Visual Learning: The Effect of Sketching on Recall of a Witness' Account

By

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Abstract

The impact of sketching on memory for details of an account was examined across three experiments. In Experiment 1, participants (*N* = 84) were provided with an account of a robbery that was delivered either in an audio-visual sketch or an audio-only format, and asked to recall the account. In Experiment 2, participants (*N* = 116) were provided with an account regarding an assault that varied in length (5-minutes, 10-minutes, 15-minutes) and was presented in either audio-visual sketch or audio-only format. In Experiment 3, participants (*N* = 173) were provided with an account of an emergency medical situation that varied in presentation modality (audio-only, static sketch, hybrid sketch, dynamic sketch) and were either given the opportunity to have access to the sketch during recall or not have access to the sketch during recall. The results of the three experiments showed that participants provided with audio-visual sketch information outperformed participants provided with audio-only information. Experiment 2 revealed that short accounts are remembered better than longer accounts. Experiment 3 showed that dynamic visual information was remembered better than static visual information or audio-only information. In addition, Experiment 3 showed that having access to the sketch while recalling the account is less important as the mobility of the sketch increases. The utility of sketching as a viable learning mechanism for investigative interviewers is discussed.

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Chapter 1: Introduction

The successful resolution of criminal investigations is inexorably linked to effective investigative interviewing (Kebbel & Milne, 1998). In a typical interview, interviewers were not present during the commission of a crime and therefore must talk to interviewees (i.e., witnesses, victims, and suspects) to learn about things they experienced; the interviewers learn about the details of the crime by listening to verbal accounts of the events that unfolded. It is crucial that interviewers understand these accounts so they can advance their investigation (e.g., ask follow-up questions, link information to other case facts). To date, numerous techniques have been developed, validated, and implemented to help interviewees increase the completeness and accuracy of their accounts. However, there is a lack of research examining how well interviewers comprehend the accounts provided by interviewees, or importantly, whether any of the memory-enhancing techniques have dual benefits of assisting both interviewees and interviewers.

The overarching goal of the current program of research was to examine the extent to which interviewers are able to comprehend the information obtained from interviewees. A review of the extant literature on memory-enhancing techniques suggests that, of the several empirically-supported techniques for helping interviewees remember and recall more information, sketching (a relatively new technique in the interviewer's toolbox) is seemingly the only technique to also benefit the interviewer. Sketching is thought to benefit the interviewer because it reduces the cognitive load on the interviewer by allowing him/her to learn material as it is presented via multiple information-processing channels (i.e., aural and visual sensory channels; Dando, Wilcock, Milne, & Henry, 2009a; Dando, Wilcock, & Milne, 2009c).[1] More specifically, the objectives of the current program of research are to test the extent to which the following impact an interviewer's memory for an interviewee's account: concomitantly viewing a sketch and listening to an account (Experiment 1); the length of the account (Experiment 2); the degree of kineticism of the sketch and access to the sketch during recall (Experiment 3).

In the remainder of Chapter 1, a review of memory-enhancing techniques in the domain of policing is discussed, along with evidence supporting memory-enhancing techniques, theoretical underpinnings for the techniques, and barriers to their implementation. Next, sketching is described, along with the effectiveness of sketching for interviewees, and the theoretical reasons why it ought to also benefit interviewers.

Memory Enhancing Techniques in Investigative Interviews

Investigative interviews are invaluable for benefiting criminal investigations because they provide police officers with the checkable and verifiable information they need to solve crimes (information pertaining to *modus operandi*, *actus reus, mens rea*; Milne & Bull, 1999, 2001; Milne & Shaw, 1999; Shepherd & Griffiths, 2013). Interviewing constitutes the majority of police officers' time (Rand Corporation, 1975), and police officers view interviewing as a key part of their job (George & Clifford, 1992; Hill & Moston, 2011; Kebbell & Wagstaff, 1997). Despite the importance of interviewing, however, it has been identified as a major weakness in the investigative process as interviewers generally do not obtain high quality accounts from interviewees, and relevant investigative information is often unexplored sufficiently (ACPO, 2009; Dando et al., 2009a; Kebbell & Milne, 1998).

Of particular importance for interviewers is their ability to have a good grasp of what transpired during a criminal event (as relayed to officers during the interview). Often at the beginning of an interview, the interviewer will request that an interviewee provide an account, or a free narrative, in order to obtain a report about the criminal event. The initial account from the interviewee provides approximately one third to one half of all information extracted during the entire interview (Milne & Bull, 2003). It is this initial phase that provides the interviewer with insight into the interviewee's mental representation of the event (Milne, Shaw, & Bull, 2007). The information obtained from an investigative interview also aids the police officer with other tasks such as identifying central lines of inquiry that can advance investigations; completing structured summaries (i.e., written reports) that are examined by other investigators and supervisors; making informed decisions of how to proceed with the investigation (e.g., laying charges); presenting information to Crown prosecutors that will be used in the development of legal proceedings; and presenting information to triers of fact such as judges and jurors, who render verdicts pertaining to culpability. Ultimately, the comprehension of an interviewee's account is the starting point of an investigation and will aid investigators in integrating the pieces that will form the basis of a successful investigation and prosecution of a crime.

Given the significance of investigative interviews, much research has been conducted over the past 30 years to develop techniques that enhance an interviewee's memory for criminal events. Effective interviewing requires the use of techniques that: (1) elicit complete and accurate information from interviewees, (2) meet the real-world needs of interviewers by being quick and easy to implement, and (3) facilitate an interviewer's comprehension of an interviewee's account. Much research has focused on the first two characteristics of interviewing, but less attention has been devoted to the third element.

A plethora of investigative interviewing protocols have been created with the purpose of obtaining complete and accurate information from interviewees. Some of these protocols include Achieving Best Evidence (formerly the Home Office Memorandum; Home Office, 2002), the Step-Wise method (Yuille, Hunter, Joffe, & Zaparniuk, 1993), hypnosis (Reiser, 1980, 1990; Wagstaff, 1993), and the Federal Law Enforcement Training Centre's Five-Step Interview Protocol (Rivard, Fisher, Robertson, & Mueller, 2014). Of particular note however, is Fisher and Geiselman's use of psychologically-based research to develop the Cognitive Interview (CI; Fisher & Geiselman, 1992; Geiselman, Fisher, MacKinnon, & Holland, 1985), as it has been shown to be the most effective memory enhancing protocol to aid in the retrieval of information from interviewees (Köhnken, Milne, Memon, & Bull, 1999; Memon, Meissner, & Fraser, 2010).

Several factors led to the creation of the CI, including interest from the U.S. Department of Justice (Geiselman & Fisher, 2014), judicial and practical issues with hypnosis (a common interviewing technique used in the mid-1980s; Sanders & Simmons, 1983), and research showing that police officers receive inadequate or scant investigative interview training (Geiselman & Fisher, 2014; Rand Corporation, 1975). In its early stages, the CI consisted of four core memory-retrieval techniques, or mnemonics, which were derived from two theories within the cognitive psychological domain, namely the multi-component view of memory trace and the encoding specificity principle.

The multi-component view of memory trace (e.g., Bower, 1967; Flexser & Tulving, 1978; Tulving, 1974; Wickens, 1970) postulates that memory may be represented in multiple mental images rather than a holistic representation of the original event (Tulving, 1974). It is therefore assumed that multiple retrieval cues that explore different memory routes are necessary to extract details of an event. MacKinnon, O'Reilly, and Geiselman (1990) studied the multi-component view of memory trace by examining individuals' memory for licence plates. Participants were shown a series of slides that depicted someone placing a television in a car, and were later asked to recall the letters and numbers on the licence plate. Participants who were questioned using probes that accessed multiple mental images (e.g., "Did the letters or number remind you of any words of things?") recalled substantially more information than participants who were given standard questions (e.g., What colours were on the licence plate?").

The encoding specificity principle (Tulving & Thomson, 1973; Vaidya, Zhao, Desmond, & Gabrieli, 2002) postulates that a retrieval probe that is similar to how an individual encoded an event will be more effective than a retrieval probe unrelated to how the event was encoded. In a classic study by Godden and Baddeley (1975), divers were presented with the task of learning unrelated words in two distinct environments: on dry land and underwater. Their results showed that recalling the words in the same environment as they were learned, compared to recalling the words from a different environment in which they were learned, led to improved learning (effect sizes ranged from $d = 0.70$ to $d = 1.08$). Their results were interpreted as context-dependent memory. Meta-analyses have shown the effect of context-dependent memory is reliable when recreating the environment (Smith & Vela, 2001; 93 effect sizes, average $d = 0.28$), and mood of the to-be-remembered event (Ucros, 1989; 40 effect sizes, average $d = 0.44$).

As mentioned, the mnemonics that compose the CI are grounded in the above two theories of multi-component view of memory trace and encoding specificity. The CI mnemonics include: (a) report everything, (b) mental reinstatement of context (MRC), (c) change recall order, and (d) change perspective (Köhnken et al., 1999). Each of the mnemonics are described below.

Report everything. The report everything instruction encourages interviewees to report everything without editing, even if the interviewee thinks that the information is trivial, cannot recall the information in its entirety (i.e., incomplete recall), or recalls the information out of order or out of place (i.e., not presented in a linear fashion). This instruction is important as research has shown that people may edit information when telling stories, or may not spontaneously report everything that they remember about an event (Loftus, 1979). Furthermore, what the interviewee considers an insignificant detail, which s/he may not share without this instruction, may be important for the interviewer. Reporting partial information can also lead to the interviewee remembering and reporting other connected or associated details (Kebbell & Milne, 1998; Milne & Bull, 2002).

Mental reinstatement of context. The mental reinstatement of context (MRC) instruction requests that an interviewee put him/herself mentally back to the scene of the event in order to recreate the internal (e.g., emotions) and external (e.g., physical features) contexts of the experienced event (Köhnken et al., 1999). For example, interviewers will provide the interviewee with retrieval cues to help tap into various memory stores in order to mentally recreate the sights, sounds, smells, and emotions of when the event was encoded. The MRC instruction draws upon what is known about context-dependent memory, where memories for details are enhanced if individuals are able to recreate the event in their mind (i.e., mentally bring them back to the scene of the crime).

Change recall order. The change recall order mnemonic involves interviewees being told to recall the event in an atypical order. For example, rather than tell a story from beginning to end, as is done normally, the interviewer may request that the interviewee tell the story in reverse order. For instance, the interviewer may ask the interviewee to start at the end of the event and work toward the beginning of the event. Requesting interviewees to recall information in different orders is particularly useful when attempting to break script memory (i.e., memory for repeated events; Geiselman & Callot, 1990). Script memory is problematic for people who have experienced multiple victimizations of the same nature (e.g., serial sexual abuse) as they may report only skeletal features or features that were common across most events. By breaking script memory, interviewers are able to obtain details of experienced events that are unique to each incident.

Change perspective. For the change perspective instruction, the interviewee is encouraged to recall the experienced event from a different point of view (e.g., that of another observer present at the scene) or a different psychological perspective. In terms of a different psychological perspective, for example, an interviewee may be asked to describe the event, or part of it, from the perspective of a mechanic. By processing an event from a different perspective, the interviewee is encouraged to think about the event in a different manner, helping him/her to focus on details other than those reported previously (Milne & Bull, 2002).

Since its inception, the CI has evolved, and continues to do so, to meet the needs of investigative interviewers and to assist interviewers with obstacles they have encountered. For example, interviewers reported difficulties obtaining meaningful accounts from witnesses who were nervous at the outset and/or throughout an interview, and who were unclear about their role during the interview (Fisher, Chin, & McCauley, 1990; Sydeman, Cascardi, Poythress, & Ritterbrand, 1997). In response to such concerns, Fisher and Geiselman (1992) incorporated knowledge about social interaction and communication techniques into the CI (Fisher et al., 1990; Fisher & Geiselman, 1992; Memon et al., 2010).

One of the key social interaction additions to the CI was the use of rapport. Rapport refers to creating a positive and equal working relationship between the interviewer and interviewee (Abbe & Brandon, 2013; Collins, Lincoln, & Frank, 2002). Rapport building is important to ensure that the interviewee feels comfortable during the interview. Vallano and Schreiber Compo (2011) tested the impact of rapport on information provision and susceptibility to post-event misinformation. In their study, participants viewed a mock-crime video whereby a man stole money from a woman's purse. Participants then completed a five-minute filler task, and were interviewed about the video. Participants who were exposed to rapport building (in the form of self-disclosure) reported significantly more accurate information, less inaccurate information, and were less susceptible to misinformation compared to those who were not exposed to rapport building. The positive effects of rapport building have also been shown in the child interviewing literature (Abell, Locke, Condor, Gibson, & Stevenson, 2006; Gurland & Grolnick, 2008; see Hershkowitz, 2011 for a review of rapport building in child interviews). Methods of building rapport include verbal and nonverbal techniques, such as: transferring control of the interview to the interviewee, whereby the interviewee is encouraged to take charge of the pace and direction of the interview (Kebbell, Milne, & Wagstaff, 1999; Memon, Wark, Bull, & Köhnken, 1997); displaying empathy or sympathy, being courteous, open, and making eye contact and smiling (Vallano, Evans, Schreiber Compo, & Kieckhaefer, 2015; Vallano & Schreiber Compo, 2015).

The use of proper communication techniques is also important during an interview. Proper communication techniques include factors such as pausing appropriately during the interview to provide the interviewee with an opportunity to think and talk, not interrupting the interviewee, and asking appropriate questions, such as open-ended questions that allow the interviewee to provide large amounts of information. Inappropriate questions have the potential to extract short, incomplete, or inaccurate answers, and can ultimately call into question the reliability of information obtained during an interview (Snook, Luther, Quinlan, & Milne, 2012). Research also suggests that it is important to not interrupt an interviewee's account so that central topics can be noted for further exploration within the questioning phases of the interview, information of investigative value is not lost, and the interviewee is given every opportunity to express himself/herself (Beune, Giebels, Adair, Fennis, & Van Der Zee, 2011). Overall, the CI is a witness-centred toolbox of memory-enhancing techniques that incorporates three key well-founded psychological processes: cognition, social dynamics, and communication (Fisher & Geiselman, 2010).

Effectiveness of the CI. Over the past 30 years, the CI has been tested extensively in more than 100 laboratory and field experiments, consisting of thousands of individual interviews. In a typical experiment examining the CI, participants are shown a video and are subsequently questioned on the contents of the video. Participants are either questioned through the CI and either a standard interview or a structured interview (i.e., control interviews). A standard interview refers to an interview conducted by an untrained interviewer, whereas a structured interview refers to an interviewer that has been trained in the communicative techniques incorporated in the CI, but has not received any training regarding the memory-enhancing mnemonics (Köhnken et al., 1999).

Two meta-analyses have synthesized the quantitative data regarding the CI. Köhnken et al. (1999; 55 effect sizes) and Memon et al. (2010; 59 effect sizes) both reported strong overall effects for an increase in correct recall for the CI compared to control interviews (d = 0.87 and d = 1.20, respectively). However, Köhnken et al. and Memon et al. also reported a significant, but small, increase in incorrect recall when the

CI was compared to control interviews (*d* = 0.24 for both meta-analyses). While not examined by Köhnken et al., Memon et al. revealed that there was no significant difference between the CI and control group in terms of producing confabulations (*d* = 0.08).

Given the effectiveness of the CI, researchers were interested in determining the relative performance of the various mnemonics; that is, whether the inclusion of all mnemonics was necessary for its effectiveness. The results from this area of research are mixed. In a study by Boon and Noon (1994), participants watched a one-minute film of an armed robbery at a bank and were interviewed about the contents of the film two days later. All participants were given two recall attempts: the *report everything* instruction, which was followed by one of the remaining three mnemonics (*MRC*, *change recall order*, *change perspective*). Their results showed that the *change recall order* and *mental reinstatement of context* were most useful for enhancing participants' accuracy scores.

In another study examining the relative effectiveness of the individual mnemonics, Milne and Bull (2002) showed participants a three-minute video of an accident involving a car and pedestrian, and participants were interviewed two days later. Contrary to the Boon and Noon (1994) study, participants were interviewed using a single CI mnemonic (except for one condition that combined *MRC* and *report everything*). Their results showed that the condition that incorporated both the *MRC* and *report everything* mnemonics resulted in more recall compared to when the mnemonics were used individually. There was no statistically significant difference among the four mnemonics. However, Milne and Bull encouraged practitioners to use all of the CI mnemonics to ensure complete information is being obtained from interviewees. Other research points toward *MRC* being one of the most effective mnemonics for interviewees (Bekerian & Dennett, 1993; Dietze & Thomson, 1993; Memon & Bull, 1991; Memon, Cronin, Eaves, & Bull, 1996).

