

Improving the Enhanced Cognitive Interview With a New Interview Strategy: Category Clustering Recall

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Summary: Increasing recall is crucial for investigative interviews. The enhanced cognitive interview (ECI) has been widely used for this purpose and found to be generally effective. We focused on further increasing recall with a new interview strategy, category clustering recall (CCR). Participants watched a mock robbery video and were interviewed 48 hours later with either the (i) ECI; (ii) revised enhanced cognitive interview 1 (RECI1) — with CCR instead of the change order mnemonic during the second recall; or (iii) revised enhanced cognitive interview 2 (RECI2) — also with CCR but conjunctly used with ‘eye closure’ and additional open-ended follow up questions. Participants interviewed with CCR (RECI1 and RECI2) produced more information without compromising accuracy; thus, CCR was effective. Eye closure and additional open-ended follow up questions did not further influence recall when using CCR. Major implications for real-life investigations are discussed. Copyright © 2016 John Wiley & Sons, Ltd.

INTRODUCTION

Several authors (Dando & Milne, 2010; Fisher & Geiselman, 1992; Paulo, Albuquerque, & Bull, 2013) have acknowledged over the years that interviewing witnesses is a key procedure that can determine the outcome of many police investigations. However, memory is not so accurate and what witnesses report rarely corresponds fully with the witnessed event (Fisher & Geiselman, 2010). Inadequate interviewing techniques commonly used during police investigations can augment this problem often leading to poor testimonies (Flin, Boon, Knox, & Bull, 1992).

To address this issue, Geiselman et al. (1984) developed the cognitive interview. The cognitive interview initially included four cognitive mnemonics: report everything, mental reinstatement of context, change order, and change perspective. The report everything mnemonic consists of instructing witnesses to report everything they can remember whether it seems trivial or not. The mental reinstatement of context consists of asking witnesses to mentally recreate the to-be-recalled event as well as their physiological, cognitive, and emotional states at the time of the crime. The change order mnemonic consists of asking the witness now to recall the event in a different chronological order, often reverse order. Lastly, the change perspective mnemonic consists of asking the witness to recall the event from a different perspective. These last two mnemonics (change order and change perspective) are frequently used to try to obtain information that has not yet been recalled (Fisher & Geiselman, 2010).

A few years later, several social and communicative components that are crucial for conducting good investigative interviews, such as rapport building, witness-compatible questioning, transferring control of the interview to the witness, and mental imagery, were added to a new version of the cognitive interview: the enhanced cognitive interview (ECI; Fisher & Geiselman, 1992). One can read Geiselman

and Fisher (2014) or Paulo et al. (2013) for more information about the ECI components as well as the theory underlying such procedures (Tulving, 1991; Tulving & Thomson, 1973).

The ECI has been found to be very effective in many countries — for example, USA, England, Australia, Brazil, and Portugal (Paulo, Albuquerque, Saraiva, & Bull, 2015b; Stein & Memon, 2006), with different witnesses — for example, children, adults, and elderly (Verkamp & Ginet, 2009; Wright & Holliday, 2006), with a range of delays between the witnessed event and the interview — for example, minutes to months (Larsson, Granhag, & Spjut, 2002), and a variety of events — for example, crime, traffic accident, and phone call (Campos & Alonso-Quecuty, 1999), both in laboratory and field studies (Colomb & Ginet, 2012; Colomb, Ginet, Wright, Demarchi, & Sadler, 2013). These studies consistently showed that this interview technique can increase the number of correct units of information recalled by witnesses while maintaining accuracy (Paulo et al., 2013). Such a finding is frequently referred to as the ECI superiority effect (Aschermann, Mantwill, & Köhnken, 1991; Dando & Milne, 2010; Higham & Memon, 1999; Köhnken, Milne, Memon, & Bull, 1999; Memon, Wark, Bull, & Köhnken, 1997; Rivard, Fisher, Robertson, & Mueller, 2014).

The ECI has been widely used by police forces in several countries (e.g., in England, Wales, and Australia) and found to be very effective. However, it is essential to understand that the ECI comprises multiple mnemonics and instructions that can contribute differently to the ECI superiority effect (Griffiths & Milne, 2010). Thus, several authors focused on assessing the efficacy of each individual component of the ECI, concluding that procedures such as establishing rapport (Vallano & Compo, 2015; Kieckhafer, Vallano, & Compo, 2014), asking for an initial free report (Lamb, La Rooy, Malloy, & Katz, 2011), mental reinstatement of context (Milne & Bull, 1999), or ‘eye closure’ (Vredeveltdt, Tredoux, Kempen, & Nortje, 2015) are often important techniques for obtaining more information. However, other ECI components may be less effective. Although the change order and change perspective mnemonics might be useful for

