

# **The Misleading Potential of Communicative Hand Gestures in a Forensic Interview**

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# Abstract

A wealth of research has highlighted the susceptibility of eyewitnesses to verbal influence. However, considerably less attention has been paid to the role of nonverbal influence in police questioning. The purpose of this thesis was to evaluate the extent to which gestures can exert an influence on witnesses and skew their responses when questioned. Study 1 initially investigated this by presenting participants with an on-screen 'police' interviewer who accompanied his questions with gestures conveying either accurate or misleading information about a piece of video footage they had witnessed. Results showed that, for one question in particular, participants' responses concurred with the information conveyed to them in gesture; accurate gestures led more participants to giving correct responses and misleading gestures led more participants to giving fabricated responses. Study 2 built on this by examining whether gestures could also affect the confidence attributed to their responses in order to give insight into whether gestures were knowingly processed for information. It was found that, in some cases, gestures were able to increase confidence in both accurate and misled responses. Study 3 examined participants' awareness of gesture further by studying their attention to gesture during its performance and ability to identify it retrospectively on a recognition task. A new set of questions confirmed that gestures could influence the responses of participants (including those working in the legal profession) and revealed that the influence of gesture appears to be at its strongest when unnoticed by participants. Finally, study 4 considered whether the results of the previous studies could be replicated in a more ecologically valid interview scenario and confirmed that gestures continued to be influential when performed face-to-face. Overall, it was concluded that gestures can impact accurate eyewitness testimony and can be a powerful influential tool in police interviews.

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## Chapter 1 :

# Literature Review

## Introduction

To what extent can an individual influence another? At some point in our lives, we have probably all been persuaded into doing something we would not normally do due to the behaviour of those around us. Perhaps others have convinced us to go to a party we were unsure about, or persuaded us to vote for a certain political party in an election. People around us have a way of influencing our decisions or behaviours, sometimes without us even noticing.

Being persuaded or influenced a certain way can often have very positive effects, though there can sometimes be negative effects. Over the past few decades, psychologists have become very interested in how people can be mistaken or led to believe something that never actually happened, sometimes with far reaching consequences (Connors, 1996; Scheck, Neufeld, & Dwyer, 2003). Research into eyewitness testimony has revealed how sensitive a witnesses' memory of an event is and, consequently, how susceptible they can be to having this memory skewed (Loftus, 1974, 1975, 1979). Ensuring accurate eyewitness testimony is of critical importance in criminal and forensic proceedings, and psychologists have sought to understand the susceptibility of eyewitnesses in order to ensure they report accurate details of what they have witnessed. Revelations into how the wording of a question can influence eyewitnesses testimony have led to greater vigilance in interview procedures (Fisher, Geiselman, & Raymond, 1987; Geiselman, et al., 1984), with interviews adopting careful protocols and requiring an audio recording (UK Police and Criminal Evidence Act, Code E, Section 2.1). However, while much focus has been placed on verbal influence when questioning witnesses, little attention has been paid to nonverbal influence. As such, there is a paucity of research studying how witnesses can be influenced by nonverbal behaviour of the interviewer; in particular, by their hand gestures.

Research into hand gestures has confirmed their importance in language and comprehension; some of which are produced explicitly with the intention of giving meaning, whilst others occur spontaneously with speech. Gestures can build on what is said in speech (McNeill,

1985) and can also convey information that is absent from speech (Kendon, 1980; McNeill, 1992). Such an observation is important as listeners have been shown to glean information from gesture in order to interpret meaning (Cassell, McNeill, & McCullough, 1999; Kelly, Barr, Church, & Lynch, 1999). Research also confirms that gesture is tightly linked to speech (Kendon, 2004; McNeill, 1992) with neurological evidence claiming that the two are highly interactive (Decety, et al., 1997; Grezes, Armony, Rowe, & Passingham, 2003; Tanaka & Inui, 2002). In light of this evidence, gestures appear to serve an important role in communication and form part of a communicative system that conveys information and meaning to others.

Based on the evidence of eyewitnesses susceptibility and communicative function of gestures, this thesis fuses these two areas together to form a unique research question that asks whether gestures are able to mislead eyewitnesses in a similar fashion to speech. This thesis investigates whether eyewitnesses can have their memory skewed by information conveyed in gesture, and if the ramifications of misleading gestures in the interviewing of eyewitnesses can be similar to those caused by speech.

In order to elucidate these topics, this review will consider the current literature through the following:

*The Nature of Interpersonal Influence* will explore the means and nature of interpersonal influence with particular attention to research concerning the interviewing of eyewitnesses and the impact of leading questions on their memory. This section will also provide an introduction to nonverbal influence and discuss the importance of gesture in this area.

*Classifications of Gesture* will highlight different types of gesture and differentiate between those that are produced with the clear intention of communicating information and those that occur spontaneously alongside speech.

*The Purpose of Gesture* will then be discussed, and will consider the extent to which gestures perform a communicative function. Two main theories suggesting that gestures have an interpersonal function or an intrapersonal function will provide an insight into when gestures are produced with the intention of communicating information to listeners.

*The Interaction between Speech & Gesture* will cover theory on how speech and gesture are functionally related and build on evidence that gestures are an integral part of the communicative system. Neurological evidence will also be called upon to offer further support for the importance of gesture in communication.

This review will end with a *Summary* of the key messages from the literature, before providing an *Outline of Research Questions* that will be considered in this thesis.

## The Nature of Interpersonal Influence

Eyewitnesses to a crime can often provide critical information to a trial. Jurors are generally very trusting of eyewitnesses and are more likely to form a guilty verdict if an eyewitness provides positive testimony (Loftus, 1974, 1986). However, the introduction of DNA testing revealed many cases where individuals were wrongly convicted of crimes they did not commit (Connors, 1996; Scheck, et al., 2003) and eyewitness testimony has been found to be the most common evidence used in these faulty convictions (Gross, Jacoby, Matheson, Montgomery, & Patil, 2005). While people are generally unaware of how fallible memory is (Benton, Ross, Bradshaw, Thomas, & Bradshaw, 2006), Loftus (1974) describes eyewitness memory recall as a 'malleable process', and one which is susceptible to change due to leading questioning. A great deal of research has identified the unreliability of eyewitness memory under questioning to be the cause of inaccurate information (Fisher, et al., 1987; Geiselman, et al., 1984; Harris, 1973; Loftus, 1974, 1975, 1979; Loftus & Palmer, 1974). This section reviews the literature on witness susceptibility and situations in which their memories can be skewed during questioning.

The format of a question can determine a witness's answer. Leading questions asked by police interviewers can indirectly encourage a certain reply (Myers, Saywitz, & Goodman, 1996), often through subtle wording changes. For instance, asking "*was the man wearing a hat*" results in less positive responses than asking "*the man was wearing a hat, wasn't he?*" Again, the witness may feel obliged to agree with the interviewer, or simply reply "*yes*" as it may seem more appropriate or polite to do so. Other wording changes can influence responses, such as asking "*how tall was the man?*" or "*how short was the man?*". Even the inclusion of a descriptive verb can alter the perception of the event (Harris, 1973). Loftus &

Palmer (1974) demonstrated this in a study where participants were required to estimate the speed of cars in an accident after being asked *"how fast were the cars going when they \*\*\* into each other?"* The more severe sounding verbs (i.e. 'crashed') resulted in higher speed estimates than others (i.e. 'bumped').

The 'misinformation effect' (Loftus & Hoffman, 1989) explains that witnesses are sensitive to post-event information and this can alter their perception of the original event. Thus, the introduction of inaccurate information can become integrated with the original encoded memory to form an inaccurate representation of what was witnessed. Loftus & Zanni (1975) initially demonstrated this effect when showing participants footage of a car accident and asking whether they noticed *"a broken headlight"* or *"the broken headlight"*. The insinuation of *"the"* broken headlight in the latter question caused participants to integrate the image of a broken headlight into their memory of the accident and led them to report they saw this in the video. Similar effects are present when asking participants *"how fast was the white sports car going when it passed the barn?"* where participants reported seeing *"the"* barn, even though none was present (Loftus, 1975). Witness can therefore make use of information suggested to them in order to answer questions posed by police interviewers and the failure of witnesses to identify where this additional information originated increases their susceptibility to the misinformation effect (Johnson, Hashtroudi, & Lindsay, 1993). As such, misinformation is thought to be a 'mediated process', particularly as warning witnesses about the effect significantly reduces its likeliness to occur (Highhouse & Bottrill, 1995).

The misinformation effect is thought to distort the actual memory of eyewitness, not just the details they report (Loftus, 1979; Loftus & Loftus, 1980). That is, memories are *constructed* rather than *replayed* (Loftus & Hoffman, 1989). Based on this, witnesses can not only make inferences based on information provided from a police interviewer, but can also fabricate entirely new memories. Research has demonstrated that participants instructed to repeatedly imagine an event occurring leads them to believe it actually happened (Goff & Roediger, 1998; Thomas, Bulevich, & Loftus, 2003). This has been observed with events that are easy to imagine, including childhood experiences (Garry, Manning, Loftus, & Sherman, 1996; Hyman & Pentland, 1996) but even events that, although logical, are impossible (Braun, Ellis, & Loftus, 2001). Wright, Loftus & Hall (2001) highlight the importance of this effect in eyewitness testimony. They provide an example where participants watched a video of a drink driving accident and were then told to *"imagine a police officer approaching the*

*driver*". After a time interval, participants reported seeing a police officer in the original video, even though none was present. Therefore, the imagining of events occurring can become confused with the original events and, consequently, lead to witnesses reporting false information.

An explanation for this effect of 'imagination inflation' is due to the high levels of perceptual detail shared between real and imagined events (Johnson, Foley, Suengas, & Raye, 1988). False memory creation is facilitated by imagery ability (Dobson & Markham, 1993) and the greater the clarity of an imagined event, the more likely it is to become confused with a real event (Drivdahl & Zaragoza, 2001; Schacter, 1996; Zaragoza, Belli, & Payment, 2007). Eyewitnesses then appear to be highly susceptible to suggestions from police interviewers and vulnerable to confusing fabricated details with their original memory of the event.

Other biases in eyewitness testimony arise from the social interaction between the witnesses and the interviewer. Witnesses are more susceptible to suggestions from sources they deem credible or have greater expertise (Smith & Ellsworth, 1987; Underwood & Pezdek, 1998). Consequently, they may be prone to confirm suggestions provided by the police officer than providing novel evidence. As an example, witnesses are more likely to give a positive response to a question asking "*did the man have a tattoo or not?*" than "*did the man have any other distinguishing features?*" The witness may reason the fact the police officer is asking about a tattoo implies they have strong reason to believe he did. As such, witnesses may feel obliged to give an answer which favours this, as they have a "*tacit expectation that what the questioner is saying is true*" (Semin & Poot, 1997, p. 473).

Due to witness susceptibility in the interview procedure, psychologists have developed methods of interviewing to prevent such influence occurring. The cognitive interview (Geiselman, et al., 1984) was developed as a technique to cue accurate, unbiased memory recall from witnesses. While some witnesses can approach an interview with anxiety or uncertainty (Bain & Baxter, 2000), the interview technique first attempts to relax witnesses by building trust and confidence in the interviewer and reduce feelings of intimidation (Fisher & Geiselman, 1992; Shepherd & Milne, 1999). Typically, witnesses are first greeted by the interviewer who then provides reasons for the interview and details on how it will be conducted. During the interview, witnesses are invited to recall freely as much information as they can about the witnessed event. This technique is designed to reinstate mental states witnesses experienced during memory coding (Fisher, Brennan, & McCauley, 2002) on the



premise that recalling information in an environment that reproduce features of the original coding context is more likely to prompt accurate memory retrieval (Tulving, 1974). During the close of the interview, the interviewer summarises the information collected to enable witnesses the opportunity to clarify this. This method is designed to alleviate the effects of leading questioning and is widely used across the UK today, with many psychologists confirming its effectiveness (Kebbell, Milne, & Wagstaff, 1999; Köhnken, Milne, Memon, & Bull, 1999).

Witness susceptibility to verbal influence is a well researched area. However, very little attention has been paid to the role of nonverbal behaviour in misleading witnesses during a police interview and, in particular, the role of hand gestures in conveying information. The remainder of this chapter reviews the literature on the role of hand gestures as a communicative, interpersonal function with a focus on how they can convey information to listeners. This will be addressed through a discussion on the purpose of gesture and their role in language. This literature is reviewed in light of the hypothesis that gestures have the ability to lead witnesses into giving inaccurate testimonies in a similar manner to speech.

## Classification of Gestures

Hand gestures can take many forms, and it is generally accepted that a universal definition that accounts for all gesture types still eludes us. Research to date has however provided some well established gesture categories, each of which are described below. Psychologists have provided summaries of different gesture types and coined their own terms for these gestures categories (Krauss, Chen, & Gottesman, 2000; McNeill, 1992) though the most common types of gestures are summarised below.

### *Emblematic Gestures*

The first gestures of interest are emblematic gestures. These gestures, unlike many others, are produced purposefully by the speaker, well within their awareness. The gesture conveys a 'symbol' that is usually well recognised, such as a wave "hello" or a 'thumbs up' and is often produced in situations where speech is difficult, such as across the street or in a crowded

room. These gestures, widely known as 'emblems' (Ekman & Friesen, 1972) are often culturally specific, and are widely recognised within countries. One example may include "OK", where the speaker forms a ring with their thumb and middle finger and is recognised widely in United States. These emblems are also popular across European countries; in particular, France and Italy (Kendon, 1995).

Emblematic gestures can be produced in the absence of speech or as a substitute for it; that is, these gestures can be fully communicative in the absence of speech. The most important trait of these gestures though is that they are produced with the intention of conveying a clear message to a listener and occur within the awareness of both the speaker and listener.

### *Mixed-Syntax Gestures*

Other gestures that can effectively replace speech in communication include mixed-syntax gestures (Slama-Cazacu, 1976). During conversation, meaning is provided explicitly through the gesture, making it an integral part of a verbal utterance. As an example, Goldin-Meadow (2005) cites: "*the parents were all right, but the kids were...*" with the speaker concluding the sentence with their index finger spinning around the head to convey "*crazy*". Therefore, while the gesture is referent to the speech content, it provides critical information to the listener independently.

Another example of when gestures provide integral information with speech is the 'propositional' gesture (Hinrichs & Polanyi, 1986). These gestures represent 'symbolic space', and examples may include a fisherman describing a fish he caught as being "*this big*", or somebody discussing how furniture should be placed in a room. These gestures are again produced with reference to the speech content, and produced alongside speech (as co-speech gestures described in the following section), but are executed explicitly and intentionally to convey meaning independently.

### *Co-speech Gestures*

The aforementioned gestures may be performed alongside speech during conversation and produced explicitly to convey meaning, but other speech-accompanying gestures may complement speech more implicitly. The 'co-speech gestures' described in this section

provide information that is only fully interpretable in the presence of speech, and are often produced without the speaker realising (Cassel, 2000). In this case, speakers can accompany their speech with gestures that unwittingly transmit additional information to listeners and convey this meaning in a less explicit manner to the gestures described above. Whilst the purpose of these gestures and their role in communication will be discussed more thoroughly in the next section, this section will provide an overview of gestures that accompany speech spontaneously.

The most important feature of spontaneous gestures is that they accompany verbal information without disrupting the natural flow of speech. These gestures are also known by other names, including 'ideational' gestures (Hadar & Butterworth, 1997), 'gesticulations' (Kendon, 1983) and 'conversational' gestures (Rauscher, Krauss, & Chen, 1996). Once again, these gestures can be broken down into finer categories, each of which is outlined below.

*Iconic* gestures, arguably the most ubiquitous form of gesture, provide pictorial representations of semantic information in speech. Iconic gestures can be observed when the listener describes an action, such as climbing a ladder, where the hands may ascend in a repetitive, grasping motion (McNeill, 1992). Iconic gestures usually complement these descriptions of actions and often involve objects that require usage of the hands (i.e. 'hammering'). However, as well as accompanying speech, iconic gestures can also build on speech, providing additional information that does not occur in the verbal content. For example, the sentence "*she chased him out*" could be accompanied by a gesture held above the head gripping an imaginary object to indicate that a weapon was used (McNeill, 1985). Iconic gestures can also be produced during the description of physical objects; i.e. when a speaker talks of goal posts, their speech may be accompanied by a gesture of the hands slicing up and down vertically to represent the two poles. These gestures tend to accompany descriptions of objects that have a relatively simple shape construct, such as the outline of a mountain peak depicted by an upside-down V gesture (McNeill, 2000). Iconic gestures also appear to be effective at conveying size and relative position of objects (Beattie & Shovelton, 1999b). Therefore, iconic gestures can be used to depict visually both actions and objects, thus, a general explanation that accounts for all these situations is that iconic gestures accompany speech by clarifying additional physical information about the verbal content.

Whilst iconic gestures clarify physical information about objects, *metaphoric* gestures communicate abstract ideas, representing metaphorical thoughts or concepts through a concrete hand movement. Cassel, McNeill & McCullough (1999) describe an example of a person saying "*the meeting went on and on*" alongside a rolling hand gesture to portray the concept of the meeting being continuous and ongoing. Metaphoric gestures can also depict a concept in a social context: A further example provided by Cassel (2000) includes a conference speaker saying "*in this [next part] of the talk*" and producing a 'box' gesture occurring on the words "*next part*" to represent this information as a physical item. While metaphoric gestures are a widely recognised form of gesture, their presence as a separate type of gesture has been met with some criticism. Krauss et al. (2000) claim that "*to say that such gestures are visual metaphors may be little more than a way of saying that their iconicity is not obvious*" (p 23). However, one could argue that their key difference from iconic gestures is that, rather than depicting physical information about a concrete object, metaphoric gestures convey a metaphorical concept through a physical action.

Following on from this is the *deictic* gesture, which can be described most simply as a pointing movement. These gestures are the first type of gestures produced by young children, and are often produced before the child is able to speak (Greenfield & Smith, 1976) in order to draw attention to objects (Bates, Benigni, Bretherton, Camaioni, & Volterra, 1979). As children link these gestures with first word utterances, they are thought to be linked to language development (Butcher & Goldin-Meadow, 2000; Iverson & Goldin-Meadow, 2005). As adults, these pointing movements can occur in everyday situations, such as giving directions to a conversational partner in the street. As such, these gestures could be interpreted as symbolic gestures as they break up the narrative flow of speech and are produced with the intention of directing the listener to a specific object or location, well within the awareness of both the speaker and listener. Gestures of this nature can be produced in the absence of speech, or almost as a substitute for it. (i.e. accompanying verbal information such as "*it's in that direction*" adds relatively little to the answer.) However, researchers also explain that deictic gestures can point to imagined or abstract items. McNeill (1992) explains that "*abstract pointing gestures imply a metaphorical picture of their own in which abstract ideas have a physical locus*" (p.18). To further this idea, Cassel, et al. (1999) provide the example of an individual saying "*Adam looked at Chuck, and he looked back*" with the hand pointing left, and then right, to represent the change of character. The goal of

the deictic gesture then is to localise people, objects and structures in the physical space surrounding the speaker.

The previous three gestures provide meaningful and useful information to the listener, but the last category of gesture, the *beat* gesture, bears no semantic significance to the speech content. Beat gestures, also known as ‘motor’ (Hadar, 1989), ‘baton’ (Efron, 1972), ‘pathic’ (Hummels & Stappers, 1998; Wexelblat, 1994) and ‘body focused’ gestures (Freedman, O’Hanlon, Oltman, & Witkin, 1972) generally occur alongside the speakers awareness of speech, such as during a hesitation. An example may include a speaker saying “*I met him on Tues-, no sorry, on Thursday*” where this hesitation is accompanied by a swift, jagged, hand movement. These gestures can also be used to give emphasis to certain points during speech, occurring on the more prominent syllables of words (McNeill, 1992). The controversy surrounding whether these gestures are produced to alleviate tension on the lexical system or as expressions of speech will be addressed later.

Other gestures that do not provide communicative information include *Self-Adapter* gestures. These gestures describe other bodily movements, such as scratching, fidgeting or tapping (Krauss, 1998). Other nonverbal behaviours in this category may include foot-tapping or head rolling and movements made during the maintenance of physical appearance; i.e. grooming or cleansing actions. Self-adapter gestures generally receive little attention or feedback from conversational partners and, with no intrinsic relationship to speech, these gestures are performed with little awareness and with no intention to communicate (Ekman & Friesen, 1969).

In summary, hand gestures can be divided into two broad categories; namely, those which are produced explicitly in conjunction with speech (emblematic gestures), and those which naturally occur within the narrative flow of speech (co-speech gestures). Although some controversy within the definition of the examples provided above clearly exists, it is evident that some gestures are produced with intent and others are produced outside of the speaker or listener’s awareness. The remainder of this review focuses on co-speech gestures. In the following section, this review will consider when and why these gestures are produced, and what purpose they serve in conversation.

## The Purpose of Gesture

Gesture production begins at the early age of 9-12 months (Bates, et al., 1979) and is thought to play an important role in language development (Butcher & Goldin-Meadow, 2000; Iverson & Goldin-Meadow, 2005). In adulthood, gestures continue to be produced often when accompanying speech. The type and frequency of gesture performed by speakers is generally dependent on the task being performed. Iconic gesturing is thought to be most frequent in communicative situations (Beattie & Shovelton, 2002) and can occur up to three times more often when describing spatial information (Rauscher, et al., 1996), whereas deictic gesturing is understandably more common in direction-giving tasks (Iverson & Goldin-Meadow, 1998). Beat gestures however, occur as frequently regardless of the task (Alibali, Heath, & Myers, 2001).

The difference observed in gesture production across different tasks has resulted in some dispute as to what the purpose of gestures is. While some researchers claim that gestures are produced for the benefit of the listener to aid communication as an interpersonal function (Goldin-Meadow, 2005; Goldin-Meadow, Alibali, & Church, 1993), others are more sceptical, claiming that the role of gestures is mainly intrapersonal and they are produced for the sake of the speaker (de Ruiter, 1998; Krauss, 1998; Krauss, et al., 2000; Rauscher, et al., 1996). This review will now assess the evidence for both of these positions in turn with reference to empirical research.

### *Gestures Serve an Interpersonal Function*

The last section provided examples of when gestures (particularly iconic gestures) convey meaning to listeners: Research shows that gestures appear to communicate additional information outside of speech (Kendon, 1980; McNeill, 1992). In general, gestures appear to serve a communicative function by expanding on information that is communicated verbally (Langton, O'Malley, & Bruce, 1996), adding clarity to speech (Goldin-Meadow, et al., 1993), and making communication between a speaker and listener more effective (Beattie & Shovelton, 1999a). People are more likely to produce gestures in the presence of an observable conversational partner (Cohen & Harrison, 1973; Rime, 1982), particularly iconic, spatial-describing gestures (Beattie & Shovelton, 2002; Pine, Gurney, & Fletcher, 2010; Rauscher, et al., 1996) and deictic, direction-giving gestures (Iverson & Goldin-Meadow,

1998). The presentation of iconic gestures has also been shown to facilitate story comprehension (Riseborough, 1981) and the memories of verbal content (Beattie & Shovelton, 2005; Church, Garber, & Rogalski, 2007). Graham & Arygle (1975) also found that participants were able to replicate an abstract line drawing more accurately if the person accompanied their description of the image with gestures.

