The Influences of Gradual and Late Disclosure of Evidence and Guilt and Innocence of a Suspect on Verbal Cues to Deception and Cognitive Load

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Abstract

This study examines investigative interviewing of suspects looking into how to detect deception. This can be done using evidence disclosure techniques such as Tactical Use of Evidence (TUE) disclosure and Strategic Use of Evidence (SUE) disclosure. This are methods of disclosure of evidence during the interview with attempts to judge the veracity of the suspect and discriminate between guilty and innocent people. These techniques affect verbal deception cues (Statement Evidence Inconsistencies (SEI), Within Statement Inconsistencies (WSI)) and cognitive load in guilty vs. innocent suspects. Based on SUE theory, guilty suspects adopt avoidance strategies, increasing inconsistencies when evidence is strategically withheld. Tactical Use of Evidence (TUE) reveals evidence incrementally, trying to increase cognitive strain and verbal deception cues. This technique causes extra cognitive load for liars who need to readjust their strategies throughout the interview, while making things easier for truth tellers by providing retrieval cues.

A 2-way ANOVA (N=93) tested these effects. Guilty suspects showed higher cognitive load ($M = 3.11$, $SD = 0.69$ vs. $M = 2.57$, $SD = 0.77$, $p < .001$), more SEI ($M = 3.88$, $SD = 1.29$ vs. $M = 1.52$, $SD = 1.21$, $p < .001$), and WSI ($M = 1.80$, $SD = 1.40$ vs. $M = 0.34$, $SD = 0.65$, $p < .001$) than innocent subjects. However, disclosure type (SUE vs. TUE) had no significant effect on cognitive load (p=.880), SEI (p=.576), or WSI (p=.169), though a marginal interaction suggested SUE may increase WSI in guilty suspects (p=.074).

However, disclosure type (SUE vs. TUE) had no significant effect on cognitive load ($p = .880$), SEI ($p = .576$), or WSI ($p = .169$), though a marginal interaction suggested TUE may increase WSI in guilty suspects ($p = .074$). These findings support the idea that cognitive load and verbal inconsistencies are useful indicators of guilt, but not clearly influenced by disclosure method. Limitations such as small sample size and skewed data suggest these results should be interpreted with caution and confirmed by future research.

The Influences of Gradual and Late Disclosure of Evidence and Guilt and Innocence of a Suspect on Verbal Cues to Deception and Cognitive Load

Police interviews are held after a crime is committed as part of the investigation procedure. The aims are to gather as much crime-relevant information as possible, assess a witness' reliability and identify the perpetrator (Launay et al., 2021). This thesis will focus on the latter, identify the perpetrator and interviewing suspects. The goal of these interviews is to test if the suspects narrative matches with the evidence that has been gathered and detect deception. Vrij (2008) defined deception as "a deliberate attempt to create false belief in others", in this case this is done by a suspect to a police officer holding the interview. Thus, *deception detection* is an important aspect of police interviews to find the perpetrator of the crime and avoid wrongfully prosecuting innocent people.

This information raises the question: How accurate are people at *deception detection* and how can this be improved? A study by Bond and DePaulo (2006) in which people attempted to discriminate between lies and truths without special aids or training, showed that people only achieved an average of 54% correct judgements. Hartwig et al. (2014) pointed out that this percentage is close to the probability of guessing (50%). Thus, untrained judgement is not accurate. Historically, training for detecting deception was based on non-verbal cues, such as body language. Deceptive individuals are likely to exhibit increased blinking and speech hesitations, although these signs are not reliable (DePaulo et al., 2003). The widespread misconceptions regarding nonverbal cues to deception can lead to inaccurate assessments. Literature from Luke (2019) and Vrij et al. (2019) among others conclude that non verbal cues are not an accurate measure of deception to be used by interviewers.

Strategic Use of Evidence (SUE)

After getting to these conclusions, Hartwig et al. (2005) designed a study to research a more active way of detecting deception that could be adopted by police interrogators during

interviews. Her method consisted in using the evidence available strategically to affect the statements of the suspects and therefore increase the accuracy of interviewers in *deception detection*. Some trainings recommended to present evidence early to attempt to intimidate the suspect into confessing. However, Hartwig et al. (2005) argued that this can give an advantage to the suspect as then they would know what to say to not contradict the evidence and provide an innocent explanation for it, complicating the interrogator's job to judge their veracity. By delaying the disclosure of evidence until after the suspect locks their account, meaning they present their final statement and state they have shared all the information they have, and starting the interview by probing the suspect, inconsistencies and gaps may be revealed in liars' statements (Hartwig et al., 2005).

Verbal Cues to Deception

The SUE method allows us to quantify and detect deception by counting how many pieces of evidence the suspect denies or avoids to mention before the evidence is revealed, these are called Statement Evidence Inconsistencies (SEI). Another value this method allows us to measure is Within-Statement Inconsistencies (WSI), which are the amount of times the suspect contradicts their own statement after evidence is disclosed. These are produced by several processes explained below including increased cognitive load.

Theoretical background of Strategic Use of Evidence Technique

The Strategic Use of Evidence (SUE) framework developed by Hartwig et al. (2005) is built upon the assumption that guilty suspects behave differently than innocent ones when confronted with evidence during an interview. These differences in guilty suspects can be explained with the different strategies presented in the theory of self-regulation (Carver & Scheier, 2012, as cited in Oleszkiewicz & Watson, 2021). Guilty suspects adopt "avoidant" strategies, like omitting details, and "denial" strategies, like modifying details, in an attempt to give a credible narrative and reduce the risk of revealing incriminating information

(Granhag & Hartwig, 2008, 2015, as cited in Oleszkiewicz & Watson, 2021). When suspects perceive the strategy is not benefiting them anymore, they may feel the need to switch strategies (Granhag & Hartwig, 2015, Granhag & Luke, 2018, as cited in Oleszkiewicz & Watson, 2021). They can adopt "escape" strategies, like to stop communicating, or "repair" strategies, like revealing more information perceived to be known by the interviewer (Granhag & Hartwig, 2015, Granhag & Luke, 2018, as cited in Oleszkiewicz & Watson, 2021).