Barriers to CI Implementation. Despite the considerable amount of evidence for the effectiveness of the CI for eliciting complete and accurate information from interviewees, research suggests that the CI is not often implemented by practitioners, either as individual mnemonics or in full (Memon et al., 1994). Clark and Milne (2001) conducted a nation-wide evaluation of investigative interview training in the UK and found that the majority of the interviews they examined did not incorporate any CI mnemonics. Specifically, interviewers reported that they often lack sufficient training on how to implement CI components, the CI is too difficult to implement, and the CI takes too much time to implement.

The first major issue regarding implementing the CI is that police often lack sufficient investigative interview training. Research from around the world, including the United States, the UK, and Canada, revealed that proper investigative interview training is often lacking, or when training is received, is deemed insufficient (Fisher & Schreiber, 2007; Fisher, Geiselman, & Raymond, 1987; Heidt, Arbuthnott, & Price, 2016; Snook & Keating, 2011; Snook, House, MacDonald, & Eastwood, 2012; Milne & Bull, 1999; Schreiber Compo, Gregory, & Fisher, 2012; Wright & Alison, 2004). Interviewers have also reported that they are reluctant to use the CI techniques because the training they receive does not provide sufficient justification for their use (Wells, Memon, & Penrod, 2006).

Among the officers who are trained, there is some discrepancy as to how the CI is implemented. For instance, Kebbell et al.'s (1999) survey of over 100 police officers revealed that *report everything* and *MRC* are viewed as the most useful and most utilized mnemonics. In a field study that examined trained officer behaviour, Clifford and George (1996) found that the *MRC* component was used nine times more than other CI components (i.e., *change perspective, change recall order*). The mnemonics that were rated as less effective and used less often were the *change perspective* and *change recall order* mnemonics. These findings have been replicated by other researchers sampling police officers at various stages in their career (from less than two years of service to 15 years of service; Brown, Lloyd-Jones, & Robinson, 2008; Dando, Wilcock, & Milne, 2008; Dando et al., 2009c; Kebbell & Milne, 1998; Wright & Holliday, 2005).

Another barrier to implementing the CI is that is it difficult to communicate some of the CI instructions to interviewees, and thus the mnemonics are often implemented poorly (Dando et al., 2009a; Kebbell et al., 1999; Kebbell & Wagstaff, 1996). For example, a field study by Memon et al. (1994) revealed that trained interviewers had difficulty communicating the *change recall order* instruction to interviewees. As interviewers have difficulty implementing the various mnemonics, they are unlikely obtaining complete and accurate accounts from interviewees. Researchers have also raised concerns about the risks that improper implementation of CI components will have on the information that is elicited. The *MRC* component, for instance, requires an officer to give the interviewee various retrieval cues. The problem is that retrieval cues may be ineffective or incompatible with certain interviewees (e.g., those with developmental disabilities), thus resulting in incomplete or inaccurate information being obtained. Furthermore, there is also concern that interviewers may leak investigative information when delivering the retrieval cues, potentially tainting the interviewee's recall and subsequent investigative decisions (Dando et al., 2009c).

Officers also do not implement the CI due to the amount of time needed to use the protocol. Research has shown that police officers often feel strapped for time (Martinussen, Richardsen, & Burke, 2007), and because of this, they do not have the opportunity to implement the full CI and conduct a proper interview (Kebbell & Milne, 1998; Kebbell et al., 1999). Time constraints are especially prevalent for frontline (i.e., street patrol) officers who spend the majority of their time investigating volume crime (e.g., theft, robbery, break and enter; ACPO, 2009). Frontline officers are often tasked with solving these crimes quickly and are thus not given the sufficient time resources to conduct full-scale investigative interviews. Overall, researchers have recognized that the CI is a complex procedure that requires considerable training, time to implement, and places significant cognitive demands on interviewers (Fisher & Geiselman, 1992; Fisher, Geiselman, & Amador, 1989; Kebbell et al., 1999; Kebbell & Wagstaff, 1999).

To deal with the time constraints, and in an attempt to reduce the complexity of delivering some of the mnemonics, researchers have modified the CI by omitting some of the mnemonics (Davis, McMahon, & Greenwood, 2005). For instance, Davis and colleagues replaced the *change recall order* and *change perspective* mnemonics with additional free recall attempts. The results from their test of these changes to the CI, however, showed that the modified CI produced a lower accuracy rate than the complete CI (d = 0.37), and the modified CI took nearly three percent longer to use (d = 0.08). Overall, it appears that the CI, while an effective tool for eliciting complete and accurate information, is not meeting the real-world needs of practitioners of being quick and simple to implement.

Sketching: A New Tool in the CI Toolbox

The CI continues to evolve through feedback received from practitioners and by incorporating new findings from social science research. One technique that has emerged from such feedback is sketching. At a broad level, sketching has been defined as a sense-making tool that fosters the communication of ideas (Lane, Seery, & Gordon, 2010). In an investigative interviewing context, sketching typically involves asking witnesses to draw out components of the event they encoded, while at the same time providing a verbal account of what they encoded. While the other CI mnemonics (report everything, MRC, change recall order, change perspective) result in a purely verbal account from an interviewee, sketching results in an interviewee providing a verbal *and* visual account of the experienced event. It should be noted that there is no consensus on how exactly the sketching instruction should be delivered. That is, interviewees could be asked to sketch and talk at the same time, sketch and then talk, or talk and then sketch.

Compared to the core mnemonics that compose the CI, sketching is a relatively new technique for obtaining information from interviewees. However, there has been promising research in the area of sketching. In one study, Dando et al. (2009a) recruited adult participants to watch a short film (2 minutes and 30 seconds in length) that depicted a non-violent crime of a motor vehicle theft. Participants returned approximately two days later to be interviewed about the film, and were assigned randomly to one of three interview conditions (standard interview, CI, or sketching). Dando and her colleagues found that participants in the sketching condition recalled more correct details and provided fewer confabulations than participants in the standard interview condition (d = 0.84 and d = 0.68, respectively). The overall accuracy (proportion of correct details to total number of details recalled, including correct, incorrect, and confabulations) for participants in the sketching condition was also higher than those in the standard interview condition (d = 0.65). There were no statistically significant differences between CI and sketch in terms of accuracy. However, the CI instruction took nearly 37% longer to deliver than the sketching instruction (d = 1.94). To put the findings in context, sketching was just as accurate as the CI but took less time to implement.

In another study, Dando and colleagues (2009c) studied the effectiveness of sketching with undergraduate students. The students watched a short video (1 minute and 20 seconds) depicting a theft. Participants were interviewed two days after they watched the video, and were assigned randomly to be interviewed with either a sketch, *MRC*, or a basic free recall procedure. On average, sketching elicited more accurate accounts than the free recall procedure (d = 0.81) and the *MRC* instruction (d = 0.47). They also found that the *MRC* took 19% longer to implement than sketching (d = 1.17). The positive impact of sketching in investigative interviews has also been found in other populations such as children (Butler, Gross, & Hayne, 1995; Gentle, Powell, & Sharman, 2013; Jack, Martyn, & Zajac, 2015), children with autism spectrum disorder (Mattison, Dando, & Ormerod, 2014), seniors (Dando, 2013), and other adult samples (Dando, Wilcock, Behnkle, & Milne, 2011).

Like other mnemonics that compose the CI, sketching is grounded in Tulving and Thomson's (1973) encoding specificity theory, whereby the act of recalling cues and committing them to paper is thought to activate associated and additional memories from the encoded event. Sketching also builds on the multi-component view of memory trace mentioned previously (Bower, 1967; Flexser & Tulving, 1978; Tulving, 1974; Wickens, 1970), as more than one retrieval cue may be necessary to obtain memories. Essentially, sketching combines two retrieval cues of having the interviewee talk and draw. In addition, sketching allows the interviewee to draw upon his/her own retrieval cues, rather than ones provided by the interviewer, reducing any potential suggestibility effects of the *MRC* component of the CI (Dando et al., 2008).

The above research suggests that sketching is as effective as the CI and associated mnemonics (e.g., *MRC*) for obtaining complete and accurate information from the interviewee. The available evidence suggests that sketching appears to fulfill two core components of an effective and efficient investigative interviewing technique. First, sketching enhances the amount of complete and accurate information obtained from interviewees. Second, sketching meets the real-world needs of interviewers of being quick and simple to implement. Research has shown that interviewers have incorporated sketching in their investigative interviews without being instructed explicitly to do so (Dando, Wilcock, & Milne, 2009b). Overall, sketching can take up to 56% less time to implement than the CI, and yields comparable results in terms of information provision from the interviewee (Dando et al., 2011).

The question still remains, however, whether sketching also fulfills the third component of an effective interviewing tool. That is, does sketching facilitate an interviewer's comprehension of an interviewee's account? Below, the theoretical reasons for why sketching ought to fulfill this criterion are discussed.

In theory: Why sketching should help interviewers. No evidence exists that sketching improves an interviewer's comprehension of an interviewee's account. However, it is thought that sketching is less cognitively demanding for the interviewer to implement as they do not need to deliver complex instructions to the interviewee or provide them with appropriate and compatible retrieval cues (Dando et al., 2009c). The effect of sketching on an interviewer's recall is an issue that requires empirical study. Predictions about how sketching will reduce the cognitive burden on the interviewer, and thus impact the interviewer's recall of an interviewee's account, can be derived primarily from cognitive load theory.

Cognitive load theory. Cognitive load theory (CLT) is a comprehensive theoretical framework of learning outcomes based on principles of working memory capacity and human cognition (Paas, Renkl, & Sweller, 2004; Sweller & Chandler, 1991). In general, CLT predicts that the type of information, and the way in which the information is presented to learners, impacts the burden on memory and information processing (Tindall-Ford, Chandler, & Sweller, 1997). The majority of CLT research has been conducted in the domain of instructional design and learning (Sweller, 2010), such as police use-of-force training (Bennell, Jones, & Corey, 2010), chemistry instruction (Crippen & Brooks, 2009), and foreign language learning (Plass, Chun, Mayer, & Leutner, 2003).

CLT differentiates among three types of cognitive load: intrinsic, extraneous, and germane. Intrinsic load refers to the complexity of the information being presented (Sweller, 1994; Sweller & Chandler, 1991). Intrinsic load is determined largely by element interactivity, whereby information that can be understood in isolation is considered low in element interactivity (Sweller, 2011). However, if the information being presented cannot be understood unless presented completely, it is considered high in element interactivity. For example, the elemental activity for learning words of a foreign language would be low because the words can be learned in isolation of each other. However, learning the grammar of a foreign language would result in high elemental interactivity because the learner is required to simultaneously hold multiple pieces of complex and interacting information in their memory (e.g., words, structure, tense, syntax; Sweller & Chandler, 1994). To date, there is no objective measure of elemental interactivity (Ginns, 2005).

Extraneous load refers to the way information is presented (i.e., instructional design), such as visually or aurally (Sweller, 2011). Extraneous load is also determined by elemental interactivity. That is, when the learner is burdened by the processing of unnecessary information, s/he is presented with an inefficient learning environment and elemental interactivity is considered high due to unnecessary load. Extraneous cognitive load is determined and can be controlled by the instructor (Clark, Nguyen, & Sweller, 2006). That is, poor instructional design (e.g., listening to a presenter while attempting to read disparate text on a slide; Yue, Kim, Ogawa, Stark, & Kim, 2013) that taxes the learner's processing capabilities can increase extraneous load and impede learning.

Germane cognitive load refers to the individual characteristics of the learner. Germane load is not an independent source of cognitive load, but refers to the mental resources required for the creation, processing, and automation of schemas (Sweller, 1988). Both intrinsic and extraneous cognitive load are additive; if either or both intrinsic and extraneous loads are high, individuals may not have the sufficient cognitive resources required to facilitate comprehension (Sweller, 2011; van Merriënboer & Sweller, 2005). When intrinsic and extraneous load levels are sufficient to exceed the learner's cognitive capacity, learning is often impeded (Ginns, 2006).

Researchers in the CLT domain have focused on how to maximize learning, and have identified numerous theoretical effects to do so. For example, researchers have broken information into smaller sections to increase understanding (i.e., isolation effect) and removed redundant information from instructional material (i.e., redundancy effect; see Sweller, 2011 for a review of the various cognitive load theory learning effects). However, the modality effect (also referred to as the multimedia principle; Mayer & Moreno, 2003), described below, appears to explain how providing information in an audio-visual format (i.e., sketching) will reduce the cognitive burden on the interviewer and increase the interviewer's recall of an interviewee's account.

The modality effect refers to an observed cognitive load learning effect whereby presenting information in two modalities (e.g., visual and verbal) has a greater positive impact on learning compared to presenting information in just one modality (e.g., text, verbal; Low, 2012). Studies that focused solely on comparing information presented in audio-visual format to audio-only format revealed that participants had a better memory for multimodal presentations compared to unimodal presentations. The effect sizes were large and ranged from d = 0.71 to d = 2.43 (Brewer, Harvey, & Semmler, 2004; Mayer & Anderson, 1991, 1992; Moreno & Mayer, 2002).

Research has also shown that the enhanced memory for information from multimodal presentations, compared to unimodal presentations, is more pronounced when the information is being presented to novices as opposed to experts. For example, Brewer and his colleagues (2004) examined mock-jurors' comprehension of jury instructions. The researchers compared the performance of untrained adults (novices) to law students (experts). Overall, they found that participants presented with audio-visual information outperformed those presented with audio-only information. The audio-visual presentation produced a stronger effect for novices (d = 0.71) compared to experts (d = 0.05); that is, the audio-visual presentation increased the novices' comprehension to the same level as the law students.

Meta-analyses have revealed consistently that presenting information in two modalities can enhance learning. For example, Ginns (2005) reported that learning is most effective when instructional materials include graphics and spoken text rather than text only (d = 0.72; 95% CI = 0.52, 0.92). A number of variables were found to moderate the modality effect, including when: elemental interactivity (i.e., complexity of the information) was high (d = 0.62) compared to low (d = 0.10); and the pacing of the presentation was system-paced (i.e., out of control of the learner; *d* = 0.93) compared to self-paced (*d* = -0.14). In a more recent meta-analysis, Höffler and Leutner (2007) tested the effect of static and dynamic visualizations on learning outcomes. Their results showed a stronger effect for learning when learners were presented with dynamic animations rather than static pictures (*d* = 0.37). Learning was further enhanced when the animation was representational of the to-be-learned material (*d* = 0.40) rather than decorational in nature (*d* = -0.05). Similar results of the modality effect have been shown in other meta-analyses (Mayer, 2001; Reinwein, 2012).

Numerous suppositions have been proposed for the theoretical reasons of the modality effect, and there is some disagreement among researchers as to the exact underlying mechanisms (Reinwein, 2012). Researchers have cited Baddeley's (1992) model of working memory, whereby memory is thought to be composed of both a visual-spatial sketchpad to process visual material, and an auditory loop to process verbal information (also referred to as the dual-channel assumption). Thus, when information is presented in both the visual and auditory modalities, a single processor is not taxed and working memory capacity is increased. By engaging multiple channels, the learner is able to increase their working memory capacity and avoid overloading a single channel (Tindall-Ford et al., 1997). Furthermore, by accessing the visual-spatial sketchpad, the learner is able to access more robust memory stores. Specially, individuals can remember substantially more visual information for longer periods of time compared to auditory information (Bigelow & Poremba, 2014; Brady, Konkle, Alvarez, & Oliva, 2008; Cohen, Evans, Horowitz, & Wolfe, 2011; Cohen, Horowitz, & Wolfe, 2009; Dallet, Wilcox, &

D’Andrea, 1968; Larsson & Bäckman, 1998; Pezdek, Whetstone, Reynolds, Askari, & Dougherty, 1989; Shepard, 1967; Standing, 1973; Standing, Conezi, & Harder, 1970).