Speech and gesture therefore appear to work together to form a 'single integrated system' (Goldin-Meadow, 1998) that provides a 'unified representation' (McNeill, Cassell, & McCullough, 1994) to the listener. These two components of communication combine to create an overall, coherent meaning to a listener where each has its own role in conversation. While speech conveys information in a "*segmented, combinatorial*" format, gestures convey information in a "*global, mimetic*" style (Goldin-Meadow, McNeill, & Singleton, 1996). As gestures can communicate information visuospatially, rather than verbally, they can communicate information that is difficult to articulate in speech (Church & Goldin-Meadow, 1986) such as giving directions (Iverson & Goldin-Meadow, 1998) or describing abstract shapes, such as the outline of a country (Goldin-Meadow, 1999). More focus is directed at the gesture when the verbal source is ambiguous (Thompson & Massaro, 1986) or completely inaudible (Rogers, 1978).

In addition, gestures can also communicate information that is not available in speech. Kendon (1980) gives a well documented example of this; where somebody describes a "*large cake*" and accompanies their speech with a large circular gesture of their arm with their index finger pointing downwards. This communicates to the listener that the cake is "round" without explicitly stating so in speech. Similarly, Kelly, Barr, Church & Lynch (1999) found that gestures can play an important role in the comprehension of pragmatic communication. In their study, participants were more likely to understand the intention of the speaker if their speech was accompanied by a certain hand gesture (i.e. accompanying the statement "*I'm getting cold*" with a pointing gesture towards an open window). Their research went on to demonstrate that gestures can also communicate additional semantic information that is absent from speech (i.e. "*I told him about the party*" accompanied by a gesture of a telephone held up against the face). Participants were found to recall more information about the story when the accompanying hand gestures were present. Furthermore, when describing narratives to others, participants include information that was only conveyed to them in gesture and

incorporate this information as if it was presented to them in speech (Cassell, et al., 1999; Goldin-Meadow, Wein, & Chang, 1992; Kelly & Church, 1998).

Gestures do therefore appear to serve an important role in communication. Further support for gestures being designed for the listener comes from evidence of speakers tailoring their gestures according to the communication environment. People gesture more in face-to-face situations (Bavelas, Gerwing, Sutton, & Prevost, 2008) and change the orientation of their gestures according to the listener's location (Funiyama, 2000; Özyürek, 2002). Gestures represent more information when common ground between speaker and listener does not exist (Gerwing & Bavelas, 2004; Holler & Stevens, 2007) although speakers may still gesture at a higher rate (Holler & Wilkin, 2009). Speakers continue to gesture to conversational partners even when they cannot see them (Cohen & Harrison, 1973): Speakers also gesture to listeners if they are behind a screen (Alibali, et al., 2001; Pine, et al., 2010; Short, Williams, & Christie, 1976), talking through an intercom (Krauss, Dushay, Chen, & Rauscher, 1995) or over the telephone (de Ruiter, 1995; Rime, 1982). It has even been observed that blind speakers gesture to blind listeners (Iverson & Goldin-Meadow, 1998). This suggests that there may be more to conversational gestures than conveying information to listeners. In some cases, gestures may serve an alternative function in conversation and are produced to serve the speaker rather than the listener.

The extent to which gestures serve a communicative purpose may depend on the context of the speech they accompany. Krauss (1998) observes that restricting gesture when describing non-spatial content has little effect on a person's speech, although, when describing spatial content, speech is impaired. Alibali, Flevares & Goldin-Meadow (1997) build on this with the *Semantic Information Hypothesis*; stating that the visibility of gesture production is dependent on whether the gesture conveys semantic information. The authors investigated this by placing a screen in between two people whilst they communicated with each other on a series of speaking tasks. Whilst the rate of beat gestures remained consistent across conditions with or without the screen, the rate of 'representational' gestures decreased with the presence of the screen; that is, gestures that were representative of the speech content occurred more frequently when an observable partner was present.

The Semantic Specificity Hypothesis (Pine, et al., 2010) builds on this by explaining that gesture production is dependent on the word articulated. The authors manipulated the type of word given to participants in an object description task: Participants were required to describe



either a 'praxic' or 'non-praxic' item in the presence of an observable partner from behind a screen (where praxis is defined by how functional the object is through manipulation of hand movements). Whilst the number of iconic gestures produced for praxic items (such as 'scissors' or 'iron') remained the same regardless of the condition, participants were found to gesture significantly more for non-praxic items (such as 'tree' or 'chicken') when the observable partner was present.

To summarise, gestures do appear to facilitate communication between speaker and listener, although research demonstrating that speakers continue to gesture in the absence of a visible conversational partner implies they are not produced exclusively for communicative needs. The following section explores the alternative theory that gestures can serve an intrapersonal function; that is, they are produced for the sake of the speaker rather than the listener.

### *Gestures Serve an Intrapersonal Function*

If gestures do not always serve the listener, they may be produced to serve the speaker. A number of theories have been suggested to provide an explanation as to why people gesture in the absence of a conversational partner or what purpose gestures serve in conversation if they do not always communicate information. To understand how gestures can influence, it is important to understand situations where gestures communicate critical information to listeners or when they are being produced to aid the speaker.

The *Cognitive Load Lightening Hypothesis* (Goldin-Meadow, Nusbaum, Kelly, & Wagner, 2001) posits that gestures reduce cognitive load so that additional resources can be attributed to other tasks, such as speaking. At first, this may seem counter-intuitive, as the production of gesture requires additional neurological resources to administer motor planning (Andersen, 1995) and would therefore be expected to increase cognitive load (Norman & Bobrow, 1975). However, Goldin-Meadow, et al. (2001) found that performance on a maths task improved if participants gestured while conducting it. This was found in particular for young children, who pointed to objects whilst counting them. Here, it was found that using a gesture to suspend a cognitive task in physical space made the task more manageable and reduced cognitive burden so that the task could be completed more easily. Therefore, gesture production appears to 'ease up' cognitive load and improve performance on cognitive tasks.

The *Image Activation Theory* builds on this, claiming that gestures facilitate the maintenance of spatial representations in working memory (de Ruiter, 1998; Wesp, Hesse, Keutmann, & Wheaton, 2001). As verbal information and visual spatial information require separate neurological resources (Smith & Jonides, 1997), the gesture serves to maintain spatial imagery to free up cognitive resources to ease speech. In much the same way as vocalisations are maintained by rehearsal in the phonological loop of Baddeley's (1986) working memory model, gestures suspend spatial representations of objects in the visuospatial sketchpad and can hold the concept in memory while lexical tasks are performed (Hadar & Butterworth, 1997).

The *Information Packaging Hypothesis* (Alibali, Kita, & Young, 2000; Kita, 2000; Özyürek & Kita, 1999) explains how gestures can also help to organise spatial representations in 'packages' so that they can be articulated in speech. The use of gestures to create physical representations has been demonstrated in '3D mental rotation' tasks (Chu & Kita, 2008) as well as 'interlocking gears' tasks (Schwartz & Black, 1996) where participants use their hands to 'suspend' spatial concepts in order to solve the problem and verbalise their answer.

Gestures are well suited to maintaining visuospatial information as they can provide a spatio-motoric representation of the word being described (Frick-Horbury, 2002). Rauscher, Krauss & Chen (1996) observe that gestures generally occur more often when describing words of a spatial nature. This may be because objects and actions can be associated with each other (Klatzky, Pellegrino, McCloskey, & Doherty, 1989). For instance, the word 'doorknob' can be associated with the action of a hand clenching. This has given rise to the theory that information from gesture can be encoded with speech, and performing an action of the words being described can ease lexical access to help retrieve the word from the lexicon (Frick-Horbury, 2002).

This leads to the *Lexical Retrieval Hypothesis* which states that gestures facilitate the retrieval of words from the lexicon by acting as a cue to recall. Krauss, Chen & Gottesman (2000) suggest that items are encoded to memory in both a visual and semantic format, and the production of gesture activates a visual link to the word so it can be retrieved. The authors, in turn, suggest that these gestures are not performed with the intention of communicating information to a listener (even though they may do so) but rather to serve as a retrieval tool. In Kendon's (1980) cake example, the shape of the cake is remembered visually rather than semantically. Therefore, at retrieval stage, the encoded information of

'round' is represented visually whilst the other, more semantic, features of the cake (such as its size or colour) are vocalised through speech.

However, while gestures accompany spontaneous speech more than rehearsed speech (Chawla & Krauss, 1994) gestures used to retrieve words are not always iconic (Beattie & Coughlan, 1999; Krauss & Hadar, 1999). Other gestures performed when retrieving words can serve other social functions; such as interruption suppression signals (Butterworth & Hadar, 1989), where the gesture serves a holding function to inform the listener they are in the process of retrieving the word and should not be interrupted (Duncan, 1974). Gestures can also dissipate frustration when unable to recall the word (Dittman & Llewellyn, 1969). This tension can also manifest itself as other body movements, such as foot-tapping, and may even be linked to the behaviour of a person pacing nervously across a room to alleviate tension.

The theory that gestures facilitate lexical retrieval is met with some empirical support, as studies have shown that restricting hand movements impairs lexical retrieval, both in children (Pine, Bird, & Kirk, 2007) and in adults (Frick-Horbury & Guttentag, 1998). However, some studies have reported no effects on participants' ability to produce coherent speech as a consequence of having their hand movements restricted (Beattie & Coughlan, 1999; Graham & Heywood, 1976; Lickiss & Wellens, 1978). However, the conclusions of these reports have been met with much criticism, stating that such anomalies could occur from methodological flaws and limited word sets. Further problems can occur as asking participants to keep their hands still during speech can have a deleterious effect, as unnaturally focusing on obeying a constraining instruction is very cognitively demanding (Goldin-Meadow, et al., 2001; Rauscher, et al., 1996).

Further support for the lexical Retrieval Hypothesis comes from studies investigating Tip-of-the-Tongue (TOT) states. As described by Brown (1991), a TOT state is when "*we are sure that the information is in our memory but are temporarily unable to access it*" (p. 204). Research has confirmed that more gestures are produced by people when in a TOT state (Frick, 1991) and that the production of gesture can result in more resolved TOT cases (Beattie & Coughlan, 1999; Frick-Horbury & Guttentag, 1998; Pine, et al., 2007).

## Summary

Both interpersonal and intrapersonal theories for the function of gestures have gained much support, thus the answer to what purpose gestures serve is that they are likely to have multiple functions. There is evidence that gestures convey information to listeners (Goldin-Meadow, 2005; Goldin-Meadow, et al., 1993) but may also help the speaker (de Ruiter, 1998; Krauss, 1998; Krauss, et al., 2000; Rauscher, et al., 1996). Gesturing may also just be habitual (de Ruiter, 2000), or perhaps the function of gesture differs according to the task. Methods requiring participants to retrieve words place different cognitive demands on those requiring them to describe an object to a conversational partner.

There may also be an overlap in the function of gesture, in particular between a 'lexical movement' and an iconic gesture. When trying to recall the word "*corkscrew*" for instance, the speaker may perform a gesture signifying the usage of that item to aid their recall and a listener may interpret this as the presentation of visual information used to help them identify what the speaker is representing. That is, people may not gesture with the intention of communicating information, but the gleaning of information can just be a 'by-product' of the speaker representing the word to themselves.

Whilst Krauss & colleagues do not deny that gestures can serve an interpersonal function, they reason that this is not their primary purpose. These claims are given extra weight from research suggesting that gestures are often produced without the speakers knowing (Cassel, 2000). If information conveyed by gesture is incidental, this makes the study of gestures even more intriguing, and makes them ideal candidates for covert influence.

## The Interaction between Speech & Gesture

The previous section discussed how people produce co-speech gestures when they speak and how these can refer to semantic information presented in speech. However, gestures not only reveal information that is semantically related to speech but can also reflect a speaker's thoughts, giving an insight into their knowledge and understanding. The following section considers situations where gestures reveal information that is not linked to their speech and, in some cases, conflicts with what is being expressed verbally. These speech-gesture

'mismatches' are considered in light of a discussion into whether speech and gesture share the same communication system or whether they occur independently of each other.

### *Gestures Reveal Knowledge*

The majority of the research concerning what gestures reveal about thought has been conducted on children, where it has been found that their gestures can reveal more about their knowledge and understanding than their speech. Goldin-Meadow (1999) cites an example of a child presented with two rows of an equal number of coins, but with the coins in one row more spaced out than the other. The child protests that the longer row has more coins than the other but, while expressing this thought verbally, points between each of the corresponding coins of the two rows demonstrating the knowledge that the coins in each row can be aligned to each other. Therefore, an insight into the child's understanding can be expressed through gesture before it can be expressed in speech, possibly as the child has not yet developed the linguistic skills needed to articulate the explanation. A similar effect has also been replicated for Piagetian conservation tasks (Church & Goldin-Meadow, 1986) where children see liquid poured from a tall, narrow glass into a shorter, wider glass. While the child struggles to explain why the height of the water has dropped when poured into the wider glass, their hand gesture makes reference to the larger width of the glass, demonstrating they understand the glass width as a factor. Children are also able to use gestures in explanations of pivot and weight distribution in a balance beam task before they can express an explanation verbally (Pine, Lufkin, & Messer, 2004).

### *Gesture Mismatches*

The studies above describe situations where speech and gesture separate to communicate different information. These gesture *mismatches* refer to situations when one idea is expressed in speech, and another through gesture. While gesture mismatches have been studied as an insight into children's learning, research has also considered how these gesture mismatches convey information during conversations with adults. Cassel, et al. (1999) conducted a study where speech and gesture were deliberately mismatched. That is, the speaker only gave some details through speech, and conveyed additional details through gesture. In their study, the speaker narrated a cartoon story and would say, for example,

*"Sylvester goes down the street"* with a mismatched gesture of a 'bouncing' motion. The authors found that mismatched gestures, that conveyed additional information about the characters' behaviour (referred to as 'manner mismatches'), were effective at conveying additional information to listeners. Not only this, but participants integrated the two pieces of information together, confirmed by their reports that the speaker had said *"he bounced down the street"*. Kelly, et al. (1999) built on this by explaining that gestures can also assist pragmatic understanding. The authors' research was based on the observation that gestural information can help listeners understand instructions. In their study, participants were more likely to interpret requests (*"I'm getting cold"*) when they were accompanied by a gesture (pointing at a window). Their study also confirmed that mismatched gestures were able to communicate information independently of speech. In one example, a speaker said *"my brother went to the gym"*, and accompanied this with a 'shooting a basketball' gesture. Their results confirmed that participants were able draw on the information in gesture to understand the complete message, and that participants even remembered the gestured information as being part of speech; i.e. *"my brother went to play basketball"*.

In these examples of gesture mismatches, the speech provides the listener with fundamental information and the gesture completes the image. This observation is in line with the view that conversation has both visual and linguistic aspects (McNeill, 1992). In the cases cited above, gestures convey information individually and need to be considered with speech to convey the full meaning. While speech and gesture may compete with each other for attentional resources (Thompson, Malmberg, Goodell, & Boring, 2004), gestures that are predominantly semantic in nature are more likely to be remembered ( Craik, 1979). In addition, during the integration of speech and gesture, the information in gesture has greater impact when the information in speech is ambiguous (Thompson & Massaro, 1986). Thus, gestures play an important role in the interpretation of information.

### *Speech & Gesture as an Integrated Communication System*

The mismatch between speech and gesture can occur naturally in conversation which may imply that they function on two separate levels. This raises an important question as to whether speech and gesture are linked or occur independently of each other. Do speech and gesture share the same communication system, or do the two belong to separate cognitive systems? Psychologists have been divided on this issue, with some claiming that speech and

gesture are part of the same communication system (Bernardis & Gentilucci, 2006; Kendon, 2004; McNeill, 1992) and others suggesting the two are processed independently (Butterworth & Hadar, 1989; Hostetter & Alibali, 2008; Krauss & Hadar, 1999).

The research reviewed in this dissertation has already described how speech and gesture work together to form a 'single integrated system' (Goldin-Meadow, 1998) and how the restriction of gesture can impair the production of speech (Frick-Horbury & Guttentag, 1998; Pine, et al., 2007). Further evidence of how well speech and gesture are related comes from examples of how gestures naturally accompany speech. McNeill (1992) explains that the production of speech-accompanying, representational gestures has three phases, namely a 'preparation' phrase (where the speaker moves their hand in position to elicit a gesture), a 'stroke' (the gesture itself) and a 'retraction' or 'hold' (the gesture is either retracted or held in position). In contrast, beat gestures have just two phrases; a movement in, and a movement out (Cassel, 2000). The gesture stroke is the most important phrase and occurs alongside the specific semantic expression in speech. McNeill describes an example where a speaker says "*he grabs an oak tree and he bends it way back*" and the gesture stroke of the hand 'bending backwards' occurs on the phrase "*bends it way back*". Gesture strokes can often occur on the most prominent syllable of the word they accompany (i.e. "*there was this gi-[gan]-tic building*"). This elicitation of gesture and its alignment with speech suggests a semantic and temporal coordination between the two.

To further this, the way in which a speaker's messages are comprehended provides insight into the integration between speech and gesture. Kelly, Özyurek & Maris (2010) propose the 'integrated-systems' hypothesis; claiming that speech and gesture interact bi-directionally during language production. To study this, participants were shown a video of a person chopping vegetables and were then presented with sentences containing a mismatched gesture (the word "chop" accompanied by a 'cutting' gesture) or mismatched speech (the word "cut" accompanied by a 'chopping' gesture). The authors report more errors and delayed reactions in comprehension for both mismatched conditions compared to a baseline, control group (the word "chop" accompanied by a 'chopping' gesture) but note no differences between the two mismatched conditions. This lack of difference in comprehension between the speech-mismatch and gesture-mismatch conditions implies that, rather than one modality having precedence over the other in communication, the two bi-directionally interact with each other to provide the listener with one, overall meaning. That is, regardless of whether

the speech or gesture conveys mismatched information, the resulting level of comprehension is the same.

To investigate the process through which speech and gesture are integrated further, Özyürek, Willems, Kita, & Hagoort (2007) compared the effects of individual, 'local', mismatches (information in speech or gesture are mismatched; one conveyed incorrect information) with more general, 'global', mismatches (information in speech and gesture are matched, but both conveyed incorrect information). This method was devised in an effort to understand whether mismatches between speech and gesture need to be resolved before they are comprehended for meaning, or whether the two are processed together simultaneously. Their results revealed no differences between any of the mismatched conditions, concluding that co-occurring speech and gestures are integrated simultaneously (adding that this occurs within 350-550ms after word and gesture onset). Additional research in this area explains that the integration between speech and gesture in comprehension is mediated by other factors, such as the listener's awareness of the relationship between the two (Kelly, Ward, Creigh, & Bartolotti, 2007) or the amount of other, meaningful gestures presented to them (Holle & Gunter, 2007).

The research discussed in this section provides some evidence towards the integration of speech and gesture, though it is difficult to draw any firm conclusions about how the two are linked at this stage. To help understand any underlying link between speech and gesture, researchers have turned their attention to neurological imaging studies in the interest of obtaining more fundamental evidence of gestures relationship with speech, and identify their role in language comprehension.

### *Neurological Support*

Neurological evidence clarifies a communicative role of gesture as the observation of gesture has been shown to activate areas in the brain associated with language. More specifically, Broca's area, located in the inferior frontal gyrus of the frontal lobe in the language dominant hemisphere (usually the left) which engineers speech production. Recent research has found Broca's area to be activated during imitation of gesture (Grezes, et al., 2003; Tanaka & Inui, 2002), observation of gesture (Decety, et al., 1997) or more simply, observing an arm movement (Buccino, et al., 2004). Although this may provide an argument for any type of



gesture triggering activation of Broca's area, this activation appears to be dependent on the semantic context of the gesture performed. Willems, Ozyurek & Hagoort (2007) draw a distinction in the activations of Broca's area between meaningful and mismatched co-speech iconic gestures. Their results confirmed an overlap in the activation between speech and meaningful co-speech gesture. That is, the observation of meaningful co-speech gestures activate the same brain regions as listening to speech. Similarly, a difference in brain activation has been found between beat gestures and nonsense hand movements (Hubbard, Wilson, Callan, & Dapretto, 2009). These studies hold that hand gestures do carry linguistic information and portray semantic meaning to an listener, thus finding additional support for a communicative function of gesture.

In addition to language activation from the observation of gesture, the observation of speech has also been found to activate areas of the motor system. Cortical motor areas of the brain have been shown to be active during comprehension of 'action' words (Hauk, Johnsrude, & Pulvermüller, 2004; Martin & Chao, 2001; Pulvermüller, 1999) i.e. words that are associated with a physical action, such as 'kicking'. In addition, the activation in motor cortex region appears to be specific to the action described. i.e. actions describing the tongue provoked activations in areas of the motor cortex associated with tongue movements (Fadiga, Craighero, Buccino, & Rizzolatti, 2002). To confirm, Hawk et al. (2004) demonstrated that different types of action words can activate separate parts of the motor cortex. In their study, participants were presented with the words 'lick', 'pick' and 'kick' to respond to the face, arm and legs respectively. The results of an fMRI study revealed that motor cortex activation caused by reading the words was comparable to the activation when physically performing the movement. This evidence suggests a link between speech and action, and lends further support to a lexical encoding of gestures (Krauss, Morrel-Samuels, & Colasante, 1991) and an deep conceptual integration between the two (Kita & Özyürek, 2003; McNeill, 1992).

Further insights into how language and action are linked come from literature on the mirror neuron system. Research on this system explains how the observation of a behaviour provides a similar sensation to if that behaviour was physically performed by the observer. Such a system was first observed in monkeys (Gallese, Fadiga, Fogassi, & Rizzolatti, 1996) though a similar system is thought to be present in humans (Decety & Grezes, 1999). The mirror neuron system, which helps an individual to empathize with another's actions, has obvious social advantages, enabling us to 'feel' another's pain, and attributing sympathy to someone

that appears upset. The mirror neuron system also has an important link to gesture. Watching another person's physical actions elicits the ability to imagine and represent those actions within the observer's own repertoire of motor function. Zwaan & Taylor (2006) use an example of the sentence "*turning down the volume*" with the speaker performing a hand gesture of their thumb and forefinger rotating in front of them. The authors reason that the action of turning a knob anti-clockwise to 'turn down the volume' is an action familiar amongst many listeners, and this familiarity gives the message more clarity. That is, knowledge and understanding of the observer's actions facilitates the comprehension of that message.

A great deal of neurological studies provide evidence to suggest an interaction between language, gesture and action (Bernardis & Gentilucci, 2006; Bernardis, Salillas, & Caramelli, 2008; Willems & Hagoort, 2007). The evidence presented here not only suggests a tight neurological link between the speech and gesture systems, but also accentuates the importance of gesture in conveying information to listeners. To clarify this, Kelly, Criegh & Bartolotti (2010) state that "*gesture appears to be a real contender in communication, one that has an inextricable link with the speech that it naturally and ambitiously accompanies*" (p. 691). Thus, gestures should be considered as being part of a communicative system which is able to convey meaningful information covertly to a listener.

## Summary

This thesis has provided an overview of the literature concerning the susceptibility of eyewitnesses to police questioning and suggests that communicative hand gestures, which are tightly linked to speech, have the ability to mislead witnesses into giving false testimonies.

Forensic research has revealed that witnesses can be highly suggestible to police questioners who may convey misleading information to them. Eyewitnesses responses can vary by manipulation of the question (Loftus, 1975; Loftus & Zanni, 1975; Marquis, Marshall, & Oskamp, 1972) and be biased towards a particular response by the way a answer set is presented to them (Loftus, 1975; Tversky & Kahneman, 1974) or with the inclusion of a descriptive verb (Harris, 1973; Loftus & Palmer, 1974). However, there is little research

detailing how communicative hand gestures could also convey potentially misleading information to eyewitnesses that would result in inaccurate testimonies.

