Eyewitness Evidence Obtained with the Self-Administered Interview (c) Is Unaffected by Stress

Eyewitness evidence obtained with the Self-Administered Interview© is unaffected by stress

Alana C. Krix[1], Melanie Sauerland[1], Linsey H. C. Raymaekers[1], Amina Memon[2], Conny W. E. M. Quaedflieg, and Tom Smeets[1]

[1]Maastricht University, The Netherlands

[2]Royal Holloway University of London, United Kingdom

Author Note

Alana C. Krix, Melanie Sauerland, Linsey H. C. Raymaekers, Maastricht University, Department of Clinical Psychological Science, Section Forensic Psychology; Amina Memon, Department of Psychology, Royal Holloway University of London, United Kingdom; Conny W. E. M. Quaedflieg, Tom Smeets, Maastricht University, Department of Clinical Psychological Science, Section Forensic Psychology.

Correspondence regarding this article should be addressed to Alana C. Krix, Maastricht University, Department of Clinical Psychological Science, P.O. Box 616, 6200 MD Maastricht, The Netherlands, Phone +31 43 3881613. Electronic mail may be sent to Alana.Krix@maastrichtuniversity.nl.

Final author version.

To cite this article:

Krix, A. C., Sauerland, M., Raymaekers, L. H. C., Memon, A., Quaedflieg, C. W. E. M., & Smeets, T. (2016). Eyewitness evidence obtained with the Self-Administered Interview© is unaffected by stress. *Applied Cognitive Psychology, 30*, 103-112. doi:10.1002/acp.3173

Eyewitness evidence obtained with the Self-Administered Interview© is unaffected by stress

The Self-Administered Interview© (SAI) serves to elicit eyewitness statements directly after the crime. Witnesses could still experience stress then. Because stress during retrieval produces memory-impairing effects, this study sought to compare the SAI with free recall under stress. An interaction between stress and interview was expected such that the SAI would elicit more comprehensive accounts than free recall in the control, but not in the stress group. One-hundred-and-twenty-seven participants underwent a stress or control task. They witnessed a live staged crime and completed an SAI or a free recall. The SAI elicited a higher number of correct verifiable event details and a higher number of correct and incorrect perpetrator details than free recall. Accuracy rates were unaffected. Unexpectedly, despite causing moderate stress-induced cortisol elevations, stress exposure did not influence memory performance and did not interact with interview type. Hence, the SAI can safely be used, when witnesses are moderately stressed.

Key words: eyewitness memory, stress, Self-Administered Interview, stress-induced cortisol response, Maastricht Acute Stress Test

When witnesses observe a crime, they may experience heightened stress levels. During the investigations, however, the police are likely to approach all witnesses to obtain eyewitness evidence, irrespective of their stress levels. A novel eyewitness interview procedure that is likely to be employed shortly after the incident when witnesses may still be stressed is the recently developed Self-Administered Interview© (Gabbert, Hope, & Fisher, 2009; see Hope, Gabbert, & Fisher, 2011, for a detailed description). To avoid problems of delayed interviewing (e.g., forgetting, Rubin & Wenzel, 1996, or misinformation effects, Gabbert, Memon, Allan, & Wright, 2004) this self-administered booklet is independently completed in writing by the witnesses at the crime scene. Its purpose is to secure an early witness statement when limited police resources do not allow conducting an immediate personal interview. The SAI is based on the Cognitive Interview (Fisher & Geiselman, 1992) and adopts some of its memory-enhancing techniques, such as mental context reinstatement, the report everything component, and multiple and varied retrieval. The tool hence provides ample retrieval support. The SAI is often compared with written free recall (FR) that provides only little retrieval support. Relative to FR, the SAI elicits a higher number of correct details – which usually amounts to a large effect –, but also a higher number of incorrect details. Importantly, however, accuracy rates (number of correct details reported divided by all reported details; see Meissner, Sporer, & Susa, 2008) do not differ between the SAI and FR (Gabbert et al., 2009; Gawrylowicz, Memon, & Scoboria, 2014; Gawrylowicz, Memon, Scoboria, Hope, & Gabbert, 2014). That accuracy rates are unaffected by the SAI is essential because it shows that information gain does not compromise the amount of correct information that is elicited. In other words, the SAI increases information output relative to FR, while high accuracy rates are maintained. The SAI also preserves memory for a subsequent personal interview (Hope, Gabbert, Fisher, & Jamieson, 2014; Krix, Sauerland, Gabbert, & Hope, 2014).

As to the effects of stress on recall performance, Christianson (1992) argued that memory for emotionally stressful events, relative to neutral events, is enhanced for central details, but impaired for peripheral details. Such a memory advantage for central details (Christianson & Loftus, 1987, 1991), however, did not always emerge (Heuer & Reisberg, 1990; Wessel, van der Kooy, & Merckelbach, 2000), partly because of diverging opinions whether central details are spatially central (Christianson & Loftus, 1991; Wessel et al., 2000) or central to the plot (Heuer & Reisberg, 1990; Ibabe & Sporer, 2004). In a recent attempt to combine these two definitions, Houston, Clifford, Phillips, and Memon (2013) hypothesized that for emotionally stressful events, memory for the perpetrator may be enhanced because the perpetrator is a central element both spatially and thematically. In line with this prediction, Houston et al. observed recall of more correct perpetrator details, but fewer correct event details, after participants watched a crime relative to a neutral event.

Instead of focusing on the memorability of central versus peripheral details of stressful events, Deffenbacher (1994) proposed a model addressing memory for stressful events as a whole. According to this model, highly stressful incidents, such as witnessing a crime, triggered an activation mode. In this activation mode, increases in somatic anxiety would initially moderately enhance memory performance, but further increases would result in a massive drop of memory performance. In line with this, a meta-analysis showed that stress indeed negatively affects eyewitnesses' recall accuracy rates, especially the accuracy rate of responses to specific questions relative to narrative recall (Deffenbacher, Bornstein, Penrod, & McGorty, 2004).

A third research line originating from the neurobiological field has emphasized the importance of the timing of the stressor for memory performance. Specifically, stress during encoding or consolidation generally leads to memory-enhancing effects (Cahill, Gorski, & Le, 2003; Roozendaal, 2002; Smeets, Otgaar, Candel, & Wolf, 2008). This is likely due to cortisol acting on the amygdala, thereby modulating the activity of the hippocampus during memory consolidation (Roozendaal & McGaugh, 2011; Schwabe, Joëls, Roozendaal, Wolf, & Oitzl, 2012). Stress during retrieval, however, causes memory impairment, as displayed in recall of fewer correct details and reduced accuracy rates (de Quervain, Roozendaal, Nitsch, McGaugh, & Hock, 2000; Kuhlmann, Piel, & Wolf, 2005; Smeets et al., 2008). Here, cortisol is also likely to be involved by inhibiting the activity of hippocampal parts involved in memory retrieval (Buchanan, Tranel, & Adolphs, 2006; Roozendaal, 2002).