Other researchers postulated that the modality effect is caused by a reduction in extraneous cognitive load whereby integrating audio and visual-based information reduces the elemental interactivity, and hence complexity, of instructional designs (Tabbers, Martens, & van Merriënboer, 2004). It is thought by some that when information is presented in a dual-mode manner, it reduces visual search and cognitive overload caused by mental integration, resulting in enhanced learning environments (i.e., reducing a split-attention effect; Jeung, Chandler, & Sweller, 1997; Mousavi, Low, & Sweller, 1995; Tindall-Ford et al., 1997). For example, in a study by Mayer and Moreno (1998; Experiment 1), participants were taught about lightning formation. Participants were assigned randomly to either view an animation with concurrent narration, or view an animation with concurrent on-screen text. Students who viewed the animation with narration performed significantly better on numerous tests compared to the group who viewed the animation with on-screen text (type of performance: retention, $d = 0.89$; matching, $d = 0.55$; transfer, $d = 1.75$). Similar results were found in their second experiment that taught students about a car’s braking system. These results suggest that participants who viewed the narration and on-screen text experienced higher cognitive load than the other group that did not have to read the text. That is, participants exposed to the on-screen text had to divide their attention between reading the information on the screen and applying it to the images in the animation.

Also of relevance for explaining the modality effect is Mayer's (2001) Cognitive Theory of Multimedia Learning (CTML), which was adapted from and builds on CLT. Mayer's CTML is based on three underling cognitive assumptions. First is the dual channel assumption, which states that visual and auditory information are processed in separate channels (see Baddeley, 1992; Clark & Paivio, 1991; Paivio, 1990; Penney, 1989). Second is the bounded capacity assumption, where the amount of information that can be processed in any one channel is limited and presenting information in separate channels increases processing capacity (Chandler & Sweller, 1991; Sweller, 1999). Third is the active processing assumption, which proposes that learners are active participants in learning. Specifically, for meaningful learning to occur, a learner must engage in five cognitive processes, including: selecting relevant words for processing in verbal working memory; selecting relevant images for processing in visual working memory; organizing the selected words into a verbal mental model; organizing the selected images in a visual mental model; and combining the information from the two separate mental models into one integrated model (Mayer, 2009; Wittrock, 1974). Regardless of the actual theoretical underpinnings of the modality effect, there is a robust finding that learning is enhanced when information is presented in dual modalities.

From theory to practice: Mapping CLT onto sketching. The investigative interviewing context can be considered a learning environment for the interviewer because s/he is ignorant to the criminal event encoded by the interviewee. That is, as the interviewer was not present during the commission of the crime, s/he must learn about the criminal event from the interviewee.

The interviewer also faces intrinsic and extraneous cognitive load when receiving the interviewee's account. The intrinsic load is determined by the complexity of the interviewee's account. Arguably, the information presented by the interviewee would generally be considered high in element interactivity because interviewers must comprehend the entirety of the account and its interconnected parts in order to advance the interview and overall investigation (e.g., ask follow-up questions, link the information to other case facts).

The extraneous load faced by the interviewer is determined by the manner in which the witness presents his/her account. In the majority of investigative interviews, the interviewee is providing his/her account in an audio-only format, as all of the techniques comprising the CI (with the exception of sketching) allow only for verbal accounts.[2] As the inherent complexity of the details reported by witnesses cannot be altered because the interviewer must understand the inter-connected pieces of the account (i.e., intrinsic load), one way to make those details more comprehensible is to change the way interviewees report them (i.e., reduce extraneous load). Of particular relevance to the current study is research showing that dynamic visualizations (i.e., animations as opposed to static pictures) paired with auditory information often produced optimal learning situations (Brewer et al., 2004; Tabbers et al., 2001: 2004).

The learning environment for the interviewer would be considered system-paced as the interviewee controls the pace of information dissemination. In addition, the interviewer would arguably be considered a novice in the interview. While the interviewer may be an expert in the area of policing, s/he was not present when the interviewee encoded the criminal event. Thus, the interviewer has to learn the entirety of the event from the interviewee, meaning that the modality effect should produce a large effect for the learning task.

The Current Research

It is imperative that interviewers have a complete and accurate understanding of an interviewee's encoded experiences of the criminal event. The interviewee's initial account of the incident is the first step in allowing interviewers to conduct an effective interview. For instance, having comprehension of an interviewee's narrative means that the interviewer is able to identify all of the relevant information (e.g., people, locations, actions, conversations, times), and follow-up on that information throughout the interview and investigation. The information obtained during an interview serves as the foundation for the overall criminal investigation and resolution to solving the crime.

To date, it appears that only one study has examined how memory enhancing techniques, developed for interviewees, impact an interviewer's memory for an interviewee's account (Köhnken, Thürer, & Zoberbier, 1994). In their study, students were trained for approximately four hours on the CI or a structured interview procedure (e.g., use of appropriate/inappropriate question types). Each trained student interviewed a fellow student regarding a film about a blood donation procedure. Following the interview, the interviewers had to produce a written account of what they recalled from the interview. Their results showed that interviewers trained on how to use the CI recalled significantly more correct details than those trained on the structured interview. However, interviewers using the CI produced more confabulations compared to those using the structured interview. While both conditions produced nearly identical accuracy rates (approximately 77%), the CI-trained students took almost twice as long to conduct their interview compared to the structured interview-trained students.

The goal of the current program of research is to conduct the first known empirical examination of the effect of sketching on the interviewer's memory for details of an interviewee's account. In the following three experiments, the methodology employed is akin to what has been used throughout the investigative interviewing research (i.e., listening to/watching stimuli and producing a recall of what was remembered). The scenarios presented to participants are analogous to what would be faced by an investigative interviewer who monitors an interview. Across three experiments, the extent to which sketching is beneficial for memory of an interviewee's account was examined.

Chapter 2: Experiment 1

As mentioned in Chapter 1, research on instructional design has shown that learning is enhanced when information is presented in two modalities (audio-visual) compared to just one (audio-only; modality effect; Sweller, 2011). Research has also shown that presenting information as a dynamic visual resulted in an optimal learning environment (Höffler & Leutner, 2007). In the interviewing context, the use of sketching allows the interviewer to receive information as a dynamic visual (i.e., viewing the interviewee sketch the account) and an audio (i.e., verbal account from the interviewee) format. Therefore, sketching should result in superior recall of an interviewee's account compared to audio-only information. The objective of Experiment 1 was to conduct the first known examination of the usefulness of sketching for recalling information from an interviewee's account.

Hypothesis: In line with the modality effect, presenting a verbal account concurrently with a dynamic sketch should result in greater recall ability (i.e., lower error rate) than when an exclusively verbal account is given.

Method

Participants. The participants (*N* = 84) were undergraduate students from Memorial University. The sample consisted of 54 women (M_{age} = 21.33, *SD* = 2.31) and 30 men (M_{age} = 24.27, *SD* = 4.51). The average year of study was 3.31 (*SD* = 1.33; three participants did not report their year of study). There were no statistically significant differences in terms of participants' age, gender, or year of study between the two conditions (ps > .05).

Design. A single-factor between-participants design was used, with modality as the independent variable (audio-visual sketch vs. audio-only). Participants were assigned randomly to the audio-visual sketch or audio-only conditions (n = 42 per condition). In the audio-visual sketch condition, participants watched a video where they concurrently listened to the event details and watched the sketch being drawn. In the audio-only condition, participants were presented with a blank computer screen and listened to the audio from the video recording. The decision was made to use a blank screen (rather than see to the interviewee's face) to obtain a conservative baseline for comparison with the audio-visual sketch. That is, the goal was to minimize distractions in the audio-only condition. Research has shown that distractions can impair memory and learning (e.g., Allport, Antonis, & Reynolds, 1972; Glenberg, Schroeder, & Robertson, 1998; Vredeveldt, Hitch, & Baddeley, 2011). Thus, comparing the sketch against a blank computer screen is arguably the most conservative measure. Dependent variables included the percentage of *total details recalled* (correct + incorrect), percentage of *details recalled correctly*, percentage of *details recalled incorrectly*, and *number of confabulations*. The omnibus dependent measure, however, was *error rate* as it reflects both the amount of correct, incorrect, and confabulated information recalled by the participants. Specifically, error rate was calculated by dividing the total number of incorrect details and confabulations by the total number of details reported and then multiplying that number by 100 ([incorrect details + confabulated details / correct details + incorrect details + confabulations] * 100).

Materials. The stimuli consisted of a video recording of a research assistant describing a robbery of medication from a pharmacy. As the research assistant described the event, he simultaneously sketched out various event details (e.g., location of buildings, movements of individuals) using a black fine point permanent marker on a sheet of 8.5 x 11" white paper. The camera was focused directly above the sheet of paper, which filled the majority of the screen. The video recording lasted for seven minutes and ten seconds. The experimental videos can be found here: Audio-Only condition: https://youtu.be/gcaEv80tJJ4; Audio-Visual Sketch condition: https://youtu.be/LZJOWynNZqg (see Figure 1 for a still image of the completed dynamic sketch).

Procedure. The study was conducted in the Psychology and Law research laboratory at Memorial University. Each participant was greeted by a research assistant and directed to one of four computer testing cubicles. Participants were asked to read and sign an informed consent form. The experimental instructions were then outlined, and it was verified that the participant understood how to complete the study. Participants were then provided with a pair of headphones to listen to/watch the account on the computer, and instructed to begin the experiment. Once participants finished listening to/watching the account, they were instructed to open a Microsoft Word document that contained an open-ended invitation to type what they recalled from the described event. The specific instruction given to the participants was: "In the space below please describe, in as much detail as possible, everything you can remember from [the video you just watched/the story you just heard])". Upon answering the open-ended invitation, each participant received a verbal debriefing that outlined the purpose of the experiment. No time limit was imposed on respondents to complete the open-ended questions, and the experiment took approximately 30 minutes to complete. Participants were compensated with a bonus mark in their applicable undergraduate psychology course.

Coding procedure. The account of the robbery was transcribed. A total of 296 individual idea units were parsed from the account and used as the coding guide. For example, the statement *a man entered the pharmacy* was broken down into three individual idea units (i.e., man; entered; pharmacy). Each participant's memory for the event was measured by calculating the total number of idea units s/he recalled correctly and incorrectly. For ease of interpretation, the correct and incorrect details were then converted to percentages. Any idea units provided by participants that were not in the coding guide (confabulations) were also coded.

Reliability coding. In order to mask the participant's condition, each participant's response was given an anonymous code prior to coding. The primary researcher coded the entire sample. Coding agreement of the variables was assessed by having a research assistant code 20 (23.81%) of the participants' free recall responses. The research assistant was provided with a training session for coding the data whereby the variables in the coding guide were reviewed and a practice session was carried out. Categorizing the 296 idea units in the coding guide (not mentioned, correct, incorrect), along with the confabulations, revealed substantial agreement between the two coders (κ = 0.70 and 0.64, respectively; Landis & Koch, 1977).

Statistical analyses. Null hypothesis significance testing (NHST) was applied as it is the conventional tool among psychological researchers. Unless specified otherwise, the data were distributed normally and parametric independent samples *t*-tests were used. However, practical significance, rather than statistical significance, was of primary concern for this program of research. Thus, the use of 95% Confidence Intervals (*CI*s) and effect sizes (Cohen's *d*; Cohen, 1988; Kirk, 1996) were emphasized for the presentation and interpretation of results. For the purpose of this analysis, *CI*s were interpreted as containing a range of plausible values for the population mean, while values outside the *CI* are relatively implausible (Cumming & Finch, 2005). Effect sizes were interpreted using Cohen's (1988) guidelines for small (d = 0.20), medium (d = 0.50) and large (d = 0.80) effects.

Results

For ease of interpretation, the total details recalled (correct + incorrect), correct details recalled, and incorrect details recalled were converted to percentages (out of 296 individual idea units). The means (and associated 95% confidence intervals) for all of the dependent variables for the two conditions are shown in Table 1.

In terms of the percentage of *total details recalled*, participants in the audio-visual sketch condition recalled significantly more total details than those in the audio-only condition, $t(82) = 2.64$, $p = .010$, and the size of the effect was medium, $d = 0.58$. With regard to percentage of *details recalled correctly*, participants in the audio-visual sketch condition recalled a significantly higher percentage of the idea units compared to those in the audio-only condition, $t(82) = 2.84$, $p = .006$, and the size of the effect was medium, $d = 0.62$. In terms of percentage of *details recalled incorrectly*, participants in the audio-visual sketch condition also recalled a significantly fewer idea units incorrectly compared to those in the audio-only condition, $t(82) = -2.86$, $p = .005$, and the size of the effect was medium, $d = -0.63$. There was no statistically significant difference in terms of the number of *confabulations* reported by those in the audio-visual sketch condition or the audio-only condition, $t(82) = -1.79$, $p = .077$, and the effect size was small, $d = -0.39$. For the omnibus measure of *error rate*, participants in the audio-visual sketch condition had a statistically significantly lower error rate compared to those in the audio-only condition, $t(82) = -3.99$, $p < .001$, and the size of the effect was large, $d = -0.87$.

Discussion

The goal of the current experiment was to determine the effect of sketching on recall for an interviewee's account. As predicted, participants who listened to the account that was accompanied by a sketch recalled more information, more correct details, and fewer incorrect details and confabulations (although the difference in confabulations was not statistically significant) than those who only listened to the narrative. Of most importance, however, is the fact that those in the sketching condition had a significantly lower error rate than those in the audio-only condition, and the size of the effect was large. These data provide support that sketching – in addition to extracting complete and accurate information from interviewees and being quick and easy for interviewers to implement (Dando et al., 2009a; 2009c) – also helps an interviewer gain a better overall understanding of an interviewee's account. That is, the results of the current study suggest that information received in an audio-visual sketch format is better recalled than information received in an audio-only format.

The results of the current experiment support cognitive load theory. Specifically, the results demonstrated a modality effect, as presenting information in two modalities (audio-visual sketch) had a greater impact on recall compared to presenting the same information in just one modality (audio-only; Low, 2012; van Merriënboer, & Sweller, 2005). Participants in the sketching condition benefited from the visualization of the account possibly because they were not required to formulate a visual representation while listening to the auditory information. Instead, the visualization was provided to them, which presumably reduced extraneous cognitive load. That is, the dynamic visualization may have increased connections between topics of the to-be-learned information or reduced the effort required for mental integration of the to-be-learned information, ultimately strengthening their memory for the account.

When considering the lower and upper bounds of the confidence intervals for error rate, it is clear that sketching outperformed audio-only information in creating an optimal learning environment. If the best case scenario is examined (the lower bound *CI* for sketching vs. the upper bound *CI* for audio-only), presenting information in the audio-only format would result in an error rate nearly three times larger than presenting information via sketching. Conversely, if the most conservative estimate is examined (the upper bound *CI* for sketching vs the lower bound *CI* for audio-only), the error rate resulting from sketching would still be 20% lower than the error rate observed from the audio-only presented information. Overall, the large effect for memorial performance found in the current experiment is similar with the large effect sizes found in previous studies comparing information presented in audio-visual format to audio-only format (e.g., Brewer et al., 2004; Mayer & Anderson, 1991, 1992; Moreno & Mayer, 2002). While it is difficult to do a direct quantitative comparison with previous studies due to differences in methodology (e.g., content of to-be-learned information, learning task), the results of the current experiment add to a convergence of evidence for the modality effect.

The current experiment represents a novel finding as it is the first known examination of whether sketching is a beneficial tool for interviewers in terms of enhancing their recall of an interviewee's account. This experiment also represents only the second known empirical examination of the investigative interview from the interviewer's perspective (as opposed to the interviewee's perspective). As mentioned in Chapter 1, it is important that the interviewer is able to understand the account from an interviewee to perform their investigative duties. The findings from the current experiment translate into the provisional conclusion that sketching meets the real-world needs of interviewers by helping the interviewer understand the interviewee's account beyond what is accomplished by simply listening to the account.

There is at least one potential limitation of the current study. Participants typed their response to the open-ended question. Perhaps other methods of recall (e.g., verbal) may have produced different results. Having said this, the response medium was the same across both conditions. Further, there does not appear to be any theoretical reason to expect that changes in the response medium would result in differences between conditions with respect to answer quantity and quality, especially given the ubiquity of computers in today's society.

The goal of the next two experiments was to test the bounds of sketching. Specifically, in what contexts will the effect of sketching no longer be observed? The goal of Experiment 2 was to examine a potential significant bound that is imposed by the *interviewee* – that is, the length of the interviewee's account. The goal of Experiment 3 was to examine two potential significant bounds that are imposed by the *interviewer* – the instructions given to the interviewee on how to complete the sketch and whether the interviewer keeps the completed sketch accessible during recall.