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some specific purposes, such as increasing cognitive load (Vrij *et al.*, 2008), these are somewhat controversial procedures, particularly the change perspective mnemonic (Boon & Noon, 1994; Brown, Lloyd-Jones, & Robinson, 2008; Clarke & Milne, 2001; Clifford & George, 1996; Dando, Wilcock, & Milne, 2008; Kebbell, Milne, & Wagstaff, 1999; Mello & Fisher, 1996). These two techniques have been criticized mainly because (i) time constraints are common in police investigations and these procedures take a considerable amount of time; (ii) these usually elicit only a limited number of additional units of information (Bensi, Nori, Gambetti, & Giusberti, 2011); and (iii) police officers sometimes consider these two procedures to be ineffective, time-consuming and difficult to use (Dando *et al.*, 2008; Kebbell *et al.*, 1999). Therefore, replacing these two procedures has frequently been discussed in order to develop even more effective interview protocols. For instance, Davis, McMahon, and Greenwood (2005) compared the change order and change perspective mnemonics with free recall attempts and found no advantage of both ECI mnemonics in comparison with free recall tasks. Brunel, Py, and Launay (2013) found that using the open depth instruction (asking participants to focus their attention on the small details while recalling the event once again) instead of the change perspective mnemonic allowed the interviewer to obtain more information. Dando, Ormerod, Wilcock, and Milne (2011) found that recalling in reverse order might be less effective in comparison with another free recall regarding the number and accuracy of recalled units of information. These authors argue that reverse order should be used with caution and only when free recall retrieval has been exhausted. On the other hand, Bensi *et al.* (2011) found that a second recall provided in reverse order was more effective than a motivated second free retrieval attempt.

Therefore, it is arguable whether these two original cognitive interview mnemonics are superior, similar, or inferior, to a second free recall attempt. Nonetheless, even though these interview strategies (change order, change perspective or a further free recall) often only produce low levels of additional information (Davis *et al.*, 2005), this additional information can be very valuable. It is often crucial for an interviewer, after a free recall attempt has been conducted and fully exhausted and open-ended questions have been asked of the witness, to obtain more information through the use of other recall strategies. However, there could be other methods to conduct this second or third retrieval attempt which might be more effective. For instance, the spreading-activation theory of semantic processing (Collins & Loftus, 1975) suggests that memory is often organized according to semantic similarity and that the activation of semantically related memories may occur when successively recalling information related to one specific semantic category (Collins & Loftus, 1975). This is, if asked to recall objects, recalling 'chair' might prime the recall of similar objects (e.g., 'desk' and 'counter') that might in turn prime other related objects, such as 'paper' and 'pencil'. Furthermore, when asked to memorize random word lists, participants often organize these words into semantic categories (e.g., animals, objects, and plants) either during encoding and/or recall — semantic clustering (Manning & Kahana, 2012). When participants use this recall strategy either spontaneously or when

instructed to do so, it typically allows participants to recall more words (Dalrymple-Alford & Aamiry, 1969; Robinson, 1966). However, to our knowledge, this strategy has never been adapted to and tested in an interview setting. It seems likely that similarly to what was found for free recall with word lists, organizing the recall of a crime event in categories (e.g., object details, action details, and person details) may increase the amount of information witnesses can report. Furthermore, memory can be accessed by using several different cues and paths and other recall strategies such as organizing the recall of a crime in semantic categories might trigger further memories (Tulving, 1991). Therefore, guiding witnesses to recall in category clusters might be an effective recall strategy with several advantages over temporal clustering (e.g., reverse order): for example, (i) Recalling a crime event in category clusters might be more natural and compatible with the witness' mental organization of the event in comparison with recalling in a different, often reverse, chronological order. Even though participants seldom spontaneously encode, organize, or recall information in reverse order, they often naturally/spontaneously do this in semantic categories (Dalrymple-Alford & Aamiry, 1969; Manning & Kahana, 2012; Robinson, 1966). Therefore, using a recall strategy that is compatible with the witness' mental organization of the event might optimize recall by facilitating access to the memorized information and preventing the negative impact that an unnatural output of the information can have in disrupting recall (Fisher & Geiselman, 2010); (ii) Recalling in reverse order is a very demanding task which might be useful in some situations (e.g., increasing cognitive load) but may sometimes impair recall because it demands high levels of cognitive resources (e.g., attention) that could otherwise be devoted to recall new information (Vrij *et al.*, 2008). Because category clustering is often performed spontaneously, witnesses might be more familiarized with this task and use less cognitive resources to perform it, focusing more on recall; (iii) As previously stated, memory traces for a given event are often linked and recalling one memory might trigger other related memories (Tulving, 1991). Therefore, according to the spreading-activation theory of semantic processing (Collins & Loftus, 1975), it is possible that successively recalling information (e.g., 'paper', 'desk', and 'pencil') related to one specific cluster (e.g., objects) gradually triggers other memories (e.g., 'counter'), which are closely related to that cluster and might otherwise not be activated and recalled. Based on these premises, we focused on developing a new interview strategy that could serve the purpose of obtaining more accurate information from the witness: the category clustering recall (CCR) instruction.

Current study

In this study, we tested if replacing the change order mnemonic with a new interview technique, CCR (see Method Section), during the second recall attempt (when the change order is typically used) would assist participants to recall more information without compromising report accuracy. This is, we assessed if using semantic clustering to guide retrieval instead of temporal clustering would allow participants to recall more correct information.