A large body of research confirms that gestures serve a communicate function by expanding on information that is communicated verbally (Langton, et al., 1996) adding clarity to speech (Goldin-Meadow, et al., 1993) and marking the communication between a speaker and listener more effective (Beattie & Shovelton, 1999a; Graham & Argyle, 1975). As well as complementing speech, gestures can also convey information that is difficult to articulate in speech (Church & Goldin-Meadow, 1986), and more focus is shifted onto gesture when the verbal source is ambiguous (Thompson & Massaro, 1986) or completely inaudible (Rogers, 1978). More importantly, listeners can glean information from gesture when speech alone does not contain substantial information (Cassell, et al., 1999; Kelly, et al., 1999) and when the speaker directs attention towards their gestures (Gullberg & Kita, 2009). Gestures in this sense can be a powerful tool in communication as they can convey information to listeners in the absence of speech. Gestures can convey additional semantic properties of objects (Kendon, 1980), and can also be used to facilitate pragmatic understanding (Kelly, et al., 1999). Thus, the ability to convey information that are only communicated through gesture suggests they serve an important, interpersonal function.

To find further support that gestures are produced with the intention of conveying information to listeners, more gestures are produced in face-to-face situations (Bavelas, et al., 2008), and are often tailored to the position of listeners (Özyürek, 2002). However, people continue to gesture when they cannot see their conversational partner (Cohen & Harrison, 1973); if they are behind a screen (Short, et al., 1976), speaking over an intercom (Krauss, et al., 1995), or on the telephone (de Ruiter, 1995; Rime, 1982). This has led researchers to believe that gestures are more intrapersonal in nature and are produced to ease cognitive load (Goldin-Meadow, et al., 2001), maintain spatial concepts in working memory (Alibali, et al., 2000; de Ruiter, 1998; Hadar & Butterworth, 1997; Kita, 2000; Özyürek & Kita, 1999; Wesp, et al., 2001), or facilitate lexical access (Frick-Horbury, 2002; Krauss, et al., 2000). However, if gestures are lexically encoded with speech (Krauss, et al., 2000; Krauss, et al., 1991), this gives rise to the argument that speech and gesture are part of the same system (Kendon, 2004; Kita & Özyürek, 2003; McNeill, 1992) and are inseparable (Butterworth & Hadar, 1989; de Ruiter, 2000). As such, gestures can reflect the thoughts of speakers, provide an insight into their understanding (Church & Goldin-Meadow, 1986; Goldin-Meadow, 1999; Pine, et al.,

2004). and may 'give away' critical information to listeners, serving a communicative, interpersonal function incidentally (Krauss, et al., 2000).

While researchers posit a link between speech and gesture (McNeill, 1992), neurological research confirms that gestures are linked to language (Decety, et al., 1997; Hubbard, et al., 2009; Willems, et al., 2007) and speech is linked to action (Fadiga, et al., 2002; Hauk, et al., 2004; Martin & Chao, 2001; Pulvermüller, 1999). These observations not only confirm that speech and gesture are functionally related, but that gestures do carry linguistic information and should be considered to serve an important role in communication (S. Kelly, et al., 2010). Moreover, gestures can prompt object-action associations (Klatzky, et al., 1989), and the observation of a gesture can elicit a familiar sensations to listeners as if they are experiencing the gesture themselves (Zwaan & Taylor, 2006). Thus, gestures are a unique and powerful tool in communication.

Finally, the two areas of 'eyewitness susceptibility' and 'communicative gestures' are brought together to form an important case for gestures being able to mislead witnesses. The 'construction hypothesis' (Loftus, 1975) explains that witnesses can make use of information from a police interviewer to "fill in the gaps" of their memory, leading to inaccurate testimonies. While this has been well documented for verbal information (Harris, 1973; Loftus & Palmer, 1974; Loftus & Zanni, 1975; Marquis, et al., 1972), a large amount of research claims that information can be gleaned from gestures as well as speech (Cassell, et al., 1999; Goldin-Meadow, 2005; Goldin-Meadow, et al., 1993; Kelly, et al., 1999; Kendon, 1980). Moreover, research has also shown that information conveyed in gesture can also integrate itself into the memory of the speech content (Cassell, et al., 1999), and the listener is often not aware that this information was presented to them in gesture rather than speech (Goldin-Meadow, et al., 1992; Kelly, et al., 1999). A recent study by Broaders & Goldin-Meadow (2010) has demonstrated that misleading gestures in police interview situations can affect the responses of child witnesses. Thirty nine children were given open ended questions where the interviewer accompanying his questions with gestures conveying specific information. (For instance, asking "*what else did he do?*" while gesturing playing a whistle.) Their study provided evidence that gestures conveying misleading information can cause children to give inaccurate information.

To date, this effect has only been observed for children, who are thought to be more suggestible than adults (Bruck & Ceci, 1999; Ceci & Bruck, 1993). This thesis argues that

hand gestures used by police interviewers can manipulate the responses of adults in a formal interview. A series of tightly controlled experiments investigated whether eyewitnesses' responses could be skewed by a range of gestures (including symbolic gestures and those more spontaneous in nature) and in different interview situations. This thesis also addresses the affect gestures may have on the confidence-accuracy relationship of witnesses and provides an insight into how gestures integrate themselves into the memory of witnesses through the study of attention afforded to gesture and gesture recognition.

## Outline of Research Questions

In light of the literature reviewed in this chapter, this thesis will address the question of whether a police questioner's hand gestures can influence a witness, with attention to the following research questions:

*Can information conveyed in gesture skew eyewitnesses response as can verbal influence?*

Research has offered a wealth of support of the effect of verbal influence in police questioning. However, very little research has been directed at nonverbal gestures as a form of influence under the same conditions. The main focus of this thesis is to investigate whether gestures that convey misleading information to witnesses can cause them to give inaccurate testimony. If witnesses glean information conveyed to them through gesture, it would be expected that they would integrate this information into their representation of the event and give responses that are congruent with this information. This could be expected if witnesses were unsure of the response and depend on additional information from the questioner. The experiments in this thesis will examine the differences in responses between those that see no gesture, a gesture conveying accurate information and a gesture conveying misleading information about a piece of crime footage. These results will provide an understanding into whether inaccurate responses are more likely to be given after seeing a misleading gesture conveying this information.

*What information can be suggested to witnesses through gesture?*

If gestures containing critical information can become integrated into a witnesses' representation and skew their responses, it would be important to understand what type of

information is able to do this. This question will build on the first and identify which gestures in particular are most effective at conveying misleading information and skewing responses. Throughout the thesis, the studies will consider the suggestion of a range of critical information, including the presence of objects in a scene, the size of objects, the speed of cars and information about a culprit's physical appearance and behaviour. This research will investigate which of these details can be suggested to witnesses through gesture.

*Are witnesses aware of when information has been conveyed to them through gesture?*

This question will first consider whether participants knowingly glean information from gesture or whether this information integrates itself into their representation of the event outside of their awareness. This will be considered initially by assessing the confidence witnesses attributed to responses. If confidence in correct responses increases after seeing an accurate gesture, it is expected that witnesses would have acknowledged the gesture in order to justify such a confidence increase. However, little difference in confidence of incorrect responses given between those that saw a misleading gesture or not would be in favour of the information from gesture becoming integrated into memory.

Further measures into awareness of gesture will consider the ability of witnesses to recall or recognise the gesture afterwards. Witnesses' retrospective identification of gesture will provide some insight into their awareness of it. If a gesture influence occurs within awareness, the rate of gesture recognition would be expected to increase with 'positive' responses. If, however, gestures influence outside of awareness, gesture recognition would be expected to be low and have little relationship with response. This will be studied further with real-time eye tracking equipment to ascertain whether gestures conveying information are fixated during their performance. If gestures require a fixation to convey information, gesture-congruent responses would be expected to rise with gesture fixations. If no relationship between response and gesture fixations is found however, this would be evidence that gestures influence outside awareness.

To investigate whether witness naivety is a variable in gesture influence, this thesis will also consider whether those working in a legal profession (specifically, lawyers) are susceptible to the gestures also.

*Is it possible to identify whether a gesture has influenced a response?*

This question will draw on the evidence presented across studies and investigate whether measures of confidence and gesture identification are indicators for when a response has been given as a consequence of seeing a misleading gesture. This question will consider the conditions for which gestural influence is most likely to have occurred and whether witness' self reports (confidence ratings and gesture identification) can be used as an indication that a gesture has skewed their response. To offer further insight, the thesis will also make use of the Gudjonsson Suggestibility Scale (GSS) to ascertain whether suggestibility scores are an accurate reflection of susceptibility to influential gestures.

*Under what situations is gestural influence most effective?*

The studies in this thesis will consider the susceptibility of witnesses across a variety of situations, including when they respond freely or from an answer set, when they are questioned individually, or as a group, and when the questioner appears to them through video footage or in a live interview. Interviewing witnesses through a live interview will be of most interest due to its higher ecological validity and relevance to real forensic interviews. It is expected that engagement in a live interview procedure, and more social interaction between the witness and questioner would cause misleading gestures to have a more powerful influence.

## Chapter 2 :

# To what Extent can Eyewitnesses be Misled by a 'Police' Questioner's Hand Gestures?

## Introduction

Can misleading information be conveyed to eyewitnesses through gesture? Forensic research has uncovered much about the susceptibility of eyewitness's memory, with a large focus placed on the communication between the witness and a police interviewer (Geiselman, Fisher, MacKinnon, & Holland, 1985). Such research has led to greater awareness of 'leading questions' and how susceptible memory reconstruction can be to ambiguous questioning (Loftus, 1975; Loftus & Zanni, 1975; Marquis, et al., 1972). In particular, research has found that witnesses can be biased towards a particular response by the way an answer set is presented (Loftus, 1975; Tversky & Kahneman, 1974) or with the inclusion of a descriptive verb (Harris, 1973; Loftus & Palmer, 1974). Whilst research into misleading witnesses has focused on how this information is presented through speech, it is possible that such information may also be conveyed to witnesses through gesture.

Gestures can serve a communicative, interpersonal function by expanding on information that is communicated verbally (Langton, et al., 1996), adding clarity to speech (Goldin-Meadow, et al., 1993) and making communication between a speaker and listener more effective (Beattie & Shovelton, 1999a; Graham & Argyle, 1975). Gestures can also communicate information that is difficult to articulate in speech (Church & Goldin-Meadow, 1986; Goldin-Meadow, 1999) and more focus is placed on the gesture if the verbal information is ambiguous (Thompson & Massaro, 1986) or completely inaudible (Rogers, 1978). When verbal information is accompanied by a gesture, the meaning and comprehension of the speech is greatly increased. For example, if somebody tells a story of how they hurt their arm a few years ago, a gesture of them rubbing their bicep muscle indicates precisely where the pain was. Similarly, an individual describing how they were in contact with a friend earlier could accompany this sentence with either a gesture of a phone held up against their face, miming the typing of a text message or the tapping of a keyboard, to communicate how this contact was made.



Whilst gestures can build on information in speech, they can also provide information that is absent from speech. Kendon (1980) provides an example of the 'large cake', in which this verbal information is delivered simultaneously with a large circular movement of the index finger to portray the additional semantic property of the cake being round; a detail not included in the verbal content. When asked what shape the cake was, people are able to identify it as being round. Thus, gestures can serve an important role in the acquisition of information.

Further support for this comes from the work of Kelly, Barr, Church & Lynch (1999) who found that gestures play an important role in pragmatic processing. In one of four studies, the authors demonstrated that additional semantic information about a story could be gleaned from gesture and reported by listeners afterwards. Participants watched a video of a woman saying "*my brother went to the gym*" in one of two conditions; 'speech' (no gesture) or 'speech and gesture' (the woman accompanies her speech with a gesture of her 'shooting a basketball'). Their results showed that participants in the latter condition reported this additional basketball detail, whereas those who did not see the gesture could not. Further insight into their findings reveals that the gesture also improved the memory of speech, but also caused some participants to misremember the woman as saying "*my brother went to play basketball*". The empirical evidence presented by the authors implies that gestures can have a powerful impact in the comprehension and memory of pragmatic information.

This can have important implications for the interviewing of eyewitnesses. Loftus' (1975) 'construction hypothesis' explains how witnesses reconstruct incidents based on presupposing evidence. In the absence of critical details, a witness makes use of information suggested to them to 'fill in the gaps' of their memory. This effect has been observed when information provided verbally integrates itself into memory representation (Loftus & Palmer, 1974), though little research has considered whether nonverbal information can integrate itself into memory in a similar fashion. The results of Kelly, et al. (1999) go some way into explaining how information presented in gestures can be remembered as being part of speech, an observation which has been confirmed in the research by McNeill, Cassel & McCullough (1994). In their study, participants watched a video narration of a 'Sylvester & Tweetie' cartoon showing a narrator accompanying his speech with either supplementary (matched) hand gestures or contradictory (mismatched) hand gestures. For instance, for the phrase "*Granny whacks Sylvester*", the narrator either performed a (matched) 'slapping' gesture or a (mismatched) 'punching' gesture. The authors reported a marked difference in the retelling of

the stories across the two groups, with those that saw the mismatched gestures reporting more (40%) of the incorrect details conveyed by them in the story than those who saw the other, matched gestures (5%). An important observation comes from analysing the participants' retelling of the story where one example cites "...and granny like punches him or something", providing additional support that information from gesture can be integrated into memory representation.

Understanding circumstances in which witnesses can be misled through verbal information could facilitate an understanding of where this may also occur in nonverbal information. Research into misleading questioning has already confirmed that witnesses can believe something was present in a scene if its existence is implied through speech. Loftus & Palmer (1974) asked participants to watch footage of a car accident and then asked them whether they had seen "*any broken glass?*" or "*the broken glass?*" Participants were more likely to confirm the presence of broken glass in the latter condition where the questioning more heavily implied its existence. From the evidence presented above, it is clear that participants can have certain actions and behaviours portrayed in gesture integrated into their memory representation. It would therefore seem reasonable to assume that participants can also have the presence of an object suggested to them if such an object was portrayed to them through an iconic gesture. If participants were asked if they noticed any jewellery for instance, an accompanying gesture of a 'ring' may prompt them into giving that response.

Additional research explains how the presentation of an answer set can also affect the responses given. Loftus (1975) found that when asking participants how many headache products they had tried, those presented with a smaller answer set (1, 2 or 3) on average gave lower estimates (3.3) than those presented with a larger answer set (1, 5 or 10) (5.2). This effect has already been well documented by Tversky & Kahneman (1974) through their anchoring heuristic, stating that people are generally quite reluctant to stray too far away from an answer suggested to them in the question. In their classic example, when asked "*how many African nations are members of the UN?*", participants gave lower estimates when the question was followed by "*more or less than 45%?*" than when followed by "*more or less than 65%?*". By setting an 'anchor' for their answer, the participant feels obliged to answer the question using the marker suggested to them as a basis for their answer. With respect to this observation, a similar effect may be achievable when a hand gesture acts as a marker for an answer set. The 'propositional gesture' (Hinrichs & Polanyi, 1986) is produced when a person describes the size of an object by placing their hands a certain distance apart to

represent a 'symbolic space'. An example of this being a fisherman describing a fish he caught as being "*[this] big*". Here, the propositional gesture may provide a basis for an answer when accompanied alongside a question asking participants to estimate the length of an object.

The following study was conducted to see whether the misleading effects observed in verbal questioning were also obtainable when misleading information is portrayed in nonverbal gesture. Research by Broaders & Goldin-Meadow (2010) already provides some support that information from gestures can convey information to child witnesses, causing them to report false information. In their study, 39 children (aged 5-7 years) watch a live performance by a musician in a classroom and were questioned about it in a series of interviews afterwards. During the interviews, the interviewer would ask questions with either speech alone, or with an accompanying gesture that conveyed critical information. For instance, in the 'speech alone' condition, the interviewer would ask "*what else did [the man] do?*" with no accompanying gesture. However, in the speech and gesture condition, the interviewer would accompany this same question with a 'blowing a whistle' gesture. Consequently, more children reported seeing the whistle when the gesture conveyed this (accurate) information. In addition, the interview would also suggest details of non-occurring events, such as asking "*where did he hurt himself?*" with a misleading 'pat on the hip' gesture. The children reported that the man had hurt his hip, although this had not occurred in the video. Thus, gestures are able to skew the responses of children under questioning.

This present study builds on this and asks whether this effect is replicable in adults and across a range of gestures. Participants watched 2 videos of mock-up crime scene footage (a 'knife attack' and a 'car crash' video) and were then asked 2 critical questions on each: Participants were asked what jewellery the man was wearing, and how big the knife was in the 'knife attack' video. They were also asked how fast the cars were travelling and how many parked cars there were in the 'car crash' video. Each critical question was accompanied by a hand gesture conveying either 'accurate' or 'misleading' information in an effort to see whether participants' responses to questions could be manipulated by the gesture presented to them. Based on the research presented here, it was reasoned that participants could glean information from gesture and consequently have their memory representation skewed, resulting in giving the responses suggested through gesture.

## Experiment 1

In experiment 1, participants took part in the experiment individually where they were shown footage of the crime scenes on a laptop screen. Participants were questioned by an onscreen 'police' questioner who accompanied his questions with gestures that contained either accurate information about the scene (an 'accurate' gesture) or false information (a 'misleading' gesture). A control group heard only the audio from his questions. The first experiment was conducted on psychology undergraduates at the University of Hertfordshire and sought to provide evidence that participants' responses would concur with the information conveyed to them in gesture.

## Method

### *Design*

A between subjects design was used with the independent variable being the gesture performed; 'accurate', 'misleading' and control (no gesture). Order manipulations and counterbalancing of the videos presentation created 6 different groups. The dependent variable measured the participants' responses to the questions and considered participant's estimates of a value (knife size, speed of cars) or which objects they identified as being present in the scenes (jewellery, number of parked cars). The study predicted that participant's responses would concur with the information conveyed to them in the gesture.

### *Participants*

A sample of 66 participants (13 males, 53 females) were selected opportunistically from the University of Hertfordshire. Participants were mainly students of psychology, ranging in age from 18 to 48 ( $M = 21.24$ ,  $SD = 4.51$ ) who were awarded participation credit for taking part.

## *Materials & Apparatus*

A series of video clips were prepared for the study. Two separate video clips depicting a crime scene made up the stimuli for each trial and 'questioner' videos showed a 'police' questioner asking details about each of the videos.

### Stimuli

The first of the videos presented to participants, the 'knife attack' video, showed a young male with a knife approaching the victim in a dark alleyway. The video showed the young male to be holding a knife of roughly 7" and also showed the victim wearing a ring. The second video, the 'car crash' video, showed one car chasing a smaller one until the two of them collided in a street, near two parked cars.



Figure 2.1: Screenshots from the "knife-attack" and "car crash" stimulus videos

Both crime scene videos had their quality and colour richness reduced to add further ambiguity to their appearance. The audio in the video was 'dampened' to make any dialogue indistinguishable. Each video lasted approximately 40 seconds.

### Questioner videos

For the recall phase of the experiment, a video was constructed where an actor played the role of a police questioner in order to ask participants about the crime they had just seen. A set was made up to look like a police questioner's office with a desk and some props, filmed in the University of Hertfordshire's Psychology Observation Laboratory.



Figure 2.2: The actor as a 'police' questioner in a mock-up questioning office

During filming, one camera was positioned in front of the questioner whilst a second was positioned over his shoulders to capture his hand gestures. In order that all participants heard and saw the same part of the video where he delivered the questions, the filming of the question was only recorded once, and the accompanying gestures were recorded separately afterwards. Each of the two 'over-shoulder' videos of the gesture were then edited into the main questioning video individually to produce two separate videos. The video in each condition thus comprised of the questioner talking directly into the camera lens, but with the camera angle changing for a couple of seconds to show a different gesture accompanying the question for each condition.

For the 'knife attack' scene, the questioner asked "*you may have noticed some [jewellery] worn by the victim, please write down what jewellery you think he was wearing*", accompanied by an accurate gesture of a "ring", or a misleading gesture of a "watch" on the word "*jewellery*". (The crime scene footage showed the man wearing a ring, but no watch was present.) The questioner also asked "*the younger male was holding a [knife], please write down how big you thought that knife was*", accompanied by either an accurate "7 inch" gesture, or a misleading "2 foot" gesture on the word "*knife*". In addition to these, 3 distracter questions (how tall was the man? / how old was the man? / what colour jacket was he wearing?) were filmed.

For the 'car crash' scene, the questioner asked "*the two cars [collided]; at what speed would you say the first car travelling when it hit the side of the second?*" accompanied by either an accurate gesture of his two hands coming together slowly, or a misleading gesture of his hands coming together quickly. Another critical question asked "*at the end of the video there were some parked cars. How many parked cars were there?*" accompanied by either an accurate gesture of "two cars" or a misleading gesture of "many cars". Distracter questions included "what colour was the car?", "how many people were in the car?" and "how many doors did the car have?"

An introductory video (showing the questioner writing at the desk) with a voiceover explaining the procedure of the experiment was also filmed. This video, as well as the distracter videos, were all directed in the same manner, with occasional camera angle changes so to not make participants suspicious of the camera angle changes in the critical question videos. A full summary of the questions asked with screenshots of the gestures performed is available in Appendix A.

### *Procedure*

Participants took part individually at the psychology department of the University of Hertfordshire. The presentation of the videos varied by condition; those in condition A saw the accurate 'knife-attack and misleading 'car crash' questioning, whereas those in condition B saw the misleading 'knife-attack' and accurate 'car crash' questioning. Participants in the control group saw no questioner footage and heard only the audio from his questions. Each of the three conditions were split to counter-balance the presentation order of the 'knife-size' and 'car crash' videos, forming 6 conditions in total.

An introductory video of the 'police' questioner was shown to the participants accompanied by a voiceover instructing participants to watch the crime scenes that followed carefully so they would be able to answer questions about them afterwards. For the recall phase, the videos were played in a designated order (2 distracter questions, 1 critical, 1 distracter, 1 critical), and each was separated by a 12-second segment of black screen to enable participants to write down their answer for each question. Participants in the control group saw a black screen throughout.

## Results

Participants responded to four critical questions ('jewellery', 'knife-size', 'speed estimate' and 'parked cars') asked by the 'police' questioner on the two crime scene videos. Participants saw the questioner perform either an 'accurate', 'misleading', or no gesture during the question, depending on condition. To rule out order effects of the videos presentation, an initial analysis compared the responses given in each condition against their respective, counterbalanced condition. No significant differences were found in any of the comparisons ( $p > 0.1$ ), thus the data were collapsed into three conditions; 'accurate', 'misleading' and control.

### *'Jewellery' Question*

For the jewellery question, participants that saw the 'accurate' gesture of the ring were more likely to respond with ring (95.0%) compared to those in the 'misleading' (66.7%) or control (62.5%) groups. Twelve participants (18.18%) failed to give an answer. The association between condition (accurate, misleading, control) and response (ring, watch, other) was examined in a 3x3 chi-square test which revealed a significant effect,  $\chi^2(4, N = 54) = 12.19, p = .016$ . Figure 2.3 summarises this data.

