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\*Corresponding author: Uta Kraus,  
Institute of Psychology, Psychology chair  
I - Differential Psychology, Personality  
und Psychological Assessment, Julius-  
Maximilians-University Würzburg,  
Marcusstraße 9-11, 97070 Würzburg,  
Germany  
E-mail: [uta.kraus@uni-wuerzburg.de](mailto:uta.kraus@uni-wuerzburg.de)

Reviewing editor:  
Peter Walla, University of Newcastle,  
Australia

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the end of the article

## APPLIED PSYCHOLOGY | RESEARCH ARTICLE

# Comparing the quality of memory reports in different initial eyewitness questioning approaches

Uta Kraus<sup>1\*</sup>, Fabian Zeier<sup>1</sup>, Wolfgang Wagner<sup>1</sup>, Marko Paelecke<sup>1</sup> and Johannes S. Hewig<sup>1</sup>

**Abstract:** High-quality initial memory retrieval can enhance initial and subsequent eyewitness memory. The quality of initial memory retrieval has been increasingly examined in single approaches. The aim of our study was to compare the quality of memory reports in different initial eyewitness questioning approaches to examine their strengths and limitations. Sixty-two adults participated in the study and were allocated to one of three initial questioning groups: self-administered interview (SAI), police officer's questioning (POQ) and written free recall (FR). Participants individually observed a video of a real criminal event and afterwards gave in initial eyewitness reports using the SAI, the POQ or the FR. After a one-week delay all participants were asked 16 written, non-suggestive questions about the criminal event. The study revealed that adults using the SAI for their initial retrieval reported more correct victim and setting details compared to adults in the POQ or FR group. Compared to adults in the FR group, adults in the SAI group also reported more correct offender and action details. Adults in the POQ group reported more correct offender details compared to adults in the SAI and FR groups. Accuracy was not affected. After one week, adults in the FR group reported more correct object details

### ABOUT THE AUTHORS

Uta Kraus is a lecturer in psychology at the FernUniversität in Hagen. Her PhD is in psychology with an emphasis of legal psychology, differential psychology and psychological diagnostics. Her research focuses on eyewitness memory, suggestibility, testimony and the impact of cultural diversity.

Fabian Zeier was a bachelor student at the Julius-Maximilians-University in Würzburg. Wolfgang Wagner is a police officer and was a bachelor student at the Julius-Maximilians-University in Würzburg. They conducted the study during their bachelor studies.

Marko Paelecke is a lecturer in psychology at the Julius-Maximilians-University in Würzburg. His PhD is in cognitive psychology. His research topics are individual differences in information processing.

Johannes S. Hewig is a professor of psychology at the Julius-Maximilians-University in Würzburg. His research mainly focuses on personality psychology, motivation, emotion, attention, decision-making and their psychophysiological correlates.

### PUBLIC INTEREST STATEMENT

One of the challenges in the legal context is to obtain accurate and undistorted eyewitness reports that describe the criminal event as precisely and comprehensively as possible. Thereby, the quality of an initial retrieval is important because it affects the quality of the subsequent eyewitness reports. Currently, we know little about the individual strength and limitations of different initial questioning approaches. In this study, we compared an initial self-administered interview (SAI), a police officer's questioning (POQ) and a free recall (FR) to close this gap. We found that an initially applied SAI and high-quality POQ enhances the quality of initial memory retrieval. The SAI particularly enhances offender, victim, setting and action details, although it increases the number of incorrect victim and setting details. The POQ facilitates a superior retrieval of offender characteristics and the FR particularly enhances object characteristic. Based on that, the three initial eyewitness questioning approaches can be applied and refined precisely to obtain the most accurate and comprehensive eyewitness report as possible.

and were more accurate than adults in the SAI and POQ groups. Results are discussed in relation to their empirical and practical relevance.

**Subjects: Evidence; Legal Skills; Method & System; Psychological Science**

**Keywords: eyewitness memory; self-administered interview; initial police questioning; adult witnesses; offender**

### 1. Introduction

One of the most important challenges in the legal context is to obtain accurate and undistorted eyewitness reports that describe the criminal event as precisely and comprehensively as possible. Thereby, the quality of an initial retrieval seems to be important for the quality of the subsequent eyewitness reports. A high-quality initial retrieval can enhance eyewitness memory by creating various retrieval routes, which give access to the original event by countervailing immediate forgetting (Brock, Fisher, & Cutler, 1999; Raaijmakers & Shiffrin, 1980; Roediger & Butler, 2011). The creation of various retrieval routes can increase memory accuracy and may strengthen the resistance against external and internal distortions. Therefore, quality of initial memory retrievals on eyewitness reports has been increasingly examined in the last years. To date, previous research has focused mainly on one initial eyewitness retrieval approach in comparison to a control condition. The aim of this study is therefore to compare the quality of memory reports in different initial eyewitness questioning approaches directly and to contrast them to a basic control condition.

One method to obtain an initial eyewitness statement is to verbally question the eyewitness. Initial eyewitness questionings are mainly used by police officers at the beginning of an investigation. The aim of such a questioning is to get an overview of the crime and to collect first information about what happened, about the offender and about evidence (e.g. Fisher, Geiselman, & Raymond, 1987; Gabbert, Hope, Carter, Boon, & Fisher, 2016; George & Clifford, 1992; Schaal, 2002). Each police officer uses a typical set of verbal questions to get an overview of the crime. The set of questions is based upon the police officer's basic education, advanced trainings, hand-on experiences and feedback received by colleagues (Dando, Wilcock, & Milne, 2008; Gabbert et al., 2016; Smets & Rispens, 2014). In Western countries, police officers are instructed (e.g. during basic education, advanced interrogation trainings) to use mainly open-ended non-suggestive questions and to adapt the questions to the capabilities of the individual eyewitness (Evans & Fisher, 2011; Fisher et al., 1987; Lipton, 1977; Powell, Fisher, & Wright, 2005; Schaal, 2002; Snook & Keating, 2011). If open-ended questions do not provide sufficient information, police officers should use funnel-shaped open- and closed-ended non-suggestive questions (Powell et al., 2005; Schaal, 2002; Snook & Keating, 2011). In addition, police officers are instructed to avoid suggestive behaviour. Although initial eyewitness questions are executed in a heterogeneous manner (Gabbert et al., 2016; Schaal, 2002), they all aim to get an overview of the crime and to collect reliable and undistorted first-hand information about the crime.