DePaulo et al. (2003) states that liars share less information than truth tellers, as they try to avoid contradicting the evidence held by the interviewer. This is cognitively less demanding and allows the suspect to add details later in the interview without incriminating themselves, as well as giving them more time to think. This aligns with the illusion of transparency which states that liars are hesitant to tell lies as they fear their lie will be detected (Gilovich et al., 1998; Kassin & Norwick, 2004, as cited in Hartwig et al., 2005). Consequently, when evidence is disclosed later in the interview, previously omitted details can lead to inconsistencies and contradictions of the evidence. Hartwig et al. (2005) found a significant effect on *deception detection* accuracy between observers watching an interrogation that used SUE (67.6%) compared to observers that watched an interrogation that disclosed evidence at the beginning (40.6%).

Tactical Use of Evidence (TUE)

In addition to early and late disclosure, this thesis will also investigate gradual disclosure or Tactical Use of Evidence (TUE). With this method, the interviewer presents the evidence incrementally throughout the interview, not all at once at the beginning or end. This procedure allows observers to update their assessment of the suspect's veracity throughout the interview permitting a more dynamic and potentially accurate judgement (Oleszkiewicz & Watson, 2021). Furthermore, the study by Oleszkiewicz and Watson (2021) points out that

the TUE and SUE methods of evidence disclosure are rarely directly compared, leading us to question which, if either, is superior when assessing veracity.

One effective strategy within this method is evidence slicing, where each piece of evidence is divided into multiple units and disclosed within increasing specificity. First the interviewer asks a more general question about a piece of evidence and lets the suspect answer, then incrementally the interviewer reveals a more specific piece of evidence and asks the suspect to address the inconsistencies if any. This method helps encourage verbal cues to deception in guilty suspects while helping innocent suspects share information (Oleszkiewicz & Watson, 2021). In guilty suspects, this process causes an increase in cognitive load as it forces them to reevaluate how much information the interviewer holds and possibly reevaluate their strategy regarding the interview. Suspects may speculate that the interviewer has more evidence than assumed previously as the interview advances and more evidence is disclosed. This thought often provokes suspects to give additional or more truthful details to maintain credibility and appear cooperative (Polman et al., 2024). For innocent suspects, this method could add retrieval cues which should reduce their cognitive load and make disclosing information easier, avoiding accidental SEIs and WSIs due to forgetfulness or deeming information as unimportant and therefore not mentioning it (Oleszkiewicz & Watson, 2021).

However, the empirical support for the effectiveness of the slicing tactic is varied. Some studies suggest it influences WSI, but not SEI, and there are concerns about small-study effects and limited generalizability (Granhag et al., 2013; Granhag et al., 2015; Luke et al., 2013, as cited in Oleszkiewicz & Watson, 2020).

Cognitive load

The last concept that is important to understand why liars behave differently from truth tellers during investigative interviews is cognitive load. Cognitive load is the mental

effort required to process information, this affects user performance and experience (Sweller, 2018). Cognitive Load Theory is based the assumption that a human's working memory has limited capacity (Bannert, 2002). The content complexity approach (Zuckerman et al., 1981) offers a theoretical explanation for the difference in behavior between liars and truth tellers. It states that lying is more cognitively demanding than telling the truth as a liar must manage multiple tasks at once. When fabricating a story liars must ensure that their account is consistent with the evidence the interviewer holds, sufficiently detailed to appear as if it was experienced by themselves, and simple and easy to remember to remain consistent (Burgoon et al., 1995). Truth tellers experience less cognitive load as they rely on actual memories rather than fabrication. Furthermore, liars carry another cognitive burden as they must monitor their behavior to ensure an honest opinion while also monitoring the interviewers' reactions for signs of suspicion (Buller & Burgoon, 1996; DePaulo & Kirkendol, 1989, as cited by dePaulo et al., 2003). Because of this high cognitive demand, deceptive individuals are more likely to omit details and provide simpler narratives. By taking advantage of this cognitive strain, techniques such as TUE can increase the likelihood of SEI and WSI in the suspect's story.

Hypothesis

The goal of this paper is to investigate the influence of gradual and late disclosure of evidence and the guilt and innocence of a suspect on verbal cues to deception and cognitive load. I aim to broaden the research on gradual disclosure and get a better understanding of which is a more accurate tool for deception detection: SUE or TUE. After revising the literature above, guilty suspects are expected to produce more SEI and WSI and have a higher cognitive load score than innocent participants. Also, suspects subjected to TUE are expected to have higher WSI and cognitive load than suspects subjected to SUE.

Methods

Participants

The techniques used to recruit participants consisted of convenience sampling and volunteer sampling. Participants were recruited by asking friends and fellow students, by asking participants to refer the study to others, and through a database of the University of Twente (SONA). This is a website where participants sign up to participate in studies and get rewarded with credits needed to graduate university. For taking part in our study, 1.5 credits were awarded to each participant. The criteria for participants to take part in the research were being 18 years old or older and proficient in English.

Finally, 94 responses were recorded and of these 93 participants were included in the analysis. This exclusion was because the audio recording of the interview was corrupted. The sample consisted of 42 males and 50 females, and one participant identified as non-binary or third gender. The mean age of the sample was 22.27 (SD = 2.40), with the youngest participant being 19 and the oldest being 30. Of these participants 24 were guilty and received late disclosure, 24 were guilty and received gradual disclosure, 21 were innocent and received late disclosure, and finally 24 were innocent and received gradual disclosure.

Materials

Vignette 1: Guilty condition

The vignette starts with a short story about the participant's need for money and how a friend from college, Anna, approached them at a bar asking them for help to commit a heist in a museum. During this conversation Anna introduces the other people involved in the crime with pictures and a small description. Finally, the object the suspect is stealing during the heist, the painting *"the Monk by the Sea"*, is shown followed by text messages between the participant and the heist organizer. To encourage participants to read the text carefully so they would be able to remember details, they were required to respond to text messages going

over the plan. It is important to note that the responses did not affect the evidence. The text messages contained the key details of the crime that relate to the evidence held by the interviewers. For example, a metro ticket indicating the suspect used the metro to get to the museum.