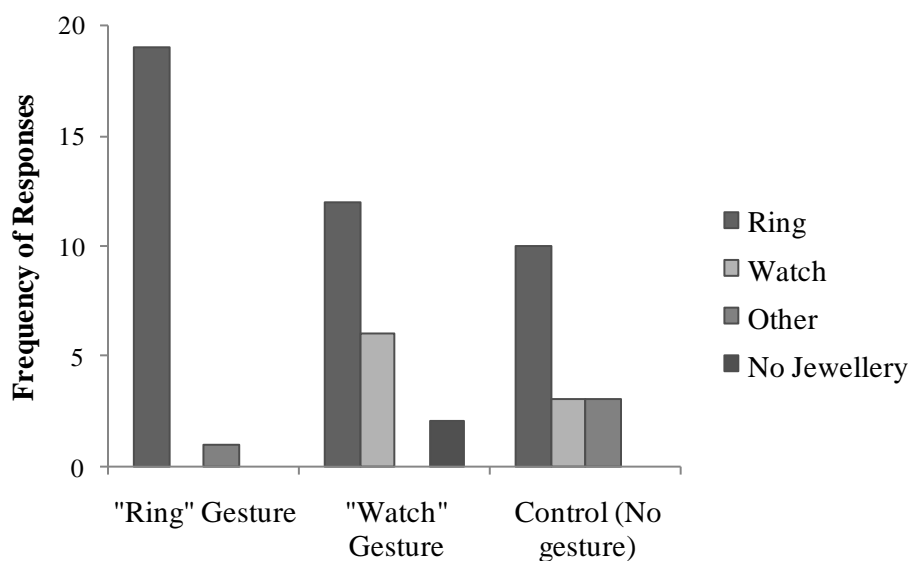


Figure 2.3: Responses to the 'jewellery' question by condition



To examine this effect further, a series of 2x2 chi-square tests compared the frequency of responses (ring, all other responses) given between the 'accuracy' and control groups and retrieved a significant effect;  $\chi^2(1, N = 36) = 5.99, p = .014$ . A comparison of responses (watch, all other responses) between the 'misleading' and control groups however did not reach significance;  $\chi^2(1, N = 34) = .93, p = .336$ .

Of the incorrect responses given by participants, 75% of those that saw the misleading 'watch' gesture gave the answer 'watch', compared to 50% in the control group, and none in the accurate group. Controls were also more likely (27.27%) to say they did not know the answer compared to those in 'accurate' (9.09%) and 'misleading' (9.09%) groups.

### *'Knife Size' Question*

For the knife-size question, participants gave their responses in either centimetres or inches, though all answers were converted to inches for consistency. For answers given on a scale (i.e. "between 6 and 8"), the median value (7") was recorded as their answer and all qualitative responses (e.g., "quite big") were excluded from the analysis. Four participants failed to respond. Contrary to the prediction, participants that saw the accurate knife-size gesture estimated the knife to be larger ( $M = 5.59", SD = 3.04$ ) than those that saw the 'large' misleading gesture ( $M = 4.80", SD = 1.95$ ). Estimates for controls were closer to the misleading group ( $M = 4.96", SD = 2.23$ ). An independent samples t-test revealed no significant difference between the estimates of the two experimental groups,  $t(40) = 1.01, p = .321$ , and subsequently no significant effect from a one factor analysis of variance (ANOVA) comparing all three groups,  $F(1, 59) = 1.38, p = .260$ . The true size of the knife was thought to be approximately 7", thus the average estimate of the accurate group was actually closer to the correct answer. However, the generally low estimates could be explained by participants estimating just the size of the blade, rather than the whole knife.

### *'Speed Estimate' Question*

For the speed estimate question, participants again gave free estimates in either metric (km/h) or imperial (mph) measurements, though all data were converted to 'mph' for consistency. As with the knife-size data, median values were calculated for answer sets (i.e. 35mph for

"between 30 and 40mph") and qualitative responses (e.g. "quite fast") were excluded from the analysis. Two participants failed to respond. Concurring with the prediction, participants that were shown the 'fast' misleading gesture on average gave higher speed estimations ( $M = 47.61\text{mph}$ ,  $SD = 10.48$ ) than those that saw the accurate 'slower' gesture ( $M = 40.78\text{mph}$ ,  $SD = 10.09$ ). The estimations for the control group were closer to the 'misleading' group, but with greater variance in answers ( $M = 47.42\text{mph}$ ,  $SD = 13.72$ ). An independent samples t-test between the two experimental groups revealed a significant difference in estimates,  $t(40) = -2.147$ ,  $p = .038$ , although no effect was found across all three conditions in a one-way ANOVA,  $F(1, 61) = 2.32$ ,  $p = .167$ . These results suggest that the 'accurate' gesture caused participants to lower their estimates, whilst the 'misleading' gesture was less effective, resulting in responses closely resembling those given by default from controls.

### *'Parked Cars' Question*

Responses for the number of parked cars question were grouped into categorical responses of "less than 2", "2", and "more than 2". Only one participant failed to answer. Participants that saw the accurate "2 cars" gesture were no more likely to answer correctly (31.8%) than those who saw the misleading "many cars" gesture (42.9%) or no gesture (27.3%). An association between condition (accurate, misleading, control) and response (less than 2, 2, more than 2) was not found in a 3x3 chi-square test,  $\chi^2(4, N = 65) = 2.00$ ,  $p = .736$ .

## Discussion

Overall, the study produced mixed findings for the prediction that the 'police' questioner's gestures could affect participant's responses. The answers given in response to the 'jewellery' and 'speed estimate' questions differed according to the gesture they saw whereas the gestures accompanying the knife size and parked cars questions appeared to have little effect. Explanations for these results are outlined below.

Participants that saw the questioner performing a 'ring' gesture when asking what jewellery the man was wearing were more likely to give this correct answer. Similarly, those that saw him perform a watch gesture were more likely to give incorrect watch responses. This suggests participant's recall can be biased by the accompanying gesture performed to them.

The gesture is able to both lead participants to a correct answer and mislead them into giving an incorrect answer. Noteworthy is that some participants who gave the incorrect responses of 'watch' were able to report additional details, such as a bracelet being 'gold', suggesting that the gesture had implanted a false representation into their memory of the scene.

Some participants in the control group also gave the incorrect 'watch' responses suggesting that, when the correct answer was unknown, participants defaulted to this as their answer. Interestingly, none of the participants that saw the ring gesture gave the 'watch' response (with the only incorrect answers being other items of jewellery), thus rejecting the 'watch' answer in favour of the 'ring' answer suggested to them. In a similar effect to verbal misleading, offering the 'witness' an answer prompts them into giving a positive response (Howitt, 2006). Witnesses have "*a tacit expectation that what the questioner is saying is true*" (Semin & Poot, 1997, p. 478) particularly if the police officer is believed to be knowledgeable of the events in the scene (Smith & Ellsworth, 1987) .

A similar case arose for the 'speed estimate' question where, although a difference was observed between the estimates of those in the 'accurate' and 'misleading' groups, the responses of controls tended to reflect those of the 'misleading' group. By default, participants appeared to think the cars were travelling quickly, but it was the 'accurate', slower, gesture which effectively misled participants into giving slower responses. Regardless of this, the study showed that a hand gesture can make a significant difference to participants' response to speed estimates. This question was also very similar to the research of Loftus & Palmer (1974) and, although the study is typically well known to psychology students, the gestures still managed to produce an effect. Perhaps curiosity into the phrasing of the question may have distracted participants and made them more susceptible to the gesture, confirming their ability to influence covertly is potentially very powerful.

A curious finding occurred where participants that saw the smaller 'knife-size' gesture actually gave higher estimates than those that saw the larger gesture. One possibility for this finding is that participants gave estimates for the knife blade size rather than the knife as a whole (as conveyed in the questioner's gesture). If this was the case, it would be understandable that participants would have regarded the 'accurate' gesture as a particularly large knife. In turn, participants may have thought that the misleading knife gesture portrayed an unrealistically large knife and thus, disregarded the information conveyed by it. It is possible even that participants could have thought the gesture to represent something

different, such as the characters' position in the scene, rather than the ends of the knife. Although research shows that it is possible to create memories of information that did not occur (Braun, et al., 2001; Crombag, Wagenaar, & Van Koppen, 1999; Wright, et al., 2001), these observations tend to be biased towards situations where the event is possible to imagine (Loftus & Hoffman, 1989).

Research confirms that verbal influence is most effective when the answer is uncertain (Tversky & Kahneman, 1974); the more ambiguous a question is, the more participants rely on further information to form an answer. In relation to this, the knife size question may not be considered to be an ambiguous question due to its practical limit on answers. This, coupled with the confusion over whether to include the handle in the estimate, could have prevented an effect occurring. Similarly, the parked cars question had the same limitations, with the gestures having little effect on the participants' responses. Not only was there little room for variance in answers, but the gestures portraying the number of cars may not have been obvious enough to participants in providing the additional information needed to mislead. Thus, the lack of clarity from the gesture and relative ease of the question may have prevented the gestures from influencing the responses.

In summary, this experiment provided support for the hypothesis that gestures have the ability to skew the responses of participants and further studies will test this in a larger group with a revised method to give these results extra weight.

## Experiment 2

The previous experiment provided an insight into the role of gestures in skewing the responses of witnesses. To further this research, it was deemed necessary to attain a more solid foundation for future research with a larger sample of participants and a wider range of demographics. In experiment 2, some methodological changes were made. Further instruction was given to participants to estimate the knife size with the handle included in order to produce a more consistent answer set. Participants took part together in three large groups during an Open Day presentation regarding psychology research at the University of Hertfordshire.

## Method

### *Design*

A between subjects design was used. The independent variable was the gesture performed by the 'police' questioner; an 'accurate' gesture, 'misleading' gesture and a control group (no gesture), forming three conditions. No counterbalancing measures for the order of video presentation were taken in this study. As before, the dependent variables measured the participants' responses to the four critical questions ('jewellery', 'knife size', 'speed estimate' and 'parked cars'). The prediction again was that participants' responses would concur with the information conveyed to them through the questioner's gestures.

### *Participants*

A sample of 292 participants took part in this study voluntarily. All participants were attendees at a University of Hertfordshire Open Day, including A-level students and their parents or grandparents from across the United Kingdom. The age of participants ranged from 17 to 79, with a mean of 29.95 ( $SD = 15.43$ ).

### *Materials & Apparatus*

The same videos were used as in the previous study; including the stimuli and questioner videos. Two NEC projectors were used to display the videos onto large screens in a lecture theatre.

A question booklet was produced for each participant. The booklet consisted of a single folded A4 sheet of paper structured such that participants could write their answers in answer fields provided and turn the page only when instructed to do so. The reason for this format was so that directions for answering questions (specifically, to include the handle in the 'knife-size' estimate) would be hidden until the participant turned the page to reach that question.

## *Procedure*

The experiment was conducted during the University of Hertfordshire Open Days where the three conditions were conducted on three separate occasions. For each occasion, participants were tested in a lecture theatre together as a large group and recorded their responses on the answer sheets independently.

Participants were told that they would be able to see two crime videos appearing to them on the screen and would be required to answer the questions posed to them by the police questioner appearing on-screen afterwards. The series of videos were then projected on screen, with the 'accurate', 'misleading' or control questioning (depending on the condition). Participants wrote down their answers to the questions in the answer booklets during 20-second pauses in between questions. They were asked politely to keep their answers anonymous. After the video series had finished, participants were fully debriefed on the purposes of the study.

## Results

The following results consider the participants' responses to the four critical questions asked by the onscreen 'police' questioner; 'jewellery', 'knife size', 'speed estimate' and 'parked cars'.

### *'Jewellery' Question*

Participants again gave nominal responses to the question asking what jewellery they noticed the victim wearing in the video. Those that did not provide an answer were excluded from the analysis ( $N = 22$ , 7.5%). A total of 88.03% of the participants in the 'accurate' condition correctly identified the ring, compared to 71.71% in the 'misleading' condition and 77.63% in the control group. A 3x3 chi-square test considering condition ('accurate', 'misleading', control) by response ('ring', 'watch', and 'other') revealed a significant association between the two;  $\chi^2(4, N = 289) = 19.13, p = .001$ . Further 2x2 chi-square tests compared the frequency of responses (ring, all others) between the 'accuracy' and control groups and revealed a significant association;  $\chi^2(1, N = 177) = 10.85, p = .001$ . However, no association was found between response (watch, all others) and the 'misleading' and control groups;  $\chi^2(1, N = 164) = .973, p = .324$ .

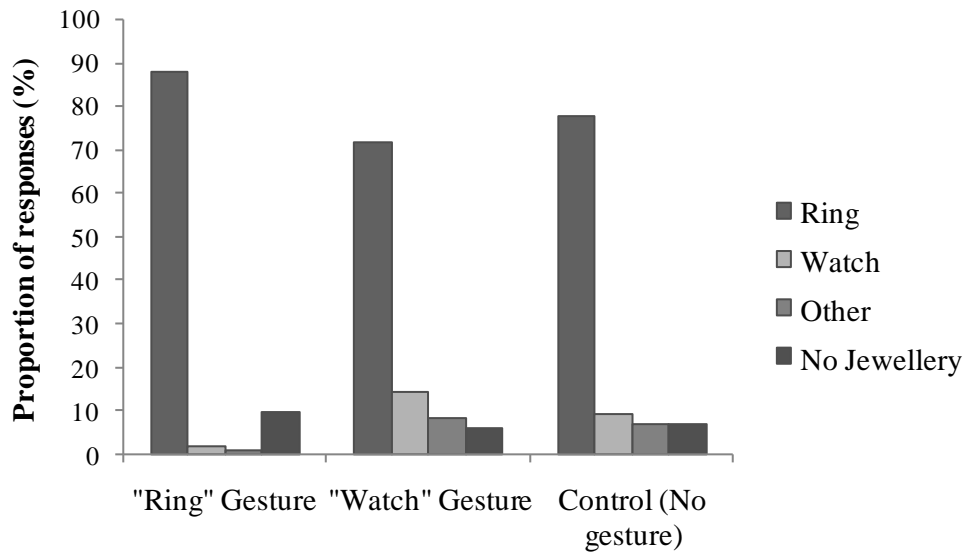


Figure 2.4: Responses to the 'jewellery' question by condition

Over half (51.85%) of the incorrect responses given by participants in the misleading condition consisted of the answer "watch" (or bracelet), as conveyed by the questioner's gesture in the misleading video. Comparatively, the answer "watch" comprised of just 15.38% of the incorrect answers given in the accurate condition, and 46.67% for the controls.

### *'Knife Size' Question*

Participants were asked to estimate the size of the knife (including the handle) shown in the stimulus video. As before, median values were calculated for answer sets and qualitative responses (e.g. "quite big") were excluded from the data set, along with one extreme value of 38" (96.5cm). Table 2.1 summarises the range of responses given across each condition.

Participants that saw the misleading (large) gesture of the knife gave the highest size estimates and had the greatest range of answers ( $M = 6.25$ ,  $SD = 3.07$ ) compared to the accurate (smaller) gesture ( $M = 6.08$ ,  $SD = 2.49$ ) and controls ( $M = 5.91$ ,  $SD = 2.24$ ). An independent samples t-test considered the estimations of the 'accurate' and 'misleading' groups, however, no significant difference was found between the two,  $t(196) = .44$ ,  $p = .661$ . Similarly, a one-way ANOVA revealed no significant difference between all three groups,  $F(1,2) = .34$ ,  $p = .710$ .

To investigate the dispersion of responses further, the data were then collapsed into categories (under 4", 4 to 6", 6 to 8" and over 8") and frequencies were obtained for each group. Table 2.1 summarises this data.

Table 2.1: Responses to the 'knife-size' question grouped into categories

	Accurate	Misleading	Control
Under 4"	23	13	9
4" to 6 "	25	38	27
6" to 8"	41	19	20
Over 8"	21	26	18

The majority (39.4%) of participants in the accurate condition gave an answer in the category considered most accurate ('6 to 8"') compared to 20.2% for misleading and 27.4% in the control group. The majority of answers for both the 'misleading' (44.18%) and control groups (36.49%) fell in the category below (4" to 6"). A 3x4 chi-square revealed a significant association between condition and response;  $\chi^2(6, N = 271) = 13.95, p = .030$ . Thus, participants that saw the accurate gesture were more likely to give a response within the category that reflected the correct knife size. A further 2x4 chi-square testing an association for response between just the accurate and control group was just short of significance,  $\chi^2(3, N = 184) = 6.88, p = .076$ , was not significant between misleading and controls,  $\chi^2(3, N = 170) = 1.24, p = .743$ , but was significant between the accurate and misleading groups,  $\chi^2(3, N = 206) = 13.17, p = .030$ .

#### *'Speed Estimate' Question*

Responses for speed estimates were free estimations interpreted as interval data. Median values were taken for answer sets and qualitative responses (e.g. "quite fast") were not considered in the analysis. Four extreme values (100mph; 110mph; 180mph; 400mph) were also excluded from the data set. Speed estimations remained quite consistent across the three groups, with the participants in the misleading groups giving the slowest estimates ( $M =$



35.20,  $SD = 11.93$ ) compared with the accurate ( $M = 36.86$ ,  $SD = 14.46$ ) and control group ( $M = 37.06$ ,  $SD = 12.80$ ). An independent-samples t-test considered the responses of participants in the two experimental groups (accurate and misleading) but retrieved no significant effect,  $t(193) = .87$ ,  $p = .388$ . Similarly, no effect was found when a one-way ANOVA compared all three groups,  $F(1,2) = 5.33$ ,  $p = .588$ .

The data were then grouped into categories (under 25mph, 25 to 34mph, 35 to 44mph, 45 to 54mph, over 55) and frequencies were calculated for each. The data were normally distributed for each condition, with the majority of responses falling in the central "35 to 44mph" category for accurate (34.34%), misleading (40.66%) and control (33.33%) groups. A 3x5 chi square test failed to find an association between condition and response,  $\chi^2(8, N = 280) = 9.70$ ,  $p = .287$ . Table 2.2 presents this data.

Table 2.2: Responses for 'speed estimate' grouped into categories

	Accurate	Misleading	Control
Under 25mph	17	17	10
25 to 34mph	26	23	23
35 to 44mph	34	37	25
45 - 54mph	15	11	11
Over 55mph	7	3	6

### *'Parked Cars' Question*

The next analysis consider the participant's responses to the question asking how many parked cars there were in the video. Responses of '2' were correct and any other response (either above or below this) were scored as incorrect. Participants that did not give an answer were excluded from the data set. Initially, the responses from participants were treated as continuous data. Participants that had seen the 'accurate' gesture of "2 cars" on average gave a figure closer to the correct answer ( $M = 2.36$ ,  $SD = 0.90$ ). Participants' estimates were lower for both the misleading ( $M = 2.54$ ,  $SD = 1.05$ ) and control ( $M = 2.46$ ,  $SD = 1.06$ ) groups.

However, an independent t-test did not find a significant difference between the estimates of the accurate and misleading groups,  $t(211) = -1.381$ ,  $p = .169$ , and a one-way ANOVA revealed no significant difference between all three groups,  $F(1,2) = .92$ ,  $p = .401$ . The data were grouped into categories (less than 2, 2, more than 2) and submitted to a 3x3 chi-square test. However, no significant association between condition and response was found,  $\chi^2(4, N = 289) = 3.71$ ,  $p = .447$ .

## Discussion

The aim of this experiment was to investigate whether participants' responses would be affected by the questioner's hand gestures. The results again produced tentative support for this prediction: Participants' responses tended to be consistent with the questioner's gestures for the 'jewellery' question and, to some extent, the 'knife size' question. However, responses for the 'speed estimate' and 'parked cars' questions seemed largely unaffected by the gestures. Possible explanations for these findings are discussed below.

The study confirmed that responses for the jewellery question differed according to the gesture presented, producing a highly significant effect. The results confirmed that responses of the control group fell between the responses of the two experimental groups, reiterating that a gesture was able to both guide participants to a correct or incorrect answer and away from their default responses. Gestures also appeared to have some effect on responses in the 'knife-size' question where, unlike in experiment 1, participants that saw the smaller 'accurate' gesture gave lower responses (which fell mostly within the most accurate category) than those that saw the larger gesture. The inclusion of the instruction to include the handle size appeared to produce a more consistent data set, and thus, a more valid reflection of the gestures ability to mislead.

Significant effects were not observed for both the 'speed estimate' and 'parked cars' questions. Whilst it is not surprising that the 'parked cars' question followed another non significant finding, It is unclear as to why the significant effect observed in experiment 1 was not observed here. However, the lack of effect could be explained by a number of factors, including the different testing environment or the larger demographic sample, which this time included a large number of A-level psychologists, whom are typically very familiar with the research of Loftus & Palmer (1974). It is possible that the knowledge of this could have made

participants resistant to the questioning as witnesses typically give more accurate responses when aware they may be led into giving an answer (Greene, Flynn, & Loftus, 1982; Highhouse & Bottrill, 1995). The results of this experiment however provided support that, when accompanying a question with a gesture conveying a specific piece of information, a police questioner can have an impact on the responses given by witnesses.

## General Discussion

Previous research has shown that the manipulation of verbal information can affect the responses given by a witness (Harris, 1973; Loftus, 1975; Loftus & Palmer, 1974; Loftus & Zanni, 1975; Marquis, et al., 1972). This study demonstrates that, in certain cases, this effect can also extend to the manipulation of hand gestures. With the 'jewellery' question in particular, participants that saw the 'police' questioner performing an 'accurate' hand gesture were more likely to give the correct answer compared to those who saw the 'misleading' gesture, who consequently gave more incorrect answers. Since the detail reported by participants was only expressed in the questioner's gesture (while his speech remained identical across all conditions) it is clear that his gestures had an effect on the participants' responses. Thus, gestures do appear to have the ability to mislead eyewitnesses to a crime scene as does misleading questioning.

These results largely confirm the study of Broaders & Goldin-Meadow (2010), who found that children could have their responses influenced by gestures under questioning. The study here adds that this effect also extends to adults and that certain gestures can both prompt participants into confirming accurate answers and also suggest misled, fabricated responses. Together, these results restate the importance of considering gestures as a form of influence in police interviews. Whilst UK PACE (Police and Criminal Evidence Act) Guidelines state that an audio recording of police interviews is required (Code E, Section 2.1), a lack of video evidence may allow any influential gestures to go undetected. It is therefore important to understand when gestures can affect witnesses' responses. This discussion now addresses the question of which gestures are most likely to skew responses of witnesses and gives an insight into the process through which this influence occurs.

This study produced mixed results for which types of gestures were able to mislead, with the 'jewellery' question producing consistent results across both conditions whilst the 'knife-size' and 'speed estimate' questions showed trends in one experiment but not another. Prior discussions in each of the experiments offer some suggestion as to why effects were observed in some cases but not others, though this discussion focuses on a more general explanation of what may affect the likelihood of a gesture misleading a witness.

Some gestures are more communicative than others. While some gestures are produced with the intention of communicating clear information to listeners (Ekman & Friesen, 1972), others may only be performed simply to help the speaker (Butterworth & Hadar, 1989; de Ruiter, 2000; Krauss, Chen, & Chawla, 1996; Rauscher, et al., 1996) and thus have little communicate value (Krauss, et al., 2000). Although all the gestures in this experiment were considered communicative and 'representational' (i.e., they depicted representations of the information conveyed in speech), one similarity between the gestures that were not as effective in misleading participants was that there were more abstract in nature: In these cases, it may not have been obvious to participants when the hand gestures represented cars moving quickly or the ends of a knife. However, in contrast, the jewellery gestures of 'ring' and 'watch' were much more concrete, and clearly depicted the presence of a physical object. Thus, variability in the clarity of information conveyed through the gestures may account for the apparent differences in effects observed across questions. That is, gestures that conveyed clear information were more effective at communicating information and thus skewing responses than those that did not.