Another method to obtain an initial eyewitness statement is to conduct the self-administered interview (SAI; Gabbert, Hope, and Fisher (2009)). The SAI is a written, semi-structured interview in form of a booklet developed to support the Police in crimes with a larger number of eyewitnesses (Hope, Gabbert, & Fisher, 2011). The SAI obtains eyewitnesses' systematic and undistorted report without the accompaniment of a police officer. The SAI uses the retrieval strategies of mental reinstatement, non-suggestive accurate rapport building, free and cued-recall of the event, cued-recall of the offender, cued-recall of other person characteristics and asks for secondary information. Research on the SAI has shown that adults who had completed the SAI immediately after witnessing a staged crime reported more correct details than adults using a written free recall (FR, Gabbert et al., 2009; Gabbert, Hope, Fisher, & Jamieson, 2012; Gawrylowicz, Memon, & Scoboria, 2014; Krix, Sauerland, Gabbert, & Hope, 2014; Krix et al., 2016) or a written structured recall interview (Maras, Mulcahy, Memon, Picariello, & Bowler, 2014). The advantage of the SAI was observed for the event categories person, action, setting and objects, indicating that the SAI enhances eyewitness memory

consistently after short delays without reducing accuracy (Gabbert et al., 2009; Gawrylowicz et al., 2014). Regarding longer delays, research on the SAI has shown that adults who had completed the SAI immediately after observing a staged crime again reported more correct details without a loss of accuracy after one-week or two-week delays (Gabbert et al., 2009, 2012; Gawrylowicz et al., 2014; Gittins, Paterson, & Sharpe, 2015; Paterson, Eijkemans, & Kemp, 2014). The effect of an initial SAI on a subsequent interrogation has been addressed by Hope, Gabbert, Fisher, and Jamieson (2014). In the study, adults watched a video of staged crime and then either completed the SAI, a FR or no interview at all. One week later, all adults completed a Cognitive Interview (CI, Fisher & Geiselman, 1992). Adults in the SAI group reported more correct details (correct person, setting and action details) and showed higher accuracy in the CI compared to adults in the FR or the no-initial interview group. In addition, participants were more consistent in the SAI group than in the FR group. Thus, the SAI seems to be an appropriate method to obtain an accurate and detailed initial eyewitness statement. However, the efficacy of the SAI appears to depend upon application within 24 h of a crime event as reported recently by Paterson et al. (2014).

A direct comparison of an initial application of SAI with an initial eyewitness questioning, however, has not been conducted yet. Such a comparison would allow evaluating the quality of the obtained memory reports more precisely and help to identify the strengths and limitations of each approach. Based on that, the questioning approaches could be applied and refined selectively according to their strength. One reason for the absence of such a comparison might be the heterogeneity in the execution of initial eyewitness questionings by police officers.

One possibility to cope with the heterogeneity of initial eyewitness questionings is to compile a typical initial police officer's questioning (POQ) containing the minimum standards for police interviews (e.g. Fisher, 1995; Lichtenstein, 2007; Milne & Bull, 1999; Powell et al., 2005; Smets & Rispens, 2014). For this study, such a typical initial POQ was compiled. The POQ aims to get a primal orientation about the crime by asking open-ended as well as funnel-shaped closed-ended questions about the course of the event, offender characteristics and potential evidence. As in realistic initial eyewitness questionings, the POQ will be executed verbally and responses will be protocolled by the interrogator.

However, comparing a written SAI with a verbally presented and external protocolled POQ implies two methodological problems that may affect the quality of eyewitness memory. The first problem is that the initial retrieval occurs either in a written or a verbal modality. Research on eyewitness memory has shown that various modalities differ from each other in terms of memory performance (e.g. written > verbal) and modality changes (e.g. from a written to a verbal retrieval modality) can affect memory performance (Gabbert et al., 2016; Sauerland, Krix, van Kann, Glunz, & Sak, 2014; Sauerland & Sporer, 2011). In addition, motivation and feedback may differ between written and verbal retrievals and can influence the length and quality of memory reports (e.g. McPhee, Paterson, & Kemp, 2013). To control this methodological problem, in this study a written control condition will be used in that participants protocol their responses by themselves. This control condition allows to determine the basic quality of memory reports of an initial written retrieval and to examine the effects of additional written (SAI) or verbal (POQ) retrieval strategies. Besides this, the control condition allows to estimating a modality induced memory decline (SAI written > POQ verbal) and a motivational induced memory increase of verbal memory (POQ > SAI). To control the influence of feedback in the POQ, the POQ will contain no feedback information and the interrogator will be instructed to give no verbal, para- or non-verbal feedback.

The second methodological problem refers to questions and instructions used in the different initial questioning approaches. Open-ended, closed-ended and probing questions are used to ask for memory details or to specify previously reported statements (Fisher et al., 1987; George & Clifford, 1992). The use of closed-ended and probing questions has been criticized because they may increase incorrect responses, can imply suggestions or may induce false information (Evans & Fisher, 2011; Fisher et al., 1987; Koriat & Goldsmith, 1996; Lipton, 1977; Loftus, 1979). Therefore, the use of open-ended non-suggestive questions is preferred (Weber & Brewer, 2008). Closed-ended questions

are used frequently in police questionings (Snook & Keating, 2011) to ask for further details, although they may increase the number of incorrect details. However, closed-ended questions do not necessarily reduce accuracy or introduce false information per se. Migueles, García-Bajos, and Aizpurua (2016) found reduced accuracy for perceptual details but not for action details. In addition, closed-ended questions can be expressed in a non-suggestive manner to reduce potential suggestive impacts. In the SAI and POQ, mainly open-ended non-suggestive questions or instructions are used and thus the instruction in the written control condition will be presented in an open-ended, non-suggestive manner as well.