Taken these approaches into consideration, how may stress affect recall performance with the SAI? One study examined recall performance with the related Cognitive Interview, when participants were stressed during encoding (Ginet & Verkampt, 2007). In this study, all participants watched a videotaped car accident. Stress was manipulated before the presentation of the film by telling half of the participants that they would be exposed to electroshocks during the film. Two weeks later, participants were interviewed about the film with a Cognitive Interview or a control interview. First, memory-enhancing effects of stress during encoding occurred: Whereas stress had no influence on the number of correct details, the high-stress group made fewer errors and therefore achieved a higher accuracy rate than the low-stress group. Moreover, the usual recall pattern observed with the Cognitive Interview (Memon, Meissner, & Fraser, 2010) emerged: The Cognitive Interview group recalled a higher number of correct details (but also a higher number of incorrect details) than the control group, while accuracy rates remained unaffected. There was no interaction between stress and interview type, suggesting that the Cognitive Interview elicits more comprehensive accounts, irrespective of whether witnesses were stressed during the incident. Although the study yielded important findings, it is unclear whether its results are transferable to the SAI, because the stressor was present only during encoding. In contrast, when the SAI is employed in a stressful incident, both encoding and retrieval are likely to occur under stress. It is conceivable that by inhibiting hippocampal activity, stress during retrieval may impair recall and counteract the effects of the retrieval-supporting components of the SAI. In this situation interviews that provide ample retrieval support, such as the SAI, may become more similar and so may not differ from interviews without retrieval support, such as FR, in terms of recall performance. Hence, an interaction would emerge such that the SAI only differs from FR in terms of recall performance when the witness does not experience stress. Previous research indeed found that the SAI only outperformed FR regarding the number of correct details recalled (but not regarding accuracy rate) when conditions during encoding and retrieval allowed for unimpaired recall performance (Krix et al., 2014, Experiment 1).

It was the aim of this study to compare the SAI with FR concerning recall performance immediately after the crime, when witnesses were or were not stressed. A written FR was chosen as the control interview for two reasons. First, it provides only little retrieval support relative to the SAI. Second, FR is an obvious alternative to the SAI, as it can be employed for the same purpose, namely, to obtain an immediate written account at the crime scene when the personal interview has to be delayed. In fact, the German police regularly distribute so called witness questionnaires that are to be completed shortly after the incident and that closely resemble FR. In this study, we pursued an innovative approach that combines eyewitness testimony research with elements from neurobiological research (i.e., the method of stress induction and measurement). To induce a meaningful level of stress, we used a powerful, standardized procedure, the Maastricht Acute Stress Test (MAST; Smeets et al., 2012), which is known to elicit robust subjective, autonomic and glucocorticoid stress responses (e.g., Meyer, Smeets, Giesbrecht, Quaedflieg, & Merckelbach, 2013; Quaedflieg, Meyer, Schwabe, & Smeets, 2013). In previous research, the MAST and similar stress induction protocols have been found to reliably influence subsequent performance in recalling and recognizing images and word lists (e.g., Hupbach & Dorskind, 2014; Quaedflieg et al., 2013; Schwabe & Wolf, 2014; Smeets et al., 2008). Participants' salivary cortisol stress levels were measured to control for the effectiveness of the stress manipulation in stimulating the hypothalamic-pituitary-adrenal (HPA) axis that is responsible for stress reactions (e.g., cortisol secretion) and has the potential to influence recall performance through the effects of cortisol. By exposing all participants to a live staged crime, a high level of ecological validity in terms of the stimulus event was attained.

In line with Deffenbacher's (1994) model of the impact of stress on recall performance and findings from the neurobiological field (Kuhlmann et al., 2005; Smeets et al., 2008), we hypothesized that participants exposed to stress during retrieval would recall a lower number of correct details and achieve a lower accuracy rate in their reports than participants not exposed to stress. Drawing from previous SAI research (Gabbert et al., 2009; Gawrylowicz, Memon, & Scoboria, 2014; Krix et al., 2014), we hypothesized that participants completing the SAI would report a higher number of correct details, but also a higher number of incorrect details, compared to those completing an FR. No differences were expected regarding accuracy rate. Moreover, an interaction between stress and interview type was expected. The SAI should only elicit a higher number of correct and incorrect details than FR in the no-stress control group. No difference between the interview types regarding recall performance was expected in the stress group.

Method

Participants and Design

In total, $N = 127$ participants (21 men; age range 18-63, $M = 22.2$, $SD = 4.9$) took part in the experiment in exchange for course credit or a €10-voucher. Participants were mostly students (81.1%) or recruited in the vicinity of the university. The study was approved by the local ethical committee. Participants were randomly assigned within a 2 (stress: control vs. stress) x 2 (interview type: FR vs. SAI) between-participants design. Participants interacted with one of two confederates, which was counterbalanced across experimental conditions.

Interviews

Self-Administered Interview©.

Based on the Cognitive Interview, the SAI is an interview booklet that provides ample retrieval support by featuring several memory-enhancing components (Gabbert et al., 2009; Hope et al., 2011). It is a standardized, yet generic recall tool that can be used for different types of crimes. Before writing down their recollections, witnesses first mentally reinstate the context. That is, they are instructed to think back to the witnessed incident and picture in their minds what they saw or heard, what they were thinking and how they were feeling at the time that the incident took place. Hereafter, witnesses describe the course of events. In subsequent separate sections, non-leading cues are used to prompt descriptions of the appearance of the perpetrator(s), and, if applicable, of potential other witnesses or vehicles involved. In another section, witnesses are requested to draw a sketch of the scene to facilitate the retrieval of spatial information (e.g., locations). Thereby, the SAI relies on multiple and varied retrieval.

In the final sections, the witnessing conditions are prompted (e.g., lighting conditions or obstructions) and witnesses have the opportunity to write down any other information that comes to mind. As in the Cognitive Interview, throughout the interview, witnesses receive the instruction to provide the most complete and accurate account possible and to refrain from guessing.

Free recall.

Following previous SAI studies (Gabbert et al., 2009; Gawrylowicz, Memon, & Scoboria, 2014; Hope et al., 2014), the written FR form simply instructs participants to report all details they can remember about the sequence of actions and events, and about all persons involved, including the perpetrator(s) and potential other witnesses. Analogous to the SAI, participants are reminded to provide the most complete and accurate account possible, but not to guess. The FR provides only little retrieval support and differs from the SAI in the following ways. First, it does not feature memory-enhancing components (e.g., mental context reinstatement); second, it involves only one instead of multiple and varied retrieval attempts. Finally, the FR does not feature prompts to cue recall.

Stress Induction versus No-Stress Control Manipulation

The MAST (Smeets et al., 2012) is a concise procedure to reliably elicit robust subjective, autonomic and glucocorticoid stress responses. It consists of a 5 min preparation phase and a 10 min acute stress phase that includes repeated exposure to cold pressor stress and mental arithmetic. Participants immerse their hands into ice water (4°C) during 5 trials lasting 60 to 90 sec. Alternating with the hand immersion trials, participants have to count backwards as fast and accurately as possible in steps of 17 starting at 2043 (for 45, 60, or 90 sec). Whenever they count too slowly or make a mistake, they are told to count faster or recommence at 2043. To increase task unpredictability, participants are told that the duration of the hand immersion and mental arithmetic trials is randomly chosen by the computer, and that they are videotaped throughout.

The no-stress control condition (see Smeets et al., 2012, Experiment 3) also comprises a 5 min preparation phase and a 10 min hand immersion phase, albeit in lukewarm water (25

°C), alternated with having participants repeatedly count from 1 to 25 at their own pace. No feedback is given, nor are participants videotaped. The duration and order of hand immersion and arithmetic trials parallels that of the MAST.

Salivary Cortisol Responses

Cortisol stress measures were obtained with synthetic Salivette (Sarstedt®, Etten-Leur, The Netherlands) devices 5 min before ($t_{pre\text{-}stress}$) and three times after the MAST (t_{+0min}, t_{+10min}, t_{+20min} with reference to the end of the stress or control procedure). Samples were stored at -20°C until cortisol levels were determined by a commercially available luminescence immune assay kit (IBL, Hamburg, Germany).

Positive and Negative Affect Schedule (PANAS)

The negative affect subscale of the PANAS (Watson, Clark, & Tellegen, 1988) was used as a valid tool to measure subjective distress (see also Crawford & Henry, 2004). PANAS consists of two mood scales each containing 10 items that measure positive or negative affect. In each item, participants are asked to rate the extent to which they experience a certain emotion on a 5-point scale (1 *'very slightly or not at all'* to 5 *'very much'*).