To consider this further, Kelly, et al. (1999) explain that gestures require a context in order to convey meaning. They draw a distinction between an '*interactive contribution*' approach (i.e. that the comprehension of speech and gesture relies on the comprehension of the other) over an '*additive contribution*' hypothesis (that the speech and gesture can be understood independent of each other). The authors use the former '*interactive contribution*' view to explain that gestures become more communicative when interacting with information in speech. Indeed, this may well be the case where gesture is context dependent (i.e., a deictic 'pointing' gesture at a window is largely redundant without the supporting speech; "*it's getting hot in here*"). However, the gesture alone may also convey meaning without depending on information in speech. Consider, for instance, the aforementioned example from Kelly, et al (1999) where the participant is told "*my brother went to the gym*" accompanied by an iconic gesture of 'shooting a basketball'. Although the authors found support for the '*interaction*

*contribution'* hypothesis here (on the grounds that the gesture interacted with the information in speech to convey meaning) this gesture could be considered to have strong semantic meaning independent of speech. In the absence of a 'gesture only' condition, it is difficult to rule out the possibility that the gesture alone could convey this information to listeners. If participants saw only the basketball gesture it is highly likely that, when asked "*what did he do?*", they would be able to identify the action of playing basketball. As the authors found that many participants gleaned information from this gesture, it would appear that highly semantic gestures such as this are particularly effective at communicating information to listeners. This has implications for the study reported here in that a pattern appears to emerge when gestures that communicate clear, concrete piece of information (such as the 'ring' and 'watch' gestures) appear more powerful than those that only convey information when presented alongside speech (such as the knife size or speed portrayals). Perhaps the basis for forming an answer portrayed through gesture requires the gesture to convey clear, concrete information that can be interpreted without depending on information in speech.

While gestures may convey clear semantic information to listeners (Kendon, 1980), the process through which they influence eyewitness may be considerably more covert than how they are influenced verbally. Gestures typically differ from speech in representation and often serve a different role in communication (McNeill, 1992). While speech conveys information in a 'segmented, combinatorial' format, gestures convey information in a 'global, mimetic' style (Goldin-Meadow, et al., 1996). Gestures also compliment speech fluently, whereas speech is far less fluent, and full of errors and hesitations (Cassel, 2000). Also, gestures are often produced spontaneously with speech (Krauss, 1998; McNeill, 1992) and speakers are often unaware they are producing them (Cassel, 2000). That is, gestures appear to be more subtle communicators of information than speech. Due to the difference in nature between verbal and nonverbal influence, the gesture may be able to skew responses of eyewitness through a more covert process.

Gestures may convey misleading information in a unique way. One notable feature of gestures is that they serve as a visual tool and convey pictorial information to participants that is very difficult, or not possible through speech (Goldin-Meadow, 1999). This becomes an important discussion point as it is possible that witnesses may confuse these extra visual details with original details of an event. Research confirms that people can confuse real life events with ones that are imagined (Braun, et al., 2001; Crombag, et al., 1999; Loftus & Hoffman, 1989; Wright, et al., 2001) and the ease with which details can be imagined

facilitates the creation of false memories (Drivdahl & Zaragoza, 2001; Zaragoza, et al., 2007). Thus, as gestures can convey visual information to listeners (Graham & Argyle, 1975; Kendon, 1980) they may serve as a method of creating visual information that can become confused with the original information. While suggesting the presence of a watch through speech requires the participant to visualise it themselves, a gesture of a watch provides a visual representation which may become more easily integrated into the memory of the original event. To take this discussion further, neurological evidence explains how the mirror neuron system enables people to 'empathize' with another person's actions, eliciting a sensation similar to if they were experiencing it themselves (Rizzolatti, Fadiga, Gallese, & Fogassi, 1996; Zwaan & Taylor, 2006). Perhaps, after seeing a gesture of a watch and subsequently experiencing the sensation of performing a watch gesture, it is this sensation which prompts participants into giving this response. If gestures are able to influence participants by presenting visual representations of objects or events, they can be a covert and powerful method of skewing responses under police questioning.

One question that remains unanswered however is whether participants saw the gesture and gave the answer conveyed by it because they thought they should, or whether the gesture implanted information into their memory outside of their awareness. At debrief, some participants claimed to have felt misled by the interviewer, and others reported that they gave an answer because "it just felt right". Interestingly though, none of the participants voluntarily reported noticing any of the gestures, implying that gesture influence may have gone unnoticed.

To investigate whether participants gave their answer as a consequence of having the information conveyed to them knowingly or implanted into their memory, it is necessary to acquire a measure that considers how participants rank the credibility of their answers. Not only may this serve as an indicator for when their responses were given as a consequence of being misled, but may also provide an insight into the process of how a gesture misleads. Do participants intuitively glean the information conveyed in gesture or does this information become integrated into their representation of the event outside of their awareness? Before revising the type of gestures performed, it was considered appropriate to obtain a measure of how participants rated the credibility of their answers to gain insight into why they were given. Such a measure would offer some indication of whether the information from gesture had been processed intuitively, or whether it had become integrated into their representation of the video.

Chapter 3 :

# Assessing the Relationship between Confidence and Accuracy of Eyewitnesses Subjected to Misleading Gestures

## Introduction

Can we judge the credibility of a witness's testimony by how confident they are in their statement? Moreover, does a misleading hand gesture influence the confidence witnesses attribute to their responses as well as the response itself? Psychologists have been sceptical of the relationship between accuracy and confidence for some time, claiming that a relationship between the two is often weak (Brewer, Keast, & Rishworth, 2002; Deffenbacher, 1980; DePaulo, Charlton, Cooper, Lindsay, & Muhlenbruck, 1997; Sporer, Penrod, Read, & Cutler, 1995). However, while much research has investigated how confidence in responses can be affected by misleading questioning, little attention has been paid to how nonverbal communication and hand gesturing may affect a witness's confidence.

Jurors are more trusting of witnesses that appear confident (Bradfield & Wells, 2000; Cutler, Penrod, & Stuve, 1988) and witness confidence can be used to judge the reliability or accuracy of their claims (Cutler, Penrod, & Dexter, 1990). Some researchers claim that confidence is an important indicator of eyewitness accuracy (Brewer, Potter, Fisher, Bond, & Luszcz, 1999; Deffenbacher & Loftus, 1982) and that eyewitnesses give higher confidence judgements after giving correct answers than incorrect answers (Nolan & Markham, 1998; Robinson, Johnson, & Robertson, 2000).

However, confidence and accuracy are thought to be influenced by different factors (Luus & Wells, 1994) and contrasting research has also found that people give similar confidence ratings to their responses regardless of whether they are correct or not (Loftus, Donders, Hoffman, & Schooler, 1989; Weingardt, Leonesio, & Loftus, 1994). People also find it easy to assess how well they know something, but difficult to assess how unsure they are of something (Schneider & Laurion, 1993). Therefore, when recalling episodic events, the lack

of calibration implies that confidence and accuracy will be poorly correlated (Gwyer & Clifford, 1997).

Witnesses are generally reported as being overconfident (Berger & Herringer, 1991) though this overconfidence can be reduced by making participants aware of this fact before (Bornstein & Zickafoose, 1999). Another method for reducing overconfidence includes inviting the witness to consider the accuracy of their testimony more carefully by questioning themselves; e.g. “*was I able to get a clear look at his face?*” (Brewer, et al., 2002). In a series of studies on identity parades, Wells & Bradfield (1998) found that witnesses’ confidence could be manipulated by the post-identification feedback provided by the experimenter. I.e. “*Good, you identified the subject*”. This effect was found to diminish when told that the feedback they received was false (Lampinen, Scott, Pratt, Leding, & Arnal, 2007).

Gwyer & Clifford (1997) focused on the confidence of witnesses’ testimony in police interviews. When comparing two methods, they found that the cognitive interview can improve accuracy of witness’ testimony but has little affect on the confidence they attribute to their responses. Wells & Murray (1984) have claimed that a general inconsistency between accuracy and confidence can occur due to many factors, including the methodology and realism of the study, or on the eyewitnesses’ limited experience of judging their own confidence. Perhaps then, the subjectivity of the police interview, as well as the subjectivity of a crime being recalled, makes any generic conclusions difficult to draw. Gwyer & Clifford clarify this by stating that “*the vividness of a reconstructed memory is likely to act as a cue for confidence in that memory’s underlying accuracy and this vividness may in part be dependent upon the interview technique administered*” (p. 124).

The way in which a witness is interviewed can have an impact on their accuracy (Loftus, 1975). Perry et al. (1995) provides examples of how a witness can be misled by a lawyers’ speech content. Certain wording changes can make a question more ambiguous, such as introducing double negatives: “*Did John not say that he would not go to the shops?*” or using advanced vocabulary “*Was the perpetrator of the crime occluded by any vehicles?*” Other examples include multipart questions where the lawyer deliberately asks two questions in quick succession (i.e. “*At 11 o’clock were you in the bar? Was John at the garage?*” The premise being that not allowing the witness a chance to answer the first implies that the question is unanswerable.



Keibell & Johnson (2000) reason that greater cognitive efforts are required to interpret an ambiguously worded question and, when this is the case, the witness becomes less confident in their answer. Presumably, as a witness believes that a question is taking them a long time to process, there is a subtle implication that they are uncertain of their answer. In their study, the authors found that the use of negatives, double negatives and multipart questions significantly impacted the confidence of the witness whilst complex vocabulary and syntax did not. Similarly, gestures may also provide the listener with additional, sometimes conflicting, information. Many examples are cited where gestures convey additional information to speech (Cassell, et al., 1999; Goldin-Meadow, 1999; Goldin-Meadow, et al., 2001; Kendon, 1980). In these cases, the listener is provided with additional information which may require greater cognitive processing. If ambiguity is introduced to a witness via a misleading gesture (i.e. a gesture which contradicts information previously stated), the witness's confidence in their answer may be compromised. If, however, speech and gesture form part of the same communication system (Kendon, 1980; McNeill, 1992) and are integrated at interpretation (Cassell, et al., 1999; Kelly, et al., 1999), this 'extra' information presented in gesture may be less overt and, hence, less likely to impact confidence.

There is evidence that witnesses use nonverbal clues to strengthen their confidence in a statement. Studies have shown that distinctive facial features and attractiveness can strengthen the relationship between confidence and facial-recognition accuracy (Brigham, 1990; Cutler & Penrod, 1989). When witnesses assess the credibility of a speaker's account, various nonverbal clues elicited by the speaker can increase confidence without affecting accuracy. Davis & Markus (2006) hypothesized that the nonverbal cues of a speaker would provide additional information and cause participants to report higher confidence in their decisions regarding the speaker's credibility; i.e. participants would be able to pick up on useful nonverbal behaviours of the speaker and use them to increase confidence in their decision. In the study, participants watched videos of criminal confessions and assessed how credible they were based on the speaker's performance. Amongst the nonverbal cues were gaze aversion, body shifting and face rubbing (correlates of nervous behaviour when lying) to suggest that the speaker was not being truthful. The authors report that participants were more confident in their judgements that the speaker was lying when seeing the nonverbal observations compared to decisions based purely on verbal information. This evidence suggests that witnesses can draw on nonverbal cues to increase confidence in their judgements. In this situation, it seemed as though confidence increase was dependent on

awareness of this nonverbal behaviour, suggesting that in order to feel more confident about a decision one needs to be able to draw on evidence to justify a boost in confidence. Thus, if gestures are able to alter confidence of witnesses, they would only do so if the witness was aware of the information conveyed by them.

Gestures differ from the aforementioned nonverbal cues. In the Davis & Markus (2006) study, the nonverbal cues were particularly noticeable by a third-party, possibly due to their unconventional nature (seeing somebody fidgeting is a noticeable feature of somebody behaving nervously). On the contrary, gestures are less overt; they occur spontaneously with speech, though information can still be extracted from them (Alibali, et al., 1997; Goldin-Meadow, 2005). If people extract information from the gestures that accompany speech, as well as from the speech content, does the additional information conveyed through a second source enough to make them more confident in their answer? More importantly, are participants aware that they have extracted information from gesture?

Beattie & Shovelton (1999) studied the confidence of participants' responses when answering questions about a comic book story narration. Fourteen participants originally narrated the story whilst a further 10 participants were asked to analyse their narrations. Participants saw the full video of the narration (video), heard only the sound (audio) and saw 'still' screenshots from the video (vision). Participants were asked seven types of questions regarding information that was portrayed through hand gestures and were asked how confident they were in each answer.

Beattie & Shovelton's results showed that gestures communicated more information to participants. Greater accuracy was observed for the 'video' and 'visual' groups for all questions. However, only accuracy in the objects' size and position was increased in the 'video' condition compared to the 'audio'. Although not much is reported on the confidence judgements, it is interesting nonetheless that participants in the 'vision' condition were more confident in their answers for 'size' and 'relative positioning' questions than any of the others (description of action, movement, direction and speed). This may be because information regarding size and position of an object can be portrayed quite effectively through a still, inanimate gesture. The authors also argue that participants were aware that more information was communicated to them: "*it is not just that respondents were receiving more information from gestures in these 2 semantic categories, but they also knew they were*" (p. 452).

While participants may make use of information conveyed to them to increase confidence, they may also become confident in ideas created by themselves. Many studies have shown that human memory is very fallible and, in some cases, witnesses have reported being more confident in false memories than real memories (Loftus, et al., 1989; Weingardt, et al., 1994). Therefore, false memories of events not only lead to witnesses giving inaccurate information, but also an incorrect sense of confidence attributed with them. A claim from Lieppe (1980) states that memory reporting and confidence reporting require separate cognitive processes and occur independently of each other. However, more recent research by Garry, Manning & Loftus (1996) has shown that ‘imagination inflation’ (i.e. visualising the event occurring) can significantly alter how confident a person is that the event occurred, implying that confidence is tied to memory creation, sharing the same cognitive process. The authors state that “*people routinely produce myriad counterfactual imaginings (i.e. daydreams and fantasies) but usually do not confuse them with past experiences*” (no p no.). However, being forced or encouraged to imagine specific events occurring can blur the distinction between imagined and real-life experiences.

Lieppe cites the research of Sherman et al. (1985) who found that participants judged diseases as more likely to occur when the symptoms of such a disease were easier to imagine. This is further explained by the availability heuristic (Tversky & Kahneman, 1974) which states that events that are easily pictured are more cognitively available and thus, seen as more likely to occur. Other, more everyday examples of this may include a fear that somebody did not turn the oven off or lock the door when imagining the consequences of failing to do so. Thus, being presented with information that is likely to have occurred increases the probability that witnesses believed it had occurred. Garry et al. (1996) asked participants to consider how sure they were that certain events had or had not happened to them in the childhood, such as ‘breaking a window with your hand’. After participants had imagined the event occurring, their confidence that it had occurred significantly increased. Jacoby, Wolostyn & Kelley (1989) explain that if something has been imagined before, the sense of familiarity is stronger.

To understand how gestures may increase confidence in false memories, it is important to consider two lines of research: The ‘*construction hypothesis*’ (Loftus, 1975) explains that eyewitnesses use extra information conveyed to them in under questioning to ‘fill in the gaps’ of their memory. Gestures can convey extra meaning by providing a visual representation of information conveyed in speech (Goldin-Meadow, 1999; Graham & Argyle, 1975; Kendon,

1980; McNeill, 1992). By drawing on the evidence above, these two ideas together suggest that the visual information conveyed through gesture could be used to 'construct' a false memory of the event with the information from gesture present. i.e. by gesturing a ring and asking "*what jewellery was the man wearing?*", the witness may reconstruct the scene as if a ring was present and assess how likely it was to occur. If the scene is easy to imagine, this falsely created perception may be enough to skew the witness's memory and increase confidence in their response.

Studying the relationship between accuracy and confidence within the framework of gesture sheds light upon two important factors. Firstly, it examines the interaction between accuracy and confidence of responses given as a consequence of nonverbal information, and assesses whether the relationship between the two is comparable to situations where information is conveyed verbally: Research reports that verbal influence can increase confidence without affecting accuracy (Luus & Wells, 1994), although it is unclear whether nonverbal reinforcement also has the power to do this. This study asks whether a hand gesture portraying information can cause participants to be more confident in an answer and does so without affecting accuracy; i.e. can the confidence and accuracy of a witness be independently manipulated by gesture? Secondly, studying confidence gives insight into the how the gesture is processed by witnesses: Does the gesture *implant* information in memory covertly or does it *reinforce* information manifested by the witness overtly? If it is the latter, confidence levels are predicted to rise with factual gestures that are consistent with information from the video, or drop with misleading gestures that introduce conflicting information. If, however, the gesture implants a false memory into the witness's representation, we would expect accuracy to be compromised with no change in the level of confidence reported.

## Method

### *Design*

The experiment used a between-subjects design. The independent variable was the 'police' questioner's gesture when asking the questions; either 'accurate', 'misleading' or control (no gesture), forming three conditions. The two dependent variables were the accuracy of the

response to his question (a qualitative answer from an answer set) and the confidence score attributed to the response (measured on a 5-point scale).

### *Participants*

A sample of 60 adults (33 males, 27 females) were selected opportunistically via email invitation to participate online. The mean age of the sample was 28.06 ( $SD = 13.56$ ).

### *Materials & Apparatus*

The study used the same ('knife' and 'car crash') stimuli and 'police' questioner videos as the previous study. The videos were uploaded to the internet so they could be embedded in an interactive website created by the online survey engine, 'Survey Share'.

The interactive website comprised of 12 pages, enabling participants to watch the videos and select their answers from a given answer set (the categories for the answer sets were based on the range of answers given by participants in the previous study). For each of the two trials, the first page embedded the stimulus video and included instructions to play the video once and 'continue' to the next page when the video had finished. For the following five pages, the video of the 'police' questioner was embedded into the page with a drop-down list of answers below. A rating scale for confidence was also included, ranging from 1 (not at all confident) to 5 (very confident). An answer to both of these questions was required before progressing to the next page.

An additional page thanked participants for taking part in the study and gave them the opportunity to leave feedback if they wished to do so. The website automatically logged the answers and was available to view and download by the experimenter at any stage.

### *Procedure*

Participants were recruited to this study via an email invitation. If they were happy to take part, they followed a link to the 'Survey Share' website where they could start the experiment. After a short background into the study, participants were told that this was a short memory test and that they could progress through the study in their own time. The

instructions informed participants that they would be required to watch two videos of crime scenes and answer five questions on each afterwards.

Participants were told that the quality of the stimulus video was deliberately poor and had muffled sound. The instructions also stressed the importance of watching the video only once. When continuing to the questioning videos, the participants were told again to only watch the video once before selecting their answers from the answer sets below. If the participant did not select both an answer to the question or a confidence rating, they were unable to progress to the next page. When the participant had watched the first ('knife') stimulus video and completed the five questions, the format repeated itself for the second ('car crash') stimulus video with the following five questions. Participants in the control group followed the same procedure though, as before, the questioner videos were blank and consisted only of audio from the questioner's speech.

When both of the trials has been completed, participants were directed to a final page where they were fully debriefed on the purposed of the study and given the opportunity to contact the experimenter for further questions or comments.

## Results

For each question, participants chose an answer from the provided answer sets and attributed a confidence score to their choice. As in the previous study, the two critical questions for the 'knife attack' video asked about the jewellery worn by the assailant and the size of the knife used in the attack. The two critical questions for the 'car crash' video asked how fast a car was travelling when it hit the other and how many cars were parked on the road. The analysis below considers the responses participants gave to each of these questions and the confidence they attributed to each of their answers.

### Accuracy

As participants responded to given answer sets, none failed to give a response to any question. For the jewellery question ("*what jewellery was the man wearing?*"), participants chose from either the correct answer 'ring', or incorrect answers 'watch', 'bracelet' or 'chain'. Table 3.1 summarises the frequency of responses given across conditions.

*Table 3.1: Frequency of responses given for the 'jewellery' question*

	Accurate ("ring" gesture)	Misleading ("watch" gesture)	Control (no gesture)
Ring	20	10	16
Watch	0	7	4
Other	0	3	0

All (100%) participants that saw the accurate (ring) gesture chose the correct answer ring, compared to 50% of the 'misleading' group and 80% of controls. Participants that saw the misleading (watch) gesture were more likely (35%) to give the "watch" response than controls (20%). To aid statistical analysis, all incorrect responses ("watch" and "other" jewellery) were collapsed into one category and compared, using a chi-square test of frequency distribution, with the ring (correct) category. Expected values were based on the frequency of responses from the control group, who heard the questions orally and received no visual influence. Responses differed significantly from expected values for both accurate,  $\chi^2(1, N=20) = 5.0, p = .025$ , and the misleading condition,  $\chi^2(1, N=20) = 11.25, p = .001$ . Thus, the questioner's gestures appeared to sway participants towards both correct and incorrect responses.

Table 3.2: Frequency of responses given for the 'knife-size' question

	Accurate ("7 inch" gesture)	Misleading ("2 foot" gesture)	Control (no gesture)
Under 4"	2	1	5
4" to 6"	9	14	12
6" to 8"	9	5	3

Responses for the 'knife-size' estimates were collapsed into three categories (under 4", 4" to 6", 6" to 8"). No participants in the study considered the knife to be larger than 8". More responses were given in the category considered most accurate (6" to 8") for the accurate group (45%) compared to misleading (25%) and controls (15%) who both defaulted to the more average answer. Responses differed from controls for the accurate group,  $\chi^2(1, N=20) = 5.99$ ,  $p = .014$ , but not the misleading group,  $\chi^2(1, N=20) = 17.09$ ,  $p = .100$ . Thus, the accurate gesture was able to sway participants into giving a more accurate answer, but the misleading gesture did not affect responses.

Table 3.3: Frequency of responses given for the 'speed estimate' question

	Accurate ("slower" gesture)	Misleading ("faster" gesture)	Control (no gesture)
25 to 34mph	3	4	10
35 to 44mph	13	15	8
45 to 54mph	4	1	2

Responses for speed estimate were again collapsed into three categories (25 to 34mph, 35 to 44mph and 45 to 54mph). The majority of responses for the control group (50%) fell within the lowest category, whereas the majority of responses for the accurate (65%) and misleading (75%) groups were both given in a higher category. A chi-square test found that participants'



responses in the accurate condition did not differ significantly from controls,  $\chi^2(1, N=20) = 4.32, p = .116$ , but responses for the misleading group did,  $\chi^2(1, N=20) = 13.27, p = .001$ . Therefore, only the misleading gesture appeared to sway participants into giving responses in the higher category.

*Table 3.4: Frequency of responses given for the ‘parked cars’ question*

	Accurate ("2 cars" gesture)	Misleading ("many cars" gesture)	Control (no gesture)
Under 2	4	4	2
2	12	10	9
Over 2	4	6	9

The final question considered the number of parked cars, where participants could chose from any figure between 0 and 4. Table 3.4 collapses the data into three categories (under 2, 2, or over 2). The results across all three groups was relatively similar, although slightly more participants were able to give the correct answer of two in the accurate condition (60%), compared to the misleading (50%) and control (45%) groups. A chi-square test however revealed that responses did not differ significantly from controls for both the accurate,  $\chi^2(1, N=20) = .20, p = .653$ , and misleading groups,  $\chi^2(1, N=20) = .20, p = .653$ .

### *Confidence*

Participants rated how confident they were in their response on a 5-point scale (1 = not at all confident, 5 = very confident). This analysis considers the confidence scores attributed to answers of the four critical questions. Table 3.5 provides an overview of the confidence in answers for all conditions.

Table 3.5: Means and standard deviations of confidence scores by condition

	Jewellery	Knife Size	Speed Estimate	No. Parked Cars
Accurate	4.00 (1.21)	3.05 (0.95)	2.50 (1.15)	3.80 (0.95)
Misleading	2.55 (1.73)	3.45 (0.69)	2.80 (0.83)	2.70 (1.13)
Control	4.00 (1.49)	3.05 (0.83)	3.05 (0.76)	3.05 (1.23)

For the jewellery question, participants that saw the accurate gesture were more confident in their responses than those that saw the misleading gesture, but no more so than controls. A one-way analysis of variance (ANOVA) revealed that the differences between the groups was significant,  $F(2) = 6.30, p = .003$ . The Bonferroni post hoc criterion for significance revealed that significant differences were found between the accurate and misleading group ( $p = .010$ ) and misleading and control group ( $p = .010$ ).