Besides this, the SAI asks for additional information regarding the offender (e.g. glasses, facial hair, scars) and about further details (e.g. vehicle: shape, model, driving style). This additional information serves as retrieval cues. The SAI always ask in a non-suggestive manner for additional information. In the POQ, additional information is contained in the funnel-shaped closed-ended non-suggestive questions, which serve as well as additional retrieval cues. Independent of their type of presentation (listing vs. question), additional retrieval cues should not differ from each other as long as they are presented in a non-suggestive manner.

In our study we compare the quality of memory reports of an initial applied SAI, an initial POQ and an initial FR to (1) examine the strength and limitations of each approach directly, (2) to be in the position to select the approaches according to their strength and (3) to be able to refine the different approaches according to their limitation. We compare the quality of memory reports immediately after observing a video of a real-life crime and in a written questioning after a one-week delay.

Based on previous findings on the SAI (Gabbert et al., 2009, 2012; Krix et al., 2014, 2016), we expected that adults in the SAI condition report more correct memory details than adults in the POQ condition because the written form and the retrieval strategies of the SAI should lead to a deeper memory processing and a more extensive memory retrieval. We expected that the higher number of correct details in the SAI condition do not affect accuracy rate because eyewitnesses are instructed to report everything they remember without guessing. Based on the findings of Gabbert et al. (2009, 2012) we expected to find more correct details in the SAI condition in the crime related memory categories “victims”, “setting”, “objects” and “action” compared to the POQ condition because the SAI consistently enhances memory retrieval in these memory categories. Regarding the memory category “offender”, we expected that adults in the POQ condition report more correct memory details than adults in the SAI condition because the focus of the initial POQ lies on the investigation of offender characteristics to initiate a potential manhunt close to the criminal event (Fisher et al., 1987; Gabbert et al., 2016; George & Clifford, 1992; Schaal, 2002). In addition, we expected to find the same pattern of results at session 2 because findings on the SAI indicate that the advantage of the SAI persists after a one-week delay (Gabbert et al., 2009, 2012; Gawrylowicz et al., 2014; Gittins et al., 2015; Paterson et al., 2014).

Besides this, we expected that adults using the SAI would report more correct memory details than adults in the written FR condition without a loss of accuracy because the different retrieval strategies of the SAI should lead to a deeper memory processing and detailed memory retrieval (Gabbert et al., 2009, 2012; Gawrylowicz et al., 2014; Krix et al., 2014, 2016; Maras et al., 2014; Paterson et al., 2014). We expected to find an advantage on the SAI in all crime related memory categories in both test sessions (Gabbert et al., 2009, 2012). In addition, we assumed that adults in the POQ group would report more offender characteristics than adults in the FR group because the focus of the initial POQ lies on the investigation of offender characteristics at test session 1 (Fisher et al., 1987; Gabbert et al., 2016; George & Clifford, 1992; Schaal, 2002). Based on findings of deeper memory processing in high-quality initial retrieval accounts (Brock et al., 1999; Raaijmakers & Shiffrin, 1980; Roediger & Butler, 2011), we expected that the POQ group reports more correct offender characteristics than the FR group after one week. Regarding the remaining memory categories we explored possible differences between the POQ and FR in post hoc analyses at both test sessions.

## 2. Method

### 2.1. Design and participants

A between-subject design with the factor *questioning group* (SAI vs. POQ vs. FR) was used. Participants were allocated randomly to the questioning groups. Sample size per group was based on previous studies (Gabbert et al., 2009; Hope et al., 2014) and on a power analysis (G\*Power 3.1, Faul, Erdfelder, Lang, & Buchner, 2007). The power analysis for MANOVAs with special effects and interactions yielded a total sample size of  $N = 62$  for a medium effect size ( $\geq .25$ ) given  $\alpha = .05$ ,  $\beta = .80$ , 2 predictors, 6 groups and 15 response variables. Participants were recruited directly or through online advertising (Rewards: 10 Euro or course credits).

Sixty-two adults participated in the study, 57 were German native-speakers, and 5 were non-native speakers with good language abilities. Participants were aged between 18 and 67 years ( $M = 30.15$ ,  $SD = 10.84$ ). 41 of them were female and 21 were male. There were more females in the POQ group than in the SAI and FR groups ( $\chi^2(2) = 9.71$ ,  $p = .004$ ). Age, native language, education, seeing aids, dyslexia, attention deficit hyperactivity disorder, victim/witness experience, testimony experience at police/court did not differ significantly between questioning groups. Sample characteristics were presented in Table 1.