Because appropriate questioning can help the witness to recall more accurate information (Gudjonsson, 1992), we also tested whether this could further increase the number of recalled units of information when appropriate open-ended witness-compatible follow up questions are asked during CCR to address the information that is being reported by the witness (e.g., What else do you remember about the objects that were at the crime scene? What did the robber do next?). Furthermore, because eye closure, which refers to asking participants to close their eyes during a memory task, may sometimes enhance recall for event-related details (Mastroberardino & Vredeveldt, 2014; Vredeveldt, Hitch, & Baddeley, 2011; Vredeveldt et al., 2015), we also examined if CCR effectiveness would be enhanced when combined with additional witness-compatible open-ended questions and eye closure. Thus, in this study, one of the groups of participants performed their second recall attempt using the CCR technique in conjunction with both these procedures (see Method Section).

Lastly, we tested if replacing the change perspective mnemonic with the change order mnemonic at the third recall attempt (when change perspective is usually used) would have an impact on recall. As discussed earlier, the change perspective mnemonic has been particularly criticized (Boon & Noon, 1994; Kebbell et al., 1999) for, among other things, having somewhat unclear instructions that are difficult to explain for instance to children (Stein, 2010). Therefore, if participants are able to recall more details, or at least a similar number of details, during this third recall attempt with the aid of the change order mnemonic instead of the change perspective mnemonic, this suggests that the use of a potentially controversial mnemonic (change perspective) can be avoided.

Overall, our main goal was to assess if the number of reported units of information can be increased during the ECI second recall attempt through the use of CCR instead of the change order mnemonic. Furthermore, we tested if eye closure and appropriate open-ended follow-up questions, when used in conjunction with the CCR strategy, would have a further positive impact on recall. Lastly, we compared the change order and change perspective mnemonics effectiveness at the ECI third recall task. Therefore, we established three main hypotheses: (i) Participants interviewed with the CCR instead of the change order mnemonic will recall more information (Dalrymple-Alford & Aamiry, 1969; Manning & Kahana, 2012; Robinson, 1966); (ii) This increase in recall will be higher when eye closure and open-ended follow-up questions are used conjunctly with CCR because, when used properly (e.g., without suggestive questioning), these two procedures have been found to have a positive impact on the number of recalled event related details; (iii) At the third recall attempt, the change order mnemonic can be as, or more, effective than the change perspective mnemonic.

METHOD

Participants

A total of 66 Portuguese psychology students, 59 female and seven male, with an age range from 17 to 48 years ($M=20$,

$SD=5$) participated in this study for course credits. We have used G*Power 3.1 (Faul, Erdfelder, Buchner, & Lang, 2009) to conduct power analysis based on the effect sizes reported in a recent ECI meta-analysis review (Memon, Meissner, & Fraser, 2010) to ensure that our sample size was adequate. Participants were randomly assigned to three interview groups with 22 participants each. The ECI group had 18 female participants and four male participants with an age range from 17 to 46 years ($M=21$, $SD=6$), the revised enhanced cognitive interview 1 (RECI1) group had 22 female participants with an age range from 17 to 29 years ($M=19$, $SD=2$), and the RECI2 group had 19 female participants and three male participants with an age range from 18 to 48 years ($M=21$, $SD=7$).

Design

A between participants' experimental design was used with interview condition as the independent variable with three levels: (i) ECI; (ii) RECI1 — with CCR instead of the change order mnemonic; and (iii) RECI2 — also with CCR instead of the change order mnemonic but conjunctly used with eye closure and additional open-ended follow-up questions ($M=22$, $SD=8$) in comparison with participants interviewed with the RECI1 ($M=4$, $SD=2$) and the ECI ($M=7$, $SD=5$). In both RECI2s (RECI1 and RECI2), the change perspective mnemonic was replaced with the change order mnemonic at the third recall attempt. The amount of reported information and accuracy were measured in information units and proportions, respectively.

Materials

The participants watched the recording on a Fujitsu L7ZA LCD computer screen. The video recording was edited from the second episode of the first season of the 2004 Portuguese television drama 'Inspector Max' (Riccó & Riccó, 2004) and was 3 minutes and 11 seconds long. This non-violent video recording shows a male-armed subject walking inside a bank and taking several hostages to carry the robbery. He verbally and physically interacts with them, with the cashier and a police officer who later approaches the robber. All interviews were video and audio recorded.

Procedure

Ethics committee approval was obtained. Having signed a consent form after reading general information about the study, participants took part in two sessions. At the first session, after being randomly assigned to one of the three interview conditions (ECI vs. RECI1 vs. RECI2), they were shown the video recording. They were asked to pay as much attention as possible to the video recording because they would be later interviewed about it. The second session took place approximately 48 hours later and each participant was interviewed with the ECI, or the RECI1, or the RECI2, according to the interview group.

Interview conditions

The ECI interview protocol employed (Fisher & Geiselman, 1992) had previously been translated and

adapted for the Portuguese language. This interview protocol proved to be effective with a Portuguese population (Paulo, Albuquerque, & Bull, 2015a; Paulo *et al.*, 2015b). This is, the authors were able to replicate the ECI superiority effect (in comparison with a Structured Interview) as well as many other common findings in the ECI literature such as the decline in recall of new information at later stages of the interview (Paulo *et al.*, 2015a; Paulo *et al.*, 2015a, 2015b).

All interview protocols included at least three of the four ECI cognitive mnemonics: Report Everything, Context Reinstatement and Change Order, as well as all the social and communicative components described in Fisher and Geiselman (1992) such as rapport building, transfer of control, appropriate questioning (e.g., witness-compatible questioning), and mental imagery. Fisher and Geiselman (1992) guidelines for conducting the ECI were followed for all interview conditions.