Vignette 2: Innocent condition

This vignette starts with the participant also needing money but their friend, Anna, instead offers them a job interview in Berlin. She says that while they are in Berlin, they could go for a museum visit with friends. Then, the participant gets an introduction of the friends joining with pictures and short descriptions and joins a text conversation in which they plan their visit, and a short story of how the day went. The innocent participants were implicated in the crime by the same evidence as in the guilty condition, but they had an innocent explanation for it. For example, the innocent participant takes their friend Femke to the basement's disabled bathroom because she was going to have an epileptic seizure, which explains why their fingerprints are found there. Whereas in the guilty condition, the suspects hide in this bathroom until the museum closes to perform the heist. The evidence derived from these key details were used as pieces of evidence throughout the police interview.

The interview

Two interview scripts were created, one for gradual disclosure (TUE) and one for late disclosure (SUE), see Appendix A. To improve rapport building, and minimize bias and coercion, while maintaining the interview above ethical standards, the PEACE model of investigative interviewing was used to create the script for the interviewers (Davison, n.d.). Also, to ensure we maintained the SUE and TUE interviewing method, we used previous studies with similar methodology to create the interview scripts (Hartwig et al., 2014; Luke & Granhag, 2022; Nyström et al., 2024).

Both interviews start in a similar way with the “Engage and explain” stage of the PEACE model (Davison, n.d.) by having an opening statement where we introduced ourselves, the reason the suspects were being interviewed and the process and expectations during the interview. Then, we moved on to the “Account, clarification and challenge” stage where the interviewee started by freely narrating their overview of the day in which they visited the museum and is asked open questions regarding the evidence held by the interviewer, without revealing it. Then during TUE, the evidence was shared after the interviewee answered the questions for each piece of evidence. During late disclosure, the evidence was revealed later after every question was asked and the suspect had locked their full account. In other words, the suspect was probed about every piece of evidence in succession before any evidence was revealed. The Evidence Framing Matrix by (Granhag et al., 2013) was used to present the evidence in a deliberate way, from vague statements to more precise, regarding the source of the information and the evidence itself. This increases the difficulty to make credible statements for guilty participants and increase Within-Statement Inconsistencies.

Furthermore, the evidence was also released in increasing order of how closely the evidence connected the suspect to the crime, as seen in Oleszkiewicz et al. (2023). For example, the first evidence disclosed was the suspect’s degree in computer science, with the last piece of evidence disclosed being CCTV footage of the suspect in front of the painting. After every piece of evidence was disclosed, the suspect was given a chance to explain the inconsistencies between their initial statement and the evidence. Following the guidelines of the PEACE model (Davison, n.d.), clarifying inconsistencies should be done gently, without confrontation.

We closed the interview by following the guidelines of the final stage of the PEACE model during investigative interviews “Closing”. The interviewers summarized what was

said and asked the suspects if they had anything else to add or clarify before closing the interview.

All interviews were hosted in experiment rooms at the University of Twente and recorded and transcribed on Online Microsoft Word in order to safely store the documents on the universities protected drive.

Cognitive load questionnaire

A questionnaire developed by Herrema (2025) was included in the Qualtrics after the interview to measure the cognitive load experienced by participants and test the correlation between cognitive load and statement inconsistencies, which are verbal cues to deception. The questionnaire was accompanied by an instruction that asked the participant to think about how each item related to their experience in the interview.

The questionnaire consisted of 11 items, six representing the ability to verbalize and five representing memory facilitation. An example item for ability to verbalize is “Sometimes after giving an answer, I wished I could go back and restart or change my answer.” An example item for memory facilitation is “I seemed to forget what I already told the interviewer and what I did not.”. To answer these items the participants were presented with a 5-point Likert scale, where *1* represented *strongly disagree* and *5* represented *strongly agree*, so the higher the scores, the greater the cognitive load experienced. See the cognitive load questionnaire in Appendix B. Internal consistency was measured using the Cronbach’s Alpha (.87), which indicates good internal consistency among the items of the questionnaire.

Procedure

The study was approved by the Board of Ethics of the BMS faculty of the University of Twente (approval number: 250145). After the participants signed up for the study, they were invited to a room in one of the buildings on Campus. The room was arranged so the

participant was sitting opposite to the experimenter and interviewer with a table in between them. On this table was the computer in which they accessed Qualtrics.

Throughout the interview there were three different roles, suspect, experimenter, and interviewer. The experimenter had the role of welcoming the participant and closing the study, the interviewer had the role of interviewing the participant and was always someone unknown to the participant, and the participant played the role of the suspect. The interviewer waited outside of the room while the experimenter welcomed the participant and explained the purpose of the experiment vaguely to prevent this from affecting the results. They stated the purpose was to investigate the effect of police interviews through the questionnaires participants will answer after the interview and how they behaved during it. Then they explained the procedure briefly by stating they had to read the vignette thoroughly to remember details as they will be questioned on it later during the interview. They were told they had the right to withdraw from the experiment at any time without giving an explanation and asked the participant if they had any questions. Then the participants were indicated to start going through the consent form which included the information the experimenter provided but in greater detail and how the data will be handled securely. After this, the platform had a tool that randomly allocated the participants between the two conditions: guilty and innocent, and then the corresponding vignette described above was shown and followed until they reached the screen instructing them to stop and wait to be interviewed.

To ensure participants read the text messages and information, a timer was placed on each screen to check how long a participant spent on the page, this was not visible to the participant. This would help determine if the participant simply skipped through the pages and therefore did not participate in the study correctly. If participants spent less than 30 seconds on each page, they would be excluded but this was not the case for any so no participants were excluded for this reason.

After the participant finished reading the vignette, the experimenter offered to answer any questions and left the room. Then, the interviewer walked in the room already acting as an interviewer, asked the participant for consent to being recorded and started the audio recording. The interviewer conducted the interview with the participant using one of the evidence disclosure types, chosen randomly depending on the interviewer's preference ensuring all conditions were evenly represented in the sample. The scripts followed for each disclosure type are described above and can be read in Appendix A.