### 2.2. Materials

#### 2.2.1. Film sequence

The film sequence was a security camera recording of a robbery attempt in a Post Office (provided by the Bavarian State Office of Criminal Investigation). The sequence lasted 34 s and showed the robbery attempt from a ceiling perspective without sound. In the scene, a man enters a post office where two female employees were working. He shows them an unidentifiable object, e.g. a piece of

**Table 1. Demographic characteristics of female and male participants in the three questioning conditions (SAI = Self-administered interview, POQ = Police officers questioning, FR = Free recall)**

	SAI		POQ		FR	
	Females	Males	Females	Males	Females	Males
	(N = 13)	(N = 8)	(N = 19)	(N = 2)	(N = 9)	(N = 11)
Native language	13 Yes	5 Yes	18 Yes	2 Yes	8 Yes	11 Yes
	0 No	3 No	1 No	0 No	1 No	0 No
Education	2 Level 3/4	1 Level 3/4	1 Level 3/4	0 Level 3/4	2 Level 3/4	3 Level 3/4
	11 Level 5-7	7 Level 5-7	18 Level 5-7	2 Level 5-7	7 Level 5-7	8 Level 5-7
Seeing aids	8 Yes	4 Yes	11 Yes	1 Yes	6 Yes	6 Yes
	5 No	4 No	8 No	1 No	3 No	5 No
Dyslexia	0 Yes	0 Yes	0 Yes	0 Yes	0 Yes	0 Yes
	13 No	8 No	19 No	2 No	9 No	11 No
ADHD	0 Yes	1 Yes	0 Yes	0 Yes	0 Yes	0 Yes
	13 No	7 No	19 No	2 No	9 No	11 No
Victim/Witness experience	1 Yes	1 Yes	4 Yes	0 Yes	4 Yes	3 Yes
	12 No	7 No	15 No	2 No	5 No	8 No
Testimony experience at Police/Court	2 Yes	2 Yes	5 Yes	1 Yes	4 Yes	4 Yes
	11 No	6 No	14 No	1 No	5 No	7 No

Notes: Education was classified according to the International Standard Classification of Education (ISCED-2011, OECD et al., 2015): Level 3 = Upper secondary education, Level 4 = Post-secondary non-tertiary education, Level 5 = Short cycle tertiary education, Level 6 = Bachelor or equivalent, Level 7 = Master or equivalent.

ADHD = Attention deficit hyperactivity disorder.

paper or a plastic bag, and then draws a gun. He first points the gun on one employee and then to the other one. The employees look at each other, shake their heads, shrug their shoulders and talked to the man. Afterwards, the man hesitates momentary and then leaves the office promptly. The face of the man was visible from a front view. The faces of the employees were visible only when they moved their heads to the left or to the right side. The film was presented on a notebook screen (15inch, TFT Color LCD, 1150 kbps, 25 frames/sec; Distance: 60–80 cm, individually adapted).

**2.2.1.1. Self-administered interview (SAI; Gabbert et al., 2009):** The SAI booklet comprises five sections: In Section 1, witnesses are provided with general information about the SAI and how to use it. Section 2 contains instructions about the mental reinstatement of the context of the crime event and witnesses are asked to report everything as accurate as possible without guessing. In Section 3, witnesses are asked to describe the offender as detailed as possible; in Section 4, witnesses generate a sketch of the scene and Section 5 asks about additional information that has not been reported until then (e.g. other witnesses, vehicles). The applied German version of the SAI had been successfully tested in four independent German adult samples (Kraus, Paelecke, Bössenrodt, Stephan & Hewig, under revision).

#### **2.2.2. Police officers questioning (POQ)**

A POQ for an initial eyewitness interrogation was developed by one of the authors (WW). The POQ consisted of 16 open- and closed-ended non-suggestive questions typically asked by German Police officers during an initial eyewitness interrogation. The POQ contained questions about the course of the event (2; “What did you see?”), the offender (11; “What can you tell us about the offender?”) and about objects (3, “What items did he carry (no matter where)?”). Participants were informed that they could use the respond option “I don’t know/remember it”. The POQ was developed by a German police officer in the context of his Bachelor’s degree in Psychology and was based on his working experience (26 years of service; special education in questionings of witnesses, in domestic violence, in weapons and officially appointed expert for weapons) and on the experience of colleagues. The questions were asked verbally in a standardized manner and responses were protocolled by the interrogator.

**2.2.2.1. Written free recall (FR).** Participants received a response booklet with a written instruction and blank papers. They were instructed to provide the most complete and accurate memory report without guessing. Participants could write down their memories in complete sentences or in note form. The chronological order was unimportant.

**2.2.2.2. Delayed questioning.** In the delayed questioning, participants were asked 16 open-ended and closed-ended non-suggestive questions about the offender (5), victims (1), setting (2), objects (2) and actions (6). The questions were presented in a written manner in a chronological order. Participants were asked to write down their answers as detailed and accurate as possible without guessing. If they didn’t know the answer or didn’t remember/recognize the details asked in the questions they were asked to respond “I don’t know/remember/recognize it”.

**2.2.2.3. Informed consent.** In the informed consent, participants declared that they agreed that all data were collected and used anonymously, would be deleted after data analyses and that participation could be ended at any time. In addition, participants declared that they would not talk about the film event until they had completed the study.

**2.2.2.4. Socio-demographic questionnaire.** A socio-demographic questionnaire was used to assess person-related data about age, sex, native language, education, seeing aids, dyslexia, attention deficit hyperactivity disorder, victim/witness experience and testimony experience at police or in court.

### 2.3. Procedure

Each participant took part individually at two test sessions. Test session 2 took place one week after test session 1 (+/- 1 day). At *test session 1*, the experimenter informed participants about the procedure of both test sessions and presented them the informed consent. Following that, participants were presented the film and were asked either to complete the SAI booklet, the POQ or the FR. No time restrictions were imposed for the three questioning groups. At *test session 2*, participants were informed that they would be asked about the witnessed film of session 1. Following that all participants were asked to complete the delayed questioning. No time restrictions were imposed for the questions. Afterwards, all participants were informed about the aim of the study and received their reward/credits.

### 2.4. Coding

A detailed recall-scoring template was developed for the film. The scoring template contained 196 details of the film that were categorized into the five categories offender (53), victim (38), setting (32 details), objects (21 details) and actions (52). A detail was coded as correct if it was present in the film and described correctly. A detail was coded as incorrect if it was not present in the film or if it was described incorrectly. Subjective responses were not coded (e.g. "he was aggressive"). Complex items were split up into single details. For example, the item "black baseball cap" was coded with three points (1 = hat, 1 = type of hat, 1 = colour). Each detail was counted only once. The scoring template was used for coding the SAI, POQ, FR and delayed questioning responses. Inter-coder reliability between two independent raters for correct and incorrect items was high, Cohen's  $k = .92$ ,  $p < .001$ . The second coder was completely blind to the hypotheses.