Procedure

Participants were tested individually and instructed not to consume any foods or drinks, or to engage in physical exercise for at least 2 hours before testing. After signing the informed consent form, the first saliva sample ($t_{pre\text{-}stress}$) was taken. Participants were told that the aim of the study was to examine cognitive and physical reactions to a stressful experience. They were not informed about the upcoming mock crime. After engaging in the MAST for 15 minutes, participants were informed that there would be a short break and that a saliva sample (t_{+0min}) had to be taken. The information that the MAST would be continued was false to avoid decreases of stress levels at this time (Smeets et al., 2012). Immediately before and after the MAST, participants completed the PANAS (Watson et al., 1988).

The experimenter told the participants that s/he had to put the saliva samples into the freezer and left. Moments later, one of two confederates (a woman with long blonde hair or a man with short brown hair, both 22 years old) entered the room for about one minute (*M* = 50.8 sec, *SD* = 12.6) and interacted with the participants according to a script. Before data collection, the confederates had practiced the script to ensure a standardized procedure. The confederate inquired whether the experimenter was there and introduced him-/herself as the previous participant or, if the current participant was the first one of the day, as a colleague of the experimenter. The confederate informed the participants that s/he had forgotten his/her cell phone and now wanted to pick it up. After taking the phone from a lab table the confederate left the room. When participants were reluctant to let the confederate go with the phone, the confederate had to come up with excuses why s/he could not wait for the experimenter to return (e.g., stating that his/her class would start soon). In six cases, the participants did not allow the confederate to take the phone, so s/he had to leave the lab without it.[1] After the confederate had left, the experimenter re-entered the room and looked for his/her phone. When the participants mentioned that the phone had been picked up, the experimenter informed them that the phone had been stolen and that they had witnessed a theft. In the six cases in which the confederate could not take the phone the experimenter spoke about attempted theft.

A few minutes after the confederate had left, participants were taken to another room where they completed an FR form or an SAI (Gabbert et al., 2009), depending on the interview condition. No time limits were imposed. The onset of the interview was approximately eight minutes after the termination of the MAST. While writing down their accounts, the third (t_{+10min}) and fourth (t_{+20min}) saliva samples were taken 10 and 20 min after termination of the MAST. This interfered little with retrieval, as participants could continue

[1] When the participants who did not let the confederate take the phone were excluded from analyses, analogous results emerged. Because of this and because even an attempted theft at a university may become the subject of an investigation, we decided to report the analyses with these six participants included.

writing while providing the samples. One week later, participants returned for a second session to identify the confederate in a lineup. The eyewitness identification results are unrelated to our research question and reported elsewhere (see Sauerland et al., 2015). Participants were thanked for their participation and fully debriefed upon completion of data collection.

Coding

Participants' statements were transcribed and coded against coding schemes. In line with Houston et al. (2013), perpetrator and event details were analyzed separately. Pictures of the confederates were taken on every test day. This allowed scoring the accuracy of the appearance and clothing details. Although the number of details in the perpetrator schemes slightly varied across test days (i.e., depending on the outfits worn), they comprised at least 30 details. Because the interactions between confederate and participant could not be videotaped, verifiable and unverifiable details were differentiated for coding the event descriptions and analyzed separately. Forty-eight verifiable event details were part of the script (e.g., thief took the phone) and were coded for accuracy (see the Appendix for an overview of the verifiable event details). In contrast, unverifiable event details were details not defined in the script (e.g., thief pointed to the phone) and, because it is unknown whether they actually happened, we only coded their quantity (i.e., the total amount of details), without differentiating between correct and false details.

For perpetrator details, descriptors pertaining to the face, hair, body, and clothes were coded. For the event details, identity (i.e., who did something?), action, object, setting (i.e., locations and directions), and conversation descriptors were coded. The latter were defined as the smallest unit of information still containing a subject and a predicate (Campos & Alonso-Quecuty, 2008). The statement "The female (1) thief (2) who wore a black (3) shirt (4) took (5) the cell phone (6)." would yield six details (see Sauerland, Krix, van Kan, Glunz, & Sak, 2014, for a similar approach). Subjective responses (e.g., "He was ugly") were not scored. As to the perpetrator and verifiable event details, details were considered correct or false if they did or did not match the appearance of the confederate or the script. Confabulations were coded separately and were both incorrect and non-existent (e.g., a hat when no headgear was worn; see Sauerland et al., 2014). As in previous research (Krix et al., 2014; Maras, Mulcahy, Memon, Picariello, & Bowler, 2014), information from the sketch in the SAI was also coded, namely objects and their positions. Yet, only details that were clearly labeled (e.g., cell phone) by the participant in the sketch were coded (note that not all participants used labels and generally, the sketches yielded only few extra details).

Inter-coder reliability.

For both the perpetrator and event details, thirty randomly selected statements were independently coded by two coders. Inter-coder reliability (for the decision to score a detail as correct or incorrect) was $\kappa = .91$ and $\kappa = .92$, *p*s < .001, for the perpetrator details and the verifiable event details, respectively. For the quantity of the unverifiable event details, the single-measures intra-class correlation (absolute agreement) was $ICC = 0.84$, $p < .001$, indicating *excellent* inter-coder reliability (Landis & Koch, 1977).

Results

An *alpha* level of .05 was used for all statistical tests. In case of multiple comparisons, Bonferroni-adjusted *alpha* values are reported. We report Cohen's *d* (Cohen, 1988) for dependent or independent samples for the main effects with $df = 1$ in the numerator and η_p^2 for the interaction effects and main effects with $df > 1$ in the numerator (see Sporer & Cohn, 2011).

Manipulation Check

Objective stress measure: Cortisol stress responses.

Cortisol data were log-transformed before analysis as Shapiro-Wilk tests of normality showed typical skewness of the data. At $t_{pre\text{-}stress}$ (i.e., before the stress manipulation), the cortisol concentration did not differ between the stress and the control condition, $F(1, 123) = 1.47$, $p = .228$, $d = 0.22$. Subsequently, cortisol responses over time were analyzed with a 2 (condition: stress vs. control) x 4 (time: $t_{pre\text{-}stress}$ vs. t_{+0min} vs. t_{+10min} vs. t_{+20min}) analysis of variance (ANOVA). The cortisol levels over time in the stress and control group are displayed in Figure 1.

Insert Figure 1 about here

There was a significant Time by Stress interaction, $F(3, 363) = 43.95$, $p < .001$, $\eta_p^2 = 0.27$. Follow-up tests for the stress group showed a significant main effect of time, $F(3, 189) = 32.91$, $p < .001$, $\eta_p^2 = 0.34$, with cortisol increases from $t_{pre\text{-}stress}$ to t_{+0min} ($p < .001$, $d = 0.42$) and from t_{+0min} to t_{+10min} ($p < .001$, $d = 0.36$), and stable cortisol levels from t_{+10min} to t_{+20min} ($p = .227$, $d = -0.11$). Follow-up tests for the control group also yielded a significant main effect of time, $F(3, 174) = 20.42$, $p < .001$, $\eta_p^2 = 0.26$, with cortisol decreases from t_{+0min} to t_{+10min} ($p < .001$, $d = -0.11$) and from t_{+10min} to t_{+20min} ($p < .001$, $d = -0.10$), but not from $t_{pre\text{-}stress}$ to t_{+0min} ($p = .999$, $d = -0.01$). Moreover, cortisol levels were significantly higher in the stress group than in the control group at t_{+10min} ($p < .001$, $d = 0.67$) and t_{+20min} ($p < .001$, $d = 0.66$), but not at t_{+0min} ($p = .198$, $d = 0.23$). The results of these analyses are in line with the general finding in the literature that cortisol increase occurs with temporary delay after a person has been exposed to a stressor (Dickerson & Kemeny, 2004). On the other hand, the controls' cortisol levels dropped due to the circadian rhythm of cortisol decreasing throughout the day (Nicolson, 2008).