Chapter 3: Experiment 2

The results of Experiment 1 showed that participants who viewed a sketch and heard the details of the interviewee's account had a lower error rate (better overall recall) compared to those who just heard the account. These findings are in line with what would be expected given cognitive load theory and research examining the modality effect (Sweller, 2011). Experiment 1 suggested that information provided through an audio-visual sketch will help interviewers in better remembering the interviewee's account. The purpose of Experiment 2 was to test a bound of sketching that is imposed by the interviewee – the length of the interviewee's account.

Evidence from the investigative interviewing literature (Dando, 2013; Dando et al., 2009a, 2009c, Davis et al., 2005; Milne et al., 1999; Snook & Keating, 2011), along with informal conversations with police officers, revealed that accounts from interviewees can vary greatly in length. The length of the interviewee's account will depend on numerous event factors, such as the length of the event they experienced, the time between experiencing the event and being interviewed about the event (i.e., forgetting over time), and the amount of stress experienced during of the event. In terms of excessive stress, it can lead to poor memorial performance (i.e., Yerkes-Dodson Law; Cohen, 2011). Research has shown, for example, that when a weapon is present during the commission of a crime, witnesses and victims tend to focus solely on the weapon and fail to encode other event details (weapon focus; see Fawcett, Russell, Peace, & Christie, 2013 for a meta-analysis).

In addition to event factors, the length of an interviewee’s account may also be influenced by various interviewing factors, such as the types of questions asked by the interviewer and the amount of rapport built with the interviewee. Inappropriate questions (closed yes–no, leading, forced-choice, multiple) have the potential to extract short, incomplete, and/or inaccurate accounts from interviewees. Instead, interviewers should ask open-ended questions that allow the interviewee to provide a great deal of information. The use of open-ended questions has been shown to lead to longer and more detailed accounts compared to the use of improper question types (Snook et al., 2012). How well the interviewer builds rapport with the interviewee can also impact account length. Insufficient rapport building can result in the interviewee feeling uncomfortable speaking with the interviewer and either reduce the amount of talking by the interviewee, or result in the interviewee speaking at a general level rather than a fine-grained level.

If the interviewer takes into consideration the above factors, s/he is likely to obtain a large amount of fine-grained detail from the interviewee, resulting in a long account. A potential problem for interviewers that can arise from long accounts is information overload. Specifically, when the interviewer is presented with too much information such that the amount of to-be-learned information exceeds the learner’s processing capacity, learning is often hindered (Eppler & Mengis, 2004). One potential way to reduce the negative impact of forgetting due to information overload would be to provide information in dual-modalities (Mayer & Moreno, 2003). A meta-analysis by Reinwein (2012) examined various moderating factors of the modality effect. Based on 85 pair-wise comparisons, the meta-analysis revealed that the length of the to-be-learned material moderated the modality effect. While the modality effect is observed for both short (i.e., ≤ 10 minutes) and long texts, short texts produced a stronger modality effect (d = 0.55, CI = 0.39, 0.70) compared to long texts (d = 0.24, CI = 0.08, 0.39). However, the difference in effect sizes between short and long texts was minimized when other factors were taken into account. For example, when considering factors such as pacing of the to-be-learned information (i.e., system-paced presentation), nature of the visual information (i.e., essential), and type of learning task (i.e., recall), the difference between the effect sizes of short and long texts was negligible (d = 1.02 and d = 1.03, respectively).

It is currently unknown what happens to the positive effect of sketching for interviewers for accounts of various lengths. As there are no data readily available that outline typical account lengths from interviewees, the current experiment used 10 minutes as the mid-point (as identified by Reinwein, 2012). Specially, the objective of the current experiment was to examine the impact of sketching on recall for accounts that varied in length (5 minutes, 10 minutes, 15 minutes) as a function of how the information is presented (audio-visual sketch vs. audio-only).

Hypothesis 1: Based on the results of Experiment 1, it is predicted that participants exposed to the audio-visual sketch information will have a lower error rate when recalling the account compared to those exposed to the audio-only information.

Hypothesis 2: Based on the theory of information overload, as the length of the accounts increase, the proportion of information recalled by participants will decrease.

Hypothesis 3: Based on the results of the moderator analysis conducted by Reinwein (2012), it is predicted that the strength of the observed modality effect will be similar across the various account lengths. Specifically, the effect sizes of the error rates for presentation modality will be similar across account lengths.

Method

Participants. The participants (N = 116) were undergraduate students from Memorial University. The sample consisted of 81 women (M_{age} = 21.79, SD = 4.79) and 35 men (M_{age} = 21.35, SD = 2.50). The average year of study was 3.08 (SD = 1.07). There were no statistically significant differences in participants' age, gender, or year of study between the six conditions (ps > .05).

Design. A 2 (Modality: Audio-Visual Sketch, Audio-Only) x 3 (Account Length: 5 minutes, 10 minutes, 15 minutes) between-participants design was used. Participants were assigned randomly to each of the six conditions. In the audio-visual sketch condition, participants watched the video where they listened to the event details and watched the sketch being drawn concurrently. In the audio-only condition, participants were presented with a blank computer screen and listened to the audio from the video recording.

Dependent variables included the *percentage of total details recalled* (correct + incorrect), *percentage of details recalled correctly*, *percentage of details recalled incorrectly,* and *number of confabulations*. The omnibus dependent measure, however, was *error rate* as it reflects both the amount of correct, incorrect, and confabulated information recalled by the participants. Specifically, error rate was calculated by dividing the total number of incorrect details and confabulations by the total number of details reported and then multiplying that number by 100 ([incorrect details + confabulated details / correct details + incorrect details + confabulations] * 100).

Materials. The stimuli consisted of a video recording of the primary researcher describing an assault at a pub. As the primary researcher described the event verbally, he simultaneously sketched out the event details (e.g., location of objects, movements of individuals) using a black fine point permanent marker on a sheet of 8.5 x 11” white paper. The camera was focused directly above the sheet of paper, which filled the majority of the screen. There were three different versions of the story for each of the account lengths (5 minutes, 10 minutes, 15 minutes). The experimental videos can be found here: 5-Minute Audio-Visual Sketch: http://youtu.be/h5DHVuVy8CU; 5-Minute Audio-Only: http://youtu.be/ytLHRKFQwbQ; 10-Minute Audio-Visual Sketch: https://youtu.be/nAn_Ao8V1BU; 10-Minute Audio-Only: https://youtu.be/W-J9QZMNzS8; 15-Minute Audio-Visual Sketch: https://youtu.be/c3OU76QCNjY; 15-Minute Audio-Only: https://youtu.be/wM1Qq716RHo (see Figures 2-4 for the images of the completed dynamic sketches for each of the story lengths).

Procedure. The study was conducted in the Psychology and Law research laboratory at Memorial University. Each participant was greeted by a research assistant and directed to one of four computer testing cubicles. Participants were asked to read and sign an informed consent form. Participants were then provided with a pair of headphones to listen to/watch the account on the computer, and instructed to begin the experiment. All experimental materials were hosted on SurveyMonkey (http://www.surveymonkey.com). The first page of the survey consisted of instructions regarding how to complete the experiment. The second page contained one of the six videos, depending on the condition of the participant's random assignment. The third page contained the free recall question ("In the space below please describe, in as much detail as possible, everything you can remember from the story you just heard"). The fourth page contained demographic questions. The fifth page contained a message thanking the participant and provided them with additional information regarding the experiment. No time limit was imposed on respondents to complete the open-ended questions, and the experiment took approximately 45 minutes to complete across all account lengths. Participants were compensated with a bonus point in their applicable undergraduate psychology course.

Coding procedure. As with Experiment 1, the account of the event was transcribed. The total number of individual idea units that were parsed from each of the narratives to create coding guides was as follows: 247 for the 5-minute account; 421 for the 10-minute account; and 549 for the 15-minute account. Each participant's memory for the event was measured by calculating the total number of idea units they recalled correctly and incorrectly. For ease of interpretation, the correct and incorrect details were converted to percentages. Any idea units provided by participants that were not in the coding guide (confabulations) were also coded.

Reliability coding. In order to mask the participant's condition, each participant's response was given an anonymous code prior to coding. The primary researcher coded the entire sample. Coding agreement of the variables was assessed by having a research assistant code 24 (20.69%; 8 per each account length) of the participants' free recall responses. In terms of the 5-minute account, categorizing the 247 variables in the coding guide (not mentioned, correct, incorrect) revealed substantial agreement between the two coders ($\kappa = 0.79$), and coding the confabulations revealed moderate agreement between the two coders ($\kappa = 0.55$). In terms of the 10-minute account, categorizing the 421 variables in the coding guide, along with coding confabulations, revealed substantial agreement between the two coders ($\kappa = 0.79$ and 0.75, respectively). In terms of the 15-minute account, categorizing the 549 variables in the coding guide, along with coding confabulations, revealed substantial agreement between the two coders ($\kappa = 0.77$ and 0.61, respectively; Landis & Koch, 1977).

Statistical analyses. NHST was applied as it is the conventional tool among psychological researchers. Unless specified otherwise, the data were distributed normally and parametric statistical tests were used. However, practical significance, rather than statistical significance, was of primary concern in this program of research. Thus, the use of 95% Confidence Intervals (*CI*s) and effect sizes (Cohen's *d*; Cohen, 1988; Kirk, 1996) were emphasized for the presentation and interpretation of results. For the purpose of this analysis, *CI*s were interpreted as containing a range of plausible values for the population mean, while values outside the *CI* are relatively implausible (Cumming & Finch, 2005). Effect sizes were interpreted using Cohen's (1988) guidelines for small ($d = 0.20$), medium ($d = 0.50$) and large ($d = 0.80$) effects.

Results

Percentage of total details recalled. A 2 (Modality: Audio-Only, Audio-Visual Sketch) x 3 (Account Length: 5 minutes, 10 minutes, 15 minutes) MANOVA revealed a main effect of Modality, $F(1, 110) = 5.12$, $p = .026$. The mean (and associated 95% confidence intervals) percentage of total details recalled for the Modality main effect are shown in Table 2. Participants in the Audio-Visual Sketch condition recalled a statistically significant higher percentage of details compared to those in the Audio-Only condition, and the size of the effect was small ($d = 0.38$).

The MANOVA also revealed a significant main effect of Account Length, $F(2, 110) = 13.17$, $p < .001$. The mean (and associated 95% confidence intervals) percentage of total details recalled for the Account Length main effect are shown in Table 2. Planned follow-up comparisons with Tukey's *HSD* revealed that participants presented with the 5-minute account recalled more information than participants presented with the 10-minute and 15-minute accounts, and the size of the effects were large ($d = 0.89$ and $d = 1.07$, respectively). There was no statistically significant difference between those presented with the 10-minute and 15-minute accounts, and the size of the effect was small ($d = 0.30$).

The interaction did not reach significance ($F < 1$). The mean percentage of details recalled (and associated 95% confidence intervals) for Modality as a function of Account Length are provided in Table 3.

Percentage of details recalled correctly. A 2 x 3 MANOVA revealed a significant main effect of Modality, $F(1, 110) = 5.74$, $p = .018$. The mean (and associated

95% confidence intervals) percentage of details recalled correctly for the Modality main effect are shown in Table 2. Participants in the Audio-Visual Sketch condition recalled more correct details than those in the Audio-Only condition, and the size of the effect was small (d = 0.40).

The MANOVA also revealed a significant main effect of Account Length, $F(2, 100) = 13.59$, $p < .001$. The mean (and associated 95% confidence intervals) percentage of details recalled correctly for the Account Length main effect are shown in Table 2. Planned follow-up comparisons using Tukey's *HSD* revealed that participants presented with the 5-minute account recalled more correct details than students who were presented with the 10-minute and 15-minute accounts, and the size of the effects were large (d = 0.91 and d = 1.08, respectively). There was no statistically significant difference between the percentage of correct details recalled by those in the 10-minute and 15-minute conditions, and the size of the effect was small (d = 0.29).

The interaction did not reach statistical significance ($F < 1$). The mean percentage of details recalled correctly (and associated 95% confidence intervals) for Modality as a function of Account Length are provided in Table 3.

Percentage of details recalled incorrectly. A 2 x 3 MANOVA revealed an insignificant main effect of Modality, $F(1,110) = 3.76$, $p = .055$. The mean (and associated 95% confidence intervals) percentage of details recalled incorrectly for the Modality main effect are shown in Table 2. There was no statistically significant difference in the percentage of details recalled incorrectly between participants in the

Audio-Visual Sketch condition and those in the Audio-Only condition and the size of the effect was small (*d* = -0.37).

There was no statistically significant main effect of Account Length (*F* < 1). The mean (and associated 95% confidence intervals) percentage of details recalled incorrectly for the Account Length main effect are shown in Table 2. Planned follow-up comparisons using Tukey's *HSD* revealed that participants who were presented with the 5-minute account did not differ significantly from those who were presented with either the 10-minute or 15-minute accounts, and the effect sizes were small (*d* = -0.18 and *d* = 0.11, respectively). There was also no statistically significant difference in percentage of details recalled incorrectly between participants who were presented with the 10-minute and 15-minute accounts, and the size of the effect was small (*d* = 0.31).

The interaction did not reach significance (*F* < 1). The mean percentage of details recalled incorrectly (and associated 95% confidence intervals) for Modality as a function of Account Length are provided in Table 3.

Number of confabulations. A 2 x 3 MANOVA revealed a significant main effect of Modality, *F*(1,110) = 5.94, *p* = .016. The mean (and associated 95% confidence intervals) number of confabulations for the Modality main effect are shown in Table 2. Participants in the Audio-Visual Sketch condition confabulated significantly fewer details than those in the Audio-Only condition and the size of the effect was small (*d* = -0.41).

The MANOVA also revealed a significant main effect of Account Length, *F*(2, 110) = 8.02, *p* = .001. The mean (and associated 95% confidence intervals) number of confabulations for the Account Length main effect are shown in Table 2. Planned comparisons using Tukey's *HSD* revealed that those presented with the 10-minute account confabulated more details than those who were presented with the 5-minute and 15-minute accounts and the size of the effects were medium (d = 0.76 and d = 0.53, respectively). There was no statistically significant difference in the number of confabulations reported between participants who were presented with the 5-minute and 15-minute accounts, and the size of the effect was small (d = -0.33).

The interaction was also significant, $F(2,110) = 3.92$, $p = .023$, whereby sketching had a minimal impact on reporting confabulations within the 5-minute account. Sketching had a more substantial impact on reporting fewer confabulations within the 10-minute and 15-minute accounts. The mean number of confabulations (and associated 95% confidence intervals) for the Modality, as a function of Account Length, are provided in Table 3.

Error rate. A 2 x 3 MANOVA revealed a statistically significant main effect of Modality, $F(1,110) = 19.55$, $p < .001$. The mean (and associated 95% confidence intervals) error rates for the Modality main effect are shown in Table 2. Participants in the Audio-Visual Sketch condition had a smaller error rate than those in the Audio-Only condition and the size of the effect was medium-to-large (d = -0.77).

The MANOVA also revealed a significant main effect of Account Length, $F(2, 110) = 7.14$, $p = .001$. The mean (and associated 95% confidence intervals) error rates for the Account Length main effect are shown in Table 2. Planned follow-up comparisons using Tukey's *HSD* revealed that students presented with the 5-minute account had a smaller error rate than those presented with the 10-minute account and the size of the effect was medium-to-large (*d* = -0.76). Tukey's *HSD* also revealed that those presented with the 15-minute account had a smaller error rate than those presented with the 10-minute account (*d* = -0.43). There was no statistically significant difference in the error rate by those presented with the 5-minute and 15-minute accounts (*d* = -0.36).

The interaction was not statistically significance ($F < 1$). Planned follow-up comparisons revealed that those in the 5-minute Audio-Visual Sketch condition had a lower error rate than those in the 5-minute Audio-Only condition (*d* = -0.64); those in the 10-minute Audio-Visual Sketch condition had a lower error rate than those in the 10-minute Audio-Only condition (*d* = -0.91); and those in the 15-minute Audio-Visual Sketch condition had a lower error rate than those in the 15-minute Audio-Only condition (*d* = -0.88). The mean error rates (and associated 95% confidence intervals) for the Modality as a function of Account Length are provided in Table 3.