## 3. Results

An alpha level of .05 was used for all analysis. One Multivariate Analysis of Variance (MANOVA) per test session was used to analyse continuous data. Questioning group was the independent variable (SAI vs. POQ vs. FR). Planned contrasts were used to test the hypothesized group differences (Contrast 1: SAI vs. POQ; Contrast 2: SAI vs. FR). Post hoc analyses were conducted to test putative group differences between POQ and FR. Bonferroni-Corrections were used to correct for multiple testing. Accuracy was calculated by dividing the total number of correct details by the total number of correct and incorrect details.

### 3.1. Memory recall after observing the robbery attempt

Means and standard deviations of correct details, incorrect details and accuracy rates in the five response categories were presented in Table 2.

Using Pillai's trace, there was an effect of the questioning group on the number of correct details, incorrect details and accuracy rates, ( $V = 1.35$ ,  $F(32,84) = 5.43$ ,  $p < .001$ ,  $\eta_p^2 = .67$ ).

#### 3.1.1. Correct details

The separate univariate ANOVAs showed questioning group effects for correct details in the response category offender ( $F(2,56) = 25.29$ ,  $p < .001$ ,  $\eta_p^2 = .48$ ), victim ( $F(2,56) = 5.28$ ,  $p = .008$ ,  $\eta_p^2 = .16$ ), setting ( $F(2,56) = 51.87$ ,  $p < .001$ ,  $\eta_p^2 = .65$ ) and action ( $F(2,56) = 7.71$ ,  $p = .001$ ,  $\eta_p^2 = .22$ ) but not in the category objects ( $p > .05$ ).

The contrast analysis revealed that the SAI group reported a lower number of correct offender details than the POQ group ( $p = .035$ ). However, the SAI group reported significantly more correct victim ( $p = .011$ ) and setting details ( $p < .001$ ) than the POQ group. Contrast 2 showed that the SAI group reported more correct offender ( $p < .001$ ), victim ( $p = .005$ ) setting ( $p < .001$ ) and action details ( $p < .001$ ) than the FR group. Post hoc analysis revealed that the POQ group reported significantly more correct offender ( $p < .001$ ) than the FR group. The remaining responding categories did not differ between the questioning groups (all values  $p > .05$ ).

**Table 2. Memory recall and accuracy after observing the robbery attempt (SAI = Self-administered interview, POQ = Police officers questioning, FR = Free Recall)**

Test session 1		SAI		POQ		FR	
		M	(SD)	M	(SD)	M	(SD)
Offender	Correct	13.41	(5.01)	16.38	(3.76)	6.40	(3.84)
	Incorrect	1.27	(1.49)	1.19	(1.12)	.89	(1.10)
	Accuracy	.91	(.09)	.93	(.06)	.93	(.09)
Victim	Correct	5.91	(4.62)	2.95	(2.39)	2.85	(1.53)
	Incorrect	.82	(1.10)	.14	(.47)	.21	(.53)
	Accuracy	.90	(.12)	.96	(.11)	.97	(.08)
Setting	Correct	8.18	(2.54)	2.57	(1.59)	3.05	(1.31)
	Incorrect	.59	(1.00)	.00	(.00)	.11	(.31)
	Accuracy	.94	(.08)	1	(0)	.96	(.12)
Objects	Correct	3.14	(1.64)	2.90	(.94)	2.85	(1.42)
	Incorrect	.14	(.35)	.24	(.43)	.16	(.37)
	Accuracy	.96	(.11)	.91	(.16)	.97	(.07)
Action	Correct	13.41	(3.68)	11.67	(3.73)	8.80	(3.57)
	Incorrect	.73	(.63)	.38	(.49)	1.00	(1.05)
	Accuracy	.95	(.04)	.97	(.05)	.88	(.14)

Notes: M = mean, SD = standard deviation.

Accuracy = Total correct details/(Total correct details + Total incorrect details).

### 3.1.2. Incorrect details

Regarding incorrect details, the univariate ANOVAs revealed questioning group effects in the response category victim ( $F(2,56) = 4.41, p = .017, \eta_p^2 = .14$ ), setting ( $F(2,56) = 4.95, p = .010, \eta_p^2 = .15$ ) and action ( $F(2,56) = 3.86, p = .027, \eta_p^2 = .12$ ) but not in the categories offender and objects ( $p > .05$ ).

The contrast analyses showed that the SAI group reported more incorrect victim ( $p = .010$ ) and setting details ( $p = .005$ ) than the POQ group. In addition, the SAI group reported more incorrect victim ( $p = .021$ ) and setting details ( $p = .022$ ) than the FR group. Post hoc comparisons revealed that the FR group reported more incorrect action details ( $p = .022$ ) than the POQ group. No questioning group differences were found in the other response categories ( $p > .05$ ).

### 3.1.3. Accuracy

In relation to accuracy rates, the univariate ANOVAs revealed a questioning group effect in the response category action ( $F(2,56) = 5.54, p = .006, \eta_p^2 = .17$ ) but not in the other response categories ( $p > .05$ ). The contrast analysis regarding action details showed that the SAI group was as accurate as the POQ group but more accurate than the FR group ( $p = .012$ ). Post hoc analysis revealed that the POQ group was also more accurate regarding action details than the FR group ( $p = .008$ ).

## 3.2. Memory recall after one-week delay

Means and standard deviations of correct details, incorrect details and accuracy rates after the one-week delay were presented in Table 3.

The MANOVA revealed an effect of the questioning group on the number of correct details, incorrect details and accuracy rates after the one-week delay, (Pillai's trace,  $V = 1.06, F(32,74) = 5.43, p < .001, \eta_p^2 = .53$ ).