All interview protocols included the same number of retrieval attempts in seven main phases: (i) preliminary phase; (ii) free report; (iii) open-ended questioning; (iv) second recall; (v) third recall (for new information only); (vi) summary; and (vii) closure. All differences between interview conditions were in Phase 4 and Phase 5 as described later. The remaining interview phases were exactly alike in all interview conditions (Table 1).

During Phase 1 (preliminary phase) procedures such as greeting, establishing rapport, explaining the instructions and purpose of the interview to the witness, and asking not to guess were followed for all interview protocols, including the transfer of control instruction: (...) *you are the only one who saw the video and have the ability to report all the important information (...) you can tell me what happened in the order you desire and pause whenever you want*; as well as the report everything instruction: (...) *please tell me everything that you remember with as much detail as you can (...) even the details that might seem irrelevant to you, are very important to me (...) tell me everything that pops into your mind*.

During Phase 2 (free report), all participants were asked to recall what they could remember about the video in any order and pace they desired. They were reminded to report everything they could remember with as much detail as possible and mental reinstatement of context was applied: (...) *Try to remember the day you have watched the video (...) now picture the crime scene in your mind (...) as clear as possible (...) picture all the sounds (...) all the objects (...) all the people (...) and now focus on what happened and tell me everything you can remember*.

During Phase 3 (open-ended questioning), three open-ended questions were asked to each participant according to his/her free report (e.g., *Please describe the weapon — if the participant previously reported seeing a weapon*). Mental imagery instructions were used — for example, *you told me that you looked at the weapon when the robber entered the bank. Can you please close your eyes ..., think about everything that you remember concerning the weapon ..., its color ..., its shape ..., and when you have a full picture of the weapon in your mind describe everything that you can remember about it*.

During Phase 4 (second recall), participants were asked to report what they could remember about the video once again: (...) *I know it may seem redundant, but it is actually highly important that you report one more time what happened on the video (...) report not only new information that you might recall, but also all the information you've already reported (...)*. In all conditions participants were encouraged to give this second report and the importance of such procedure was explained: *It is very important that you focus as hard as you can and tell me one more time what happened on the video*. In the ECI condition, participants were asked to recall the video in the reverse order: (...) *Please tell me everything that happened in reverse order (...) Focus on the last episode that you remember ... then focus on the previous one ... and so on (...)*. *What is the last episode that you remember? (...) Good job! Tell me everything that happened right before that (...) Ok, and before that? (...) Great! What happened before this episode? (...) Did something happen before that? What? (...)*.

In both RECI groups (RECI1 and RECI2), participants were asked to recall the video with the aid of CCR instead of the change order mnemonic (Table 1). This recall strategy consisted on asking participants to recall one more time everything they could remember about the crime episode but this time being asked to organize their recall/speech into information categories. We asked them to first recall everything they could remember about the objects that were at the crime scene and immediately after the location of those objects. Then, we asked participants to recall everything they could remember about the location of each person at the crime scene. Following that, we asked them to focus and recall the actions that occurred during the crime. Lastly, we asked participants to focus on what they might have heard during the video and first recall everything they could remember about what people said during the crime, and then everything they could remember about other sounds they might have heard: *Please tell me everything that happened but focus in one category of information at a time. For*

Table 1. Differences between the three interview conditions according to the interview phase

	Phase 1 preliminary	Phase 2 free report	Phase 3 open-ended questioning	Phase 4 second recall	Phase 5 third recall	Phase 6 summary
ECI	x	x	x	Change order	Change perspective	x
RECI1	x	x	x	CCR	Change order	x
RECI2	x	x	x	CCR (with 'Eye closure' and follow-up questions)	Change order	x

Note: x — no differences between interview conditions. ECI, enhanced cognitive interview; RECI, revised enhanced cognitive interview.

instance, I'm going to ask you to focus on the objects that were at the crime scene, the actions that occurred during the crime, the sounds and voices you might remember, among other aspects, one at a time (...). First, tell me everything that you remember about the objects that were at the crime scene and describe them one by one (...) Good Job. Now focus on the position/s of those objects (...) Ok, now tell me about the position, or positions, that people occupied during the crime (...) Great, now focus on the actions that occurred during the crime (...) Thank you, now focus on what you remember hearing (...) first tell me about what people said (...) and lastly focus on any other sounds you might have heard (...). We have selected these information categories because (i) these are frequently important topics for a police investigation, therefore commonly used in the coding process of investigative interviews; (ii) these are very broad categories that are present in almost every crime, therefore minimizing the interviewer's impact on the participant's report and replacing the need to use specific questions that can have a negative impact on recall, for instance, when information that has not been previously reported is inadvertently included in these questions; (iii) 'conversation' and 'sound' categories focus on a different sensorial mode (hearing instead of vision), which can be important for eliciting new information (Fisher & Geiselman, 1992).