Finally, the interviewer left the experiment room and the experimenter walked in again to facilitate the participant taking the questionnaire in case any questions arise.

Data analysis

As mentioned before, the interviews were recorded, transcribed, and then coded manually. This was done by counting the amount of times per interview the participant made a Statement-Evidence Inconsistency (SEI) and a Within Statement Inconsistency (WSI). When looking at SEI, I counted the amount of times the participant contradicted or did not mention any of the 7 pieces of evidence specified in the story and in the interview script before the evidence was disclosed. For example, when the participant didn't mention they specifically took the metro to get to the museum or instead said they took the bus or walked. As there were only 7 pieces of evidence, SEI was graded in the range from 0-7. For WSI, the amount of times the participant contradicted their initial statement was counted. For example, if the participant first said they study psychology and after evidence is disclosed, they changed their statement and said they study computer science, that is counted as 1. Every time the participant contradicted their initial statement, this was counted, therefore WSI could be scored from 0 to however many WSI were made by the participant. This was added manually to the dataset.

Furthermore, to analyze the data the program R-studio was used with version Rversion 4.4.2 and the packages “psych”, “dplyr”, “readxl”, “ggplot2”, “emmeans”, “car” and “e1071”. The cognitive load questionnaire was tested with a Levene’s test and a Shapiro Wilk test and the results stated it did not violate the assumption of homogeneity of variance or normality. This is shown with histograms in Appendix C. Three two-way ANOVA tests were performed to test the effect of suspect status, disclosure type and the interaction effect between suspect status and disclosure type on the three dependent variables: cognitive load, SEI and WSI.

Results

Demographics

The results of the cognitive load questionnaire were normally distributed. The distribution of SEI failed the normality assumption ($W(93) = 0.934$, $p = .008$) and was slightly positively skewed (0.098). Furthermore, the distribution of the variable WSI was also not normally distributed ($W(93) = 0.79$, $p < .001$) and was substantially positively skewed (skewness = 1.48, SE = 0.25) . The histograms showing the distribution can be found in Appendix C. Table 1 has a summary of the descriptive statistics of the variables: cognitive load, Statement-Evidence Inconsistencies, and Within-Statement Inconsistencies. This includes means, standard deviations, and the correlations between all variables. These three correlations were statistically significant ($p < .05$), meaning they represent a real correlation not just a coincidence.

Table 1.

Descriptive Statistics and Correlations

	M	*SD*	Cognitive Load	SEI
Cognitive Load	2.85	0.77		
SEI	2.76	1.71	.34	
WSI	1.11	1.32	.32	.49

N = 93

Hypothesis test

To test the hypotheses three two-way ANOVAs were conducted on the data with the objective of quantifying the effects of participant status (innocent or guilty) and evidence disclosure technique (SUE or TUE) on the dependent variables: cognitive load, Statement-Evidence Inconsistencies (SEI), and Within-Statement Inconsistencies (WSI). Table 2 shows the means and standard deviations of these dependent variables under the effect of the independent variables and their interaction. The F-test statistic is also included in this table quantifying the significance of the effect of the independent variables on these results.

As seen in Table 2, the results are consistent across the three variables. The tests revealed a significant positive effect of suspect status on cognitive load, SEI and WSI, with participants in the guilty condition having higher scores than participants in the innocent condition. The effect of evidence disclosure technique was not statistically significant on cognitive load, SEI and WSI. Also, there was no significant interaction between evidence disclosure technique and suspect status on these three variables. This suggests that while guilty participants experienced higher cognitive load and scored higher in SEI and WSI than innocent participants, the results were not affected by the evidence disclosure technique or the combined effect of suspect status and evidence disclosure technique. However, although the interaction effect of WSI is not statistically significant ($F(1) = 3.26$, $p = 0.074$), it is close to being so. Guilty participants interviewed with the SUE evidence disclosure technique producing more Within Statement Inconsistencies than guilty participants interviewed with the TUE evidence disclosure technique.

Table 2.

Group Means and Standard Deviations per Condition

Independent Variables	Dependent Variables					
Suspect Status	Cognitive Load		SEI		WSI	
	M	*SD*	*M*	*SD*	*M*	*SD*
Innocent	2.57	0.77	1.52	1.21	0.34	0.65
Guilty	3.11	0.69	3.88	1.29	1.80	1.40
Raw scores	*F = 12.54, df = 1, p < .001**		*F = 80.89, df = 1, p < .001**		*F = 41.54, df = 1, p < .001**	
Disclosure technique	Cognitive Load		SEI		WSI	
	M	*SD*	*M*	*SD*	*M*	*SD*
SUE	2.86	0.74	2.84	1.68	1.27	1.56
TUE	2.84	0.81	2.69	1.76	0.96	1.06
Raw scores	*F = 0.02, df = 1, p = 0.880*		*F = 0.32, df = 1, p = .576*		*F = 1.92, df = 1, p = 0.169*	
Interaction Effect	Cognitive Load		SEI		WSI	
	M	*SD*	*M*	*SD*	*M*	*SD*
Innocent/SUE	2.56	0.84	1.62	1.20	0.29	0.64
Innocent/TUE	2.57	0.71	1.43	1.24	0.39	0.66
Guilty/SUE	3.14	0.50	3.96	1.22	2.17	1.61
Guilty/TUE	3.08	0.83	3.81	1.36	1.46	1.10
Raw scores	*F = 0.07, df = 1, p = 0.794*		*F = 0.005, df = 1, p = 0.946*		*F = 3.26, df = 1, p = 0.074*	

N = 93

Discussion

This experiment investigated the influence of gradual (TUE) and late disclosure (SUE) of evidence and the guilt and innocence of a suspect on verbal cues to deception and cognitive load. The goal was to broaden the research on Tactical Use of Evidence and get a better understanding of which is a more accurate tool for deception detection: SUE or TUE. In the results there are differences found between the subject status groups (guilty and innocent), but no differences were found based on disclosure method. A positive correlation was shown between cognitive load and verbal cues to deception.