**Table 3. Written memory recall after the one-week delay (SAI = Self-administered interview, POQ = Police officers questioning, FR = Free recall)**

Test session 2		SAI		POQ		FR	
		M	(SD)	M	(SD)	M	(SD)
Offender	Correct	3.00	(1.36)	4.25	(1.02)	3.05	(1.09)
	Incorrect	.05	(.22)	.05	(.22)	.80	(.76)
	Accuracy	.99	(.05)	.99	(.03)	.83	(.17)
Victim	Correct	1.00	(0)	1.00	(0)	1.05	(.22)
	Incorrect	.53	(.69)	.50	(1.00)	0	(0)
	Accuracy	.71	(.28)	.84	(.24)	1.00	(0)
Setting	Correct	1.40	(.50)	1.25	(.78)	1.55	(.68)
	Incorrect	.21	(.41)	.50	(.60)	.20	(.41)
	Accuracy	.87	(.22)	.68	(.40)	.87	(.28)
Objects	Correct	1.13	(.51)	1.05	(.39)	1.50	(.60)
	Incorrect	.37	(.49)	.80	(.61)	.05	(.22)
	Accuracy	.77	(.31)	.62	(.28)	.97	(.11)
Action	Correct	4.00	(1.41)	4.15	(1.22)	3.90	(1.25)
	Incorrect	.74	(.99)	1.45	(1.01)	.85	(.93)
	Accuracy	.87	(.17)	.74	(.20)	.83	(.17)

Notes: M = mean, SD = standard deviation.

Accuracy = Total correct details/(Total correct details + Total incorrect details).

### 3.2.1. Correct details

The univariate ANOVAs revealed questioning group effects for correct details in the response category offender ( $F(2,51) = 6.83, p = .002, \eta_p^2 = .21$ ) and objects ( $F(2,51) = 6.89, p = .002, \eta_p^2 = .21$ ) but not in the other categories ( $p > .05$ ).

The contrast analyses showed that the SAI group reported a lower number of correct offender details than the POQ group ( $p = .002$ ) and a lower number of correct object details than the FR group ( $p = .008$ ). Post hoc comparisons revealed that the POQ group reported significantly more correct offender details ( $p = .011$ ) than the FR group. The FR group reported more correct object details than the POQ group ( $p = .003$ ).

### 3.2.2. Incorrect details

In relation to incorrect details, the univariate ANOVAs revealed questioning group effects in the response category offender ( $F(2,51) = 12.55, p < .001, \eta_p^2 = .33$ ), victim ( $F(2,51) = 4.12, p = .022, \eta_p^2 = .14$ ) and objects ( $F(2,51) = 11.84, p < .001, \eta_p^2 = .32$ ) but not in the category setting and action ( $p > .05$ ).

The contrast analyses showed that the SAI group reported less incorrect object details ( $p = .018$ ) than the POQ group. In addition, the SAI group reported more incorrect victim ( $p = .010$ ) and object details ( $p = .041$ ) but less incorrect offender details ( $p < .001$ ) than the FR group. Post hoc comparisons showed that the POQ group reported less incorrect offender details ( $p < .001$ ) but more incorrect object details ( $p < .001$ ) than the FR group. The remaining responding categories did not differ between the groups ( $p > .05$ ).

### 3.2.3. Accuracy

Regarding accuracy rates, the univariate ANOVAs revealed an questioning group effect in the response category offender ( $F(2,51) = 14.47, p < .001, \eta_p^2 = .36$ ), victim ( $F(2,51) = 6.71, p = .003, \eta_p^2 = .21$ ) and objects ( $F(2,51) = 10.02, p < .001, \eta_p^2 = .28$ ) but not in categories setting and action ( $p > .05$ ).

The contrast analysis revealed no differences between the SAI and the POQ groups. However, contrast 2 showed that the SAI group was more accurate regarding offender details ( $p < .001$ ) but less accurate regarding victim ( $p = .001$ ) and object details ( $p = .020$ ) than the FR group. Post hoc analysis revealed that the POQ group was also more accurate regarding offender details ( $p < .001$ ) but less accurate regarding object details ( $p < .001$ ) than the FR group. The questioning groups did not differ in the other categories ( $p > .05$ ).

#### 4. Discussion

We compared the quality of memory reports of an initial applied SAI, an initial POQ and an initial written FR to examine the strength and limitations of each approach directly. We compared the three approaches immediately after observing a video of a real-life crime and after one week in a written questioning.

##### 4.1. Initial memory retrieval

In line with our prediction, we found that adults using the SAI for their initial memory retrieval reported more correct offender, victim, setting and action details than adults using a written FR. The higher number of victim and setting details increased the number of incorrect details but not for the offender and action details. The increase of incorrect details did not reduce the accuracy for victim and action details. Regarding offender and setting details a medium to large effect size and for victim and action details a small effect size was found, indicating that the effect of an initial applied SAI is substantial. Our findings are in line with previous research on the SAI showing that adults who had completed the SAI immediately after witnessing a staged crime reported more correct memory details without a loss of accuracy than adults using a written free recall, a written structured Interview or a CI (Gabbert et al., 2009, 2012; Gawrylowicz et al., 2014; Hope et al., 2014; Krix et al., 2014, 2016; Maras et al., 2014; Paterson et al., 2014). The memory strategies contained in the SAI obviously facilitate memory retrieval reliable and lead to a more complete and accurate initial eyewitness report.