The two procedural differences between the RECI1 and RECI2 conditions were at this phase (Table 1): (i) Although both interview conditions contained the CCR instead of the change order mnemonic, in the RECI2 condition, we asked participants to close their eyes when performing this task. All participants complied with this task and subsequently reported that they felt comfortable doing so. The eye closure instruction was not given to the ECI group or the RECI1 group, where participants were free to use whatever strategy they found to be more useful (e.g., focus on a blank space of the room, look at various locations, and eye closure). In the ECI condition, seven participants spontaneously closed their eyes, and one participant focused on a blank space of the room during this interview phase. In the RECI1 condition, two participants spontaneously used eye closure, and one participant focused on a blank space of the room; (ii) Participants in the RECI2 group were asked additional open-ended follow up questions ($M=22$, $SD=8$) in comparison with participants interviewed with the RECI1 ($M=4$, $SD=2$) and the ECI ($M=7$, $SD=5$). These were witness-compatible open-ended questions to address the information that was being reported during CCR and try to obtain more details (e.g., What did the robber do next?). For the other two groups (RECI1 and ECI), the interviewer only asked a few open-ended witness-compatible questions (see number earlier) that he found to be absolutely necessary to conduct the interview. For instance, if the participant was describing the several moments of the crime together during reverse order, the interviewer would ask her to fully describe what happened during each moment separately.

During Phase 5 (third recall), participants were asked to focus one more time on the video and try to report any new detail they could remember if possible. In all interview conditions, the importance of such a procedure was

explained, and participants were encouraged to do the best they could. In the ECI condition, participants were asked to adopt a different internal perspective in order to try to remember new details: (...) please focus on the event as if it was a normal event at the bank instead of a robbery, as you probably assumed before seeing the robber entering the bank (...). In both RECI protocols (RECI1 and RECI2), participants were asked to use the change order mnemonic (as described earlier for the ECI Phase 4) in order to try to remember new details. Therefore, at this phase, the change perspective mnemonic was replaced with the change order mnemonic for both RECI groups. RECI1 and RECI2 were exactly alike at this phase (Table 1).

During Phase 6 (summary), the interviewer summarized what he understood of the witness' account and asked her to correct him if he misheard or misinterpreted any part of the statement. He also told her to interrupt him if she/he could remember any new detail while hearing the summary. On the last phase (closure), appreciation for participants' hard work and cooperation was acknowledged, and neutral topics were again discussed.

Interviewer training

An expert in the ECI who had followed several qualified courses on investigative interview techniques consisting of more than 50 hours of lectures, practice, role-playing exercises, and feedback/ evaluation conducted all the interviews. To assure that the interviewer performance was adequate and consistent across interview conditions interview protocols were read verbatim whenever possible (e.g., open-ended questioning and summary phase need to be adapted according to the participants' previous recall). Furthermore, an independent expert on human memory and forensic psychology randomly checked 25.5% of the interviews to evaluate the interviewer's verbal and non-verbal behavior using a structured evaluation grid, which included parameters such as the type of questioning used, level of established rapport, instructions clarity, and interviewer's posture/behavior, concluding that these parameters were adequate and consistent across interview conditions.

Coding

Recordings of each interview were coded using the template scoring technique from Memon et al. (1997). A comprehensive list of details in the video recording was compiled and units of information were categorized as referring to (i) person; (ii) action; (iii) object; (iv) location; (v) conversation; and (vi) sound, resulting in 378 units of information. Recalled information was classified as either correct, incorrect (e.g., saying the pistol was brown when it was black) or confabulation (mentioning a detail or event that was not present or did not happen). Also noted was the phase within the interview in which an item of information was recalled. If an item of information (correct or not) was repeated during the same or a subsequent phase, that information was scored only the first time it was mentioned (Prescott, Milne, & Clark, 2011). Subjective statements or opinions were disregarded (e.g., 'The robber was gorgeous').

Inter-rater reliability

To assess inter-rater reliability, 17 (25.5%) interviews were selected randomly and scored independently by a researcher who was naive to the aims of the experiment and hypothesis but familiar with the template method of scoring interviews and had access to the crime video. Intraclass correlation coefficients (ICC) were calculated for correct information, incorrect information and confabulations, and for the six information categories (person, action, etc.). High inter-rater reliability was found for all measures in that the values of the ICC ranged between .980 and 1.000 with an overall ICC of .995.

RESULTS

Eight participants in the ECI condition, seven participants in the RECI1 condition and nine participants in the RECI2 condition (total=27 participants) had previously viewed the television episode from which the to-be-recalled event was compiled. We found no differences between these participants and participants who had not viewed the television episode in terms of the number of recalled correct units of information during the full interview, $t(63) = .381$, $p = .705$, $d = .09$, 95% CI $[-14.76, 10.03]$, and report accuracy, $t(68) = 1.08$, $p = .282$, $d = .27$, 95% CI $[-15.69, 10.96]$. Therefore, this factor was not considered during subsequent analyses.

We then conducted a multivariate ANOVA to see if the interview condition had an effect on memorial performance throughout the interview (all interview phases combined), operationalized in three measures: (i) number of correct units of information recalled; (ii) number of errors committed; and (iii) number of confabulations committed. This found a significant difference in recall performance according to the interview condition, $F(6, 122) = 4.41$, $p < .001$, $Wilk's \Lambda = .68$, $\eta_p^2 = .18$. The univariate F tests found an effect of interview condition on the number of correct units of information

recalled, $F(2, 65) = 8.92$, $p < .001$, $\eta_p^2 = .22$ (Figure 1). There was no effect of interview condition on the number of errors, $F(2, 65) = 2.38$, $p = .101$, $\eta_p^2 = .06$, nor confabulations, $F(2, 65) = .08$, $p = .925$, $\eta_p^2 = .01$, committed throughout the interview.