Subjective stress measure: Negative affect (PANAS).

To check whether subjective stress as measured with the negative affect subscale of the PANAS was influenced by the stress manipulation, a 2 (condition: stress vs. control) x 2 (time: pre vs. post stress induction) ANOVA was calculated. The significant main effects of stress, $F(1, 122) = 26.91$, $p < .001$, $d = 0.93$, and time, $F(1, 122) = 9.43$, $p = .003$, $d = 0.26$, were qualified by a significant interaction, $F(1, 122) = 25.56$, $p < .001$, $\eta_p^2 = 0.17$. Paralleling the results of cortisol levels, while negative affect did not change over time in the control group ($M_{pre} = 11.87$, $SD_{pre} = 2.40$; $M_{post} = 11.07$, $SD_{post} = 2.17$), $F(1, 122) = 1.94$, $p = .167$, d

= -0.35, it significantly increased in the stress group (M_{pre} = 13.00, SD_{pre} = 3.15; M_{post} = 16.29, SD_{post} = 6.76), $F(1, 122) = 33.56$, $p < .001$, $d = 0.56$. Moreover, in the stress group, the negative affect was significantly lower before the stress induction, $F(1, 122) = 5.03$, $p = .027$, $d = -0.40$, but significantly higher after the stress induction, $F(1, 122) = 33.12$, $p < .001$, d = 1.03, than negative affect of the control group. Combined, these findings show that the stress induction also successfully increased the subjective experience of distress in the stress group.

Impact of Stress and Interview Type on Recall Performance

To analyze recall performance as a function of confederate (1 vs. 2), interview type (FR vs. SAI), and stress (stress vs. control group), we ran 2 x 2 x 2 ANOVAs. When there were no significant interactions with confederate, Fs ≤ 2.60, ps ≥ .110, η_p^2s ≤ 0.02, we collapsed the data across confederates. Verifiable event details, unverifiable event details, and perpetrator details were analyzed separately. The number of correct details reported, the number of incorrect details reported[2] and accuracy rate (number of correct details reported divided by all reported details; Meissner et al., 2008) of the perpetrator details and of the verifiable event details, as well as the quantity (i.e., total amount of information) of the unverifiable event details served as dependent variables.

The data of one participant could not be analyzed because contrary to instructions she only described the MAST, but not the interaction with the confederate. For the perpetrator details, the data of an additional ten participants (SAI/control: $n = 3$; FR/stress: $n = 3$; FR/control: $n = 4$) could not be analyzed because the corresponding pictures of the confederate were missing, or because it was unclear which picture the participant had been assigned to.

---

[2] Incorrect details are a combination of false details and confabulations. Due to the rare occurrence of confabulations, it was not possible to analyze them as a separate measure. Note, however, that analogous results emerged, irrespective of whether false details were analyzed separately or in combination with confabulations. We therefore report the combined measure (see Maras et al., 2014, for a similar approach).

Regarding the number of correct perpetrator details, there was a significant interaction between Stress and Confederate, $F(1, 108) = 4.09$, $p = .046$, $\eta_p^2 = 0.04$. Yet, the analysis of the simple main effects yielded no significant influence of stress on the number of correct perpetrator details for the male (stress: $M = 8.27$, $SD = 4.41$; control: $M = 7.32$, $SD = 2.70$), $F(1, 112) = 0.61$, $p = .435$, $d = -0.25$, or the female confederate (stress: $M = 7.68$, $SD = 4.23$; control: $M = 9.33$, $SD = 5.41$), $F(1, 112) = 2.12$, $p = .148$, $d = 0.34$.

Unexpectedly, none of the main effects of stress, Fs ≤ 1.40, ps $\geq .239$, $|d|$s ≤ 0.16, and interactions between stress and interview, Fs ≤ 1.07, ps $\geq .303$, η_p^2s ≤ 0.01, were significant. Hence, in the following, only the effects of interview type will be described.

Verifiable event details.

Table 1 displays the means and standard deviations of the number of correct and incorrect details and the accuracy rate of the verifiable event details.

Insert Table 1 about here

As expected, the SAI group ($M = 21.29$, $SD = 4.94$) recalled a higher number of correct verifiable event details than the FR group ($M = 13.34$, $SD = 4.90$), $F(1, 122) = 81.65$, $p < .001$, $d = 1.62$. In contrast, the number of incorrect details was not influenced by interview type, $F(1, 122) = 2.34$, $p = .129$, $d = 0.27$. Also in line with our predictions, the accuracy rate of the verifiable event details was unaffected by interview type, $F(1, 122) = 0.05$, $p = .822$, $d = -0.04$.

Unverifiable event details.

The quantity of the unverifiable event details (see Table 2 for the means and standard deviations) was not influenced by interview type, $F(1, 122) = 2.31$, $p = .131$, $d = 0.27$. As mentioned above, the accuracy rate of the unverifiable event details could not be analyzed, because it is unknown whether the details occurred.

Insert Table 2 about here

Perpetrator details.

Table 3 displays the means and standard deviations of the number of correct and incorrect details, as well as the accuracy rate of the perpetrator details.

Insert Table 3 about here

In line with our hypotheses and as with the verifiable event details, the SAI group (*M* = 10.87, *SD* = 4.24) recalled a higher number of correct perpetrator details than the FR group (*M* = 5.24, *SD* = 2.17), $F(1, 108) = 77.50$, $p < .001$, $d = 1.64$. The SAI group (*M* = 2.85, *SD* = 1.71) also recalled a higher number of incorrect perpetrator details than the FR group (*M* = 1.72, *SD* = 1.55), $F(1, 112) = 13.35$, $p < .001$, $d = 0.69$. However, the accuracy rate of the perpetrator details was unaffected, $F(1, 112) = 0.01$, $p = .916$, $d = -0.03$.

Discussion

The aim of the present study was to examine the effectiveness of the SAI relative to a control interview when the witness was exposed to stress. Insight into this matter is important, because the SAI is routinely completed directly after the crime, when witnesses may still be stressed, which could negatively influence recall performance (e.g., Deffenbacher et al., 2004; Smeets et al., 2008). In this study, we pursued an innovative approach by combining eyewitness testimony research with elements from neurobiological research. We used a powerful, standardized procedure for stress induction in the lab (MAST; Smeets et al., 2012), which allowed us to apply relatively high levels of stress. Another asset of the present study is that we directly controlled for the effectiveness of the stress manipulation, by measuring participants' salivary cortisol levels, a measure that is routinely collected in neurobiological research as a marker of physiological stress (e.g., Allen, Kennedy, Cryan, Dinan, & Clarke, 2014). Moreover, for the first time in SAI research, a live staged crime was used, which provides for increased ecological validity of the stimulus event.

From participants' cortisol levels, we can conclude that our stress manipulation was successful. Specifically, in the stress group, cortisol levels increased after exposure to the stressor and were significantly higher than levels of the control group ten and 20 minutes after the end of the stress induction, eliciting a moderate to large effect. The magnitude of the cortisol increase in the stress group was sufficient to conclude that the HPA axis was activated (Allen et al., 2014; Miller, Plessow, Kirschbaum, & Stalder, 2013). In other words, the participants in the stress group showed physical stress reactions during memory consolidation and the completion of the interview. On the other hand, the control group experienced a decrease of cortisol levels over time, which is in line with the circadian rhythm (Nicolson, 2008). Moreover, the MAST significantly increased subjective distress in the stress group, as indicated by the PANAS results. Nonetheless, stress did not influence memory performance.[3] Hence, our findings contradict previous research showing both memory-enhancing (e.g., Ginet & Verkampt, 2007; Houston et al., 2013; Hulse & Memon, 2006) and memory-impairing effects of stress on recall performance (e.g., Deffenbacher et al., 2004; Smeets et al., 2008).