In contrast to our prediction, adults using the SAI for their initial retrieval did not report more object details than adults using the FR. It is possible that the missing benefit may be due to the video scene used in our study because the benefit of the SAI on object details was consistently reported in previous studies using different video scenes (Gabbert et al., 2009, 2012; Gawrylowicz et al., 2014). Although of high external validity, the selected video scene of a Post office robbery attempt was rather short, the video quality was low to middle, the scene was visible from the ceiling perspective only and thus may have contained not enough object relevant details to reveal the benefit of the SAI. The low number of retrieved object details at both test sessions and in all questioning groups supports this explanation. Another explanation could be that the included object details failed to be remembered because they were not central perceptual features (in contrast to gist or thematic features) and require more attention for processing and cognitive resources for their retention (Brainerd & Reyna, 1990; Migueles et al., 2016).

Also in line with our prediction, adults using the SAI reported more correct setting and victim details without a loss of accuracy in their initial memory retrieval compared to adults in the POQ group. The memory strategy contained in the SAI supports particularly initial memory retrieval for setting details. However, the small effect size on victim details needs to be interpreted with caution because the sample size in our study lies beneath the critical number for small effect sizes. To date, further findings are not available to validate our findings. Thus, follow-up research should examine how stable the effect on victim details is. In contrast to our prediction, adults in the SAI group did not report more action and object details during their initial retrieval than adults in the POQ group. The retrieval strategies used in the POQ (funnel-shaped open-ended and closed-ended questions about what happened; e.g. Fisher et al., 1987; Schaal, 2002) seems to be as effective as those in the SAI. This seems to be true for action details because both groups reported a high number of action details. As pointed out before, the number of retrieved object details was rather low in all questioning groups indicating that the used video provided not enough object details for a reliable comparison.

In line with our prediction, adults in the POQ group reported more correct offender details in their initial retrieval compared to adults in the SAI or the FR group. The effect size was medium indicating a substantial benefit of the POQ on offender characteristics. The effect was not accompanied by a loss of accuracy. The strategies applied in a POQ to assess offender characteristics seem to be more effective than the ones contained in the SAI and a major strength of the POQ. However, it is possible that the differences are driven by motivational factors (e.g. direct questioning: less cognitive effort, less metacognitive control strategies, higher consciousness during the social interaction) because the strategies in the POQ and SAI are similar. Follow-up research should address this issue.

In post hoc analyses, we examined initial memory differences between adults using the POQ and adults using the FR. The study revealed no differences in the number of correct victim, setting, action and object details between the POQ and the FR groups. Nevertheless, adults in the POQ group reported a lower number of inaccurate details and were more accurate than adults in the FR group. The post hoc analyses indicate that the POQ is less effective than the SAI in the support of retrieving victim, setting and action related details. Nevertheless, it needs to be considered that a POQ aims to get a first overview of the crime with a focus on what happened, on offender characteristics and on first evidence. Besides this, it is possible that the developed POQ may underestimate the retrieval support given by police officers during real initial eyewitness questionings. Applied follow-up research should address this question.

#### **4.2. Delayed memory retrieval**

The findings in the written questioning after one week differed to a greater extent from our predictions. In contrast to our prediction, adults using the SAI for their initial retrieval did not report more correct offender (vs. FR only), victim, setting, action and object details than adults using a FR or a POQ for their initial retrieval. This pattern of result indicates that the benefit of the SAI partly disappeared in the written questioning after one week. However, it is also possible that the benefit was not visible in the written questioning. One reason for the absent benefit of the SAI might be the retrieval format. In our study a written questioning was conducted in contrast to a written free report (Gabbert et al., 2009, 2012; Gawrylowicz et al., 2014; Krix et al., 2014, 2016), a structured recall interview (Maras et al., 2014) or a CI (Hope et al., 2014). The written questioning did not assess a complete retrieval of the event and contained a selection of questions. Both aspects may interfere with a detailed retrieval and may have led to a low number of retrieved memories. The low mean in all questioning groups underpins this explanation. Besides this, the selected open-ended and closed-ended questions did not contain a complete retrieval of the scene but asked for specific aspects of the crime. This may further underestimate the available memories after the one-week delay. Although this procedure is not unusual by police officers for subsequent questionings (Snook & Keating, 2011) our study shows how memory performance can decrease. In a real subsequent questioning, memory performance might be higher because they are usually conducted verbally and thus motivation and liability might be higher than in the conducted written questioning. In addition, the number of questions in the written questioning was (1) distributed unequal across responding categories (6 for action details vs. 1 for victim details) and (2) was small for the response categories victim (1), setting (2) and objects (2). Only the number of questions for the response categories offender and action was larger (offender = 5, action = 6). For this reason, the small effect size for a higher number of incorrect victim details and lower accuracy rate for victim details in the SAI group should be taken note of with great caution. Although there were a sufficient number of questions regarding offender details, the benefit of the SAI was only found for accuracy after the one-week delay. Follow-up research is needed to examine the overall decrease in performance and to exclude the explanation of the retrieval format (free recall vs. questioning).

In contrast to our prediction, the study revealed that adults in the FR group reported more object details and higher accuracy rates for this category compared to adults in the SAI and in the POQ groups. However, the effect size is small and needs to be examined in a sufficient sample before it can be interpreted reliably. The same is true for the small number of questions about objects. Nevertheless, the effect may indicate a benefit of a FR for perceptual details, which requires more

attention for processing (Brainerd & Reyna, 1990; Migueles et al., 2016) and is well supported in a self-controlled initial written free retrieval because attention is not drawn to other relevant aspects of the crime.

In line with our prediction, adults using the POQ for their initial retrieval reported again more correct offender details in the written questioning compared to adults using the SAI or the FR for their initial retrieval. The POQ group reported as well a lower number of incorrect offender details and was more accurate than the SAI and FR groups. The effect size was small for correct details and medium to high for incorrect details and accuracy rates. As pointed out previously the small effect for correct details needs to be interpreted with caution, the medium to high effect sizes for incorrect details and accuracy rates suggest that the benefit of the POQ on offender details after one week is still substantial. The strategies applied in an initial POQ seems to be effective as well in a written questioning and preserve the benefit of the POQ on offender details over time. The benefit of the POQ may also compensate the change of the retrieval modality from initial verbal retrieval to written delayed retrieval in the POQ group. A change of the retrieval modality did not take place in the SAI and in the FR groups. Although the findings again revealed the strength of the POQ for offender details, the quality of memory retrieval might be underestimated as well by the applied written questioning instead of a free recall. Follow-up research will show whether memories on offender details are underestimated by a written questioning.