Verbal Cues to Deception

For the first hypothesis it was expected that guilty suspects would make more SEIs and WSIs than innocent suspects as before the evidence is disclosed guilty suspects avoid sharing or lie about incriminating details, making more contradictory statements of the evidence. Our findings are in line with this speculation and the results of other researchers who found a statistically significant effect on the guilty suspect status on verbal cues to deception, when using late and gradual disclosure (Hartwig et al., 2005; Herrema, 2025). This study provides proof that guilty suspects produce more statement evidence inconsistencies and within-statement inconsistencies. This effect was equally true for both evidence disclosure types, rejecting the second hypothesis which predicted that suspects interviewed using the TUE method would produce more WSI than suspects interviewed using the SUE method.

However, there was a marginal interaction effect between guilty participants who received TUE and higher scores in WSI. Although this effect was not statistically significant, it was close ($p = .074$). This effect, if it is real, means people make fewer WSIs when guilty when interviewed with the TUE method rather than the SUE method. This aligns with the theory about shift of strategy which suggests that liars start telling stories closer to the truth when evidence is disclosed gradually (Polman et al., 2024). This might be something interesting to investigate further in future research with a bigger sample and experienced interviewers as this could orient interviewers on which disclosure method to use.

Cognitive Load

It was hypothesized that guilty suspects would score higher in the cognitive load questionnaire. This hypothesis was accepted. This means that guilty participants experienced more cognitive load than innocent participants, this is supported by the assumptions made by the content complexity approach (Zuckerman et al., 1981). This theory states that liars experience high cognitive load and in consequence make mistakes that manifest in higher SEI

and WSI scores in this study. This theory explains how the increase in cognitive load causes an increase in verbal cues of deception which is shown by these results. However, again this effect is the same for both evidence disclosure methods, showing that both strategies affect cognitive load equally for innocent and guilty suspects. When also considering the moderate correlation between cognitive load and SEI and WSI, this might suggest these findings may be better explained by investigating other additional causes or factors. When developing TUE, Dando and Bull (2011) base the model on cognitive load theories, while Hartwig et al. (2006) developing SUE suggest that the differences between guilty and innocent suspects are caused by the strategies used in response to the disclosure of evidence. The results of this paper may suggest that the conclusions made by Dando and Bull (2011) are not accurate.

Limitations

This study was a laboratory study which means it faced some limitations which decreased the generalization and significance of the results. The first limitation of the study is the small sample size. There were 93 participants which by having a 2x2 design and four groups, every group had a little over 20 participants. This reduces statistical power and increases the likelihood of Type II errors (Cohen, 1992). As Cohen (1992) noted, many psychological studies lack sufficient power to detect even medium-sized effects, calling into question the reliability of non-significant findings. Without adequate power, true effects may go undetected, leading to false conclusions about the absence of an effect (Cohen, 1992). Therefore, this could mean the interaction effect found between guilty participants, interviewed using the TUE method and higher scores in WSI could be seen as significant in future studies with a larger sample size.

Furthermore, all participants were students, middle class, predominantly white, and with an average age of 22.27. This is the demographic we could reach with this study due to lack of time and financing. Although this causes low external validity, laboratory studies benefit

from high internal validity as they allow precise control over variables and researchers can use random assignment and controlled environments to isolate the effects of independent variables (Wilson et al., 2010). It is true that this study would be more accurate with a sample of criminal offenders who have committed similar crimes but laboratory studies allow us to investigate the psychological processes more closely by eliminating external conditions (Wilson et al., 2010).

Lastly, the results for the verbal cues to deception were skewed, reducing the reliability of the findings. The distribution for Statement Evidence Inconsistencies was very slightly skewed, which can be ignored for this study and the results can still be accepted. However, the distribution for Within Statement Inconsistencies was severely skewed, meaning the results regarding that dependent variable are not completely reliable unless compared to the findings of other studies in the area which found similar results (Oleszkiewicz & Watson, 2021).

Artificial Intelligence Statement

Several AI tools were used in the present study. The first tool used is ChatGPT for coding in R studio, when an error message came up the error was placed in ChatGPT for help. After which, the code was double checked and adjusted if necessary. ChatGPT was also used occasionally to interpret results from R studio to help with understanding the findings. The second tool used is Scribbr citation generator to help format the citations in this study.

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Appendix A

Interview Scripts

Script 1 (SUE)

Part 1 – Opening and initial free narrative

Hello, my name is NAME.
I am investigating an incident at the Natural History Museum in Berlin. There has recently been some criminal activity there. A painting has been stolen and we have reason to believe you may have been involved.
Because of that, I need to ask you some questions about your recent visit there. Please answer our questions as fully as you're able to. This is your chance to give your side of the story so we don't make any wrong decisions.

1. First, can you let me know in as much detail as possible about your visit to the museum?

Part 2 – Probing and locking the account

Topic 1 - Establishing they were at the museum

If they admit being at the museum and in Berlin within the opening statement, then these items can be omitted.
If not then they need to be disclosed to prove that we know they were there – a way to get the ones who want to be too clever to engage properly with the task:

1. Thank you for giving me an overview of your day, but you don't discuss being at the museum and we have reason to believe you were in Berlin and at the museum at the time of the event. Can you tell us what you were doing there and what you did while you were there?

If still deny being there:

2. I'm sorry, but we have train tickets in your name travelling to Berlin before the event, and CCTV footage of you entering the museum. So we have a discrepancy here with what you're saying and the evidence we have. Please let me know what you were doing during the visit to the museum.

Possible contradictions and clarifications to note for later probing:
Method of travel – **you have tickets showing they were on the U5 metro line to Berlin**.
Your have CCTV of the suspect entering the museum alone.
Did they describe and explain wearing the disguise shown in the CCTV?

Topic 2 – Expertise

1. One thing we wanted to ask you about was your background, can you tell us a bit about your education and profession?

2. Can you tell us any more about your expertise in physical security measures, like alarm systems?

If they have not yet mentioned a reason to know about or purchase tools and materials for physical security:

3. To clarify, you are saying that there is no reason why you would need access to materials for building physical security devices?

Possible contradictions and clarifications to note for later probing:
Do they mention they studies computer science and security – **you know about their study and employment history in security design**.
Do they explain why they might have ordered parts to make physical security devices – **you have financial records showing they purchased equipment needed to make a device to interrupt the museum security systems**.