Discussion

The impact of presenting information in audio-visual sketch or audio-only formats on recall, as a function of the length of the account, was examined in the current experiment. In support of the first hypothesis, the way in which information was presented had a significant impact on error rate, whereby participants presented with audio-visual sketch information had a lower error rate than those presented with audio-only information. The second hypothesis, which predicted that the proportion of details recalled would decrease as account lengths increased, was also supported. The third hypothesis predicted that the modality effect observed within the various account lengths would be similar; this hypothesis was supported partially. As will be discussed, these results are similar to those observed in Experiment 1 and within the broader cognitive load literature. The practical implications of the results will also be discussed.

The results of the current experiment showed that participants who were presented with audio-visual sketch information recalled more overall details, more correct details, fewer incorrect details (although not statistically significant) and confabulated less than those presented with the audio-only information. Of particular interest was the observed error rate. Specifically, participants presented with audio-visual sketch information had a much lower error rate than those provided with audio-only information, and the size of the effect was medium-to-large in magnitude. An examination of the effect sizes comparing audio-visual sketch information to audio-only information in the current experiment and Experiment 1 revealed a similar magnitude of the effect (d = -0.77 and d = -0.87, respectively). Together, Experiments 1 and 2, along with past learning research (e.g., Brewer et al., 2004; Mayer & Anderson, 1991, 1992; Moreno & Mayer, 2002) provide additional evidence for the modality effect. Thus far, the current program of research shows that sketching results in enhanced recall on a number of measures, likely because the dynamic visual information paired with the audio information is reducing extraneous cognitive load and easing the burden on information integration (Tabbers et al., 2004; Bilda & Gero, 2005).

In terms of examining the impact of account length on recall, the results showed that as the length of the account increased, participants recalled fewer of the *total account details* – a linear trend that was also observed when examining the percentage of correct details recalled by the participants, (but not observed for incorrect details or confabulations likely because the percentage of incorrect details and number of confabulations reported by participants were low overall). A potential explanation for why participants recalled less information as the account length increased may be information overload, wherein as the amount of to-be-learned information increased, it was more difficult for the participants to process and/or recall all of the information – their performance appeared to be related to the amount of information they were presented (Chewning & Harrell, 1990; Edmunds & Morris, 2000; Eppler & Mengis, 2004; O’Reilly, 1980; Malhotra, 1982; Owen, 1992).

However, audio-visual sketch information appeared to help mitigate information overload; while a linear decline in total information recalled was observed for the multimodal and unimodal conditions, those presented with audio-visual sketch information were able to recall more information than those presented with audio-only information. Researchers have stated that presenting information in dual modalities (i.e., an audio-visual sketch format) may increase their working memory capacity and avoid overloading a single memory channel (Baddeley, 1992; Mayer, 2001). Thus, the findings of the current study suggest that the audio-visual sketch information may have reduced the effect of the information overload experienced by the participants.

The third hypothesis, which stated that the difference in error rate between the three accounts lengths would be similar, was supported partially. While the interaction was not statistically significant, it was still of interest to examine the size of the effects between the audio-visual sketch information and audio-only information within the various account lengths to determine practically significant effects (i.e., planned follow-up comparisons within the 5-minute, 10-minute, and 15-minute accounts separately). The results revealed a medium effect within the 5-minute account (d = -0.64) and large effects within the 10-minute and 15-minute accounts (d = -0.91 and d = -0.88, respectively). The above effects revealed that the greatest differences in error rate within account lengths were observed within the 10-minute and 15-minute accounts. That is, the observed modality effect was strongest within the 10-minute and 15-minute accounts. The results of the current experiment differ slightly from the meta-analysis conducted by Reinwein (2012) which revealed that, when controlling for various factors such as the pacing of the to-be-learned information (i.e., system-paced presentation), nature of the visual information (i.e., essential), and type of learning task (i.e., recall), both short and long texts produced a large effect size. It is unclear why only a medium effect was observed between the audio-only and audio-visual sketch in the 5-minute account of the current experiment. It may be the case that the more precise measure of the number of details to be recalled, and not the length of the account, is required to make a distinction between short and long accounts.

From a practical point of view, these results replicated those of Experiment 1; interviewers would benefit from receiving an audio-visual sketch account from interviewees. These results also lead to a recommendation that, in terms of the *total amount of information recalled*, interviewers may benefit from receiving short accounts from interviewees. While the error rate was not drastically different across accounts, the amount of information recalled declined as the length of the account increased. By receiving shorter accounts from interviewees, interviewers can reduce potential information overload and maximize their ability to recall details from an interviewee's account. Reducing information overload has a number of benefits. For example, information overload has been associated with negative consequences such as ignoring or forgetting large amounts of information, lacking critical evaluation of the provided information, and having difficulty identifying links between information – all resulting in the inability to use information properly to arrive at an accurate and effective investigative decision (Herbig & Kramer, 1994; Hwang & Lin, 1999; Schultze & Vandenbosch, 1998). Thus, by reducing information overload, interviewers will arguably be able to conduct more efficient and, hence, more effective investigations.

Although a potential solution to counteract information overload would be for the interviewer to request that the interviewee break their account into smaller sections by using time segmentation, the risks of doing so appear to outweigh the benefits. That is, by putting constraints on the interviewee through interrupting or requesting them to edit their account, the interviewer risks: receiving an incomplete account from the interviewee; causing the interviewee to speak at a general (as opposed to a fine-grained) level; and losing information of investigative value (Snook et al., 2012). Additionally, as described in Chapter 1, the interviewer may harm rapport and disrupt the positive working relationship created at the beginning of the interview by interrupting the interviewee. However, as the majority of investigative interviews in Canada are audio-video recorded, the interviewer could review the completed interview multiple times in order to ensure that s/he has a comprehensive understanding of the interviewee's account, instead of requesting that the interviewee break their account into smaller sections. Unfortunately, as mentioned in Chapter 1, police are often pressed for time and may not have the opportunity to re-watch interviews (Martinussen et al., 2007). Further, re-watching the interview does not help the interviewer as the interview unfolds, as any additional questions that arise will require an additional interview with the interviewee (and the interviewee is likely to forget event details over time).

There are at least two potential limitations to the current study. First, there was a discrepancy between the time differences and number of details between the three conditions. Specifically, the differences in time between the mid-point time (10 minutes) and the 5-minute and 15-minute accounts corresponded to a 50.00% decrease and increase, respectively. However, in terms of details that made up the respective coding guides, the percent change from the 5-minute account to the 10-minute account was 70.45% more details, and the percent change from the 10-minute account to the 15-minute account was 30.40% more details. Thus, the difference in the number of details, unlike the difference in time, was not symmetrical between the mid-point and remaining two conditions. The unequal differences observed between the number of details may have been caused by various factors (e.g., speaking rate, pausing). It is important for future research to examine additional time lengths, while also attempting to control for the number of details. Second, low inter-rater agreement was observed when coding confabulations for the 5-minute account. That is, while the rating was deemed moderate (Landis & Koch, 1977), the Kappa value was relatively low. It should be noted, however, that the two raters disagreed only on two of the ten comparisons and researchers have questioned the appropriateness of Kappa for small sample sizes (Allouche, Tsoar, & Kadmon, 2006; McHugh, 2012).

As mentioned previously, the goal of the current program of research was to test some of the fundamental bounds of sketching on recall. Experiment 2 examined a bound imposed by the interviewee. The goal of Experiment 3 was to examine two bounds imposed by the interviewer – the instructions given to the interviewee to complete their sketch and whether the interviewer makes the completed sketch accessible during recall.

Chapter 4: Experiment 3

Experiments 1 and 2 provided evidence that presenting information in an audio-visual sketch format led to better recall and a lower error rate than presenting information in an audio-only format. Specifically, Experiment 1 revealed that recall was enhanced for audio-visual sketch information compared to audio-only information, and Experiment 2 replicated these findings, despite variations in account length. Experiment 2 tested the bounds of audio-visual sketch information on recall by examining actions controlled by the interviewee. It is also the case that there are potential bounds on the effect of sketching that are imposed by the interviewer. The objective of the current experiment was to examine two key variables controlled by the interviewer; that is, the instructions the interviewer gives to the interviewee regarding how to complete a sketch, and whether the interviewer makes the sketch accessible during recall.

The convergence of evidence from Experiments 1 and 2, along with research examining the modality effect, has thus far shown that interviewers would likely benefit from having the interviewee provide their account as an audio-visual sketch. As mentioned in Chapter 1, however, there is no consensus on the exact way that interviewers should deliver sketching instructions to interviewees. For example, interviewees can be told to provide their account verbally and sketch at the same time, sketch first and then provide their account, or provide their account first and then sketch. When the interviewee provides their verbal account and sketch simultaneously, they are producing a dynamic visualization. However, it may be the case that the interviewee draws the sketch first and then provides a verbal account, resulting in the interviewer being provided with a static visualization as opposed to a dynamic one. The research reviewed in Chapter 1 revealed that dynamic visualizations provide a more effective learning environment compared to static visualizations (Höffler & Leutner, 2007; Kühl, Schietier, Gerjets, & Edelmann, 2011; Reinwein, 2012). Nevertheless, if the interviewee prefers to draw first and then provide a verbal account, it would be of practical (and theoretical) interest to determine whether the usefulness of a static visualization can be improved by increasing the learner's attention to the to-be-learned static information. Determining whether the usefulness of a static visualization can be enhanced is of practical importance because, despite the interviewer's instructions, the interviewee may choose to complete the sketch first and then provide a verbal account.

One of the objectives of the current study was to vary the way in which the sketch was completed by the interviewee (i.e., degree of movement of the sketch) to determine its impact on recall. For example, additional movement can be added to a static visualization in the form of gestures (i.e., pointing to relevant information on an already completed visual), providing focus for the learner and potentially reducing split-attention. That is, the degree of mental integration required by the learner would potentially decrease the learner's attention if they are focused on relevant aspects of the visual information (Sweller, 2011).

Hypothesis 1: Dynamic audio-visual information will result in a lower error rate compared to audio-only information.

Hypothesis 2: The error rate will decrease as the mobility of the audio-visual information increases.

Another practical issue faced by interviewers is whether to leave the completed sketch accessible once the interviewee has finished drawing. The sketching literature does not provide guidance on whether the sketch should be visible to the interviewer throughout the interview. Informal conversations with police officers and observations of behaviour during investigative interviewing training revealed that some interviewers leave the sketch accessible while others will cover the sketch (e.g., place it under their notebook). Research examining external storage effects would suggest that leaving the sketch visible would be beneficial for the interviewer's recall. That is, the sketch will provide the interviewer with repeated exposure to the information provided by the interviewee and can be used for later review, along with acting as a physical retrieval context cue for the interviewer (Bromage & Mayer, 1986; Di Vesta & Gray, 1972; Middendorf & Macan, 2002; Rickards & Friedman, 1978).

Hypothesis 3: Having access to the sketch during recall will lead to a lower error rate compared to not having access to the sketch during recall.

Hypothesis 4: The impact of having access to the sketch during recall on error rate will decrease as the mobility of the sketch increases.

Method

Participants. The participants (N = 173) were undergraduate students from the University of Ontario Institute of Technology. The sample consisted of 118 women (M_{age} = 20.35, SD = 3.28; seven women did not report their age), and 55 men (M_{age} = 19.91, SD = 4.25; four men did not report their age). The average year of study was 1.79 (SD =

0.98). There was no statistically significant difference in participants' age, gender, or year of study among the eight conditions (*p*s > .05).

Design. A 4 (Modality: Audio-Only, Static Sketch, Hybrid Sketch, Dynamic Sketch) x 2 (Access to Sketch During Recall: Yes, No) between-participants design was employed. Participants were assigned randomly to each of the eight conditions. In the Audio-Only conditions, participants were presented with a blank computer screen and heard the audio of the account (see https://youtu.be/YG3sXIIUezg). In the Static Sketch conditions, participants viewed a motionless picture of the completed sketch on screen that was overlaid with the audio of the account (see https://youtu.be/GK-YBRgFwKA). In the Hybrid Sketch conditions, participants viewed the completed sketch on the computer screen with a hand holding a fine-point permanent marker that pointed to various parts of the sketch as the audio progressed (see https://youtu.be/9AMQZ7Ck55I). In the Dynamic Sketch conditions, the participants viewed the sketch being drawn using a black fine point permanent marker on a sheet of 8.5 x 11" white paper while the research assistant described the event verbally (see https://youtu.be/_L3u6sA6BXo). For all conditions (except for the Audio-Only conditions), the camera was focused directly above the sheet of paper, which filled the majority of the screen. The same completed sketch (obtained from the Dynamic Sketch conditions) was used for all other conditions (see Figure 5 for a copy of the completed dynamic sketch).

In the Access to Sketch During Recall conditions, participants were given a paper copy of the completed sketch after they finished listening to/watching the video.

Participants were instructed that they could use the sketch to answer the open-ended invitation regarding their recall of the account.

Dependent variables included the *percentage of total details* recalled (correct + incorrect), *percentage of details recalled correctly*, *percentage of details recalled incorrectly*, and *number of confabulations*. As in Experiments 1 and 2, the omnibus dependent measure was *error rate* as it reflects both the amount of correct, incorrect, and confabulated information recalled by participants. Error rate was calculated by dividing the total number of incorrect details and confabulations by the total number of details reported and then multiplying that number by 100 ([incorrect details + confabulated details / correct details + incorrect details + confabulations] * 100).

Materials. The stimuli consisted of a video recording of a research assistant describing an emergency situation whereby an individual was suffering a heart attack. The running time of the video recording was seven minutes and twelve seconds.

Procedure. The study was conducted in the Applied Law Enforcement Research and Training (ALERT) laboratory at the University of Ontario Institute of Technology. Each participant was greeted by a research assistant and directed to one of four testing cubicles. Participants were provided with a pair of headphones to listen to/watch the account on a computer, and instructed to begin the experiment. All experimental materials were hosted on SurveyMonkey (http://www.surveymonkey.com). The first page of the survey consisted of a consent form. The second page consisted of instructions regarding how to complete the experiment. The third page contained one of the eight videos, depending on the condition of the participant's random assignment. If in the

Access to Sketch During Recall conditions, the fourth page instructed participants to retrieve the paper copy of the sketch from a folder on the desk where the participant was sitting. The fifth page contained the free recall question ("In the space below please describe, in as much detail as possible, everything you can remember from the story you just heard"). The sixth page contained demographic questions. The seventh page contained a message thanking the participant and additional information regarding the experiment. No time limit was imposed on respondents to complete the open-ended question, and the experiment took approximately 30 minutes to complete. Participants were compensated with a bonus point in their applicable undergraduate psychology course.

Coding procedure. As with Experiments 1 and 2, the account was transcribed. A total of 210 idea units were parsed from the account and used as the coding guide. Each participant's memory for the event was measured by calculating the total number of idea units they recalled correctly and incorrectly. For ease of interpretation, the correct and incorrect details were then converted to percentages. Any idea units provided by participants that were not in the coding guide (confabulations) were also coded.

Reliability coding. In order to mask the participant's condition, each participant's response was given an anonymous code prior to coding. The primary researcher coded the entire sample. Coding agreement of the variables was assessed by having a research assistant code 30 (17.34%) of the participants' free recall responses. For categorizing the 210 idea units in the coding guide (not mentioned, correct, incorrect) and confabulations, inter-rater reliability calculations revealed substantial agreement between the two coders (κ = 0.81 and 0.66, respectively; Landis & Koch, 1977).

Statistical analyses. NHST was applied as it is the conventional tool among psychological researchers. Unless specified otherwise, the data were distributed normally and parametric statistical tests were used. However, practical significance, rather than statistical significance, was of primary concern in this program of research. Thus, the use of 95% Confidence Intervals (*CI*s) and effect sizes (Cohen's *d*; Cohen, 1988; Kirk, 1996) were emphasized for the presentation and interpretation of results. For the purpose of this analysis, *CI*s were interpreted as containing a range of plausible values for the population mean, while values outside the *CI* are relatively implausible (Cumming & Finch, 2005). Effect sizes were interpreted using Cohen's (1988) guidelines for small (d = 0.20), medium (d = 0.50) and large (d = 0.80) effects.

