in which the respondent never engaged, in a familiar location.

#### *Interview 1*

After returning to the interview room, all participants engaged in a spatial filler task (Trail Making A and B) lasting approximately 10 minutes (to ensure that details relevant to the critical tasks were cleared from working memory). Then participants were interviewed in one of two modes: verbal report or sketch drawing.

#### *Verbal report (audio–video recorded)*

The interview began with an open-ended question (e.g. ‘Tell me about what you did in Room 369’) to elicit a verbal narrative of the event. After the open narrative, participants attempted to recall and report verbally as many items from the task room as possible. This was a free recall; thus, there was no limit to the number of items that could have been reported. However, the instructions explicitly identified 18 items that could have been reported. Each item recalled by the participant was checked off by the interviewer on an item list. Participants then answered questions about the relative locations of the items in the task room (e.g. ‘Please tell me the location of the blocks relative to other items in the room.’). The interviewer gave an example of a relative location response to participants by using items in the interview room (e.g. ‘The monitor is to the right of the pencil sharpener and to the left of the telephone.’). Responses were notated by the interviewer and later compared against audio–video recordings of the interview.

#### *Pictorial report (audio–video recorded)*

Participants who did not report verbally during Interview 1 attempted to draw a sketch of the task room including as many items as could be recalled.

#### *Interview 2*

Interview 2 followed Interview 1 and began with a second filler task (mini-mental state examination) lasting 10 minutes. The filler task was followed by an interview using one of the two report modes described earlier (verbal or sketch).

After concluding Interview 2, all participants completed a questionnaire on which they reported (on a Likert scale of 1–7: 1 = *completely disagree*; 7 = *completely agree*) the extent to which (i) they agreed that they were motivated to convince the interviewer that they were telling the truth and (ii) they agreed that they would have to write a summary if the interviewer did not believe them. On that form, participants also chose from a fixed set of strategies, those strategies they used in each interview. Participants were told to indicate all the strategies that they used. The set of strategies for Interview 1 included the following: I recalled a mental image; I created a mental image; I located objects where I thought they would logically be found;

I located objects with respect to the sequence of tasks; and I grouped objects in ways that would make it easier to remember. The set of strategies for Interview 2 included the following: I reconstructed my experience from [the task room]; I attempted to repeat what I reported during Interview 1; I recalled a mental image; I created a mental image; I located objects where I thought they would be logically found; and I located objects with respect to the sequence of tasks.

#### **Scoring**

Consistency proportions were calculated to reflect the qualitative difference between what was reported across Interviews 1 and 2. Participants’ responses were recorded and compared across interviews. All possible responses were scored as consistent, inconsistent, reminisced, or omitted. For example, if a participant said (or sketched) at Interview 1 that the mirror is to the *right* of the vase and said (or sketched) at Interview 2 that the mirror is to the *left* of the vase, that was scored as inconsistent (this paired response received a score of 0). If a participant reported at Interview 1 that the mirror is to the *right* of the vase and also reported at Interview 2 that the mirror is to the *right* of the vase, that was scored as consistent (this paired response received a score of 1). Omissions (details reported at Interview 1 but not at Interview 2) and reminiscences (details not reported at Interview 1 but reported at Interview 2) were coded but not given numerical scores. That is, they were not factored into consistency scoring, as we were primarily concerned with inconsistencies in the form of contradictions. Thus, the primary dependent variable was the proportion of responses that were consistent from Interview 1 to Interview 2. Consistency proportions were measured as the number of consistent items divided by the number of consistent plus inconsistent items. Thus, if a participant reported nine consistent items and one inconsistent item (for a total of 10 scored items), the consistency proportion was 0.90 (9/10).

Two independent raters, blind to participants’ conditions, scored participants’ responses. Inter-rater reliability was assessed via intraclass correlation for a subset of 35 cases. Inter-rater reliability was high:  $r = .95, p < .01$ . All discrepancies between scorers were discussed, and consensus was reached before a final consistency proportion for each participant was calculated.