Topic 3 – Group membership

If they have not mentioned meeting anyone at the museum:

1. Did you meet anyone at the museum?

If they still deny meeting anyone/fail to describe them:

2. To confirm, you're saying you were alone at the museum and didn't meet anyone?/Can you tell me any more about the people you were with? (If not after latter, thanks them and move on)

Possible contradictions and clarifications to note for later probing:
Claiming to be alone.
Lying about/not mentioning being in contact with the other people.

Topic 4 – Activities within the museum

Depending on if they already explained being in in the disabled toilet:

1. While you were in the museum, did you need to use the bathroom at any point? (ask to elaborate if only say yes)

If they deny:

2. Again, just to make sure I have your story right, you're saying you did not visit the bathroom while you were there

If they indicate any bathroom other than the disabled one in the basement:

3. Again, just to make sure I have your story right, you're saying you only visited that bathroom, and no others?

Depending on if they already explained being in room 3.06 or being by "the monk by the sea"

4. Did you go to the third floor of the museum?/You mentioned going to the third floor of the museum can you remind us what you were doing there?

If they deny (only the bits that are appropriate, e.g. if they admit being at the third floor but deny being at the painting):

5. Just to check my understanding, you're saying you did not go up to the third floor and did not view the painting "The monk by the sea"?

Possible contradictions and clarifications to note for later probing:
Not mentioning being in the disabled toilet **– You have their fingerprints showing they were in the disabled toilet**.

Not mentioning being on 3rd floor/by painting – **you have CCTV they thought they had deleted showing the group together in front of the painting and being on the third floor before the heist**.

Part 3 – Evidence disclosure

Can skip items that are fully addressed in the initial account
If ALL evidence is accounted for (possible in innocent condition) then these questions can be skipped.
If in the first prompt the suspect gives an account thank them and say that this conforms with the evidence piece by disclosing it. E.g. "That makes sense, we have some CCTV of you entering the museum wearing what looks like a disguise, which seemed odd to us. Let's move on to the next thing".
If they still do not explain the evidence after the direct disclosure of the evidence remain polite and non-confrontational, but make it clear that what they have said contradicts the evidence held. E.g. "Your story doesn't really align with the evidence we have, but let's move on to the next thing".
Thank you for giving us your account. Some of the things you said don't align with some of the evidence we have, so I wanted to give you another opportunity to explain what happened.

Topic 2 – Expertise

1. We have reason to believe you would have the capability to build a device that could prevent the museum security from working properly. Is there anything you can tell us about that?

If this remains unexplained:

2. We know you have an education in computer science, have worked building security for museums in the past, and we have financial records showing you have ordered the parts that would be needed to build a device like the one used to interrupt the alarm systems in this theft. Can you explain why you decided to not tell us about this?

Topic 3 – Group membership

1. We have reason to believe you were planning to meet with some others at the museum, and we also suspect these people might also be involved in the heist. Do you want to tell me any more about anyone you might have met at the museum?

If this remains unexplained:

2. We have phone records showing you were in contact with one other person about meeting them at the museum, and that you planned to meet some others there. We also believe these people have some expertise that would be needed to perform a heist. Can you tell us any more about your plans to meet people at the museum?

Topic 4 – Activities within the museum

1. You indicated that you were never in the basement disabled persons bathroom, but we have some information indicating you were in that room. Can you help me to understand why our information conflicts with your story?

If unexplained:

2. We have your fingerprints from multiple surfaces in that bathroom. Can you help me to understand how that could have happened if you were not in that room?

3. We have additional information that indicated that you were in room 3.06, by the painting that was stolen. Can you explain why our information doesn't match with what you've told us?

If unexplained:

4. We recovered some CCTV footage that someone had attempted to delete showing you in that room with a group of people that match some our other suspects. Can you explain for me why we would have that footage if you were not in that room or by the painting?

Part 4 – closing

1. That's all the questions I have for now, I wanted to thank you for coming in and talking to us. Is there anything else you want to add before I close the interview?

Then we are finished for now. Please stay here with us and my colleague will be with you shortly and explain the next steps.

Script 2 (TUE)

Part 1 – Opening and initial free narrative

Hello, my name is NAME.
I am investigating an incident at the Natural History Museum in Berlin. There has recently been some criminal activity there. A painting has been stolen and we have reason to believe you may have been involved.
Because of that, I need to ask you some questions about your recent visit there. Please answer our questions as fully as you're able to. This is your chance to give your side of the story so we don't make any wrong decisions.

1. I want to go through each piece of what happened part by part, but first can you let me know in as much detail as possible about your visit to the museum?

Topic 1 - Establishing they were at the museum

As for late, skip questions where evidence is accounted for in the initial story.

1. First can you tell me about how you travelled to the museum?
2. Is there any reason you'd do anything special with your clothing on the day you visited the museum?

If any evidence is omitted or contradicted, challenge after these two questions
E.g.

1. "I ask you because we have train tickets in your name for the U5 metro indicating that you travelled to the Museum on the day of the theft. Can you explain for me what you were doing travelling toward the museum?"
2. We have CCTV footage of you wearing what seems to be a disguise entering the museum, and that doesn't really match the story you've given us so far. Can you help us to understand the discrepancy?

Possible contradictions and clarifications to note for probing:
Method of travel – **you have tickets showing they were on the U5 metro line to Berlin**.
Your have CCTV of the suspect entering the museum alone.

Topic 2 – Expertise

1. One thing we wanted to ask you about was your background, can you tell us a bit about your education and profession?
2. Can you tell us any more about your expertise in physical security measures, like alarm systems?

If they have not yet mentioned a reason to know about or purchase tools and materials for physical security:

3. To clarify, you are saying that there is no reason why you would need access to materials for building physical security devices?

If any evidence is omitted or contradicted, challenge after three questions are asked

3. We have reason to believe you would have the capability to build a device that could prevent the museum security from working properly. Is there anything you can tell us about that?