Planned contrasts for the number of correct units of information recalled during the full interview revealed that participants interviewed with the ECI recalled fewer correct details ($M = 77.09$, $SD = 24.96$) than participants who were interviewed with the RECI1 ($M = 104.55$, $SD = 19.30$) or the RECI2 ($M = 93.82$, $SD = 20.51$), $t(63) = 3.89$, $p < .001$. Planned contrasts also revealed no difference between the RECI1 and RECI2 regarding the number of correct details elicited, $t(63) = 1.64$, $p = .107$.

We then looked separately at Phase 4 (second recall attempt) and Phase 5 (third recall attempt) because these were the only two phases that had procedural differences across interview conditions. We conducted two independent one-way between subjects ANOVAs to see if the number of correct units of information recalled in Phase 4 (second recall attempt) and in Phase 5 (third recall attempt) varied across interviews.

Considering Phase 4 (second recall attempt), we found an effect of interview condition on the number of correct units of information newly recalled during this interview phase, $F(2, 65) = 69.45$, $p < .001$, $\eta_p^2 = .69$. Planned contrasts revealed that participants who recalled the event in reverse order (ECI condition) recalled fewer new correct details during Phase 4 ($M = 4.55$, $SD = 3.79$) than participants in the RECI1 condition ($M = 20.73$, $SD = 5.49$) or the RECI2 condition ($M = 23.09$, $SD = 7.24$) who recalled the event using CCR, $t(63) = 11.70$, $p < .001$ (Table 2).

Planned contrasts found no difference between the RECI1 and RECI2 regarding the number of correct details elicited at Phase 4 (Table 2), $t(63) = 1.37$, $p = .163$. Thus, using eye closure, and asking additional open-ended follow-up questions seems not to have an impact on recall while using CCR.

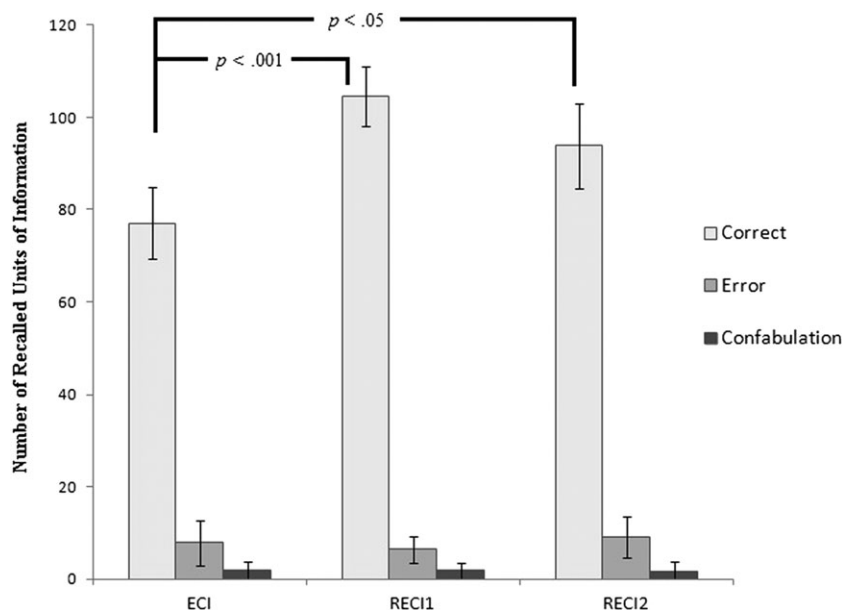


Figure 1. Number of correct units of information, errors and confabulations reported in each interview condition

Table 2. *M* and *SD* values for the number of correct units of information newly recalled in each interview phase, according to the interview condition

Interview phase	ECI		RECI1		RECI2	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Free report	37.95	17.21	38.82	17.53	32.77	9.99
Questioning	29.45	11.31	41.77	12.10	33.72	11.83
Second recall	4.55	3.79	20.73	5.49	29.09	7.24
Third recall	3.32	2.32	1.95	1.68	2.14	3.50
Summary	2.59	2.74	1.27	1.58	1.05	1.13

Note: *M*, mean; *SD*, standard deviation; ECI, enhanced cognitive interview; RECI, revised enhanced cognitive interview.

Regarding Phase 5 (third recall attempt), we found no effect of interview condition on the number of correct units of information newly recalled, $F(2, 65) = 1.77$, $p = .178$, $\eta_p^2 = .05$, which suggests that at this later phase of the interview using the change order mnemonic (RECI1 and RECI2) instead of the change perspective mnemonic (ECI condition) does not influence the number of new correct units of information that participants are able to recall. As seen in Table 2, the number of new correct units of information recalled at this phase was very low for all groups.