## **RESULTS**

### **Manipulation check**

Participants’ responses to debriefing questions were analyzed for levels of motivation. For the statement ‘I was motivated to convince the interviewer that I had completed the tasks in Room 369,’ the modal response was *very much agree* (on a scale of 1–7,  $M = 5.81, SD = 1.42$ ). Participants did not differ by veracity on that response,  $t(94) = 0.57, ns$ . For the statement ‘I believed that I would have to write a summary if the interviewer did not believe me,’ the modal response was *somewhat agree* (on a scale of 1–7,  $M = 4.96, SD = 2.08$ ). Liars were more likely to indicate stronger agreement with that

statement ( $M=5.35$ ,  $SD=1.80$ ) than were truth tellers ( $M=4.56$ ,  $SD=2.28$ ) but with only marginal significance,  $t(94)=1.89$ ,  $p=.06$ .

### Report strategies

Participants reported (with a dichotomous choice: yes or no) the various strategies they used when reporting locations of items during both interviews. Table 1 presents the different strategies that truth tellers and liars chose to use. Notably, when asked if they attempted to recall a mental image during the second interview, 92% of truth tellers responded yes, whereas only 25% of liars responded yes,  $\chi^2(1, N=96)=43.89$ ,  $p<.01$ , Cramer's  $V=.676$ . When asked if they attempted to reconstruct their pre-interview, experimental task experience, 77% of truth tellers responded yes, whereas only 8% of liars responded yes,  $\chi^2(1, N=96)=46.36$ ,  $p<.01$ , Cramer's  $V=.695$ . Finally, when asked if they attempted to repeat what they had reported during the first interview, 42% of truth tellers responded yes, whereas 88% of liars responded yes,  $\chi^2(1, N=96)=22.04$ ,  $p<.01$ , Cramer's  $V=.479$ . There was no effect of report mode (same versus different) on identified report strategies.

### Hypothesis testing

Consistency proportion scores were subjected to an analysis of variance: 2 (veracity: truth teller versus liar)  $\times$  2 (Interview 1 report mode: verbal versus pictorial)  $\times$  2 (Interview 2 report mode: verbal versus pictorial).

In support of our prediction that truth tellers overall would be more consistent than liars, there was a main effect of veracity such that truth tellers ( $M=0.952$ ,  $SD=0.069$ ) were significantly more consistent across reports than were liars ( $M=0.836$ ,  $SD=0.200$ ),  $F(1, 96)=18.50$ ,  $MSe=0.324$ ,  $p<.001$ ,  $partial\ eta^2=.174$ .

There was also a main effect of Interview 2 report mode on consistency such that reporting pictorially at Interview 2 yielded higher consistency proportions ( $M=0.921$ ,  $SD=0.122$ ) than did reporting verbally at Interview 2 ( $M=0.867$ ,  $SD=0.189$ ),  $F(1, 96)=3.96$ ,  $MSe=0.069$ ,  $p=.05$ ,  $partial\ eta^2=.156$ . There was no main effect of Interview 1 report mode on consistency,  $F(1, 96)=.107$ ,  $MSe=0.002$ ,  $p=.744$ ,

$partial\ eta^2=.001$ . However, there was an interaction between Interview 1 report mode and Interview 2 report mode,  $F(1, 96)=16.97$ ,  $MSe=0.297$ ,  $p<.001$ ,  $partial\ eta^2=.162$ . Participants who reported pictorially at Interview 1 were affected more by a change in report mode at Interview 2 than were participants who reported verbally at Interview 1. This result, however, is not relevant to issues of veracity and will not be discussed further.

Critical to the cognitive flexibility hypothesis, there was a 3-way interaction among veracity, Interview 1 report mode, and Interview 2 report mode on consistency,  $F(1, 96)=8.82$ ,  $MSe=0.155$ ,  $p=.004$ ,  $partial\ eta^2=.091$ . Truth tellers were equally consistent for all combinations of Interviews 1 and 2 report modes. Liars, however, were more consistent when Interviews 1 and 2 report modes were the same versus when they were different. Figure 1 presents the data for the 3-way interaction. Note that liars were no less consistent in the pictorial–pictorial condition than they were in the verbal–verbal condition, a result that refutes the modality hypothesis. By contrast, liars were less consistent in the mixed-modality conditions than they were in the same-modality conditions, a result that supports the cognitive flexibility hypothesis.