In contrast to our hypotheses and previous research suggesting that the SAI may only outperform FR when conditions during encoding and retrieval allowed for unimpaired recall performance (Krix et al., 2014, Experiment 1), no significant interactions between stress and interview type emerged. Yet, in line with previous studies (Gabbert et al., 2009; Gawrylowicz, Memon, & Scoboria, 2014; Krix et al., 2014) and as predicted, we found that the SAI with its ample retrieval support elicited a higher number of correct details than FR

---

[3] Note that effects of stress were absent, even though we obtained comparable differences in cortisol levels between the stress and the control group as previous research that found significant effects on memory performance (e.g., Cahill et al., 2003; Koessler, Engler, Riether, & Kissler, 2009; Smeets et al., 2008).

that offers only little retrieval support. In the case of the perpetrator details (but not the verifiable event details) this increase was accompanied by an increase in the number of incorrect details. The quantity of the unverifiable event details was not affected by interview type. Importantly, however, accuracy rates of the perpetrator and verifiable event details were not compromised. Moreover, the accuracy rates were comparable with those obtained in previous SAI studies (e.g., Gabbert et al., 2009; Gawrylowicz, Memon, Scoboria, Hope, et al., 2014; Hope et al., 2014). This pattern of increased recall comprehensiveness and stable accuracy rates has previously been termed the “SAI effect” (Gawrylowicz, Memon, & Scoboria, 2014, p. 320) and is analogous to what is commonly found in research on the Cognitive Interview (Memon et al., 2010) on which the SAI is based. More importantly, our results suggest that the SAI can enhance recall quantity (i.e., the total amount of information recalled) relative to FR also when witnesses are under moderate stress. The findings are crucial because the SAI is likely to be employed when witnesses are still stressed. The results are analogous to the ones obtained by Ginet and Verkampt (2007) who examined the related Cognitive Interview with stressed witnesses. Our results additionally demonstrate that the increased quantity not only emerges with stimulus films, but also when more realistic events are used. Although the SAI effect may seem trivial, it is important to emphasize that it is not. Rather, increases in quantity are often accompanied by a decrease of the accuracy rate, in line with a quantity-accuracy trade-off (Evans & Fisher, 2011; Koriat & Goldsmith, 1996). Yet, this is clearly not the case with the SAI.

Nevertheless, a critical note on the increase in the number of incorrect details reported in the SAI relative to the FR group observed with the perpetrator details seems in order. Of course, this can be problematic, because unlike in controlled laboratory settings, the police do not know whether a given detail is correct and every incorrect detail may have dire consequences. On the other hand, the absolute number of incorrect details was low and balanced by a larger amount of correct details. Consequently, accuracy rates were high and the SAI elicits high-quality statements. In real cases, the gain of correct details obtained with the SAI relative to FR may well yield the decisive lead for the police investigations. It should also be taken into consideration for which purpose the tool was developed, that is, to elicit early accounts and preserve the witnesses' recollections when the personal interviews will be delayed. Research suggests that the SAI, but not FR, has the potential to preserve memory (Hope et al., 2014; Krix et al., 2014, Experiment 2). Overall, the SAI can be considered a reliable eyewitness tool that is often to be preferred to FR (but see Krix, Sauerland, Merckelbach, Gabbert, & Hope, 2015; Maras et al., 2014, for possible exceptions regarding certain witness populations).

The absence of an interaction between stress and interview type observed in the present study is good news. For law enforcement personnel, this would mean that the SAI could safely be administered in the immediate aftermath of a crime, irrespective of whether the witness experiences stress. Yet, even if the police need not overly consider the amount of stress the witness has been experiencing before distributing the SAI, they should nevertheless try to set the witness at ease for the sake of the witness' mental health (Gittins, Paterson, & Sharpe, 2015). Given the unexpected lack of significant effects of stress on recall performance, however, we encourage replication of our findings, before profound recommendations regarding this matter can be made. Nevertheless, there are good reasons to assume that our results do not reflect a failure to detect an actually existing effect of stress on memory, which will be addressed below.

The question arises as to why recall performance was not influenced by stress. Different from real situations in which the stress is likely to be caused by the crime, the stress induction in our study occurred prior to witnessing the staged theft. However, given that the main human stress hormone cortisol is a slow hormone that starts to rise several minutes after stress onset (Dickerson & Kemeny, 2004), performing the MAST prior to the mock crime ensured that the cortisol levels were elevated during the crime. One possibility is that participants were stressed but did not attribute their arousal to the witnessed crime, as a result of which their recall performance remained unaffected. However, it seems unlikely that this can explain the results. First, from a neurobiological perspective, cortisol acts on the hippocampus and influences recall performance (Coluccia et al., 2008), irrespective of the attribution of the arousal. Second and more importantly, the reasoning is not supported by the results of previous studies (Buchanan et al., 2006; de Quervain et al., 2000; Smeets et al., 2008). In these studies, immediately before retrieving previously studied word lists, participants underwent a similar stress induction as in the current study. It is safe to assume with this type of material (word lists) that the participants attributed their arousal to the stress task and not to retrieving the words. Still, reliable memory-impairing effects occurred in the stress groups. Interestingly, the eyewitness study that found memory-enhancing effects of stress during encoding (Ginet & Verkampt, 2007) also introduced the stress manipulation prior to presenting the stimulus film to participants. Specifically, participants in the stress group were told beforehand that they would receive electroshocks while watching the film. Hence, they had good reason to attribute their arousal to the threat of receiving electroshocks and not to the content of the film.

The cause for the null findings may rather be found in the fact that stress was present (or absent) during both encoding and consolidation and retrieval. Accordingly, the memory-enhancing effects during encoding and consolidation (Cahill et al., 2003; Roozendaal, 2002) and the memory-impairing effects during retrieval (de Quervain et al., 2000; Kuhlmann et al., 2005) may have compensated each other, yielding null results. The SAI, however, was developed to be administered in exactly such situations, that is, immediately after a crime. Although it would be interesting from a theoretical perspective to examine the influence of stress on recall performance when the SAI is administered after a delay, from a practical perspective, the approach of this experiment is most relevant and cannot be considered a limitation per se, as it modeled the situation for which the SAI was designed.

Another explanation for the non-significant influence of stress may be derived from the results of the meta-analysis on stress and recall performance (Deffenbacher et al., 2004). Although the overall effect size for the accuracy rate of recall was significant, type of recall was identified as a moderator. Importantly, only the effect size for interrogative recall (i.e., specific questions) was significant, indicating negative effects of stress on recall accuracy rate, whereas the effect size for narrative recall was non-significant. Both SAI and FR, however, rely on narrative recall and may hence be relatively unaffected by stress. Deffenbacher et al. suppose that this may be associated with heightened control over what to report in narrative relative to cued recall (Koriat & Goldsmith, 1996).

Several limitations of the present study are noteworthy. Given the nature of the research paradigm (i.e., staged live event for each participant individually), there was no straightforward way to determine "ground truth" for the encounter. Prior to data collection, both experimenters and confederates received extensive training sessions regarding the script for the interaction with the participant so that a standardized procedure was ensured. Therefore, we deemed it justified to differentiate between verifiable and unverifiable details of the event descriptions that were scored and analyzed separately. Significant deviations from the script (e.g., the participant did not let the confederate take the phone) were recorded and considered during coding. Second, from a theoretical perspective, the design of the study did not allow a separate inspection of the effects of stress at encoding and at retrieval. However, this was not our research question. Rather, as mentioned above, our approach followed applied considerations, considering the SAI was devised to be administered directly after the crime (Gabbert et al., 2009) when the stress response is still likely to exert an impact. Finally, some points regarding the measurement of the stress response should be addressed. Measuring the physical stress response, we deliberately focused on the HPA axis and cortisol levels because of their influence on recall performance (e.g., Het, Ramlow, & Wolf, 2005; Roozendaal, 2002). Collecting measures (e.g., blood pressure) of the fast stress response, the autonomous nervous system, could have yielded an even more comprehensive impression of the objective stress response. The MAST and similar stress induction protocols are known for increasing both glucocorticoid and autonomous stress response (e.g., Allen et al., 2014; Smeets et al., 2012). We encourage future research to measure markers of both stress axes. Another point refers to the relatively high cortisol levels at baseline that were observed in our sample. This can be explained by the timing of testing. Participants were primarily tested in the morning when cortisol levels are highest (Nicolson, 2008). Importantly, however, the stress induction still elevated stress levels, eliciting the crucial relative difference between stress and control group that is important for recall differences to occur. Finally, although the stress induction also significantly increased the subjective stress response – the difference to the stress response of the control group was large in terms of the effect size – absolute levels were arguably rather low. Yet, it is known that subjective stress measures do not always correspond to physiological measures (Hellhammer & Schubert, 2012). In this situation, predominantly relying on physiological markers may be more reliable.