Results

A boxplot analysis, computed with SPSS version 22, determined that the data for Experiment 3 contained extreme outliers (National Institute of Standards and Technology, 2006; Tabachnick & Fidell, 2013). Thus, four participants were removed from the subsequent analyses (n = 1 from the Static Sketch-No Access and Hybrid Sketch-Access conditions each, n = 2 from Dynamic Sketch-No Access condition; see Appendix A for the inferential statistical analyses with the four extreme outliers included).

Percentage of total details recalled. A 4 (Modality: Audio-Only, Static Sketch, Hybrid Sketch, Dynamic Sketch) x 2 (Access to Sketch During Recall: Yes, No)

MANOVA revealed that there was no statistically significant main effect of Modality ($F < 1$). The mean (and associated 95% confidence intervals) percentage of total details recalled for the Modality main effect are shown in Table 4. The size of the effect between the Audio-Only condition and the Static, Hybrid, and Dynamic conditions was small (d = -0.27, d = -0.13, and d = -0.27, respectively). The size of the effect between the Static Sketch condition and the Hybrid and Dynamic Sketch conditions was small (d = 0.15) and negligible (d = -0.01), respectively. The effect size between the Hybrid Sketch and Dynamic Sketch conditions was small (d = -0.16).

The MANOVA revealed that there was no statistically significant main effect of Access to Sketch During Recall ($F < 1$), and the size of the effect was small (d = -0.19). The mean (and associated 95% confidence intervals) percentage of total details recalled for the Access to Sketch During Recall main effect are shown in Table 4. The interaction did not reach significance (Fs < 1). The mean percentage of details recalled (and associated 95% confidence intervals) for the Modality as a function of Access to Sketch During Recall are provided in Table 5.

Percentage of details recalled correctly. The MANOVA revealed that there was no statistically significant main effect of Modality ($F < 1$). The mean (and associated 95% confidence intervals) percentage of details recalled correctly for the Modality main effect are shown in Table 4. The size of the effect between the Audio-Only condition and the Static, Hybrid, and Dynamic Sketch conditions was small (d = -0.27, d = -0.15, and d = -0.29, respectively). The size of the effect between the Static Sketch condition and the Hybrid and Dynamic Sketch conditions was small (d = 0.13) and negligible (d = -0.02), respectively. The effect size between the Hybrid Sketch and Dynamic Sketch conditions was small (*d* = -0.16).

The MANOVA revealed that there was no statistically significant main effect Access to Sketch During Recall (F <1), and the size of the effect was negligible (d = -0.09). The mean (and associated 95% confidence intervals) percentage of details recalled correctly for the Access to Sketch During Recall main effect are shown in Table 4. The interaction did not reach significance ($F < 1$). The mean percentage of details recalled correctly (and associated 95% confidence intervals) for the Modality as a function of Access to Sketch During Recall are provided in Table 5.

Percentage of detailed recalled incorrectly. The MANOVA revealed that there was no statistically significant main effect of Modality (F(3, 161) = 2.56, p = .057). The mean (and associated 95% confidence intervals) percentage of details recalled incorrectly for the Modality main effect are shown in Table 4. The size of the effect between the Audio-Only condition and the Static and Hybrid conditions was small (d = 0.21 and d = 0.48, respectively), and medium between the Audio-Only and Dynamic conditions (d = 0.51). The size of the effect between the Static condition and the Hybrid and Dynamic conditions was small (d = 0.30 and d = 0.30, respectively). The effect size between the Hybrid and Dynamic condition was negligible (d = -0.06).

A 4 x 2 MANOVA revealed that there was no statistically significant main effect Access to Sketch During Recall (F <1), and the size of the effect was negligible (d = 0.04). The mean (and associated 95% confidence intervals) percentage of details recalled correctly for the Access to Sketch During Recall main effect are shown in Table 4. There were no statistically significant interactions (*F* < 1). The mean percentage of details recalled incorrectly (and associated 95% confidence intervals) for the Modality as a function of Access to Sketch During Recall are provided in Table 5.

Number of confabulations. A 4 x 2 MANOVA revealed that there was no statistically significant main effect of Modality (*F*(3, 161) = 2.26, *p* = .084). The mean (and associated 95% confidence intervals) number of confabulations for the Modality main effect are shown in Table 4. The size of the effect between the Audio-Only condition and the Static, Hybrid, and Dynamic Sketch conditions was small (*d* = 0.44, *d* = 0.11) and medium (*d* = 0.51), respectively. The size of the effect between the Static Sketch condition and the Hybrid and Dynamic Sketch conditions was small (*d* = -0.30) and negligible (*d* = 0.04), respectively. The effect size between the Hybrid and Dynamic Sketch conditions was small (*d* = 0.35).

The MANOVA also revealed that there was no statistically significant main effect of Access to Sketch During Recall (*F* < 1), and the size of the effect was negligible (*d* = 0.08). The mean (and associated 95% confidence intervals) number of confabulations recalled for the Access to Sketch During Recall main effect are shown in Table 4. The interaction was not statistically significant (*F* < 1). The mean number of confabulations (and associated 95% confidence intervals) recalled for the Modality as a function of Access to Sketch During Recall are provided in Table 5.

Error rate. A 4 x 2 MANOVA revealed a statistically significant main effect of Modality (*F*(3, 161) = 3.78, *p* = .012). The mean (and associated 95% confidence intervals) error rates for the Modality main effect are shown in Table 4. The size of the effect between the Audio-Only condition and the Static, Hybrid, and Dynamic Sketch conditions was small (*d* = 0.34 and *d* = 0.45) and medium-to-large (*d* = 0.76), respectively. The size of the effect between the Static Sketch condition and the Hybrid and Dynamic Sketch conditions was small (*d* = 0.10 and *d* = 0.38, respectively). The effect size between the Hybrid and Dynamic Sketch conditions was small (*d* = 0.26).

The MANOVA revealed that there was no statistically significant main effect of Access to Sketch During Recall ($F(1,161) = 1.12$, $p = .292$), and the size of the effect was small (*d* = 0.17). The mean (and associated 95% confidence intervals) error rates for the Access to Sketch During Recall main effect are shown in Table 4. The interaction was not statistically significant ($F < 1$). The mean error rates (and associated 95% confidence intervals) for Modality, as a function of access to sketch during recall, are shown in Table 5.

Discussion

The purpose of the current experiment was to examine the impact of two interviewer-controlled sketching variables on recall ability: the instructions given to the interviewee on how to complete the sketch (i.e., the degree of mobility of the sketch), and whether the interviewer had access to the sketch during recall. The results of the current experiment supported the first hypothesis. Specifically, the *core* findings of Experiments 1 and 2 were replicated. That is, participants presented with information via a dynamic sketch had a lower *error rate* than participants presented with information via audio only, and the size of the effect was large (*d* = -0.97). It should be noted, however, that there were few statistically significant differences between the remainder of the dependent variables, but when combined, a statistically significant omnibus measure (error rate) was observed. The second hypothesis was supported, as error rate decreased as the amount of movement of the sketch increased. With regard to the third hypothesis, the results showed that when participants had access to the sketch during recall, error rate was lower (except for those presented with the dynamic sketch). Finally, the importance of having access to the sketch was diminished as the mobility of the visual information increased, supporting the fourth hypothesis. These findings suggest that interviewers would benefit from having the interviewee provide their account through a dynamic sketch, while having access to the sketch is not necessary (unless receiving audio-only information or static images). In addition, if the interviewee chooses to complete the sketch before providing their verbal account, the interviewer should instruct the interviewee to point out relevant aspects of the visual as the interviewee provides their verbal account.

The results of the current experiment replicated the results of Experiments 1 and 2, as those presented with a dynamic sketch had a lower error rate compared to those presented with the audio-only information. Across accounts that varied in length and content, the effect sizes were similar across the three experiments (Experiment 1: d = -0.87; Experiment 2: d = -0.77; Experiment 3: d = -0.97), revealing medium-to-large effects for the benefit of dynamic audio-visual sketch information over audio-only information. As with the first two experiments, it appeared that extraneous cognitive load was reduced through the dynamic sketch. It is possible that participants presented with audio-visual sketch information benefited from the visualization of the account as they were not required to tax their mental processing by formulating a visual representation while listening to the auditory information.

The results of the current experiment also showed that error rates decreased sharply when the participant was provided with visual information. Specifically, there was a 27.77% decrease in the error rate from the audio-only to the static sketch conditions. The error rate continued to decrease as the amount of mobility of the visual information increased, with an observed 10.30% decrease in error rate from the static sketch to the hybrid sketch conditions. Again, a decrease in error rate was observed between the hybrid sketch and the dynamic sketch (22.13%), showing the impact of the dynamic visual information on recall. Recall may have been enhanced by the dynamic visual (compared to the other two visuals) because participants viewed the sketch being drawn, as opposed to viewing a static image of an already-drawn sketch. It is thought that dynamic visualizations reduce extraneous cognitive load by facilitating the learner in visualizing the process and mentally integrating the information. Therefore, participants provided with the static sketch might have experienced a split-attention effect, as they were required to attend to and mentally integrate information before deriving meaning from it (Sweller, Chandler, Tierney, & Cooper, 1990). The participant's attention may have been divided between listening to the audio information and attending to the various visual features of the sketch while attempting to integrate the two sources of information into a cohesive structure. A promising finding is that static visualizations can be improved by adding gestures to the relevant aspects of the visual at a given time (Hybrid Sketch). It may be the case that the gestures helped focus the individual's attention to the important visuals on the sketch at a given time, thus reducing their need for excessive visual search of the entire sketch. It may also be the case that the gestures acted as a legend and helped to define what was meant by the various elements on the sketch (e.g., dot represents a particular individual or object). An examination of the *CI*s showed that while there is overlap between the error rates of the audio-only and static and hybrid sketches, there is no overlap between the error rates of the audio-only and dynamic sketch – showing that dynamic sketches are more effective for recall than audio-only information.

In terms of having access to the sketch while recalling the interviewee's account, the results revealed a small benefit in regards to the observed error rate across all conditions. Being able to view the sketch during the recall task was most beneficial for those who only heard the account, producing a small effect (d = -0.28). One reason why having access to the sketch during recall was most effective for those in the audio-only condition (compared to the other sketch conditions) was that viewing the completed sketch may have provided an external mechanism for integrating the information stored in memory. That is, participants were now provided with a visual of the to-be-learned information which may have helped determine causal links within the account, or have clarified any unclear or confusing aspects of the account.

Having access to the sketch during recall was of minimal benefit for those who viewed the static and hybrid sketches, producing small effects (d = -0.15 and d = -0.16, respectively). Having access to the sketch during recall for those who viewed the dynamic sketch resulted in little impact on the observed error rate, and the size of the effect was negligible (*d* = 0.04). As the dynamic sketch produced the best overall recall, it appears that meaningful learning occurred and having access to the sketch was of no further benefit. Overall, the results produced a trend showing that the importance of having access to the sketch during recall diminished as the mobility of the sketch increased. Practically, it appears that the sketch may help strengthen the interviewer's memory for the event by protecting against interference (Chandler, 1989; Neath & Surprenant, 2003). It would be of interest for future research to examine whether seeing the sketch after a delay could help interviewers recall the event.

Also of interest was that there was a medium-sized effect between those who heard the account and had access to the sketch during recall and those who viewed the dynamic sketch (*d* = 0.57). Research examining instructional design has shown that providing audio-visual information simultaneously results in enhanced learning compared to when the same information is presented sequentially (i.e., temporal contiguity effect; Mayer, 2001). For example, Mayer and Anders (1991) presented 30 college students with information on how a tire pump operates. Students were presented with either audio-visual information at the same time (concurrent information presentation), or audio information followed by visual information (sequential information presentation). Their results showed that students in the concurrent group outperformed those in the sequential group, and the size of the effect was large (*d* = 0.92). A meta-analysis by Ginns (2006) supported the temporal contiguity effect, revealing that learning is enhanced when to-be-learned information is presented concurrently as opposed to sequentially (*d* = 0.78, 95% *CI* = 0.63, 0.92).

In terms of practical implications, interviewers can create an optimal learning environment by requesting that the interviewee sketch their account and provide the verbal details of the event simultaneously. However, it may be the case that the interviewer must make a compromise between the recommendations provided by the results of the current experiment and the preference of the interviewee. For example, the interviewee may prefer to sketch their account and then provide a verbal narrative of the experienced event. If the interviewee does not wish to provide their verbal account simultaneously with their sketch, the interviewer would be advised to request that the interviewee highlights relevant aspects of the completed sketch as s/he provides a verbal account. Furthermore, the interviewer should ensure that s/he has access to the sketch once the interviewee has finished providing their account.

Chapter 5: General Discussion

Investigative interviews are a crucial aspect of a criminal investigation as police officers, who were not present during the commission of a crime, must learn about the crime through information obtained from interviewees. As mentioned, an effective investigative interview technique must meet the following three criteria: (1) elicit complete and accurate information from interviewees, (2) meet the real-world needs of interviewers by being quick and easy to implement, and (3) facilitate an interviewer's comprehension of an account. Previous research demonstrated that sketching helps interviewers obtain complete and accurate information from interviewees and it is quick and simple to implement (Butler et al., 1995; Dando, 2013; Dando et al., 2009a, 2009c, 2011; Jack et al., 2015; Gentle et al., 2013; Mattison et al., 2014). The current program of research provided supporting evidence for the third criterion. Specifically, sketching appeared to help an interviewer understand an interviewee's account. Across three experiments, the bounds of sketching imposed by both interviewees (Experiment 2) and interviewers (Experiment 3) were tested. The following conclusions emerged from the current program of research regarding the optimal conditions for an interviewer to recall information during an interview: (1) information should be presented to interviewers in an audio-visual sketch format rather than an audio-only format; (2) more information is recalled from short accounts compared to long accounts; (3) dynamic sketches are the most effective type of sketch; and (4) having access to the sketch is most beneficial for recall when receiving audio-only information or static images, and is less beneficial when receiving dynamic audio-visual information.

Across three experiments, employing accounts of different lengths and content, the results showed that information provided in an audio-visual sketch format led to enhanced learning over information presented in an audio-only format. Specifically, the effect size of the error rate between audio-visual sketch information and audio-only information was large, and relatively similar, among the three experiments (average effect size across the three experiments was $d = 0.87$). These results support the modality effect found in the cognitive load literature (Sweller, 2011), whereby presenting information in two modalities (audio and visual) resulted in better learning compared to presenting information in only one modality (audio).

In terms of the potential bound of the account length on the positive impact of sketching, Experiment 2 revealed that the interviewer's recall was best for a short account. Participants remembered more information and made fewer errors when recalling the 5-minute account compared to when asked to recall information from either the 10-minute or 15-minute accounts. A potential explanation for the enhanced memorial performance for the short 5-minute account relative to the longer accounts is that participants presented with the longer accounts may have experienced information overload (Eppler & Mengis, 2004). That is, their performance was tied to the amount of to-be-learned information. However, as explained by the modality effect, presenting information in two modalities appeared to mitigate information overload, whereby those in all conditions who were presented with audio-visual sketch information recalled more details than those presented with audio-only information.

The results of Experiment 3 revealed that dynamic sketches outperformed audio-only information along with static sketches. These results are similar to what is found within the cognitive load literature, showing medium-to-large effects (Höffler & Leutner, 2007). A novel finding of Experiment 3 is that static pictures can be improved by adding gestures to the visual information. Arguably, the gestures are helped to focus the individual’s attention to specific aspects of the to-be-learned material, potentially reducing a split-attention effect and easing the burden of information integration (Mayer, 2001). In other words, when presented with a static visualization, participants were required to search the entire computer screen and determine the relevance of particular aspects of the sketch in regards to the verbal information. When gestures were added to the static visual, participants no longer had to conduct their own effortful search and were instead shown the relevant aspects of the visualization through gestures.

Although not as effective for the dynamic sketch, Experiment 3 revealed that having access to the sketch improved recall and resulted in participants making fewer errors. Although the overall effect showing the benefit of having access to the sketch when recalling the interviewee’s account was small, this finding is arguably of practical significance. The simple task of keeping the sketch visible during recall results in more information being recalled by the interviewer with fewer errors being made during recall.