Lastly, although the aforementioned results suggest that participants interviewed with the RECI1 and RECI2 recalled more correct information and that this might be explained by the use of CCR instead of the change order mnemonic, it is important to see if report accuracy was not compromised with this new recall strategy. This is, it is important to test if participants in the RECI1 and RECI2 groups were not committing a higher proportion of errors (ratio between the number of errors produced over all produced units of information) or confabulations (ratio between the number of confabulated units of information over all produced units of information), therefore compromising their report accuracy (correct recall proportion: ratio between the number of correct units of information recalled over all the recalled units of information). For this purpose, we conducted three two-way mixed-design 3×5 ANOVAs to see if interview condition (ECI vs. RECI1 vs. RECI2) as well as interview phase (Phase 2 vs. Phase 3 vs. Phase 4 vs. Phase 5 vs. Phase 6) had an effect on: (i) correct recall proportion; (ii) error proportion; and (iii) confabulation proportion. Phase 1 (preliminary phase) was not included in these analyses because participants did not recall information at this phase. We found no main effect of interview condition, $F(2, 31) = 1.46$, $p = .248$, $\eta_p^2 = .09$, and interview phase, $F(2.402, 74.475) = 2.45$, $p = .083$, $\eta_p^2 = .07$, on correct recall proportion (i.e., accuracy). There was also no interaction effect of interview condition and interview phase on correct recall proportion, $F(4.805, 74.475) = .30$, $p = .904$, $\eta_p^2 = .02$. We found no main effect of interview condition, $F(2, 32) = 1.50$, $p = .239$, $\eta_p^2 = .09$, interview phase, $F(2.081, 66.608) = 1.86$, $p = .163$, $\eta_p^2 = .06$, as well as no interaction effect, $F(4.163, 66.608) = .27$, $p = .900$, $\eta_p^2 = .02$, for participants' error proportion rate. Lastly, we found no main effect of interview condition, $F(2, 33) = 1.67$, $p = .203$, $\eta_p^2 = .09$, interview phase, $F(2.256, 74.461) = .72$, $p = .506$, $\eta_p^2 = .02$, and no interaction effect between these two variables on

confabulation proportion, $F(4.513, 74.461) = .88$, $p = .489$, $\eta_p^2 = .05$. Thus, participants interviewed with the CCR (RECI1 and RECI2) were able to provide more information without compromising accuracy.

DISCUSSION

This study examined whether the use of CCR could increase the quantity of information reported during participants' second recall attempt. Our major findings were that participants who used CCR (RECI1 and RECI2 groups) were able to recall a considerably higher number of correct details without compromising accuracy, in comparison with participants who used the change order mnemonic. Furthermore, we tested if using eye closure as well as asking participants additional open-ended follow-up questions would have an impact on recall. We found that both procedures, when used together, did not further influence the number and accuracy of newly recalled units of information at the second recall attempt while using CCR. Lastly, we found that at the third recall attempt, participants interviewed with the change perspective mnemonic (ECI condition) recalled a similar (but low) number of correct units of information in comparison with participants interviewed with the change order mnemonic (RECI1 and RECI2 conditions).

Because increasing the number of produced details is a major aim of investigative interviews (Fisher & Geiselman, 1992; Milne & Bull, 1999), we focused on developing a new recall strategy that could fit this purpose. We found that participants who used CCR during their second recall attempt (Phase 4) provided more new correct units of information than participants who used the change order mnemonic. As we have outlined in the introduction, there are relevant theoretical explanations for why CCR enhanced recall in comparison with the change order mnemonic. Recalling a crime event in category clusters might be a more natural strategy because people often spontaneously encode, organize, and/or recall information in semantic clusters. Therefore, CCR may be more compatible with the witnesses' mental organization of the event (Dalrymple-Alford & Aamiry, 1969; Manning & Kahana, 2012; Robinson, 1966). Furthermore, because participants may be used to encode and/or recall information in semantic clusters, they may be more acquainted with CCR, requiring less cognitive resources (e.g., attention) to perform this task. Consequently, they can allocate more cognitive resources for trying to remember new details, that they might otherwise not have available, for instance, while recalling the event in reverse order which is an unfamiliar and cognitively demanding task (Vrij et al., 2008). Thus, CCR might also have prevented the negative impact that an unnatural and demanding recall strategy can have in disrupting recall (Fisher & Geiselman, 2010). Lastly, as also mentioned in the introduction, memory traces for a given event overlap, and the activation of a memory trace might trigger other memories (Tulving, 1991). It is possible, according to the spreading-activation theory of semantic processing that states that memory is often organized according to semantic similarity (Collins & Loftus, 1975), that successively focusing on, and recalling, information related to one specific

cluster (e.g., objects: 'paper', 'desk', and 'pencil') gradually produced enough activation to trigger related memories/information (e.g., 'counter') that might otherwise not be activated and recalled..

Report accuracy was not compromised with CCR because participants interviewed with CCR did not commit a higher proportion of errors and confabulations in comparison with participants who were interviewed with the change order mnemonic, therefore maintaining a high correct recall proportion. High accuracy was expected for all interview conditions because all the interview protocols contained adequate instructions (e.g., instruction not to guess; rapport building; transfer of control, etc.) and adequate questioning (e.g., witness-compatible questioning) in order to maximize report accuracy (Fisher & Geiselman, 2010). Furthermore, category clustering has previously been found to enhance recall regarding information quantity (e.g., with word lists) while not compromising recall accuracy (Dalrymple-Alford & Aamiry, 1969; Manning & Kahana, 2012; Robinson, 1966).