If this remains unexplained:

4. We know you have an education in computer science, have worked building security for museums in the past, and we have financial records showing you have ordered the parts that would be needed to build a device like the one used to interrupt the alarm systems in this theft. Can you explain why you decided to not tell us about this?

Possible contradictions and clarifications to note for later probing:

Do they mention they studies computer science and security – **you know about their study and employment history in security design**.
Do they explain why they might have ordered parts to make physical security devices – **you have financial records showing they purchased equipment needed to make a device to interrupt the museum security systems**.

Topic 3 – Group membership

If they have not mentioned meeting anyone at the museum:

1. Did you meet anyone at the museum?

If they still deny meeting anyone/fail to describe them:

2. To confirm, you're saying you were alone at the museum and didn't meet anyone?/Can you tell me any more about the people you were with? (If not after latter, thanks them and move on)

If any evidence is omitted or contradicted, challenge after two questions are asked

3. We have reason to believe you were planning to meet with some others at the museum, and we also suspect these people might also be involved in the heist. Do you want to tell me any more about anyone you might have met at the museum?

If this remains unexplained:

4. We have phone records showing you were in contact with one other person about meeting them at the museum, and that you planned to meet some others there. We also believe these people have some expertise that would be needed to perform a heist. Can you tell us any more about your plans to meet people at the museum?

Possible contradictions and clarifications to note for later probing:
Claiming to be alone.
Lying about/not mentioning being in contact with the other people.

Topic 4 – Activities within the museum

Depending on if they already explained being in in the disabled toilet:

1. While you were in the museum, did you need to use the bathroom at any point? (ask to elaborate if they only say yes)

If they deny:

2. Again, just to make sure I have your story right, you're saying you did not visit the bathroom while you were there

If they indicate any bathroom other than the disabled one in the basement:

3. Again, just to make sure I have your story right, you're saying you only visited that bathroom, and no others?

Depending on if they already explained being in room 3.06 or being by "the monk by the sea"

4. Did you go to the third floor of the museum?/You mentioned going to the third floor of the museum can you remind us what you were doing there?

If they deny (only the bits that are appropriate, e.g. if they admit being at the third floor but deny being at the painting):

Toilet fingerprints

5. You indicated that you were never in the basement disabled persons bathroom, but we have some information indicating you were in that room. Can you help me to understand why our information conflicts with your story?

If unexplained:

6. We have your fingerprints from multiple surfaces in that bathroom. Can you help me to understand how that could have happened if you were not in that room?

CCTV of the group in the room

7. We have additional information that indicated that you were in room 3.06, by the painting that was stolen. Can you explain why our information doesn't match with what you've told us?

If unexplained:

8. We recovered some CCTV footage that someone had attempted to delete showing you in that room with a group of people that match some our other suspects. Can you explain for me why we would have that footage if you were not in that room or by the painting?

Possible contradictions and clarifications to note for later probing:

Not mentioning being in the disabled toilet **– You have their fingerprints showing they were in the disabled toilet**.

Not mentioning being on 3rd floor/by painting – **you have CCTV they thought they had deleted showing the group together in front of the painting and being on the third floor before the heist**.

Part 4 – closing

1. That's all the questions I have for now, I wanted to thank you for coming in and talking to us. Is there anything else you want to add before I close the interview?

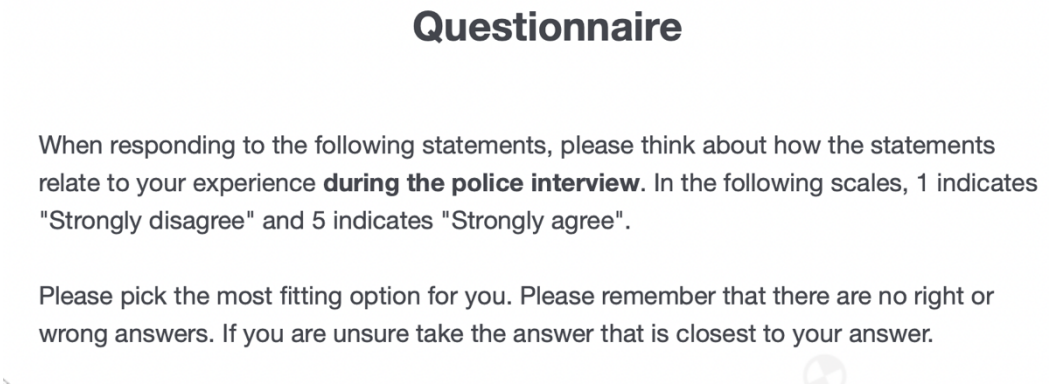
Then we are finished for now. Please stay here with us and my colleague will be with you shortly and explain the next steps.

Appendix B

Cognitive Load Questinnaire

Figure B1

Beginning statement of Cognitive Load Questionnaire



Questionnaire

When responding to the following statements, please think about how the statements relate to your experience **during the police interview**. In the following scales, 1 indicates "Strongly disagree" and 5 indicates "Strongly agree".

Please pick the most fitting option for you. Please remember that there are no right or wrong answers. If you are unsure take the answer that is closest to your answer.