Similarly, participants that saw an accurate gesture for the 'parked cars' question attributed higher confidence to their answers than controls and those than saw the misleading gesture, who attributed the lowest confidence. A one way ANOVA confirmed these differences were significant,  $F(2) = 5.12, p = .009$ , with Bonferroni post-hoc tests revealing a significant difference between the accurate and misleading groups ( $p = .080$ ).

For the 'knife-size' estimate, participants attributed similar confidence between the accurate and control groups, but the confidence of answers given in the misleading group was slightly higher. However, no significant difference between the means of these groups was found,  $F(2) = 1.57, p = .218$ . Speed estimates by those in the accurate and misleading groups were both lower than the confidence of those in controls, but this difference was not significant,  $F(2) = 1.76, p = .181$ .

### Accuracy & Confidence

The next analyses take into consideration how confidence scores varied according to the responses participants gave in each condition. While the previous analysis suggests a main effect for condition on confidence, the following analyses explore whether there is an interaction between confidence and accuracy.

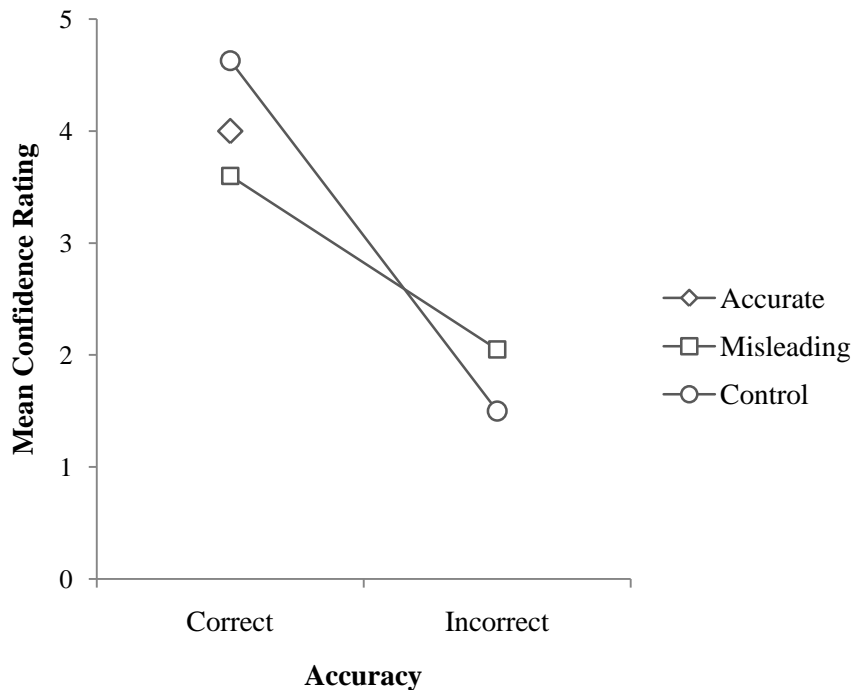


Figure 3.1: Confidence ratings for 'jewellery' question by response

For the jewellery question, participants that gave a correct response reported greater confidence in their answer ( $M = 4.50$ ,  $SD = 1.29$ ) than those that gave an incorrect response ( $M = 1.50$ ,  $SD = 0.65$ ). A two-way mixed factor analysis of variance (ANOVA) considered the confidence participants attributed to their answer by response. The between-subjects factor was the type of gesture the questioner performed (either accurate, misleading or control) and the within subjects factor was accuracy of response (correct or incorrect). A main effect was found for condition,  $F(2,57) = 6.29$ ,  $p = .003$  and accuracy,  $F(1,57) = 83.81$ ,  $p = .001$ , with a significant interaction between the two,  $F(2,57) = 8.56$ ,  $p = .001$ . Therefore, differences in confidence ratings varied by the type of gesture performed by the questioner:

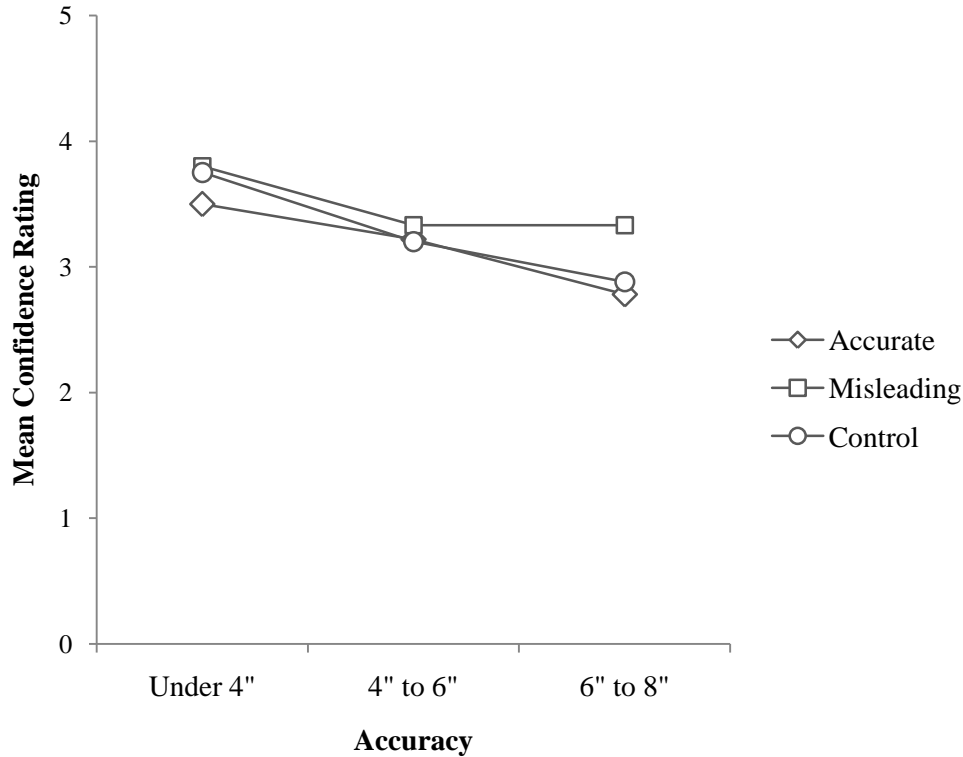


Figure 3.2: Confidence ratings for ‘knife-size’ estimates by response

For the knife-size question the confidence ratings of participants in the accurate and control groups decreased steadily as their estimates grew larger, though the confidence of participants in the misleading condition was generally higher, particularly for the highest knife estimates. Confidence ratings were generally highest for the smallest knife-size estimate ( $M = 3.75$ ,  $SD = 1.04$ ) and, decreasing uniformly, were lowest for the largest estimate ( $M = 2.88$ ,  $SD = 0.93$ ). The data were submitted to a two-way mixed ANOVA with condition as the between subjects factor (accurate, misleading and control) and response as the within subjects factor (under 4", 4"-6" and 6"-8"). A significant main effect was observed for the knife-size estimate,  $F(2,57) = 9.88$ ,  $p = .001$ , although there was no main effect for condition,  $F(2,57) = 1.57$ ,  $p = .218$ , and no interaction between estimates and the condition,  $F(8,57) = 1.37$ ,  $p = .248$ . Thus, differences in confidence ratings did not vary significantly across conditions.

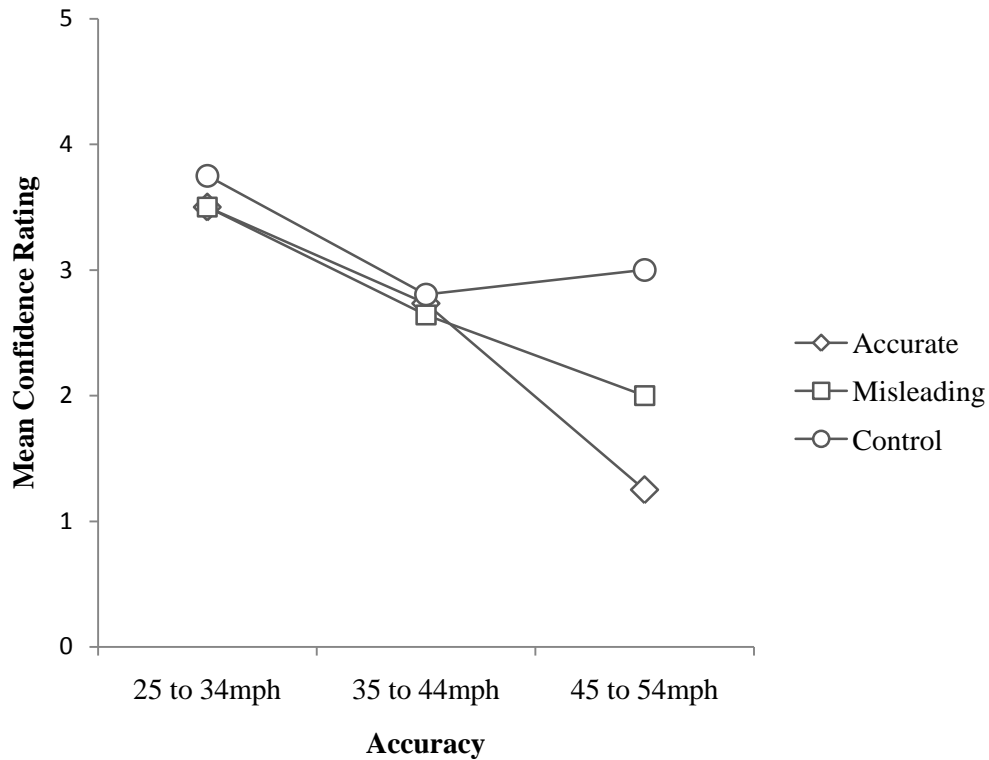


Figure 3.3: Confidence ratings for ‘speed estimates’ by response

For speed estimates, participants in all three conditions seemed to attribute similar confidence ratings up to the fastest categories, where confidence ratings dispersed considerably by condition. Those that saw the accurate (slower) gesture were less confident in giving higher estimates than those that saw the misleading (faster) gesture. The confidence scores of the control group however remained similar to those of the lower responses. Generally, confidence ratings were highest for the lowest speed ( $M = 3.35$ ,  $SD = 0.862$ ) compared to the mid ( $M = 2.72$ ,  $SD = 0.815$ ) and fastest speed ( $M = 1.71$ ,  $SD = 0.756$ ). A two-way mixed ANOVA considered the differences in confidence ratings between speed estimates and condition. A main effect was found for accuracy,  $F(2,57) = 13.89$ ,  $p = .001$ , but not for condition,  $F(2,57) = 1.76$ ,  $p = .181$ . The test also revealed an interaction between speed-estimate and condition,  $F(2,57) = 7.48$ ,  $p = .012$ . Thus, differences in confidence ratings varied according to the type of gesture performed by the interviewer.

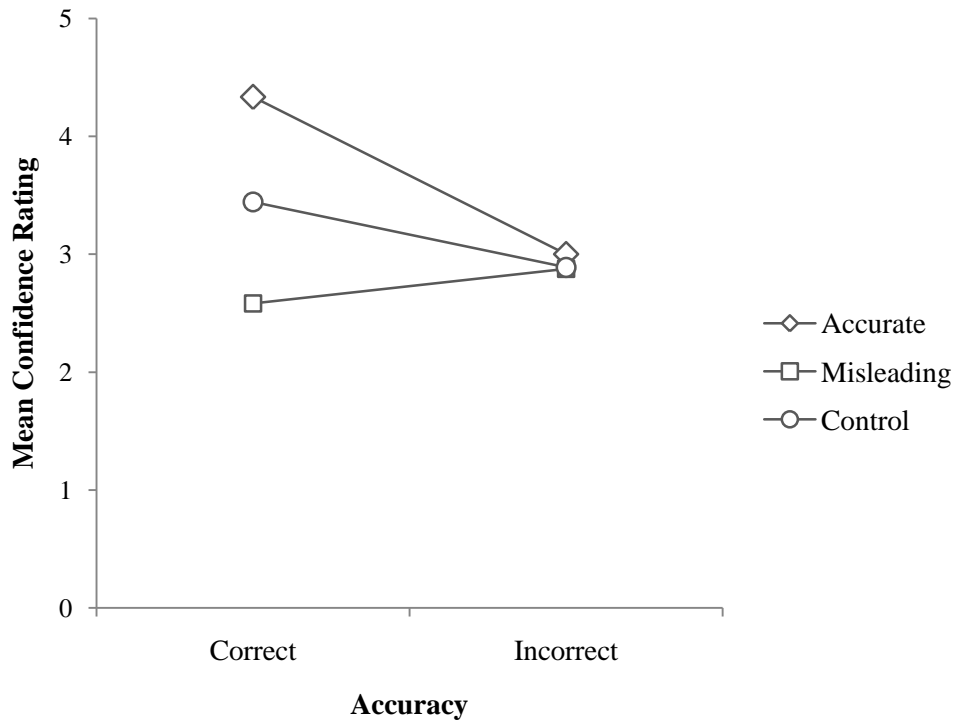


Figure 3.4: Confidence ratings for ‘parked cars’ by response

For the parked cars question, participants were more confident in correct answers ( $M = 3.45$ ,  $SD = 1.23$ ) than incorrect answers ( $M = 2.85$ ,  $SD = 1.06$ ). Those in the accurate condition were more confident in correct answers, compared to controls and the misleading group, who attributed lower confidence still. Confidence ratings decreased for the accurate groups and increased for the misleading group, and tended to converge to a similar value. A two-way mixed factor of analysis of variance (ANOVA) considered the between factor of condition (accurate, misleading and control) and within subjects factor of response (correct and incorrect). A main effect was found for condition,  $F(2,57) = 5.12$ ,  $p = .009$ , although there was no main effect for accuracy,  $F(1,57) = 2.00$ ,  $p = .162$ , and no interaction between accuracy and condition,  $F(2,57) = .86$ ,  $p = .427$ .

## *Summary*

- Participants' responses tended to concur with the information conveyed in the questioner's gesture. The responses of participants that saw a gesture differed significantly from the responses of controls for the 'jewellery', 'knife size' and 'speed estimate' questions
- The confidence participants attributed to their answers varied according to the type of gesture they saw. Significant differences were found in the confidence ratings of participants on the 'jewellery' and 'parked cars' questions, where participants were less confident in their response after seeing a misleading gesture
- Confidence in incorrect responses was always higher numerically for those that saw misleading gestures, compared to those that saw the accurate gesture. Participants that saw the accurate gesture did not always award high confidence to their correct answers, but were always less confident in incorrect answers.
- An interaction between condition and responses for confidence ratings was only significant for the 'jewellery' question.

## Discussion

The previous study asked whether a police questioner's hand gestures could influence the responses of witnesses. This study investigated whether the type of gesture a witness sees affects their confidence in their answer, and whether it does so independently of the responses they give. The results confirmed that the questioner's gestures did have an effect on the participants responses and that, for some questions, the gestures also affected the confidence participants attributed to their answer, though this relationship appeared to differ across the four critical questions. The implications of these findings are discussed here.

This study provided further evidence that a witnesses' response can concur with information conveyed to them in gesture, confirming that gestures have the ability to persuade participants to both correct and incorrect responses. Participant's representation of jewellery

appeared to be enhanced by a corresponding, factual gesture and skewed by an incorrect and misleading gesture. Similarly, participants were more likely to estimate the correct knife size when presented with an accurate gesture portraying this size and gave higher speed estimates when presented with a misleading, gesture implying greater speed.

In support of previous research, participants also appeared to be more confident in correct answers than incorrect answers (Nolan & Markham, 1998; Robinson, et al., 2000), irrespective of the gesture observed. Although misleading questions sometimes resulted in incorrect answers, these answers were given with less confidence than the confidence in correct responses (Roebbers, 2002). One exception however is that participants who saw the misleading (many cars) gesture were more confident in the incorrect answer of 'more than 2' than the correct answer '2'. Another key finding here is that participants were more confident in incorrect answers after seeing a misleading gesture conveying this information, compared to those that saw an accurate gesture or none at all. Therefore, the misleading gestures did appear to increase confidence in incorrect answers, confirming that after the misinformation effect confidence is not a reliable indicator of accuracy (Gwyer & Clifford, 1997; Leippe & Eisenstadt, 2007; Shaw, McClure, & Dykstra, 2007).

It is important to explore why the relationship between accuracy and confidence appeared to differ across the four critical questions. A clear interaction was present for the 'jewellery' question, where the confidence of witnesses across correct and incorrect responses differed according to the gesture they saw. Participants that saw the misleading gesture were less confident in correct responses and more confident in incorrect responses than controls. Although no further interactions were observed for the other questions, the confidence judgements still appeared to vary by condition.

Research has already shown how the confidence-accuracy relationship can be affected by design factors within the methodology of the study (Wells & Murray, 1984) as well as the difficulty of the questioning (Kebbell, Wagstaff, & Covey, 1996). One possible explanation for why the jewellery gestures were more likely to influence responses is that they may have greater clarity to the listener, i.e. when the gestures convey information that is more obvious to participants, they may be more inclined to glean information from them. If participants only use nonverbal cues to increase confidence when they are aware of them (Davis & Markus, 2006) the clarity of the gesture may also affect confidence.



Prior discussions have posited that the nature of the gesture can affect how likely is it to influence participants. Kelly, Barr, Church & Lynch (1999) propose that gestures can either be additive (portraying information that can be understood independent of speech) or interactive (portraying information that can only be understood alongside speech). The discussion sections of the previous experiment confirmed that the additive, jewellery, gesture offered clearer information to the participant than the gestures for the other questions. Perhaps gestures are more likely to affect confidence judgements if the information conveyed by them was more accessible or 'obvious' to the participants. If clearly portraying accurate information, the gesture was more likely to help those form a correct answer and if portraying misleading information, it was more likely to cause confusion. Of course, this is based on the assumption that participants were aware of this gesture conveying information to them; a topic which will be discussed in more detail later.

Not only did the confidence-accuracy relationship differ across questions, it was also found to differ across conditions. One can question whether it is right to compare the confidence judgements of participants in the accurate and misleading conditions since the type of response they were judging differed by condition: Participants in the accurate condition reported confidence as information was confirmed (or reinforced) by the 'police' questioner. If participants thought there may have been a ring present, a ring gesture would have confirmed this belief. Thus, the gesture here appears to serve as a recognition cue. In contrast, participants that saw the misleading gesture of a watch had no visual trace to refer this back to and could only have justified their answer with the questioner's gesture. It is perhaps not surprising then that participants who gave an incorrect answer as a consequence of seeing this novel 'watch' information were less confident than those that saw a confirmatory 'ring' gesture. The confidence-accuracy relationship varies between recall and recognition as the two use different memory processes (Odinot, 2008). Whilst the misleading 'watch' gesture prompts false recall, the accurate 'ring' gesture serves as a recognition cue.

Witnesses may be sensitive to reporting higher levels of confidence when the gesture provides a piece of information they can clarify their answer with. The previous study highlights that a gesture may convey misleading information in a similar manner to biased questioning: For instance, while asking a witness "*do you remember any jewellery?*" does not suggest any specific response, asking "*do you remember a watch?*" may prompt them to imagine a watch being present. Similarly, asking the former question with a "watch" gesture

may elicit a similar bias, as well as providing a visual representation of a watch for witnesses to identify with.

Research into false memories explains that it is it easy to confuse recognition of a real event with an imagined one (Garry, et al., 1996; Jacoby, et al., 1989) and witnesses can be just as confident in these imagined events as real ones (Loftus, et al., 1989; Weingardt, et al., 1994). Thus, if a gesture provides listeners with a visual representation (Goldin-Meadow, 1999; McNeill, 1992), and witnesses 'reconstruct' memories of the scene with information conveyed to them present (Loftus, 1975), witnesses may confuse this information as being part of the witnessed event. While the UK PACE (Police and Criminal Evidence Act) guidelines only require an audio recording (Code E, Section 2.1) there would be no log of a gesture serving as a probe to false-memory creation. If, as found in this study, the misleading gesture can increase confidence in the incorrect answer it suggests, this answer could be mistaken as a freely-recalled response, particularly if awarded with a level of confidence indicative of freely recalled information.

While confidence may not be a reliable indicator of a witness's accuracy, it is important to understand how a gesture might increase confidence in an answer. Studying confidence in this experiment had two purposes. Whilst it produced evidence to suggest that the unreliability of the confidence-accuracy relationship extends to information conveyed through gesture, it also provides some insight into how the gesture misleads, i.e. whether it influences participants outside of their awareness. If participants were aware of the gesture and used this to aid their answering of the question, one would have expected their responses to have been accompanied by significantly higher confidence ratings than controls. If, however, the gesture integrated itself into the participant's representation, outside of their awareness, we would expect the gesture to have little effect on their confidence. i.e. In order to increase confidence in an answer, it is assumed there must be some ground upon which to justify such an increase in confidence. However, it is worth highlighting that studying confidence is not a robust measure of gesture awareness, and it may be possible for a gesture to increase confidence in a participant's response without them understanding why they feel more confident about their answer.

Davis & Markus (2006) claim that participants only use nonverbal cues to increase confidence when they are aware of them. This study found the only question that yielded an interaction of confidence judgements between condition and response was the jewellery

question. This was also the only question that was accompanied by 'additive' gestures (those that could be interpreted in the absence of verbal information) and one that has significantly affected the responses of participants in all three experiments so far. Conversely, confidence judgements did not appear to vary by condition or response for the other questions which produced a less clear, interactive gesture (one that only supported the information in speech) and were not as effective at manipulating the responses of participants. Therefore, it appears that the gestures that have the greatest potential to mislead are 'additive', i.e. they convey information which can be understood independent of speech. Having established that additive, rather than interactive, gestures are more likely to influence witnesses the next studies will focus only on these.

Any claims that participants were aware of the gesture are rather speculative. Before drawing any firm conclusions about when a gesture affects the participant's confidence, it is important to establish whether the gestures occur outside of their awareness. One way to assess whether a participant noticed the gesture, or felt misled by it, is simply by asking them. Measures asking participants whether they noticed the gestures in this research so far have been included as points of interest during debrief. To ascertain whether participants were aware that they had been exposed to misleading gestures this needs to be systematically investigated. It is also necessary to determine whether participants whose responses corresponded to a misleading gesture would identify where the misleading information came from.

Whilst this study has produced evidence that an accurate gesture can clarify information, what is of more concern is whether misleading gestures can prompt the reporting of false information. Therefore, for future experiments, it was decided to focus solely on misleading gestures. For example, including a misleading ring gesture when one was absent from the scene would clarify whether it is possible to suggest a ring, rather than confirm its presence. Having this second misleading condition would also provide an additional control that would enable a comparison to be made against a gesture suggesting an alternate item of jewellery.

In addition to these measures, it is necessary to formally ask participants in the debrief whether they felt misled by the gestures and whether they were able to recall and recognise them afterwards. Whilst the studies to date have provided strong evidence to suggest that gestures can mislead witnesses, a future study adopting this methodology would provide the

further clarification that these gestures can influence, and an insight into whether this influence occurs outside of the participant's awareness.

## Chapter 4 :

# Attention to Gesture: Do Misleading Hand Gestures Influence Listeners Outside of their Awareness?

## Introduction

Do people knowingly extract information from gesture? There is considerable empirical and theoretical support for the 'gestures as communication' hypothesis, stating that gestures serve an important role in communication and convey information to listeners (Goldin-Meadow, 2005; Goldin-Meadow, et al., 1993). While some gestures are produced to support and build on information in speech (Goldin-Meadow, 1993; Langton, et al., 1996; Thompson, 1995), some convey information that is not contained in speech (Kelly, et al., 1999; Kendon, 1980). In such cases, attending to gesture is largely beneficial in the comprehension of the speaker's message. Graham & Arygle (1975) found that participants' performance on an abstract line drawing task improved when they viewed the gestures of a describing partner. Much research confirms that the comprehension of a speaker's message is improved when their conversational partners see them gesture (Beattie & Shovelton, 1999a; Church & Goldin-Meadow, 1986; Goldin-Meadow, 1999). The fact that information is gleaned from gesture implies that they are, on some level, processed by the listener, though the extent to which they are done so consciously or unconsciously is unclear.