Because eye closure has been found to sometimes enhance recall for event-related details (Mastroberardino & Vredeveldt, 2014; Vredeveldt *et al.*, 2011; Vredeveldt *et al.*, 2015) and using adequate open-ended follow-up questions might also have a positive impact on recall (Gudjonsson, 1992), we tested how the combined use of these two procedures could influence recall when using CCR. However, we found that participants who closed their eyes and were subjected to additional open-ended follow-up questions during CCR (RECI1) did not recall more information in comparison with participants who also used CCR but were not subjected to these two procedures (RECI1). Our study suggests that the CCR superiority effect in terms of the number of recalled units of information does not seem to be affected by these two variables. It is quite possible that even though eye closure combined with 'questioning' can sometimes improve recall (Gudjonsson, 1992; Mastroberardino & Vredeveldt, 2014; Vredeveldt *et al.*, 2011; Vredeveldt *et al.*, 2015), such effects are not strong enough to be significant when tested only for the second recall attempt, where the number of recalled units of information is somewhat small, in comparison with the number of recalled details throughout the whole interview. Furthermore, for the purpose of conducting adequate investigative interviews, the interviewer allowed two participants to spontaneously use eye closure in the RECI1 condition and always tried to reduce to a minimum all possible auditory and visual distractions in the interview environment for all interview conditions, which research suggests that may be as effective as eye-closure (Mastroberardino & Vredeveldt, 2014; Vredeveldt *et al.*, 2011).

Lastly, because the change perspective mnemonic has been particularly criticized (Boon & Noon, 1994; Kebbell *et al.*, 1999), we examined if this ECI component could be replaced by the change order mnemonic. We found that participants who used the change order mnemonic (RECI1 and RECI2 conditions) instead of the change perspective mnemonic (ECI condition) during their third recall attempt (Phase 5) recalled a very similar number of new details in this phase with similar accuracy values. Recall of new information at this later stage of the interview is usually quite

small (Davis *et al.*, 2005) and, regardless of the procedure used, it is possible that participants have somewhat 'exhausted' their memory capacity.

In sum, CCR could be a very effective recall strategy that might trigger additional memories (Tulving, 1991), allowing the witness to retrieve additional information with the use of very broad semantic categories that are present in almost every crime (e.g., objects, actions, and locations), thus enhancing witnesses' recall. This procedure is effective without the use of eye closure, and additional questioning as sometimes used during the questioning phase, which can be a very demanding procedure particularly for less experienced interviewers that can easily inadvertently include less appropriate questions (e.g., an excessive number of close-ended questions or even the inclusion of suggestive questions) that can have a negative impact on recall (Clarke & Milne, 2001; Westera, Kebbell, & Milne, 2011).

LIMITATIONS AND FUTURE RESEARCH

As with the majority of laboratory mock witness research, the present study contained methodological limitations such as the use of a mock crime video and mock witnesses. Therefore, field research that evaluates CCR effectiveness during real police investigations as well as how to use it in a dynamic and flexible manner is necessary. Future studies that evaluate CCR effectiveness in comparison with other interview strategies (e.g., witness-compatible questioning), as well as further studies that control the effect of eye closure and/or additional questioning separately, are also important.

CONCLUSION AND PRACTICAL IMPLICATIONS

The change order and change perspective mnemonics have been somewhat criticized not only in terms of efficacy (Bensi *et al.*, 2011) but also in terms of usage (Dando *et al.*, 2008; Kebbell *et al.*, 1999) and might not be more effective than an additional free recall task (Dando *et al.*, 2011; Davis *et al.*, 2005). Considering the impressive number of details that participants interviewed with the CCR strategy were able to report at the second recall attempt, we conclude that this might be a very important technique for obtaining better testimony. Even though CCR might already be partially used in practice during witness-compatible questioning (Can you describe the location of the perpetrator and witnesses?), this is likely to occur in many different ways that might have different efficacy. To our knowledge, this is the first study to test a specific and well controlled protocol to apply CCR during the second recall attempt, which found that recalling a crime event in broad category clusters is effective. Therefore, professionals and researchers have now available a new specific tool to obtain more correct information from the witness, which can be a decisive factor in the field (Fisher & Geiselman, 1992). Lastly, our results show that using the change order mnemonic during the third recall attempt, instead of the change perspective mnemonic, might be a viable alternative because, even though both procedures seem to produce similar and low amounts of recall, the change order mnemonic might be easier to apply and explain to the witness

(Boon & Noon, 1994; Kebbell et al., 1999). As previous research suggests (Bensi et al., 2011), our study also supports that a possible alternative for time critical situations might be to exclude both the change order and the change perspective mnemonics from the ECI protocol because these procedures seem to be unable to elicit a considerable number of new details that might justify using these in time-demanding situations.

ACKNOWLEDGEMENTS

This work was supported by the Portuguese Foundation for Science and Technology under Grant number SFRH/BD/84817/2012. This study was conducted at the Psychology Research Centre (UID/PSI/01662/2013), University of Minho, and also supported by the Portuguese Foundation for Science and Technology and the Portuguese Ministry of Science, Technology and Higher Education through national funds and co-financed by FEDER through COMPETE2020 under the PT2020 Partnership Agreement (POCI-01-0145-FEDER-007653).

CONFLICT OF INTEREST STATEMENT

The authors declare that there are no conflicts of interest.

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