Finally, further refuting the modality hypothesis, we found no statistically significant interactions between veracity and Interview 1 report mode,  $F(1, 96)<0.001$ ,  $MSe<0.001$ ,  $p=.985$ , or between veracity and Interview 2 report mode,  $F(1, 96)=2.62$ ,  $MSe=0.046$ ,  $p=.11$ ,  $partial\ eta^2=.029$ .

### Omissions and reminiscences

Omission and reminiscence scores were subjected to a 2 (veracity: truth teller versus liar)  $\times$  2 (Interview 1 report mode: verbal versus pictorial)  $\times$  2 (Interview 2 report mode: verbal versus pictorial) analysis of variance. There were no interactions between veracity and either report mode variables on either omissions (no  $F>0.895$ ) or reminiscences (no  $F>1.197$ ). However, there was an interaction between Interview 1 report mode and Interview 2 report mode on omissions: Regardless of veracity, reporting verbally at Interview 1 yielded no differences in omissions as a function Interview 2 report mode, whereas reporting pictorially at Interview 1 yielded more omissions when the Interview 2

Table 1. Report strategies and the percentage of truth tellers and liars who reported using them

Strategy	Veracity		$\chi^2$	$p$	Cramer's $V$
	Truth teller	Liar			
Interview 1					
Recalled a mental image	94%	2%	80.81	<.01	.917
Created a mental image	0%	81%	65.68	<.01	.827
Reported where objects would logically be found	2%	69%	46.63	<.01	.697
Located objects regarding the task sequence	69%	56%	1.60	.206	.129
Grouped objects for easy recall	48%	38%	1.06	.302	.105
Interview 2					
Reconstructed critical event experience	77%	8%	46.36	<.01	.695
Tried to repeat report from Interview 1	42%	88%	22.04	<.01	.479
Recalled a mental image	92%	25%	43.89	<.01	.676
Created a mental image	2%	44%	23.59	<.01	.496
Reported where objects would logically be found	6%	48%	21.10	<.01	.469
Located objects regarding the task sequence	65%	42%	5.06	.024	.230

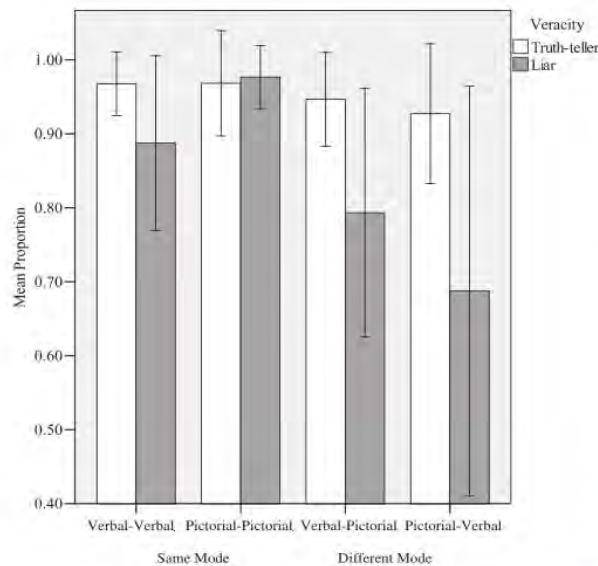


Figure 1. Influence of report modality and veracity on consistency. Error bars represent one standard deviation in either direction

report mode was verbal ( $M=2.43$ ,  $SD=2.37$ ) compared with when the Interview 2 report mode was pictorial ( $M=0.08$ ,  $SD=0.28$ ),  $F(1, 96)=10.754$ ,  $MSe=21.07$ ,  $p=.001$ ,  $partial\ \eta^2=.109$ .