Overall, the present study should be considered a first step of investigating the effects of stress on recall performance with the SAI and we encourage further research on this issue. Moreover, we advocate a combination of a neurobiological and an applied cognitive approach for studying the effect of stress on eyewitness memory, as was followed in this study. Three research questions may be promising for future research to address. First, given that our participants were bystanders rather than victims does the pattern of results also hold for victim witnesses who may experience higher stress levels than bystanders? Second, what is the effectiveness of the SAI when only encoding but not retrieval occurred under stress? This would entail a delayed administration of the SAI. Whereas the latter has been found to reduce the effectiveness of the SAI (Paterson, Eijkemans, & Kemp, 2014), stress during encoding enhances recall performance (Cahill et al., 2003; Smeets et al., 2008). It would be interesting to examine how these opposing effects interact to influence recall performance. Third, does stress during encoding impact the previously found memory-preserving effect of the SAI in a subsequent interview (Hope et al., 2014; Krix et al., 2014)? Encouraging replication, for now, we can conclude that the SAI may elicit more comprehensive statements than FR immediately after a crime, irrespective of the amount of stress that is experienced.

References

Allen, A. P., Kennedy, P. J., Cryan, J. F., Dinan, T. G., & Clarke, G. (2014). Biological and psychological markers of stress in humans: Focus on the Trier Social Stress Test. *Neuroscience & Biobehavioral Reviews, 38,* 94-124. doi:10.1016/j.neubiorev.2013.11.005

Buchanan, T. W., Tranel, D., & Adolphs, R. (2006). Impaired memory retrieval correlates with individual differences in cortisol response but not autonomic response. *Learning & Memory, 13,* 382-387. doi:10.1101/lm.206306

Cahill, L., Gorski, L., & Le, K. (2003). Enhanced human memory consolidation with post-learning stress: Interaction with the degree of arousal at encoding. *Learning & Memory, 10,* 270-274. doi:10.1101/lm.62403

Campos, L., & Alonso-Quecuty, M. L. (2008). Language crimes and the cognitive interview: Testing its efficacy in retrieving a conversational event. *Applied Cognitive Psychology, 22,* 1211-1227. doi: 10.1002/acp.1430

Christianson, S.-Å. (1992). Emotional stress and eyewitness memory: A critical review. *Psychological Bulletin, 112,* 284-309. doi:10.1037/0033-2909.112.2.284

Christianson, S.- Å., & Loftus, E. F. (1987). Memory for traumatic events. *Applied Cognitive Psychology, 1,* 225-239. doi:10.1002/acp.2350010402

Christianson, S.-Å., & Loftus, E. F. (1991). Remembering emotional events: The fate of detailed information. *Cognition and Emotion, 5,* 81-108. doi:10.1080/02699939108411027

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences.* Mahwah, NJ: Lawrence Erlbaum Associates.

Coluccia, D., Wolf, O. T., Kollias, S., Roozendaal, B., Forster, A., & de Quervain, D. J. F. (2008). Glucocorticoid therapy-induced memory deficits: Acute versus chronic effects. *The Journal of Neuroscience, 28,* 3474-3478. doi:10.1523/jneurosci.4893-07.2008

Crawford, J. R., & Henry, J. D. (2004). The Positive and Negative Affect Schedule (PANAS):Construct validity,measurement properties and normative data in a large non-clinical sample. *British Journal of Clinical Psychology, 43,* 245-265. doi:10.1348/0144665031752934

Deffenbacher, K. A. (1994). Effects of arousal on everyday memory. *Human Performance, 7,* 141-161. doi:10.1207/s15327043hup0702_3

Deffenbacher, K. A., Bornstein, B. H., Penrod, S.D., & McGorty, E. K. (2004). A meta-analytic review of the effects of high stress on eyewitness memory. *Law and Human Behavior, 28,* 687–706. doi:10.1007/s10979-004-0565-x

de Quervain, D. J. F., Roozendaal, B., Nitsch, R. M., McGaugh, J. L., & Hock, C. (2000). Acute cortisone administration impairs retrieval of long-term declarative memory in humans. *Nature Neuroscience, 3,* 313-314. doi:10.1038/73873

Dickerson, S. S., & Kemeny, M. E. (2004). Acute stressors and cortisol responses: A theoretical integration and synthesis of laboratory research. *Psychological Bulletin, 130,* 355-391. doi:10.1037/0033-2909.130.3.355

Evans, J. R., & Fisher, R. P. (2011). Eyewitness memory: Balancing the accuracy, precision and quantity of information through metacognitive monitoring and control. *Applied Cognitive Psychology, 25,* 501-508. doi:10.1002/acp.1722

Fisher, R. P., & Geiselman, R. E. (1992). *Memory enhancing techniques for investigative interviewing: The cognitive interview.* Springfield, IL: Charles C. Thomas.

Gabbert, F., Hope, L., & Fisher, R. P. (2009). Protecting eyewitness evidence: Examining the efficacy of a self-administered interview tool. *Law and Human Behavior, 33,* 298-307. doi:10.1007/s10979-008-9146-8

Gabbert, F., Memon, A., Allan, K., & Wright, D. B. (2004). Say it to my face: Examining the effects of socially encountered misinformation. *Legal and Criminological Psychology, 9,* 215-227. doi:10.1348/1355325041719428

Gawrylowicz, J., Memon, A., & Scoboria, A. (2014). Equipping witnesses with transferable skills: The Self-Administered Interview©. *Psychology, Crime & Law, 20,* 315-325. doi:10.1080/1068316x.2013.777961

Gawrylowicz, J., Memon, A., Scoboria, A., Hope, L., & Gabbert, F. (2014). Enhancing older adults' eyewitness memory for present and future events with the Self-Administered Interview. *Psychology and Aging, 29,* 885-890. doi:10.1037/a0038048

Ginet, M., & Verkampt, F. (2007). The cognitive interview: Is its benefit affected by the level of witness emotion? *Memory, 15,* 450-464. doi:10.1080/09658210601092670

Gittins, C. B., Paterson, H. M., & Sharpe, L. (2015). How does immediate recall of a stressful event affect psychological response to it? *Journal of Behavior Therapy and Experimental Psychiatry, 46,* 19-26. doi:10.1016/j.jbtep.2014.07.006

Hellhammer, J., & Schubert, M. (2012). The physiological response to Trier Social Stress Test relates to subjective measures of stress during but not before or after the test. *Psychoneuroendocrinology, 37,* 119-124. doi:10.1016/j.psyneuen.2011.05.012

Het, S., Ramlow, G., & Wolf, O. T. (2005). A meta-analytic review of the effects of acute cortisol administration on human memory. *Psychoneuroendocrinology, 30,* 771-784. doi:10.1016/j.psyneuen.2005.03.005