#### **4.3. Limitations**

Our study represents a selection of different methodological strategies to examine the quality of the three initial eyewitness questioning approaches. The selection goes along with some limitations that need to be considered. First, we used a mute and short film of a robbery attempt in a post office. The film scene was a real-life shoot observable from the security camera at the corner close to the ceiling. Although the film is highly externally valid, it may have been too short. It is possible that the quality of eyewitness memory is higher in longer criminal events and in criminal events with speech/sound features. Besides this, the ceiling view of the security camera does not represent a typical witness view of a scene and may further underestimate the quality of memory retrieval in this study. Because the same film sequence was used in all questioning groups, the putative influence of the ceiling view is present constantly in the three questioning conditions. Second, a 15inch monitor was used and participants observed the video in a distance of 60 to 80 cm. Although the distance was individually controlled and adapted by the experimenter (experimenter asked each participant about the appropriateness before and after presentation), it is possible that the presentation might have been too small for some participants. Nevertheless, the distance was equal in each questioning group to control for group-specific presentation effects. Third, we used a typical initial POQ containing the minimum standards of an initial police questioning. As pointed out previously, initial POQs vary from police officer to police officer and depend on his/her education and individual adaptations. The developed initial POQ is a first approach to standardize a POQ for the use in an evidence-based study. However, it is possible that our version of the POQ underestimates the quality of the initial POQ and that memory performance is usually higher than with our selected minimum criteria. Fourth, a student in his role as an experimenter and not as a police officer carried out our initial POQ. Although we used the experience of the student as a police officer, it was not allowed to apply the initial POQ in the role of a police officer. From there, it is possible that memory performance of an initial POQ will be higher if it is carried out by an official police officer, wearing a uniform. Fifth, the majority of our participants had a high education level (mainly academic background) and higher literacy abilities. It is possible, that the quality of memory reports will vary in persons with different educational backgrounds and lower literacy abilities. Sixth, after the one-week delay no free recall or realistic interrogation was used (e.g. CI or Police interrogation). It is possible that the quality of memory retrieval would be much higher and more detailed in a free recall or a realistic interrogation than in the comparable short conducted written questioning.

#### 4.4. Summary and conclusion

Based on the study we conclude that the strength of an initial applied SAI lies in the extensive and accurate retrieval support of offender, victim, setting and action characteristics. The strength of an initially conducted POQ containing the minimum standards is the superior retrieval of offender characteristics. The strength of an initial FR is the self-controlled manner of presentation and an almost unaffected retrieval of initial memory characteristics.

The limitations of an initially applied SAI lay in the immediate increase of incorrect victim and setting details and a delayed decrease of accuracy rates for victim and object details. An increase of incorrect details is problematic for the practical work of investigators because investigators do not know what details are reliable and what are not. Therefore, investigators need to know as precisely as possible which kind of details may go along with a higher risk for incorrect memory details. Based on that information, investigators can carefully validate risky memory details using additional sources of information (e.g. objective evidence, other witnesses, coherence analysis) without a total disclaimer of available high-quality memories. In addition, the SAI was less effective in retrieving offender details immediately and after the one-week delay in comparison to the POQ. Thus, one starting point for a refinement of the SAI could be to include further non-suggestive questions assessing offender characteristics as it is done in initial POQs. The limitations of the POQ are that compared to the SAI it was less effective in retrieving victim, action and setting details, although it needs to be considered that these aspects are not addressed primarily in an initial POQ. Compared to the FR, the POQ was less effective in retrieving object details. The limitations of the FR are that it was less effective in retrieving offender, victim, action and setting details. It may be interesting for future research to see how these limitations can be reduced effectively.

In sum, our study revealed that the quality of memory retrieval in an initial applied SAI, an initial POQ and an initial FR was rather high. The quality of initial memory retrieval can be substantially enhanced using an initially applied SAI and a high-quality initial POQ. The initial SAI particularly enhances offender, victim, setting and action details. Nevertheless, it needs to be considered carefully that the SAI also increases the number of incorrect victim and setting details and partly reduces accuracy. The initial POQ facilitates a superior and sustainable retrieval of offender characteristics but not victim, action and setting characteristics. The initial FR particularly enhances object details but not offender, victim, action and setting details. Based on that, the three initial eyewitness questioning approaches can be selected and applied according to their individual strength and can be refined specifically according to their respective limitations in follow-up research.

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The authors declare no competing interest.

#### Author details

Uta Kraus<sup>1</sup>  
E-mail: [uta.kraus@uni-wuerzburg.de](mailto:uta.kraus@uni-wuerzburg.de)  
Fabian Zeier<sup>1</sup>  
E-mail: [fabian.zeier@t-online.de](mailto:fabian.zeier@t-online.de)  
Wolfgang Wagner<sup>1</sup>  
E-mail: [wagnerwolf.wbb@t-online.de](mailto:wagnerwolf.wbb@t-online.de)  
Marko Paelecke<sup>1</sup>  
E-mail: [marko.paelecke@uni-wuerzburg.de](mailto:marko.paelecke@uni-wuerzburg.de)  
Johannes S. Hewig<sup>1</sup>  
E-mail: [hewig@uni-wuerzburg.de](mailto:hewig@uni-wuerzburg.de)

<sup>1</sup> Institute of Psychology, Psychology chair I - Differential Psychology, Personality und Psychological Assessment,

Julius-Maximilians-University Wuerzburg, Marcusstraße 9-11, 97070 Wuerzburg, Germany.

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