## DISCUSSION

In the present experiment, liars' reports were less consistent when report mode changed across interviews (e.g. verbal/pictorial) than when report modes were the same (e.g. verbal/verbal). By comparison, truth tellers' reports were not affected by report mode similarity. Regarding the modality explanation presented earlier (i.e. merely including a pictorial report should impair liars' ability to deceive), veracity did not interact with either of the report mode variables individually. Thus, differences in consistency cannot be explained by the mere inclusion of one type of report versus another. Rather, those differences are better explained by the unique combination of mismatched report modalities used in both the present study and in the study of Leins et al. (2011). Hence, a more feasible explanation for the inconsistency found among liars in the two studies is that liars are less cognitively flexible than truth tellers.

Cognitive flexibility involves the ability to manipulate details flexibly across different report types. That is, individuals with unconstrained cognitive flexibility should be able to report event details (e.g. the locations of items in a room) consistently across interviews regardless of the type of report (e.g. verbal versus pictorial). The present truth tellers were able to do just that. They apparently retrieved the same event details across interviews and reported those details consistently regardless of report mode. In other words, they used the encoded details from their experience to respond consistently to requests for information in verbal and pictorial formats. This interpretation is further supported by truth tellers' self-reported

strategies for reporting locations of items during the second interview: 92% attempted to recall a mental image of the task room, and 77% attempted to reconstruct their experience of being in the task room. These results reflect truth tellers' frequent use of the *reconstruct* strategy, identified in the *repeat versus reconstruct hypotheses* posited by Granhag and Stromwall (1999). When using that strategy, truth tellers will attempt to reconstruct from their episodic memories the details of critical events.

By contrast, the consistency of individuals with constrained cognitive flexibility (e.g. the present liars) will be affected by the similarity of report modes across interviews. When report modes are the same across interviews, cognitive flexibility will be less important, as liars can simply attempt to repeat their reports from one interview to the next and likely be consistent (the *repeat strategy* in the *repeat versus reconstruct hypotheses*; Granhag & Stromwall, 1999). The present liars appeared to engage in the *repeat strategy*: 88% of liars indicated that they attempted to repeat their initial report when interviewed a second time. Such a strategy appeared to be effective whether they reported twice verbally or twice pictorially. However, when report modes differ across interviews, liars will have more difficulty repeating their reports and remaining consistent. The present liars seemingly encountered that difficulty, as evidenced by their relatively low consistency scores. Perhaps their difficulty resulted from not experiencing the event that they were reporting. By not experiencing the event, they did not have the opportunity to encode event details relevant to the interview questions they were asked (i.e. provide the relative locations of objects in the task room). In the absence of those details, liars may have attempted initially to report details generated from their general knowledge (e.g. schemas for furniture in a room). Then, when asked to report a second time differently, they had difficulty adapting their general knowledge to satisfy the demands of the different report types, resulting in inconsistency across interviews. In other words, because liars did not experience the event that they were reporting, they did not have a singular, relevant memory trace to reference when responding. Thus, because liars suffered from constrained cognitive flexibility, when precluded from merely repeating their reports, they were unable to remain as consistent as truth tellers across reports.

## Implications

The results of this experiment imply that examining cognitive flexibility (among other cognitive factors) may be useful to detect deception. Specifically, objective measures of inconsistency, as indicators of constrained cognitive flexibility, may help identify liars who fabricate large chunks of testimony. These results seemingly contradict previous results indicating that liars can be as consistent as truth tellers (Granhag, Stromwall, & Jonsson, 2003; Stromwall, Granhag, & Jonsson, 2003; for an exception, see Vrij et al., 2009). Those previous results, however, obtained using designs that allowed respondents to report event details the same way across interviews (i.e. a verbal report followed by another verbal report). Repeated interviewing using the same format may allow respondents to remain consistent because they can simply repeat the same testimony across interviews

(Fisher, Vrij, & Leins, in press). By contrast, the present design reduced the efficacy of the *repeat* strategy by forcing liars to report in ways that they may not otherwise choose to report. Rather than allowing *respondents* to control how they report (thus, allowing liars to conceal their deceit), this experiment presents a potential strategy that allows *investigators* to control how respondents report (thus actively uncovering liars' deceit). Moreover, by actively controlling the format in which respondents report, investigators can take advantage of liars' potentially rigid adherence to certain report strategies (e.g. the repeat strategy). In fact, our liars indicated that they used, to a large extent, the repeat strategy for maintaining consistency across reports; and, they used that strategy despite obvious deficiencies. Their adherence to that strategy suggests that our liars did not adjust their strategy as a result of any cognitive constraints. Real-world liars may be just as rigid. Hence, investigators can take advantage of liars' inflexibility (both in report strategy and the ability to manipulate event details), and improve lie detection performance, by incorporating multiple report modes in interviewing protocols.