Practical Implications

It is imperative that interviewers are able to recall information obtained from interviewees to allow them to advance a criminal investigation (e.g., ask follow-up questions, link information to other case facts). Although a more expansive program of research and replication of the current experiments are required before practical and policy recommendations can be made, the provisional conclusion is that interviewers should receive a sketch-based account from interviewees. Rather than obtain an audio-only version of the account (as would be achieved through the CI mnemonics), the interviewer is advised to request that the interviewee simultaneously complete a dynamic sketch while providing the verbal details of their experienced event. If, however, the interviewee wishes to complete their sketch and then provide their verbal account, the interviewer should instruct the interviewee to gesture to the relevant aspects of the sketch as they provide their verbal account. Furthermore, in the case of completing the sketch first, the interviewer is also advised to keep a copy of the sketch visible. Granted, more research is required to determine the effect of viewing the completed sketch on further questioning, the results of the current research suggest that interviewers would benefit from having the sketch accessible when thinking about what they are being told by the interviewee.

Another practical implication of the current research is that interviewers may benefit from chunking the interviewee’s account into smaller accounts. By receiving shorter accounts from interviewees, interviewers can reduce potential information overload and maximize their ability to recall details from an interviewee’s account. However, this recommendation needs to be weighed against the potential drawback of the interviewee not providing a complete and accurate account because of an interruption in their memorial recall.

Future Research

It is important that researchers continue testing the bounds of sketching. As the results of the current program of research showed, sketching is a promising tool to help interviewers recall an interviewee's account. However, it is important to ensure that the findings of the current study are replicable before accepting them as well-established and making policy recommendations for investigative interviewing practices.

In terms of advancing this program of research, there are a number of directions in which this emerging field of research should continue. For instance, it would be worthwhile to examine whether the positive impact of sketching will be reduced by the complexity of the interviewee's account. While the complexity of an account is difficult to measure objectively (Ginns, 2005), researchers are attempting to tackle this issue (Brünken, Plass, & Leutner, 2003). Researchers could also examine the effects of sketch quality and labelling various elements of the sketch will have on recall ability. Other future avenues of study include determining whether sketching can help protect the interviewer against misinformation and whether sketching can aid in the interviewer's recall ability following a delay.

In addition, the current program of research would benefit from increasing its ecological validity. Future research should examine the impact of sketching: (a) while viewing the interviewee's face and (b) during a live interview. In the current program of research, participants in the audio-only condition viewed a blank computer screen. It is possible that the participants' attention diminished because they did not have any relevant visual cues to focus on (e.g., person's face, gestures). However, the decision was made to use a blank screen (rather than view the interviewee's face) to obtain a conservative baseline for comparison with the audio-visual sketch. That is, the goal was to minimize distractions in the audio-only condition. As mentioned, the current program of research would be akin to what is faced by an individual monitoring the interview. Research has shown that distractions can impair memory and learning (e.g., Allport, Antonis, & Reynolds, 1972; Glenberg, Schroeder, & Robertson, 1998; Vredeveldt, Hitch, & Baddeley, 2011). Thus, comparing the sketch against a blank computer screen is arguably the most conservative measure.

Concluding Thoughts

Prior to the current research, only one known study examined the ability of interviewers to recall information obtained from an interviewee (Köhnken et al., 1994). Köhnken and his colleagues showed that the cognitive interview resulted in more accurate recall compared to a structured interview. However, the results also showed that the cognitive interview resulted in more incorrect and confabulated details being reported. The results of the current research, however, revealed that sketching did not result in more incorrect or confabulated details compared to the audio-only information.

Although replication of the current results and a more expansive program of research are required before any definitive practical recommendations can be made, the current study represents an understanding of the extent to which sketching improves the interviewer's ability to recall details from the interviewees' accounts. Future contributions to this emerging area of investigative interviewing are of interest as it is anticipated that research on sketching will have practical implications for police interviewing, along with many other related areas of investigation interviewing.

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Footnotes

[1]Anecdotal evidence from police officers who received investigative interviewing training via the Psychology and Lab research laboratory have reported that sketching is a useful interviewing tool.

[2]Interviewees can also present their information to interviewers in the form of a written statement; however, this is seemingly an uncommon practice.

Table 1

The Means (and 95% Confidence Intervals) for Percentage of Total Details Recalled, Percentage of Details Recalled Correctly, Percentage of Details Recalled Incorrectly, Number of Confabulations, and Error Rate for the Sketch and Audio Conditions (Experiment 1).

Dependent Measures	Sketch	Audio
Percentage of Total Details Recalled	38.29 (35.26, 41.32)	32.36 (28.98, 35.74)
Percentage of Details Recalled Correctly	37.44 (34.36, 40.52)	30.99 (27.60, 34.38)
Percentage of Details Recalled Incorrectly	0.85 (0.58, 1.12)	1.37 (1.13, 1.61)
Number of Confabulations	1.50 (1.06, 1.94)	2.07 (1.60, 2.54)
Error Rate	3.81 (2.81, 4.81)	7.07 (5.75, 8.39)

Table 2

The Means (and 95% Confidence Intervals) for Percentage of Total Details Recalled, Percentage of Details Recalled Correctly, Percentage of Details Recalled Incorrectly, Number of Confabulations, and Error Rate for the Main Effects of Modality and Account Length (Experiment 2).

	Modality		Account Length		
Dependent Measures	Sketch (*n* = 58)	Audio (*n* = 58)	5 Minutes (*n* = 40)	10 Minutes (*n* = 38)	15 Minutes (*n* = 38)
Percent Total Details Recalled	45.35 (41.61, 49.09)	39.81 (35.93, 43.69)	50.95 (47.20, 54.70)	40.30 (36.29, 44.31)	36.06 (30.85, 41.27)
Percent Recalled Correctly	44.55 (40.86, 48.24)	38.78 (34.96, 42.60)	50.05 (46.33, 53.77)	39.28 (35.30, 43.26)	35.23 (30.13, 40.33)
Percent Recalled Incorrectly	0.80 (0.64, 0.96)	1.03 (0.86, 1.20)	0.90 (0.68, 1.12)	1.02 (0.81, 1.23)	0.83 (0.64, 1.02)
Number of Confabulations	1.00 (0.76, 1.24)	1.60 (1.11, 2.09)	0.80 (0.53, 1.07)	2.00 (1.33, 2.67)	1.13 (0.77, 1.49)
Error Rate	2.36 (1.99, 2.73)	3.85 (3.24, 4.46)	2.40 (1.93, 2.87)	3.95 (3.13, 4.77)	3.00 (2.39, 3.61)

Table 3

The Means (and 95% Confidence Intervals) for Percentage of Total Details Recalled, Percentage of Details Recalled Correctly, Percentage of Details Recalled Incorrectly, Number of Confabulations, and Error Rate as a Function of Modality and Account Length (Experiment 2).

	Account Length					
	5 Minutes		10 Minutes		15 Minutes	
Dependent Measures	Sketch (*n* = 20)	Audio (*n* = 20)	Sketch (*n* = 19)	Audio (*n* = 19)	Sketch (*n* = 19)	Audio (*n* = 19)
Percent Total Recalled	53.06 (47.21, 58.91)	48.85 (43.79, 53.91)	43.24 (37.74, 48.74)	37.35 (31.29, 43.41)	39.35 (31.96, 46.74)	32.77 (25.01, 40.53)
Percent Recalled Correctly	52.35 (46.56, 58.14)	47.75 (42.75, 52.75)	42.28 (36.82, 47.74)	36.28 (30.30, 42.26)	38.62 (31.40, 45.84)	31.85 (24.29, 39.41)
Percent Recalled Incorrectly	0.71 (0.43, 0.99)	1.09 (0.75, 1.43)	0.96 (0.63, 1.30)	1.08 (0.81, 1.35)	0.74 (0.47, 1.01)	0.92 (0.62, 1.22)
Number of Confabulations	0.85 (0.47, 1.23)	0.75 (0.32, 1.18)	1.21 (0.77, 1.65)	2.79 (1.56, 4.02)	0.95 (0.48, 1.42)	1.32 (0.74, 1.90)
Error Rate	1.94 (1.30, 2.58)	2.85 (2.17, 3.53)	2.91 (2.14, 3.68)	4.99 (3.65, 6.34)	2.24 (1.68, 2.80)	3.76 (2.73, 4.79)

Table 4

The Means (and 95% Confidence Intervals) for Percentage of Total Details Recalled, Percentage of Details Recalled Correctly, Percentage of Details Recalled Incorrectly, Number of Confabulations, and Error Rate for the Main Effects of Modality and Access to Sketch During Recall (Experiment 3).

	Modality				Access to Sketch During Recall	
Dependent Measures	Audio-Only (*n* = 45)	Static Sketch (*n* = 41)	Hybrid Sketch (*n* = 42)	Dynamic Sketch (*n* = 41)	No (*n* = 85)	Yes (*n* = 84)
Percent Recalled	37.83 (32.77, 42.89)	42.23 (37.08, 47.38)	39.85 (35.06, 44.64)	42.42 (37.02, 47.82)	39.82 (36.16, 43.48)	41.22 (37.77, 44.67)
Percent Recalled Correctly	36.74 (31.67, 41.81)	41.31 (36.12, 46.50)	39.17 (34.35, 43.99)	41.70 (36.32, 47.08)	38.95 (35.28, 42.62)	40.37 (36.92, 43.82)
Percent Recalled Incorrectly	1.09 (0.83, 1.35)	0.92 (0.68, 1.16)	0.68 (0.42, 0.94)	0.72 (0.55, 0.89)	0.87 (0.71, 1.03)	0.84 (0.66, 1.02)
Number of Confabulations	1.58 (0.97, 2.19)	0.83 (0.43, 1.23)	1.36 (0.69, 2.03)	0.78 (0.48, 1.08)	1.21 (0.87, 1.55)	1.08 (0.68, 1.48)
Error Rate	5.51 (4.07, 6.95)	3.98 (2.67, 5.29)	3.57 (2.36, 4.78)	2.78 (2.25, 3.31)	4.33 (3.42, 5.24)	3.66 (2.88, 4.44)

Table 5

The Means (and 95% Confidence Intervals) for Percentage of Total Details Recalled, Percentage of Details Recalled Correctly, Percentage of Details Recalled Incorrectly, Number of Confabulations, and Error Rate as a Function of Modality and Access to Sketch During Recall (Experiment 3).

	Modality							
	Audio		Static Sketch		Hybrid Sketch		Dynamic Sketch	
Dependent Measures	No Access	Access	No Access	Access	No Access	Access	No Access	Access
Percent Recalled	36.19 (28.88, 43.50)	39.55 (32.00, 47.10)	42.81 (34.84, 50.78)	41.68 (34.37, 48.99)	39.55 (32.27, 46.83)	40.19 (33.38, 47.00)	41.29 (32.83, 49.75)	43.49 (35.96, 51.02)
Percent Recalled Correctly	35.05 (27.80, 42.30)	38.51 (30.89, 46.13)	41.90 (33.86, 49.94)	40.75 (33.43, 48.07)	38.83 (31.49, 46.17)	39.55 (32.71, 46.39)	40.60 (32.14, 49.06)	42.74 (35.29, 50.19)
Percent Recalled Incorrectly	1.14 (0.84, 1.44)	1.04 (0.58, 1.50)	0.90 (0.51, 1.29)	0.93 (0.60, 1.26)	0.71 (0.35, 1.07)	0.64 (0.22, 1.06)	0.69 (0.47, 0.91)	0.75 (0.48, 1.02)
Number of Confabulations	1.87 (1.19, 2.55)	1.27 (0.21, 2.33)	0.75 (0.45, 1.05)	0.90 (0.13, 1.67)	1.41 (0.38, 2.44)	1.30 (0.36, 2.24)	0.70 (0.27, 1.13)	0.86 (0.40, 1.32)
Error Rate	6.16 (4.13, 8.19)	4.83 (2.65, 7.01)	4.31 (1.93, 6.69)	3.66 (2.23, 5.09)	3.86 (2.06, 5.66)	3.24 (1.48, 5.00)	2.75 (1.98, 3.52)	2.82 (2.03, 3.61)

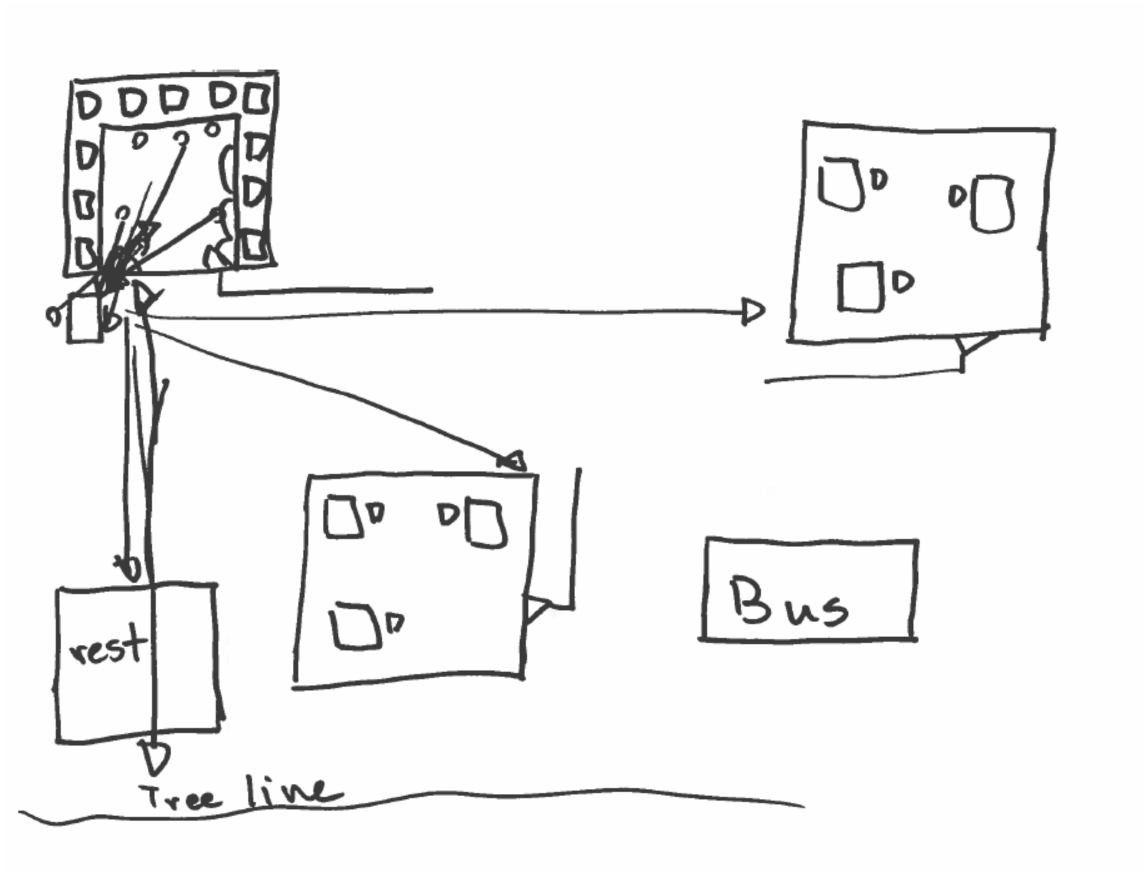

Figure 1. Image of the completed dynamic sketch for Experiment 1.

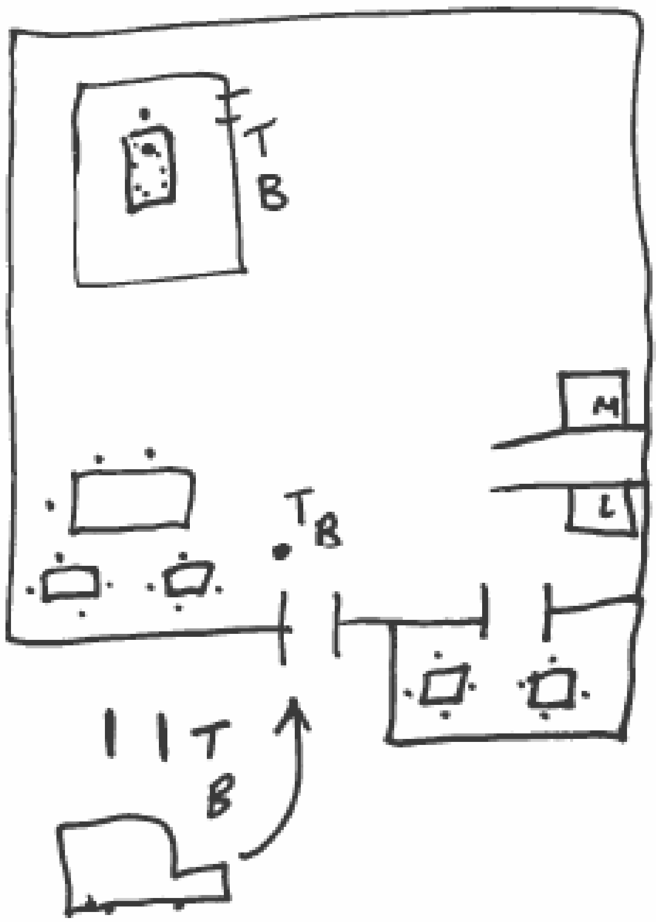

Figure 2. Image of the completed dynamic sketch for Experiment 2 (5-Minute Account).