Heuer, F., & Reisberg, D. (1990). Vivid memories of emotional events: The accuracy of remembered minutiae. *Memory & Cognition, 18,* 496-506. doi:10.3758/BF03198482

Hope, L., Gabbert, F., & Fisher, R. P. (2011). From laboratory to the street: Capturing witness memory using the self-administered interview. *Legal and Criminological Psychology, 16,* 211-226. doi:10.1111/j.2044-8333.2011.02015.x

Hope, L., Gabbert, F., Fisher, R. P., & Jamieson, K. (2014). Protecting and enhancing eyewitness memory: The impact of an initial recall attempt on performance in an investigative interview. *Applied Cognitive Psychology 8,* 304-313. doi:10.1002/acp.2984

Houston, K. A., Clifford, B. R., Phillips, L. H., & Memon, A. (2013). The emotional eyewitness: The effects of emotion on specific aspects of eyewitness recall and recognition performance. *Emotion, 13,* 118-128. doi:10.1037/a0029220

Hulse, L. M., & Memon, A. (2006). Fatal impact? The effects of emotional arousal and weapon presence on police officers' memories for a simulated crime. *Legal and Criminological Psychology, 11,* 313-325. doi:10.1348/135532505x58062

Hupbach, A., & Dorskind, J. M. (2014). Stress selectively affects the reactivated components of a declarative memory. *Behavioral Neuroscience, 128,* 614-620. doi:10.1037/bne0000006

Ibabe, I., & Sporer, S. L. (2004). How you ask is what you get: On the influence of question form on accuracy and confidence. *Applied Cognitive Psychology, 18,* 711-726. doi:10.1002/acp.1025

Koessler, S., Engler, H., Riether, C., & Kissler, J. (2009). No retrieval-induced forgetting under stress. *Psychological Science, 20,* 1356-1363. doi:10.1111/j.1467-9280.2009.02450.x

Koriat, A., & Goldsmith, M. (1996). Monitoring and control processes in the strategic regulation of memory accuracy. *Psychological Review, 103,* 490-517. doi:10.1037/0033-295x.103.3.490

Krix, A. C., Sauerland, M., Gabbert, F., & Hope, L. (2014). Providing eyewitnesses with initial retrieval support: What works at immediate and subsequent recall? *Psychology, Crime & Law, 20,* 1005-1027. doi:10.1080/1068316X.2014.902456

Krix, A. C., Sauerland, M., Merckelbach, H., Gabbert, F., & Hope, L. (2015). How effective is retrieval support for witnesses with different levels of working and source memory? *Journal of Cognitive Psychology, 27,* 335-348. doi:10.1080/20445911.2014.1003219

Kuhlmann, S., Piel, M., & Wolf, O. T. (2005). Impaired memory retrieval after psychosocial stress in healthy young men. *Journal of Neuroscience, 25,* 2977-2982. doi:10.1523/jneurosci.5139-04.2005

Landis, J. R., & Koch, G. G. (1977). The measurement of observer agreement for categorical data. *Biometrics, 33,* 159-174. doi:10.2307/2529310

Maras, K. L., Mulcahy, S., Memon, A., Picariello, F., & Bowler, D. M. (2014). Evaluating the effectiveness of the Self-Administered Interview© for witnesses with autism spectrum disorder. *Applied Cognitive Psychology, 28,* 693-701. doi:10.1002/acp.3055

Meissner, C. A., Sporer, S. L., & Susa, K. J. (2008). A theoretical review and meta-analysis of the description-identification relationship in memory for faces. *European Journal of Cognitive Psychology, 20,* 414-455. doi:10.1080/09541440701728581

Memon, A., Meissner, C. A., & Fraser, J. (2010). The cognitive interview: A meta-analytic review and study space analysis of the past 25 years. *Psychology, Public Policy, and Law, 16,* 340-372. doi:10.1037/a0020518

Meyer, T., Smeets, T., Giesbrecht, T., Quaedflieg, C. W. E. M., & Merckelbach, H. (2013). Acute stress differentially affects spatial configuration learning in high and low cortisol-responding healthy adults. *European Journal of Psychotraumatology, 4,* 19854. doi:10.3402/ejpt.v4i0.19854

Miller, R., Plessow, F., Kirschbaum, C., & Stalder, T. (2013). Classification criteria for distinguishing cortisol responders from nonresponders to psychosocial stress: Evaluation of salivary cortisol pulse detection in panel designs. *Psychosomatic Medicine, 75,* 832-840. doi:10.1097/PSY.0000000000000002

Nicolson, N. A. (2008). Measurement of cortisol. In L. J. Luecken, & L. C. Gallo (Eds.), *Handbook of physiological research methods in health psychology* (pp. 37–74). Los Angeles, CA: Sage.

Paterson, H. M., Eijkemans, H., & Kemp, R. I. (2014). Investigating the impact of delayed administration on the efficacy of the Self-Administered Interview. *Psychiatry, Psychology and Law, 22,* 307-317. doi:10.1080/13218719.2014.947670

Quaedflieg, C. W. E. M., Meyer, T., Schwabe, L., & Smeets, T. (2013). Time dependent effects of stress prior to encoding on processing efficiency and 24h delayed retrieval. *Psychoneuroendocrinology, 38,* 3057-3069. doi:10.1016/j.psyneuen.2013.09.002

Roozendaal, B. (2002). Stress and memory: Opposing effects of glucocorticoids on memory consolidation and memory retrieval. *Neurobiology of Learning and Memory, 78,* 578-595. doi:10.1006/nlme.2002.4080

Roozendaal, B., & McGaugh, J. L. (2011). Memory modulation. *Behavioral Neuroscience, 125,* 797-824. doi:10.1037/a0026187

Rubin, D. C., & Wenzel, A. E. (1996). One hundred years of forgetting: A quantitative description of retention. *Psychological Review, 103,* 734-760. doi:10.1037/0033-295x.103.4.734

Sauerland, M., Krix, A. C., van Kan, N., Glunz, S., & Sak, A. (2014). Speaking is silver, writing is golden? The role of cognitive and social factors in written versus spoken witness accounts. *Memory & Cognition, 42,* 978-992. doi:10.3758/s13421-014-0401-6

Sauerland, M., Raymaekers, L. H. C., Otgaar, H., Memon, A., Waltjen, T. T., Nivo, M., Slegers, C., Broers, N. J., & Smeets, T. (2015). *Stress, stress-induced cortisol responses, and eyewitness identification performance.* Manuscript submitted for publication.

Schwabe, L., Joëls, M., Roozendaal, B., Wolf, O. T., & Oitzl, M. S. (2012). Stress effects on memory: An update and integration. *Neuroscience & Biobehavioral Reviews, 36,* 1740-1749. doi:10.1016/j.neubiorev.2011.07.002

Schwabe, L., & Wolf, O. (2014). Timing matters: Temporal dynamics of stress effects on memory retrieval. *Cognitive Affective & Behavioral Neuroscience, 14,* 1041-1048. doi:10.3758/s13415-014-0256-0

Smeets, T., Cornelisse, S., Quaedflieg, C. W. E. M., Meyer, T., Jelicic, M., & Merckelbach, H. (2012). Introducing the Maastricht Acute Stress Test (MAST): A quick and non-invasive approach to elicit robust autonomic and glucocorticoid stress responses. *Psychoneuroendocrinology, 37,* 1998-2008. doi:10.1016/j.psyneuen.2012.04.012

Smeets, T., Otgaar, H., Candel, I., & Wolf, O. T. (2008). True or false? Memory is differentially affected by stress-induced cortisol elevations and sympathetic activity at consolidation and retrieval. *Psychoneuroendocrinology, 33,* 1378-1386. doi:10.1016/j.psyneuen.2008.07.009

Sporer, S. L., & Cohn, L. D. (2011). Meta-analysis. In B. D. Rosenfeld, & S. D. Penrod (Eds.), *Research methods in forensic psychology* (pp. 43-62). New York: Wiley.

Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology, 54,* 1063-1070. doi:10.1037/0022-3514.54.6.1063

Wessel, I., van der Kooy, P., & Merckelbach, H. (2000). Differential recall of central and peripheral details of emotional slides is not a stable phenomenon. *Memory, 8,* 97-111. doi:10.1080/096582100387641

Appendix: Verifiable Event Details

- Location: lab
- Black Blackberry cell phone lies on the table left of the participant.
- Participant sits on a chair behind a computer with the back to the door.
- Experimenter hands questionnaires to participant.
- *Experimenter asks participant to fill in this questionnaire.*
- *Experimenter tells participant that he is going to put the saliva samples into the freezer.*
- Experimenter leaves the room.
- Participant remains alone in the lab.
- Participant completes the questionnaire.
- Thief opens the door of the lab.
- Thief enters the room.
- *Thief asks for the experimenter.*
- *Thief tells participant that s/he was an earlier participant in the study or colleague of the experimenter.*
- *Thief tells participant that s/he left his/her cell phone in the room.*
- *Thief tells participants that s/he wants to pick up the cell phone.*
- Thief takes the cell phone.
- Thief leaves the room.
- Experimenter returns.
- *Experimenter tells participant that s/he became witness of a theft.*

Equipment of the lab

- Tables
- Chairs
- Computer right of the water tank in the back of the room
- TV between computer and table on which tank stands

- Tank left of the participant for the stress task

Details in italics pertain to conversation details.

Table 1

Mean Number of Correct Details Recalled, Number of Incorrect Details Recalled and Accuracy Rate of the Verifiable Event Details as a Function of Interview Type and Stress Condition

		SAI			FR			Across interview types		
		M	*95% CI (M)*	*SD*	*M*	*95% CI (M)*	*SD*	*M*	*95% CI (M)*	*SD*
Number of correct details	Control	21.59	19.97, 23.21	4.67	14.10	12.16, 16.04	5.42	17.97	16.41, 19.53	6.27
	Stress	21.00	19.21, 22.79	5.24	12.61	11.10, 14.12	4.30	16.94	15.38, 18.50	6.37
	Across stress conditions	21.29[a]	20.09, 22.49	4.94	13.34[a]	12.11, 14.57	4.90	17.44	16.34, 18.54	6.32
Number of incorrect details	Control	0.53	0.27, 0.79	0.76	0.30	0.09, 0.51	0.60	0.42	0.25, 0.59	0.69
	Stress	0.42	0.18, 0.66	0.71	0.29	0.09, 0.50	0.59	0.36	0.20, 0.52	0.65
	Across stress conditions	0.48	0.30, 0.66	0.73	0.30	0.15, 0.45	0.59	0.39	0.27, 0.51	0.67
Accuracy rate (%)	Control	97.79	96.73, 98.85	3.05	98.16	96.78, 99.54	3.87	97.97	97.11, 98.83	3.45
	Stress	98.05	96.90, 99.20	3.36	97.98	96.41, 99.55	4.45	98.02	97.07, 98.97	3.89
	Across stress conditions	97.92	97.14, 98.70	3.19	98.07	97.03, 99.11	4.14	97.99	97.35, 98.63	3.67

Note. Means sharing the same superscript letter within a row indicate significant main effects with $p < .05$. Verifiable event details do not include unverifiable event details.

Table 2

Mean Quantity of the Unverifiable Event Details as a Function of Interview Type and Stress Condition

		SAI			FR			Across interview types		
		M	*95% CI*	*SD*	*M*	*95% CI*	*SD*	*M*	*95% CI*	*SD*
Quantity	Control	11.06	8.13, 14.00	8.47	9.83	7.65, 12.02	6.11	10.47	8.63, 12.31	7.39
	Stress	11.58	9.65, 13.50	5.64	9.23	7.21, 11.24	5.73	10.44	9.03, 11.85	5.76
	Across stress conditions	11.32	9.59, 13.06	7.12	9.52	8.05, 11.00	5.88	10.45	9.30, 11.60	6.59

Table 3

Mean Number of Correct Details Recalled, Number of Incorrect Details Recalled and Accuracy Rate of the Perpetrator Details as a Function of Interview Type and Stress Condition

		SAI			FR			Across interview types		
		M	*95% CI (M)*	*SD*	*M*	*95% CI (M)*	*SD*	*M*	*95% CI (M)*	*SD*
Number of correct details*	Control	10.93	9.14, 12.72	4.91	5.85	5.04, 6.66	2.11	8.53	7.31, 9.75	4.60
	Stress	10.82	9.58, 12.06	3.62	4.68	3.90, 5.46	2.11	8.00	6.92, 9.08	4.30
	Across stress conditions	10.87[a]	9.81, 11.93	4.24	5.24[a]	4.66, 5.82	2.17	8.25	7.44, 9.06	4.43
Number of incorrect details	Control	2.72	2.14, 3.30	1.58	1.92	1.42, 2.42	1.29	2.35	1.96, 2.74	1.49
	Stress	2.97	2.35, 3.59	1.83	1.54	0.89, 2.19	1.75	2.31	1.83, 2.79	1.92
	Across stress conditions	2.85[b]	2.42, 3.28	1.71	1.72[b]	1.31, 2.13	1.55	2.33	2.02, 2.64	1.72
Accuracy rate (%)	Control	78.59	73.58, 83.60	13.76	76.53	71.53, 81.53	13.00	77.62	74.10, 81.14	13.32
	Stress	78.93	75.05, 82.81	11.37	81.55	74.81, 88.29	18.19	80.13	76.41, 83.85	14.82
	Across stress conditions	78.77	75.67, 81.87	12.44	79.13	74.87, 83.39	15.96	78.94	76.37, 81.51	14.13

Note. The asterisk behind the variable indicates the presence of a significant interaction between Stress Condition and Confederate. Means sharing the same superscript letter within a row indicate significant main effects with $p < .05$.

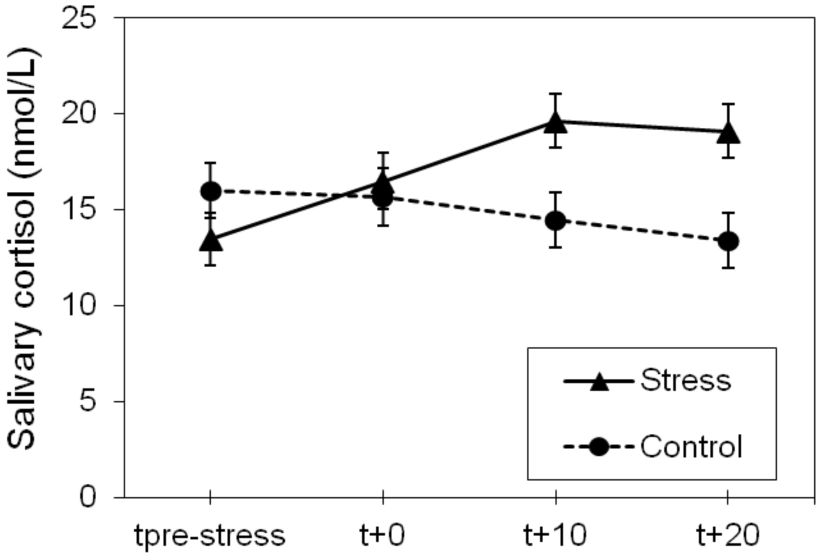

Figure Captions

Figure 1. Salivary cortisol levels (nmol/L) over time in the stress and in the control group. Error bars represent standard errors. tpre-stress = measurement before administration of the MAST/control task; t+0 = measurement upon termination of the MAST/control task; t+10 = measurement 10 min after termination of the MAST/control task; t+20 = measurement 20 min after termination of the MAST/control task.