### Limitations

The current design is limited by some factors that are difficult to avoid in deception research. The first, and the most relevant limit to studying deception, is ecological validity. When studying deception in the laboratory, the low stakes of the consequences for being judged a liar may not have an effect on motivation. Undergraduate respondents in a laboratory study probably know they will not suffer unreasonably (or at all) if they fail to generate convincing lies, and they probably do not feel a great deal of anxiety. Therefore, we can assume that not all participants will put in the same amount of effort in the laboratory as they might in a higher stakes scenario (e.g. a police interrogation). Strategies used by liars in a higher stakes scenario may allow them to be more consistent; perhaps, liars who perceive more severe consequences for being caught use stricter criteria for deciding the amount and the specificity of details that they will report. Using stricter report criteria may allow liars to report details that they are more likely to remember at a later time. However, the pattern of results found in the present study should not necessarily be affected by the perceived stakes involved. Unless cognitive flexibility is constrained by arousal or other affectations associated with high-stakes consequences, the present design should generalize across stakes. To that end, it would be useful for future studies to examine the effects of arousal (nervousness, anxiety, etc.) on cognitive flexibility.

Second, the paradigm used here differed from traditional deception paradigms in that it did not involve liars performing a transgression and then lying about it. Rather, our liars merely lied about (i) being in a location in which they had not been and (ii) engaging in behavior in which they had not engaged. Therefore, caution should be taken when attempting to generalize these results to a situation in which a liar is covering up a transgression. However, we expect that liars who deceive to cover up a transgression should not be any more or less cognitively flexible in general than liars who deceive for other reasons (e.g. convincing others that I have knowledge of

locations or events when in fact I do not). The critical component here is what the liar reports, not what the liar withholds. That claim notwithstanding, liars may be cognitively flexible in some situations. Specifically, when liars substitute the details of one previous (perhaps innocuous) experience for the details of the criminal (or otherwise to-be-concealed) experience, they may be cognitively flexible.

This experiment addressed only liars who never experienced the event that they reported. Real-world liars who choose to report events that they never experienced will have to fabricate completely the details of their reports. For example, if they choose to report that they were somewhere they have never been (perhaps a restaurant or store near the location of the crime or critical event), they will have to fabricate the details of that location and risk reporting inconsistently across different interviews. However, not all liars will fabricate their reports completely. In fact, many liars may construct their lies using events that they have experienced previously (Gnisci, Caso, & Vrij, 2010; Leins, Fisher, Ross, & Cahill, 2010). When liars report about actual experiences, they may tend to report in much the same way as truth tellers; that is, they may not suffer from constrained cognitive flexibility and hence may not report inconsistently across different interviews. Alternatively, the mere process of lying may impose enough cognitive demand to constrain cognitive flexibility. In other words, the mental effort required to construct any type of lie may leave too few cognitive resources to successfully report event details in different ways. However, to be clear, when liars report in much the same way as truth tellers (i.e. by reporting from past experience, with the benefit of perceptually rich memories), they may report consistently across report modes. Hence, it is critical to explore potential differences in cognitive flexibility between liars who fabricate reports and liars who report on actual experiences. Furthermore, fabricating stories and reporting previous experiences are not the only ways to lie. Liars may choose to report partial truths by withholding critical details—in this case, consistency may not be an ideal measure of veracity; rather, a single sketch drawing may aid in detecting deception (Vrij *et al.*, 2011). Liars may also present false identities or fraudulent documents—in these cases, asking unanticipated questions may be more useful than asking for sketch drawings (Vrij *et al.*, 2009). Regardless of the type of deception, a cognitive-based method for detecting it should be possible. Hence, we encourage researchers to apply what we have discussed here, as well as various other cognitive-based methods, to a variety of deception scenarios.

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