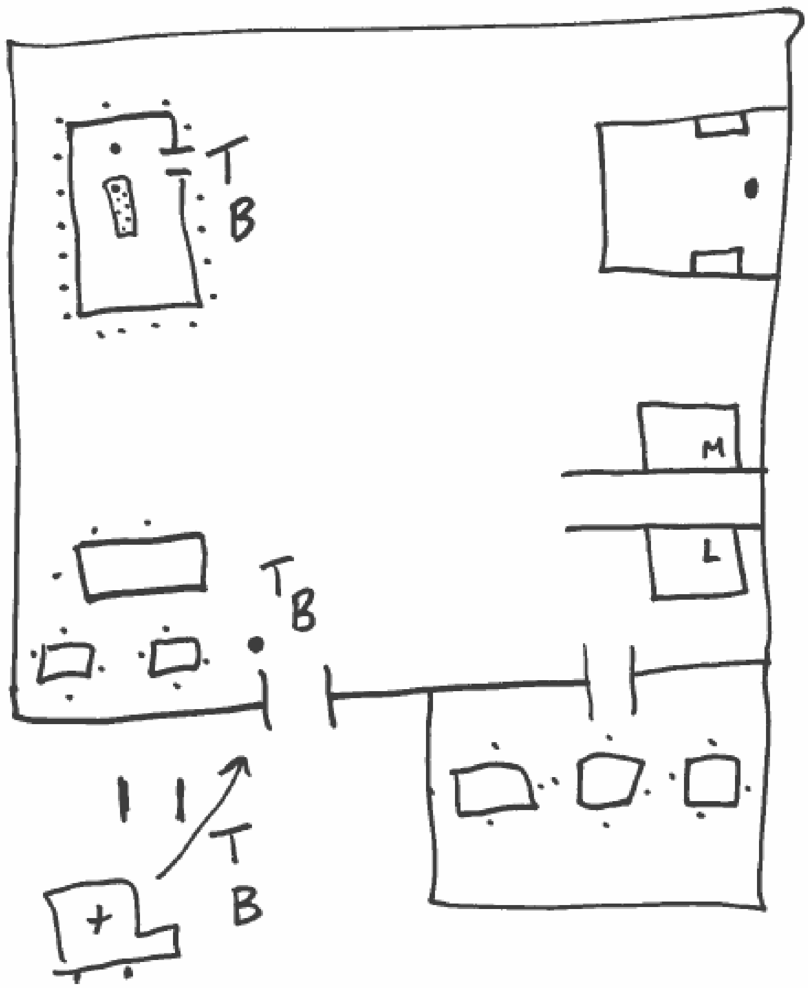

Figure 3. Image of the completed dynamic sketch for Experiment 2 (10-Minute Account).

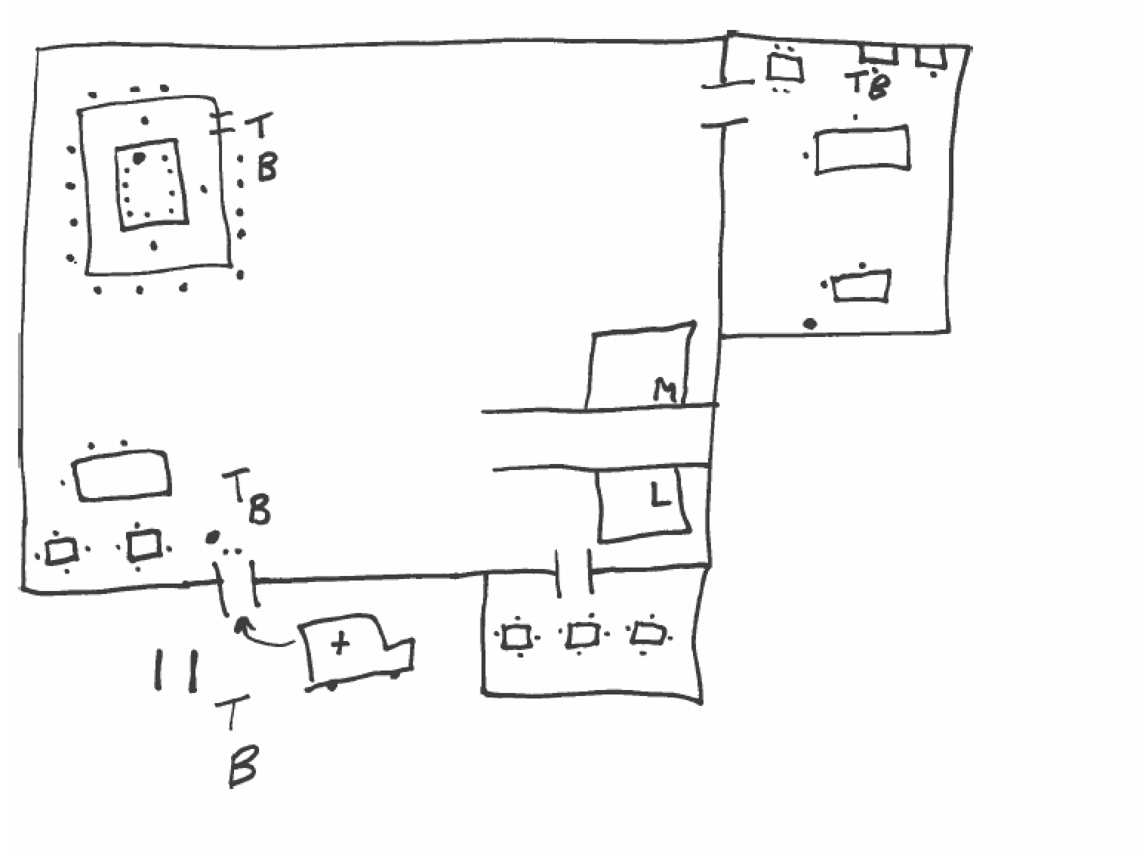

Figure 4. Image of the completed dynamic sketch for Experiment 2 (15-Minute Account).

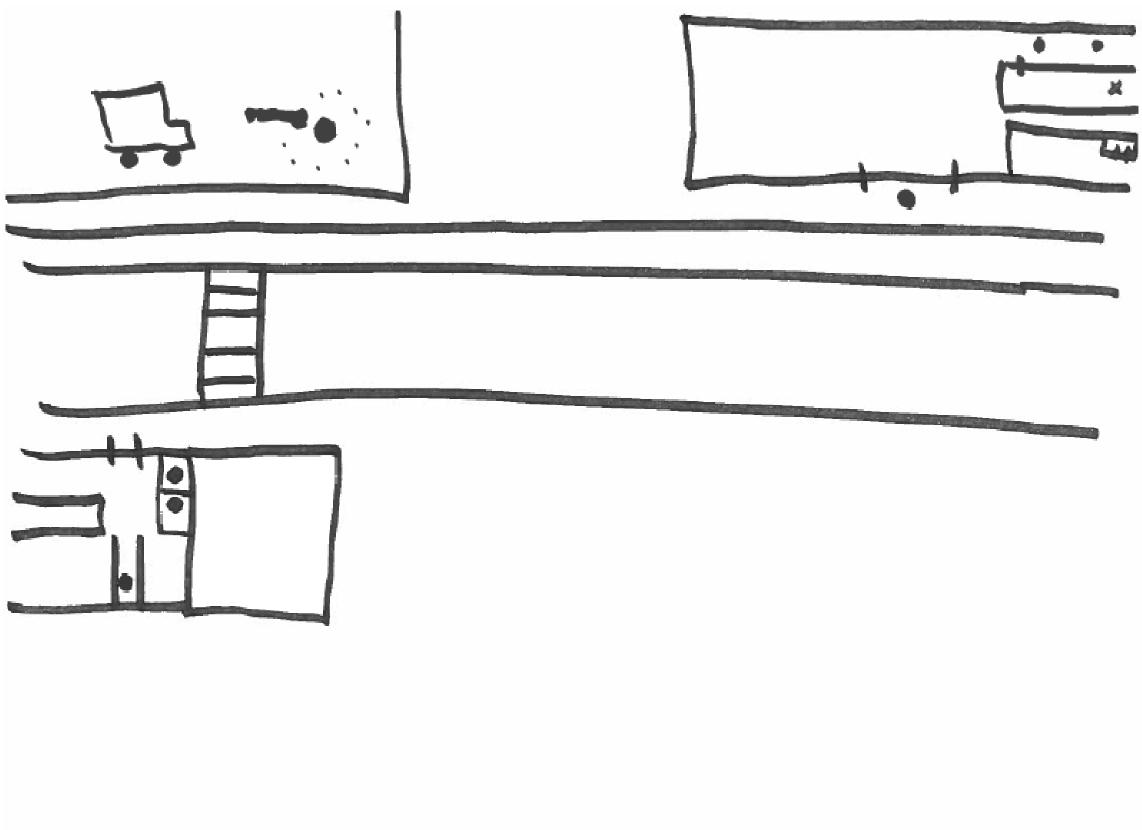

Figure 5. Image of the completed dynamic sketch for Experiment 3.

Appendix A

Below are the data analyses for Experiment 3 with all data included (i.e., without the removal of the four extreme outliers).

Percentage of Total Details Recalled. A 4 (Modality: Audio-Only, Static Sketch, Hybrid Sketch, Dynamic Sketch) x 2 (Access to Sketch During Recall: Yes, No) MANOVA revealed that there was no significant main effect of Modality ($F < 1$). In terms of Modality, the mean percentage of total details recalled for those in the Audio-Only condition was 37.83 (CI = 32.77, 42.89), 41.30 (CI = 35.94, 46.66) in the Static Sketch condition, 39.05 (CI = 34.10, 44.00) in the Hybrid Sketch condition, and 41.31 (CI = 35.86, 46.76) in the Dynamic Sketch condition. The size of the effect between the Audio-Only condition and the Static, Dynamic, and Hybrid conditions was small (d = -0.20, d = -0.20), and negligible (d = -0.07), respectively. The size of the effect between the Static condition and the Hybrid and Dynamic conditions was small (d = 0.14) and negligible (d = 0.00), respectively. The effect size between the Hybrid and Dynamic condition was small (d = -0.13).

The MANOVA revealed that there was no statistically significant main effect of Access to Sketch During Recall ($F < 1$). The mean percentage of total details recalled for those in the No Access condition was 38.92 (CI = 35.21, 42.63), and 40.80 (CI = 37.29, 44.31) in the Access to Sketch condition, and the size of the effect was small (d = -0.11). The interaction did not reach significance ($F < 1$).

Percentage of Details Recalled Correctly. A 4 x 2 MANOVA revealed that there was no statistically significant effect of Modality ($F < 1$). The mean percentage of details recalled correctly for those in the Audio-Only condition was 36.74 (*CI* = 31.67, 41.81), 40.40 (*CI* = 35.02, 45.78) for those in the Static Sketch condition, 38.34 (*CI* = 33.34, 43.34) for those in the Hybrid Sketch condition, and 40.54 (*CI* = 35.11, 45.97) for those in the Dynamic Sketch condition. The size of the effect between the Audio-Only condition and the Static, Hybrid, and Dynamic conditions was small (*d* = -0.21, *d* = -0.10, and *d* = -0.22, respectively). The size of the effect between the Static condition and the Hybrid and Dynamic conditions was small (*d* = 0.12) and negligible (*d* = -0.01), respectively. The effect size between the Hybrid and Dynamic condition was small (*d* = -0.13).

The MANOVA also revealed that there was no statistically significant main effect of Access to Sketch During Recall ($F < 1$). The mean percentage of details recalled correctly for those in the No Access condition was 38.04 (*CI* = 34.32, 41.76), and 39.94 (*CI* = 36.42, 43.46) for those in the Access to Sketch condition, and the size of the effect was negligible (*d* = -0.11). The interaction was also not statistically significant, $F < 1$.

Percentage of Details Recalled Incorrectly. A 4 x 2 MANOVA did not reveal a statistically significant effect of Modality ($F(3,165) = 1.94$, $p = .121$). The mean percentage of details recalled incorrectly for those in the Audio-Only condition was 1.09 (*CI* = 0.83, 1.35), 0.91 (*CI* = 0.67, 1.15) for those in the Static Sketch condition, 0.71 (*CI* = 0.45, 0.97) for those in the Hybrid Sketch condition, and 0.76 (*CI* = 0.55, 0.97) for those in the Dynamic Sketch condition. The size of the effect between the Audio-Only condition and the Static, Hybrid, and Dynamic conditions was small (*d* = 0.22, *d* = 0.44, and *d* = 0.43, respectively). The size of the effect between the Static condition and the

Hybrid and Dynamic conditions was small (*d* = 0.25 and *d* = 0.21, respectively). The effect size between the Hybrid and Dynamic condition was negligible (*d* = -0.06).

The MANOVA did not reveal a significant main effect of Access to Sketch During Recall, *F* <1. The mean percentage of details recalled incorrectly for those in the No Access condition was 0.88 (*CI* = 0.72, 1.04), and 0.86 (*CI* = 0.68, 1.04) for those in the Access to Sketch condition, and the size of the effect was negligible (*d* = 0.02). The interaction did not reach significance, *F* < 1.

Number of Confabulations. A 4 x 2 MANOVA did not reveal a statistically significant main effect of Modality (*F*(3, 165) = 1.98, *p* = .119). The mean number of confabulations reported by those in the Audio-Only condition was 1.58 (*CI* = 0.97, 2.19), 0.83 (*CI* = 0.43, 1.23) for those in the Static Sketch condition, 1.33 (*CI* = 0.67, 1.99) for those in the Hybrid Sketch condition, and 0.86 (*CI* = 0.55, 1.17) for those in the Dynamic Sketch condition. The size of the effect between the Audio-Only condition and the Static, Hybrid, and Dynamic conditions was small (*d* = 0.44, *d* = 0.12, and *d* = 0.45, respectively). The size of the effect between the Static condition and the Hybrid and Dynamic conditions was small (*d* = -0.28) and negligible (*d* = -0.03), respectively. The effect size between the Hybrid and Dynamic condition was small (*d* = 0.28).

The MANOVA also revealed that there was no statistically significant main effect of Access to Sketch During Recall (*F* < 1). The mean number of confabulations reported by those in the No Access condition was 1.24 (*CI* = 0.91, 1.57), and was 1.07 (*CI* = 0.68, 1.46) for those in the Access to Sketch condition. The size of the effect was small (*d* = 0.10). The interaction did not reach significance, *F* < 1.

Error Rate. A 4 x 2 MANOVA did not reveal a significant main effect of Modality ($F(3, 165) = 1.20$, $p = .311$). The mean error rate for participants in the Audio Only condition was 5.51 (*CI* = 4.07, 6.95), 4.48 (*CI* = 2.85, 6.11) for those in the Static Sketch condition, 4.33 (*CI* = 2.39, 6.27) for those in the Hybrid Sketch condition, and 3.46 (*CI* = 2.35, 4.57) for those in the Dynamic Sketch condition. The size of the effect between the Audio-Only condition and the Static, Hybrid, and Dynamic conditions was small ($d = 0.21$, $d = 0.21$, and $d = 0.48$, respectively). The size of the effect between the Static condition and the Hybrid and Dynamic conditions was negligible ($d = 0.03$) and small ($d = 0.23$), respectively. The effect size between the Hybrid and Dynamic condition was small ($d = 0.17$).

The MANOVA revealed that there was no statistically significant main effect of Access to Sketch During Recall ($F(1, 165) = 1.10$, $p = .296$). The mean error rate for participants in the No Access to Sketch condition was 4.86 (*CI* = 3.78, 5.94) and 4.04 (*CI* = 2.95, 5.13) for those in the Access to Sketch condition, and the size of the effect was small ($d = 0.16$). The interaction did not reach significance, $F < 1$.