Figure B2

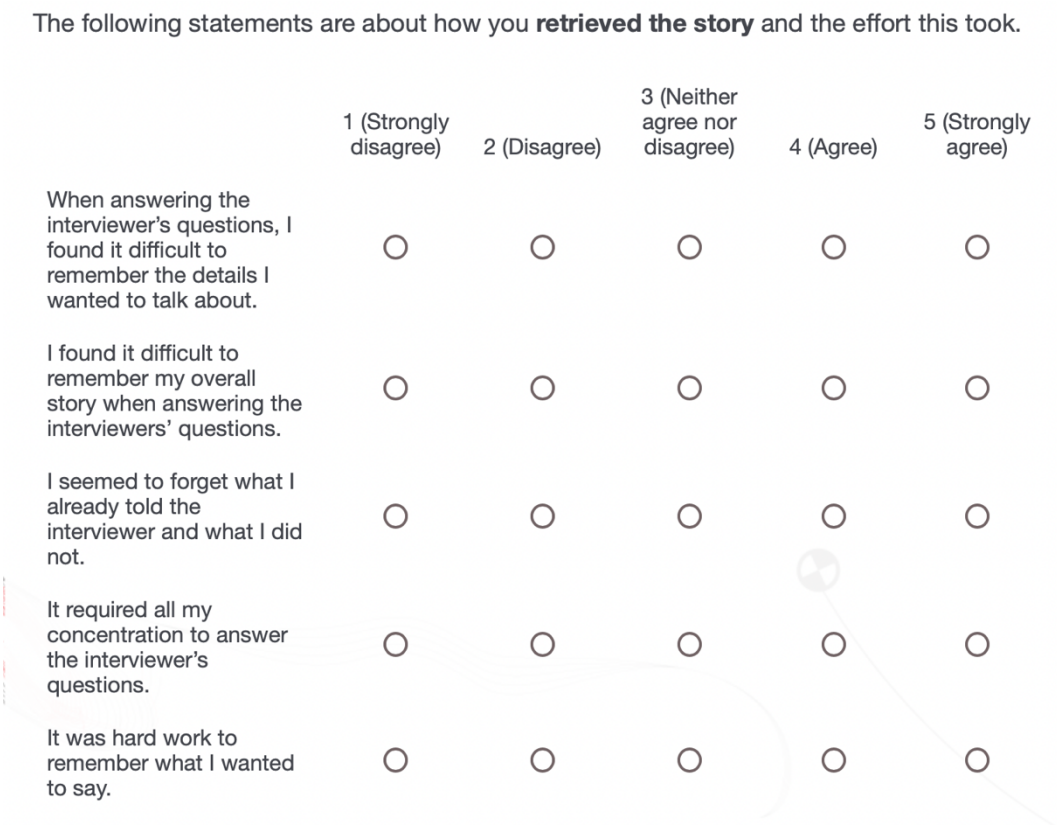
Cognitive Load Questionnaire: ability to verbalize your thought processes and story.

The following statements are about how you **could verbalize your thought processes and story**.

	1 (Strongly disagree)	2 (Disagree)	3 (Neither agree nor disagree)	4 (Agree)	5 (Strongly agree)
I found it difficult to explain the order of events while being interviewed.	○	○	○	○	○
I noticed that I shared more information than I wanted to when answering the interviewer's questions.	○	○	○	○	○
I found it difficult to answer the interviewer's questions as fully as I wanted to.	○	○	○	○	○
I felt that it took me a long time to think through how to answer the interviewer's questions.	○	○	○	○	○
Sometimes after giving an answer, I wished I could go back and restart or change my answer.	○	○	○	○	○
I found it difficult to translate the mental story I created into an actual statement.	○	○	○	○	○

Figure B3

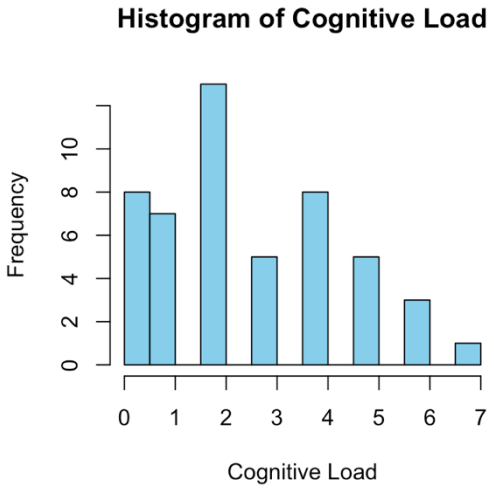
Cognitive Load Questionnaire Memory Retrieval



The following statements are about how you **retrieved the story** and the effort this took.

	1 (Strongly disagree)	2 (Disagree)	3 (Neither agree nor disagree)	4 (Agree)	5 (Strongly agree)
When answering the interviewer's questions, I found it difficult to remember the details I wanted to talk about.	○	○	○	○	○
I found it difficult to remember my overall story when answering the interviewers' questions.	○	○	○	○	○
I seemed to forget what I already told the interviewer and what I did not.	○	○	○	○	○
It required all my concentration to answer the interviewer's questions.	○	○	○	○	○
It was hard work to remember what I wanted to say.	○	○	○	○	○

Appendix C


Histogram of Cognitive Load
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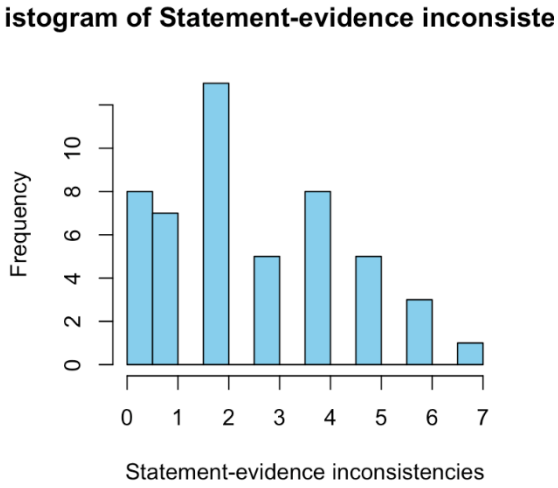
Cognitive Load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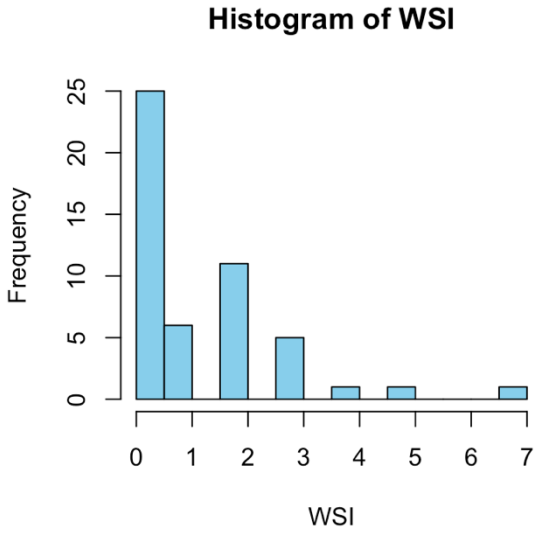
Histogram of WSI
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