Therefore, this study asks how gestures are processed by listeners and poses the research question; are gestures attended to by listeners, and are they aware when they have gleaned information from them? Such a question has great importance in this research; understanding how potentially misleading gestures are processed by listeners can give an insight into whether they communicate information through subtle process or whether they do so within the listener's awareness.

If gestures serve as a communicative tool, then spontaneous, conversational gestures have a similar function to speech (Kendon, 2004; Melinger & Levelt, 2004; Özyürek, 2002). Speech-accompanying gestures convey meaning to listeners that support speech and, often, overlap with speech content (Kita & Özyürek, 2003); i.e. an iconic gesture accompanies the word 'climb' with a grasping motion of the hand (McNeill, 1992). Thus, speech and gesture

work together to give an overall representation to the listener (Goldin-Meadow, 1998; McNeill, et al., 1994). Further support that gestures are processed similarly to speech comes from neurological evidence. Gestures have been shown to activate Broca's area; the area of the brain active during the comprehension of speech (Decety, et al., 1997). Research shows that activation of this language area is limited to gestures that convey meaningful, semantic information (Willems, et al., 2007) and is not activated with nonsense hand movements (Hubbard, et al., 2009). Further neurological evidence reports that the processing of gestural information elicits similar neurological activity that is usually observed for speech (Özyürek, et al., 2007). To further this, Kelly, Kravitz & Hopkins (2004) suggest that gestures, like speech, are processed at a sensory / phonological level before they are processed semantically. That is, a representation is drawn from both the speech and gestural information combined and the listener comprehends the two together as an overall message.

Semantic information from gesture appears to be processed alongside information in speech, but how aware are people of how information has been presented to them? Moreover, can people differentiate between information that has been conveyed to them in speech and information conveyed in gesture? If speech and gesture are both processed linguistically, it would be useful to draw on research studying participant's awareness of speech to provide an insight into their awareness of gesture. Levelt (1989) provides a literature summary of research concerning the memory of information that has been expressed to listeners through speech. Early research states that recall and recognition of verbal information is relatively good for sentences that have just been heard (Jarvella & Herman, 1972) and sentences that have an emotional impact (Keenan, MacWhinney, & Mayhew, 1977). The remembering of verbal information can also be dependent on how useful it is: Cassel (2000) explains that 'surface' structure of words is lost immediately after hearing them (Johnson, Bransford, & Solomon, 1973). Cassel gives an example of hearing either the word "*couch*" or "*sofa*" and suggests that a person would quickly have forgotten which word specifically was used to communicate this information about a piece of furniture. That is, speech is comprehended for meaning, but the words are discarded once meaning has been extracted from them. In this example, people process the concept of a large seating item of furniture found in living rooms, but forget the word that was articulated to them to convey this as holding such information in memory would be effortful and unnecessary.

If people forget what information has been presented to them through speech, can people identify what information has been presented to them through gesture, and do so independent

of information in speech? A number of gesture studies have found that information from gesture becomes integrated into their memory of a story. Cassel, McNeill & McCullough (1999) found that when participants were given a narration of a 'Sylvester and Tweety' cartoon, the speaker said "*she whacks him*" whilst accompanying this verb with either a 'punching' or 'slapping' gesture. Upon recalling the story, participants integrated the 'punching' or 'slapping' information into their memory of the story spoken to them, with no apparent knowledge that this information was actually presented to them separately through gesture. In addition to this, Kelly, et al. (1999) presented participants with a speaker saying "*my brother went to the gym*" accompanied with a gesture of shooting a basketball. In this example, participants misremembered the speaker as saying "*my brother went to play basketball*". The authors confirm that gesture facilitates memory of speech (Church, et al., 2007), but also confirm a semantic integration between speech and gesture. When accompanying information is presented through gesture, this information becomes integrated with the message articulated in speech. Consequently, participants remember gestural information as speech information.

People appear to have little or no knowledge that specific semantic information has been communicated to them through gesture rather than speech. However, it is difficult to conclude from this that participants are incapable of differentiating between information conveyed to them in speech and information conveyed in gesture. People extract meaning from both speech and gesture, but knowing the source of information given to them would be unnecessary; acquiring information from a speaker is important rather than knowledge of how this information was acquired. However, if participants are invited to recall or recognise gesture afterwards, would they then be able to identify that information was conveyed to them through such gestures rather than through speech?

Research studying people's retrospective memory of gestures is rather light, and tends to focus on gestures that complement speech rather than those that convey exclusive semantic information. One study by Krauss, Morrel-Sameuls & Colasante (1991) gives an insight into how well gestures are remembered following observation of a speaker. In a series of five experiments, participants were shown a narration of a story in one of three conditions; 'video and audio', 'video only' or 'audio only'. In experiments 3 and 4, participants were told that they would be tested on how well they could recognise gestures afterwards and were asked to distinguish between gestures they had seen and ones that had not. The study revealed that participants in the 'video and audio' condition were able to recognise more gestures,

compared to those in just 'video'. The authors conclude that the gesture is only more likely to be identified afterwards if it occurs alongside speech. That is, gestures are not remembered if they do not have a semantic context.

In the study by Krauss, et al (1991), the gestures alone did not carry semantic information, but existed simply as a pictorial representation to support speech. Other research has confirmed that identification of gestures is poor when they have no semantic value on their own: Feyereisen, Van de Wiele & Dubois (1988) showed participants silent videos of a person performing a gesture and asked them to state which word the person was describing. Participants could choose from a possible three responses; 'correct', a 'plausible' response and an 'implausible' response. They found that, whilst 'implausible' responses were the least common, participants selected the 'plausible' response more often than 'correct'. Thus, the study confirmed that people's identification of gesture is poor when the gestures do not contain specific information that can be interpreted in isolation to speech.

Kelly, et al. (1999) explain that, in their study, an accompanying gesture of a basketball to the sentence "*he went to the gym*" is in line with their 'interactive contribution' hypothesis. That is, gestures 'interact' with speech and only make sense when presented with speech alongside them. However, many iconic gestures have conventional and unambiguous meanings in the absence of speech (Feyereisen, et al., 1988; Krauss, et al., 1991) and listeners can pick up on meaning in gesture, even when it is different from speech (Kelly & Church, 1998; Singer & Goldin-Meadow, 2005). Following the alternative 'additive contribution' hypothesis suggested by Kelly, et al., gestures can be understood independent of speech. Referring to another example of their study, when participants are presented with the sentence "*the cook stepped outside for a minute*" and a gesture of a cigarette to the mouth, participants integrate these two pieces of information together to misremember the speaking saying "*the cook stepped outside for a cigarette*". However, the authors have little to say about how well the message is comprehended without speech. It is likely that when participants are presented with just the gesture of a speaker putting a cigarette to their mouth they would be able to understand the concept of somebody smoking a cigarette without any supporting speech. Is a gesture with strong semantic value more likely to be remembered? In some situations, gestures do appear to have clear semantic meaning that can be interpreted without speech. In an article about memory, Craik (1979) explains that "*if the gesture is meaningful, the resulting code is predominantly semantic*" (p. 69). Therefore, if a gesture contains meaningful



semantic information that is unavailable through speech, it's likeliness of being remembered may increase.

This has important implications for the research outlined in this thesis, which has already provided evidence that gestures can skew the responses of eyewitnesses. Police questioners are not permitted to suggest information to participants through leading questions, but are free to gesture. If police questioners were to suggest the presence of an object (without using leading questions and infringing on the rules of interview conduct), such information would be presented through gesture alone and, hence, be the source of semantic information. This line of research so far has found that participants can be influenced by misleading gestures, and such influence is most effective when the gesture follows the 'additive contribution' hypothesis suggested by Kelly, et al. That is, gestures are most effective at skewing responses when the misleading information is contained entirely through the gesture, and is not dependent on speech content.

If gestures do mislead eyewitnesses, it is important to ask how, and is it possible for any indication to be given for when a gesture has skewed the memory of an eyewitness? Ultimately, the answer to this question would give an insight into whether participants give responses that concur with the police questioner because they are aware information is being conveyed to them, or whether they are influenced outside of their awareness. The previous study gave some indication of how participants feel about the responses they had given by studying the confidence they attributed to each response. Here, it was found that participants attributed higher confidence to incorrect answers that had been misled by gesture. Following the theory that nonverbal cues affect confidence only when they are noticed (Davis & Markus, 2006) there is an implication that participants possess some awareness of the gestures that suggest misleading information to them, though the extent to which they do is unclear.

This study aimed to provide a more objective measure of whether gestures can mislead eyewitnesses outside of their awareness and build on an understanding of how gestures are processed and attended to. In experiment 1, participants were tested with a new stimulus and 'police' questioner videos before being asked which gestures they could recall and recognise. This format was then replicated in experiment 2, where the performance of lawyers was compared against psychology students to provide a measure of how people working in a professional legal industry respond to the same misleading gestures of the 'police' questioner.

Finally, in experiment 3, participant's attention to the gestures was measured through the use of an eye-tracker to understand how attention to gesture interacts with their responses and ability to recognise gestures afterwards.

## Experiment I

This study investigated whether participant's self reports were an accurate indicator of whether their responses were given as a consequence of seeing misleading gestures during questioning. In the first of three experiments, participants were questioned on a video of a crime scene by an on-screen 'police' questioner before asked which of his gestures they could recall or recognise afterwards, and whether they felt misled during the experiment.

The study used a new piece of CCTV footage which was considered to be more ecologically valid due to its one, static viewpoint (and no sudden camera angle changes). In addition, all gestures in the study were concrete, iconic gestures depicting physical objects, following the '*additive contribution*' hypothesis proposed by Kelly, et al. (1999), i.e. the gestures contained information that could be understood irrespective of speech. Unlike the speech-accompanying gestures used by Krauss, et al. (1991), semantic gestures were thought to be more meaningful to listeners (Craik, 1979) and hence, more likely to be remembered.

Finally, this study considered only gestures that provided misleading information (i.e. there was no 'factual' condition). If multiple items of jewellery could be falsely suggested to participants under the same conditions, it would give extra weight to the theory that participant's responses concur with the information conveyed to them in gesture.

## Method

### *Design*

This study used a between-subjects design with three conditions. Participants in the first experimental condition saw the 'police' questioner performing one set of misleading gestures during the questions (i.e. 'ring'), whilst those in the second saw another set of misleading

gestures (i.e. 'watch'). A third, control group, saw no gesture and just heard the 'police' questioner's voice.

The dependent variables were the response given by participants (chosen from a given answer set) and their accuracy in recognising the gesture from a screenshot afterwards (measured as correct or incorrect). Further dependent variables included the results of a self-report questionnaire (see Appendix E) where participants reported which gestures they could recall seeing and whether they felt they had been misled during the experiment.

### *Participants*

Seventy-two participants (20 males, 52 females) were selected as an opportunistic sample with a mean age of 30.31 ( $SD = 17.93$ ), ranging from 18 to 81. The sample consisted mainly of first year psychology undergraduates who were rewarded with participation credit for taking part.

### *Materials & Apparatus*

In preparation for this experiment, a series of videos were recorded. These videos included a stimulus video which participants were questioned on and footage of the 'police' questioner used to ask the questions.

The stimulus video was filmed in an office of the psychology department in the University of Hertfordshire. The video was a mock-up of CCTV footage depicting a theft occurring in the room. A young male entered the room, looking around suspiciously, and proceeded to steal a bag that was placed on a desk.



Figure 4.1: A screenshot from the CCTV stimulus video

The Adobe Premiere Elements 2.0 video editing software was used to make the video appear as CCTV footage. The finished video was produced in black and white, with a grainy texture at a very low frame rate (approximately 5fps). A fake time stamp in the bottom corner was also added.

As in the previous study, a series of questioning videos were produced. These videos showed an actor (playing the role of a police questioner) asking a question to the camera in a mock-up setting of a police interview room. All videos were filmed in the Observation Laboratory of the University of Hertfordshire. The series of questions included three critical questions and four distracter questions. Two variations of the critical questions were recorded in which the 'police' questioner performed two alternative gestures for each question. For instance, for the question "*did you notice any jewellery?*" the questioner performed a 'ring' gesture in one video, and a 'watch' gesture in the other. (As the man was not wearing jewellery, both of the gestures were misleading). The other critical questions asked "*did you remember any distinguishing features?*" with an accompanying 'beard' or 'glasses' gesture, and "*did you notice anything else he was wearing?*" with either a gesture of 'gloves' or 'hat'. As none of these details were present in the video, all gestures contained misleading information. A full list of the questions and the corresponding gestures are summarised in Appendix C.

Additional materials included a simple 'circle the squares' distraction task, an answer booklet with answer sets (Appendix D) and a funnel-debrief questionnaire (Appendix E). The questionnaire asked participants whether they felt influenced by the interviewer, which of his

gestures they could recall seeing and, finally, to identify which gestures they recognised by selecting one of two screenshots of the questioner's gestures for each critical question (though also had the option to state they did not know).

### *Procedure*

Participants usually took part individually, although some also took part in small groups of 3 or 4; in which case they were informed not to make conversation with fellow participants throughout the experiment. After being shown the CCTV (stimulus) video, the participants were then asked to complete the distracter task. The 'police' questioner videos were then presented one at a time in a designated order (see Appendix C for the question list). Participants wrote down their answers to each question in the answer booklet, indicating when they were ready to progress to the next.

After viewing the videos, participants in the experimental groups were then given the funnel-debrief questionnaire to complete at their own pace. The experiment lasted approximately 20 minutes with debriefing afterwards.

## Results

These results consider the answers given by participants in response to the 'police' questioner's gestures. In addition, their responses to whether they felt misled during the experiment and which of the gestures they could recall or recognise afterwards were also considered.

### *Responses*

The initial results focus on whether the participants responses concurred with the information portrayed in the 'police' questioners gestures. Participants gave an answer to the three critical questions asked by the questioner (concerning the man's jewellery, facial features and additional clothing) by choosing one item from a given answer set. The responses in all answer sets comprised of the 'answer' portrayed through the gesture in both conditions, as

well as a further two distracter answers and an ‘other’ (don’t know) response. The positive responses given by participants are summarised in figure 4.2.

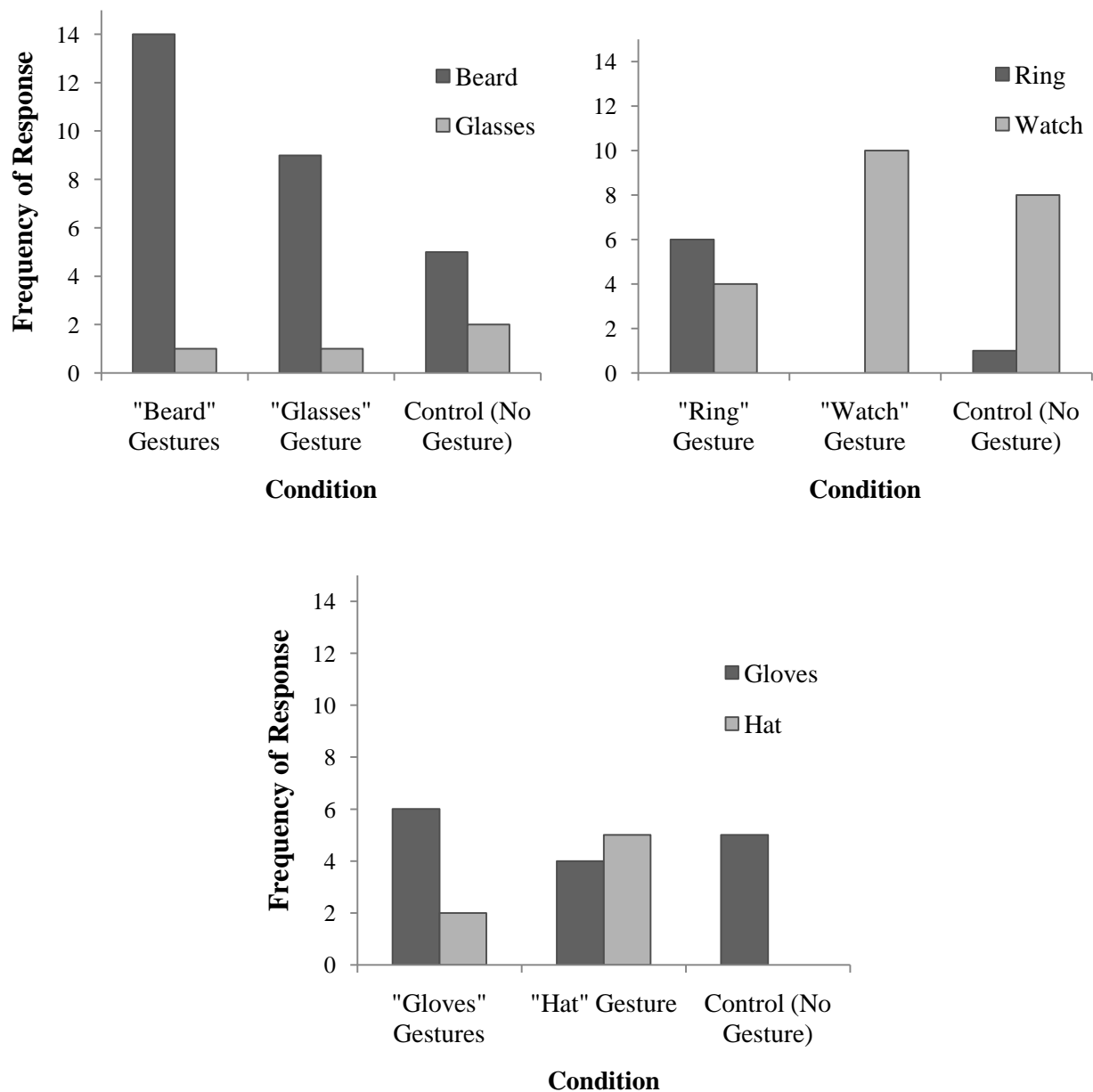


Figure 4.2: Frequency of responses for the "facial features", "jewellery" and "other clothing" questions by condition

Participants were more likely to identify the jewellery that was conveyed to them through gesture in both conditions. The 'ring' and 'watch' gestures generated more of each response in their respective conditions. Similarly, for the 'other clothing' question, the 'gloves' and 'hat' gestures prompted more of those answers in each condition. For the 'facial features' question, the 'beard' gesture did result in a greater number of 'beard' responses, though remained a

popular answer throughout the other conditions. The 'glasses' gestures appeared to have comparatively little effect.

To improve statistical reliability, the data for all three questions were collapsed into one data set comparing each misleading gesture against its respective control counterpart. Of the participants that saw a misleading gesture, 29.2% gave the response conveyed by it. Comparatively, 15.2% of participants gave the response when they did not see the gesture. This data was submitted to a 2x2 chi-square analysis testing an association between gesture (saw gesture / not) and response (gave positive response / not) and retrieved a significant effect;  $\chi^2 (1, N = 282) = 7.90, p = .005$ . Thus, in general, most of the gestures performed to participants had an effect on the responses given.

To further this analysis, a Mann-Whitney U test was performed on the participants' responses. As participants in the experimental groups saw three misleading gestures, the data were scored according to how many 'target' responses (responses concurrent with information in gesture) they gave (ranging from 0 to 3). The test revealed that those in the first misleading gesture group gave significantly more target responses than controls,  $U = 165.5, n_1 = 24, n_2 = 24, p = .006$ . Similarly, those in the second misleading gesture group gave more target responses than controls, though this did not reach significance;  $U = 229.0, n_1 = 24, n_2 = 24, p = .170$ .

#### *Gesture Recall & Recognition*

The next analysis considers how well the participants identified the gestures that were presented to them. After questioning, participants were asked whether they noticed any of the questioner's hand gestures and were invited to recall any gesture they remembered seeing. In addition, participants were then asked to identify which gestures they saw from screenshots of the 'police' questioning videos. Table 4.1 provides a summary of all the gestures recalled and recognised by participants for the three critical questions.

*Table 4.1: Summary of gestures recalled and recognised by participants*

Question	N	Gesture performed by 'police' questioner	% Recalled gesture	% Recognised gesture
Features	24	Touching chin (beard)	8.33%	87.50%
	24	Touching nose (glasses)	20.83%	33.33%
Jewellery	24	Pinching finger (ring)	29.17%	79.17%
	24	Grasping wrist (watch)	33.33%	70.83%
Clothing	24	Grasping hands (gloves)	20.83%	66.66%
	24	Touching head (hat)	12.5%	66.66%

The information in Table 4.1 suggests that some gestures were more likely to be remembered than others, although the differences in participants' recall and recognition varied by gesture. The 'beard' (touching chin) gesture was the gesture least recalled by participants but was also the most recognised. In contrast, the 'glasses' gesture was well recalled by participants, but also the least recognised.

A 2x2 chi-square considered an association between participants' ability to freely recall the gesture (recalled / not) and ability to recognise it afterwards (recognised / not). The large majority (87.1%) of participants that recalled a gesture were able to recognise it. In comparison, 59.3% of participants that could not recall a gesture were able to recognise it. An association between gesture recall and recognition was found to be significant,  $\chi^2 (1) = 8.297$ ,  $p=.004$ .

A further chi-square examined an association between participants feeling misled by the questioner and giving the answer conveyed in his gesture. A total of 76.9% of the participants that had reported feeling misled had responded with the conveyed answer, whereas just 45.5% that had not reported being misled gave the conveyed answer. Thus, an association between reporting being misled and being misled was found,  $\chi^2 (1) = 5.035$ ,  $p=.025$ .



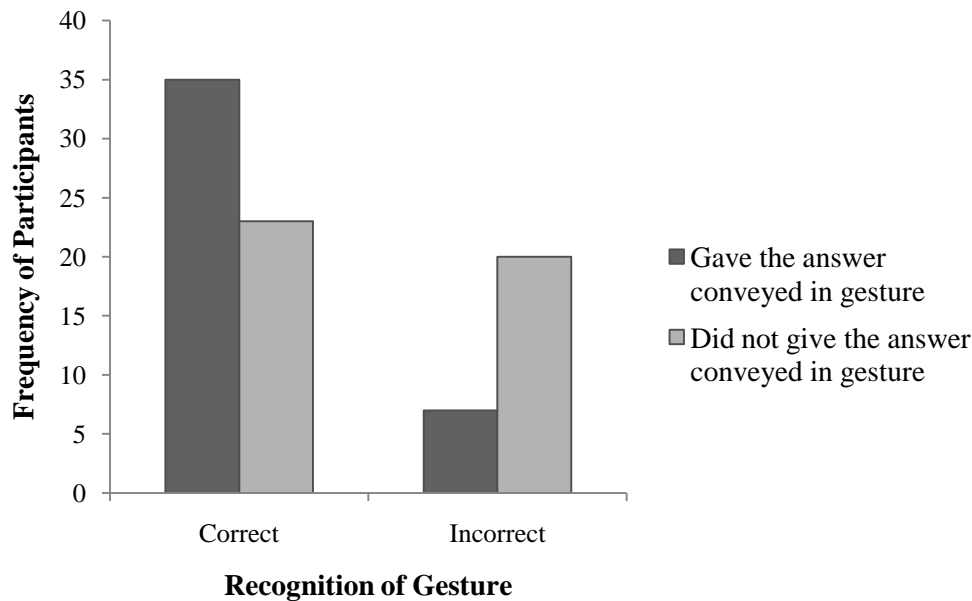
*Relationship between Response and Gesture Recognition*

The next analyses consider whether participants that correctly recognised the gesture were more likely to have given the answer conveyed in the gesture. Participants responses were grouped by whether the answer they gave was concurrent with the information conveyed to them in the questioner's gesture (i.e. if a participant saw the 'ring' gesture and then gave the 'ring' response) or not. All "don't know" responses were removed from the analysis, although other responses from the answer set (i.e. chain, earring) were included in the analysis as responses not conveyed in gesture.

Table 4.2: Breakdown of participants' answers according to accuracy of gesture recognition

<b>Question</b>	<b>Accuracy of gesture recognition</b>	<b>Gave the answer conveyed by gesture</b>	<b>Did not give answer conveyed by gesture</b>
Jewellery (N=36)	Correct	12	11
	Incorrect	4	9
Features (N=25)	Correct	14	4
	Incorrect	1	6
Clothing (N=24)	Correct	9	8
	Incorrect	2	5

For each individual question, participants that correctly recognised the gesture afterwards were more likely to have given the answer that was conveyed to them through the questioner's gesture. Results for all three critical questions were collapsed into an overall data set.

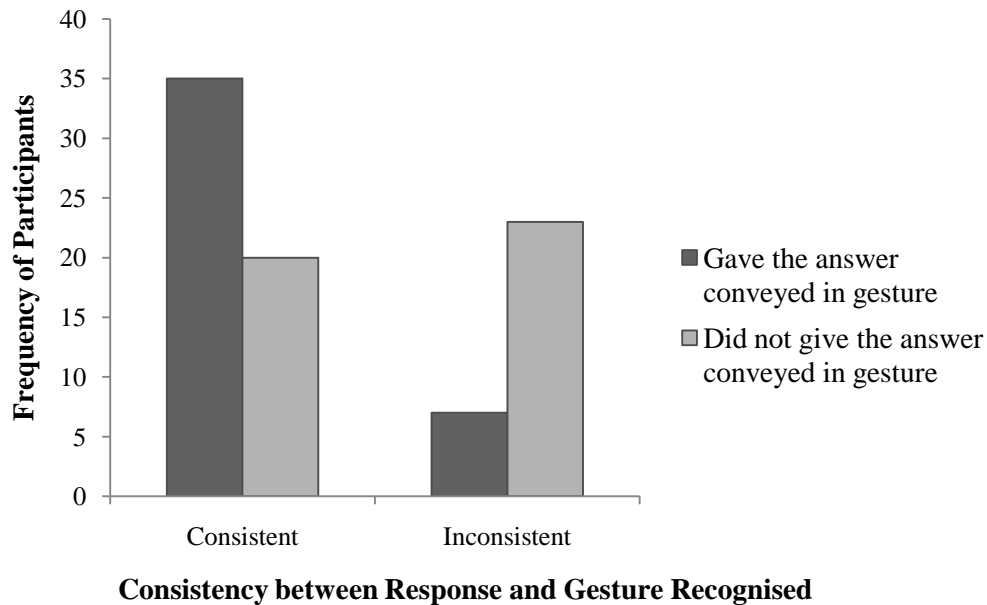


*Figure 4.3: Number of participants that gave the answer conveyed by gesture, grouped by accuracy of gesture recognition*

Participants that were able to recognise the correct gesture were more likely to have given the answer that was conveyed to them through this gesture. There was little difference in gesture recognition accuracy for those that did not give the conveyed answer. A relatively small number of participants that gave the answer conveyed in gesture were unable to recognise this gesture afterwards. The results of a chi-square test confirmed that these results differed significantly from chance,  $\chi^2 (1) = 8.731, p=.003$ .

#### *Consistency between Response and Gesture Recognition*

The final analysis considers the consistency between the participant's response and the gesture they recognised. The majority (64.71%) of participants were consistent between their response and recognised gesture (i.e. they gave a 'ring' response, and identified the ring in the recognition task). Figure 4.4 rearranges the above data in terms of response consistency.



*Figure 4.4: Number of participants that gave the answer conveyed by gesture, grouped by the consistency between their responses*

Participants that gave the answer conveyed in gesture but failed to recognise the gesture afterwards are shown here as being inconsistent between their responses. Participants that were consistent between their responses were more likely to have given the answer conveyed in gesture, whereas those that were inconsistent were not. A chi-square test revealed an association between the answer given by participants and the consistency between their responses,  $\chi^2(1) = 12.614, p < .001$ .

#### *Summary of Results*

- Participants' responses tended to concur with the information conveyed to them through the questioner's gesture. This was true for the 'ring' and 'watch' gesture, the 'beard' gesture and the 'hat' gesture (with the 'glasses' and 'gloves' gestures having comparatively little effect)
- Participants that reported feeling misled by the questioner were more likely to have given an answer that was conveyed through one of his gestures
- Participants that recognised the correct gesture were more likely to have given the answer that was conveyed to them through this gesture. Similarly,

participants that were consistent between their response and the gesture they recognised were more likely to have given the response conveyed to them through gesture (see figure 4.5)

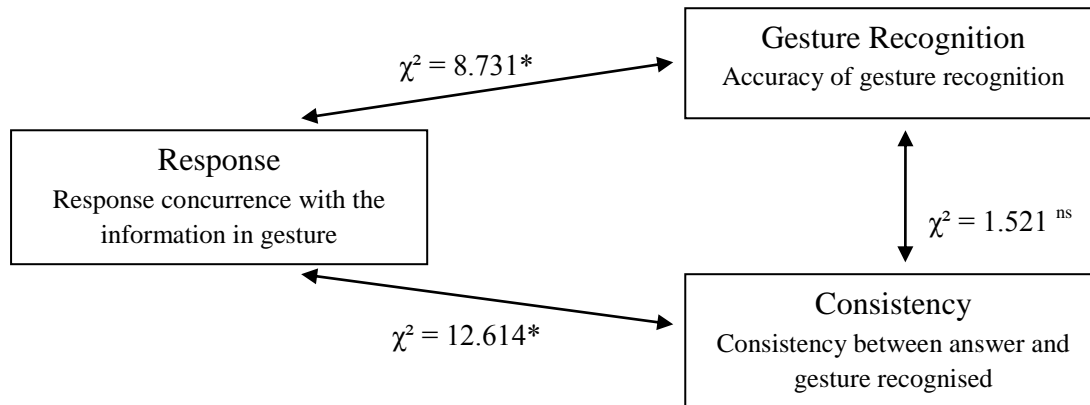


Figure 4.5: Summary of associations between variables in experiment 1

(\* significant at  $p < .005$ )

- In summary, if a participant had recognised the gesture that was presented to them, and gave a response that was consistent with this recognition, the response appeared to be given as a consequence of seeing the 'police' questioner's gesture.

## Discussion

This experiment provided further support for the idea that gestures are able to skew eyewitnesses' memory: Many participants gave responses that were conveyed to them through the questioner's gestures. In addition, the study assessed indicators for whether participant's responses were given as a consequence of seeing misleading gestures. The experiment found support for an association between response and the participant's self reports, and an association between response and gesture recognition. The implications of these results are discussed below.

The type of gestures used in this study concur with the '*additive hypothesis*' suggested by Kelly, et al. (1999), i.e. the gestures conveyed information to listeners independent of speech. Previous studies claim that gestures merely accompany speech (McNeill, 1992; Thompson, 1995) and that gestural information is largely redundant when presented without speech (Krauss, et al., 1991). However, this study confirmed that gestures conveying information independent of speech are particularly effective at communicating the presence of physical objects to listeners. This finding is in line with the view that predominantly semantic gestures are more meaningful to listeners (Craik, 1979).

To give further support to the theory that gestures can skew the responses of participants, two separate gestures were able to manipulate responses independently under the same conditions: Participants that saw a misleading gesture of a ring gave more "ring" responses, while those that saw a misleading "watch" gesture gave more "watch" responses. While some of the gestures remained a popular answer across all conditions (i.e. 'beard' and 'gloves'), the responses in general reflected the misleading information that was conveyed to them in the gesture. Interestingly, some participants even gave a combination of answers that would have been impossible; i.e. some claimed that they seen the man wearing a ring, but also stated that he was wearing gloves! Thus, in summary, this study provides strong evidence that gestures can skew the memory of eyewitnesses and manipulate their responses.

Participants in general were accurate at identifying the gestures afterwards, though this recognition accuracy appeared to differ by gesture. In particular, the 'glasses' gesture was recognised considerably less often than the others. One explanation for this could be that the 'glasses' gesture (touching the nose bridge) may have been considered by participants to be a self-adaptor gesture with little (or no) communicative value (i.e. they may have thought the questioner was scratching his nose). The results so far seem to suggest that in order for a gesture to be effective, it needs to convey clear semantic information that is comprehensible outside of speech. The fact that the 'glasses' response was by far the least frequent response given by participants may serve as further support that gestures are required to carry specific semantic information in order to convey meaningful information to listeners (Craik, 1979). In contrast, the gestures most recognised ('beard', 'ring' and 'watch') were also the most frequent responses given for their respective conditions. Therefore, one explanation could be that participant's ability to remember gestural information is dependent on them successfully conveying meaning to listeners. The results confirming an association between gesture recognition and response may serve as support for this.

The main question this study sought to answer was whether the participants self-reports were an accurate indicator of whether their responses were given as a consequence of seeing a misleading gesture. The results of this experiment found some support for this: Simply asking participants whether they felt misled by the questioner served as a useful indicator of whether they had given a gestured response. A large number of participants claimed, correctly, they had been misled on at least one question, with some specifying correctly which question in particular. It is worth noting also that participants were asked if they felt misled before they were given any indication that the questioner's gestures were misleading.

The study also intended to give an insight into whether participants were aware that the gestures presented to them were misleading. This was assessed by observing how well participants could recognise the gestures, and how this recognition was associated with the responses they gave. Only a small number of participants that gave the target (gestured) response were unable to recognise it afterwards, whilst the majority could. This may present evidence that participants, when invited to recognise gestures afterwards, were able to identify that this gesture had conveyed information to them. That is, participants appeared to be able to 'pick out' that this information was conveyed to them in gesture, and differentiate between this information and the information presented to them in speech. This finding may be in conflict with the view that speech and gestures are integrated in a listeners representation (Kendon, 2004; McNeill, 1992). However, it is important to consider that such gestures differ from the majority of speech-accompanying gestures in that they convey exclusive semantic information (Kendon, 1980), obeying the 'additive contribution' hypothesis (Kelly, et al., 1999) rather than assisting speech (Beattie & Shovelton, 1999a; Goldin-Meadow, et al., 1993; Langton, et al., 1996). Another consideration is that these results may take this theory a stage further. The experiment confirmed that speech and gesture can be integrated but, unlike other studies to date, showed also that they could be separated afterwards. Under these conditions, the results of experiment 1 seem to favour the view that participants are aware of the gestures misleading potential and can identify them as conveying misleading information. However, the fact that participants were explicitly invited to recognise the gestures (in order to trigger a memory of them), rather than remember them independently, makes this conclusion difficult to draw.

In summary, this study confirmed that gestures can convey meaningful semantic information to listeners. The results of the Krauss, et al. (1991) study, which found that gestures are only more likely to be identified when occurring alongside speech, led the authors to conclude that

gestures are largely redundant in communicating information in the absence of speech. For most spontaneous conversational gestures, this may well be the case, as the function of gesture is often to support and build on information in speech (Goldin-Meadow, 1993; Langton, et al., 1996). However, this study provided further evidence that some gestures (that are predominantly semantic) are a powerful communicative tool and can communicate information in the absence of speech (Craik, 1979; Kelly, et al., 1999; Kendon, 1980). Additionally, this study found that participants were able to identify gestures that conveyed information to them, pointing to the suggestion that they occurred within their awareness. However, the fact that they were invited by the experimenter to do so throws doubt on the conclusion that they were able to do this without prompting.

## Experiment 2

Experiment 1 provided an insight into whether participants had observed and processed the gesture presented to them subtly, or whether the gesture had entered the awareness. Although it is difficult to draw firm conclusions at this stage, the results tend to suggest that, while gestures may influence participants subtly, participants can be made aware of their misleading potential retrospectively by inviting them to recall and recognise them afterwards. Experiment 2 now turns its attention to those working in a legal profession, and investigates whether lawyers perform similarly under the same conditions and if they are just as susceptible to misleading gestures as students.

Research has shown that naive witnesses are prone to suggestions from police authorities if they perceive them to have greater expertise (Smith & Ellsworth, 1987). Eyewitnesses may 'go along' with the suggestions of a police questioner as they have a "*tacit expectation that what the questioner is saying is true*" (Semin & Poot, 1997, p. 473). As early research confirms, people can be influenced by authority figures (French & Raven, 1959) and such authority facilitates obedience (Milgram, 1974). However, a greater knowledge of law and greater authority in a legal profession could 'bridge the gap' of authority and decrease the likeliness of accepting misleading information from a police questioner. Research has revealed a difference in the knowledge of witnesses' suggestibility between experts and jury-eligible undergraduates (McAuliff & Kovera, 2007) and between legal professionals (Benton, et al., 2006).

Studying whether lawyers could be misled as students has numerous advantages. Firstly, it investigates how transferable the findings of experiment 1 are to a wider, very relevant demographic. It also investigates whether a greater knowledge of law and the study of legal practice make lawyers less susceptible to the questioners misleading gestures. If so, and if lawyers are aware of the misleading gestures, one would expect their ability to be misled would be compromised. I.e. if participants give their responses to 'go along' with, or please the police questioner, one would expect that lawyers to be less inclined to do so. However, if gestures do mislead outside of awareness, then there would be little difference expected between the performance of students and lawyers.

Experiment 2 followed the same format as experiment 1, though this time tested the performance of lawyers against the students tested in experiment 1. The results of experiment 1 confirmed that the gestures used were a reliable measure of misleading gestures, as many were able to skew the responses of participants. In the following experiment, the most effective gestures for each question were selected ('beard', 'watch' and 'gloves'). The responses given by lawyers were compared to students, as well as their recall and recognition of the gestures, and associations between the two,

## Method

### *Design*

This experiment employed a between subjects design which compared the performance of two independent groups of participants; psychology students and lawyers. All participants saw one set of misleading gesture videos. As in experiment 1, the dependent variables measured the participants' responses, whether they felt influenced by the questioner, and which of his gestures they could recall and recognise afterwards.

### *Participants*

The experiment used two sets of participants. The data for the psychology undergraduates ( $N = 24$ ) were taken from the previous experiment, who had a mean age of 31.29 ( $SD = 18.93$ ). The lawyers ( $N = 33$ ) ranged from trainees to those over 6 years qualified and were recruited from one of two law firms in the city of London. The sample consisted of both males (36.4%)



and females (63.6%) with a mean age of 28.15 ( $SD = 5.21$ ). In addition, the sample had already taken part in a seminar regarding nonverbal communication as part of their training as lawyers. All took part voluntarily, but trainees were awarded points (a requirement for completing their course) for taking part.

### *Materials & Apparatus*

The same materials used in experiment 1 were used here, including both the stimulus and 'police' questioning videos. The gestures considered most effective in experiment 1; "beard", "watch" and "gloves", formed the three gestures used in the 'distinguishing features', 'jewellery' and 'other clothing' questions respectively. As in experiment 1, an answer booklet with answer sets (Appendix D) and a debrief recognition questionnaire (Appendix E) was also provided.

### *Procedure*

Participants took part in small groups and were instructed not to make conversation with each other during the experiment. The videos were presented via a large projected screen and participants marked their answers to the questions in the answer booklets, signalling when they were ready to progress to the next. Upon completion, participants were given the recognition questionnaire shortly before being debriefed on the purposes of the experiment.

## **Results**

The results for this experiment considered the responses given by lawyers to the 'police' questioners questions. Again, the participants stated which of the gestures they could recall afterwards and identified which gestures they recognised in the following questionnaire. A further self report measure asked whether they felt misled by the questioner at any point during the experiment.

## Responses

The initial results focus on the responses given by lawyers in comparison to the responses given by participants in experiment 1. For each question, the lawyers were compared to the students (who were considered as a control group) that received the respective misleading gesture. Figure 4.6 compares the proportion of responses given by lawyers and students for the three questions.

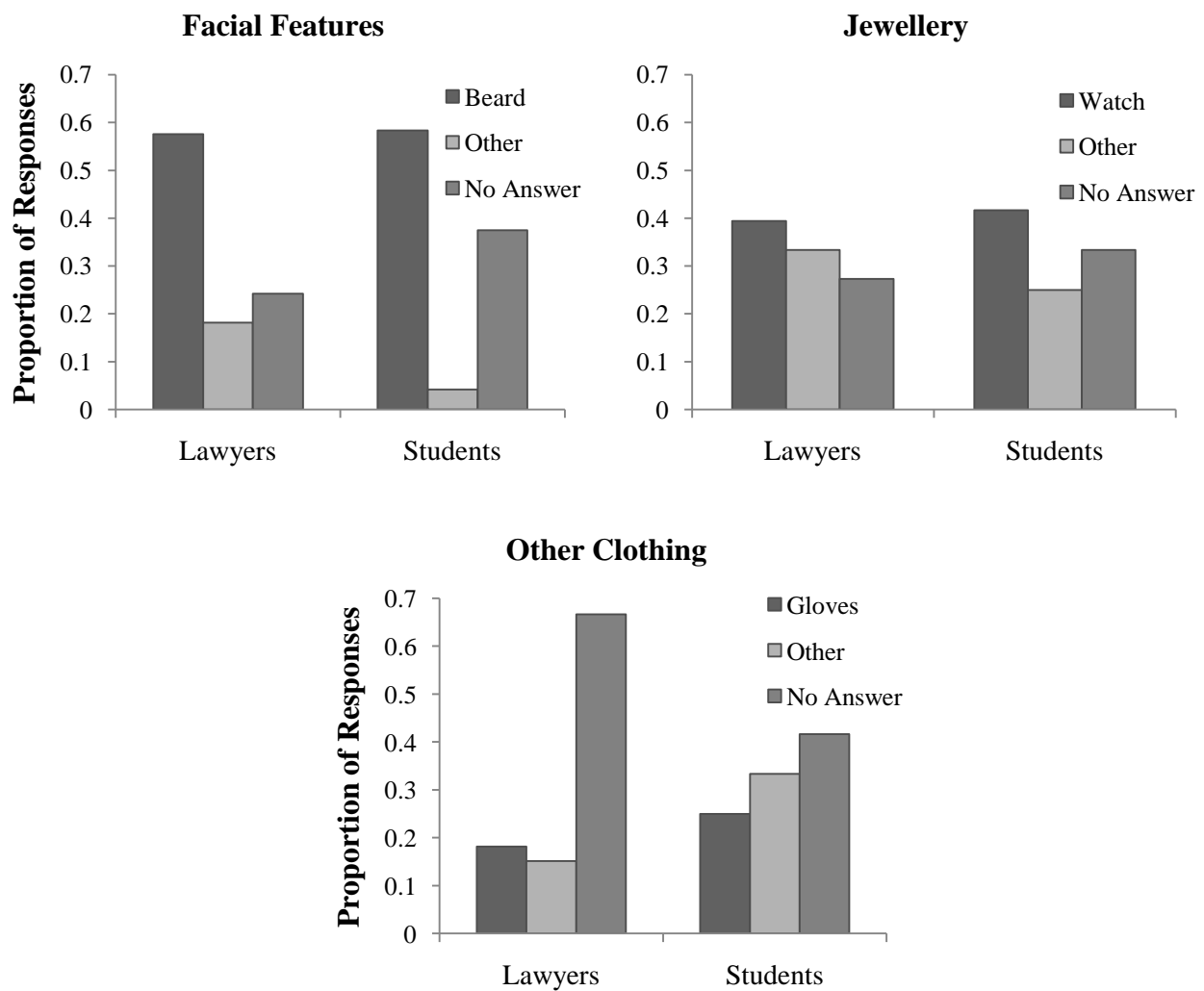


Figure 4.6: Proportion of responses for the “jewellery”, “facial features” and “other clothing” questions by group

For all questions, lawyers gave the target response when presented with a gesture that conveyed that information. As in experiment 1, the beard gesture resulted in a high number

(57.6%) of "beard" responses and, like the "watch" gesture for the 'jewellery' question, was the most popular response for that question. Some lawyers also gave the "gloves" response for the 'other clothing' question, though this gesture did not seem as effective at skewing responses. When comparing the two groups, there appeared to be little difference between the responses of lawyers and students, with the lawyers appearing to be just as likely to give the target responses conveyed by gesture as the students. Thus, the responses did not tend to differ according to the group of participants (lawyers or students).

The data for the three questions were then collapsed into one set of data to improve statistical reliability. A 2x3 chi-square, testing an association between group (lawyer / student) and response (gave target response / other response / no response) confirmed that the responses between the groups was very similar, and did not differ significantly,  $\chi^2 (2, N = 171) = .198$ ,  $p = .910$ .

A Mann-Whitney U test was also performed on this data, where the number of 'target' responses given (ranging from 0 to 3) was compared between lawyers and students. The test revealed no significant difference between the two;  $U = 365.0$ ,  $n_1 = 33$ ,  $n_2 = 24$ ,  $p = .594$ . Thus, lawyers and students appeared to subscribe to equal amounts of information conveyed to them in gesture.

### *Recall and Recognition*

The ability to recall and recognise the gestures afterwards was considered in the debrief questionnaire. As in experiment 1, participants were invited to freely recall any of the gestures they could remember seeing before being asked to identify which they recognised from photographic screenshots afterwards. Table 4.3 summarises this data for individual gestures.

Table 4.3: Proportions of gestures recalled and recognised by lawyers and students

Gesture	Lawyers		Students	
	% Recalled	% Recognised	% Recalled	% Recognised
Beard	6.1%	54.5%	8.3%	87.5%
Watch	18.2%	39.4%	25.0%	70.8%
Gloves	60.6%	72.7%	16.7%	66.7%

All gestures were recognised more than they were recalled. The proportion of gestures recalled remained consistent across the two groups, though considerably more lawyers recalled the "gloves" gesture than students. Similarly, these gestures were recognised more by lawyers, but students able to recognise considerably more of the "beard" and "watch" gestures.

The data for the three individual gestures were collapsed into one gesture group. A 2x2 chi-square considered an association between group (lawyer / student) and gesture recall (recalled gesture / did not), but not did find a significant association between the two;  $\chi^2 (1, N = 171) = 3.139, p=.076$ . Another 2x2 chi-square considering the difference of gesture recognition between groups however, retrieved a significant result;  $\chi^2 (1, N = 171) = 6.819, p=.009$ . Therefore, while lawyers appeared to have better gesture recall (but not significantly so), the students were able to recognised the gestures significantly more.

#### *Relationship between Response and Gesture Recognition*

The next analyses consider how the self-report measures given by participants interacted with the responses they gave.

A total of 62.5% of lawyers claimed to have felt misled during the experiment, compared to 56.5% of students in the respective condition. Of the lawyers that claimed to feel misled, 75% had given an answer that was conveyed to them in the gesture (target response), compared to 76.9% of students. A 2x2 chi square tested an association of response by group for those that claimed to be misled, but found no significant difference;  $\chi^2 (1, N = 33) = .016, p=.900$ .

For the next analysis, associations between participants' responses and their gesture recognition were considered for both lawyers and students. For this analysis, data from the three gestures were considered as individual observations. The data were analysed according to whether participants had recognised the gesture (recognised / did not) and whether the response they gave was the target response (target / other response). All "don't know" responses were removed from the analysis, leaving a total of 105 observations (N = 60 lawyers, N = 45 students). Figure 4.7 shows the comparisons of response and gesture recognition by group.

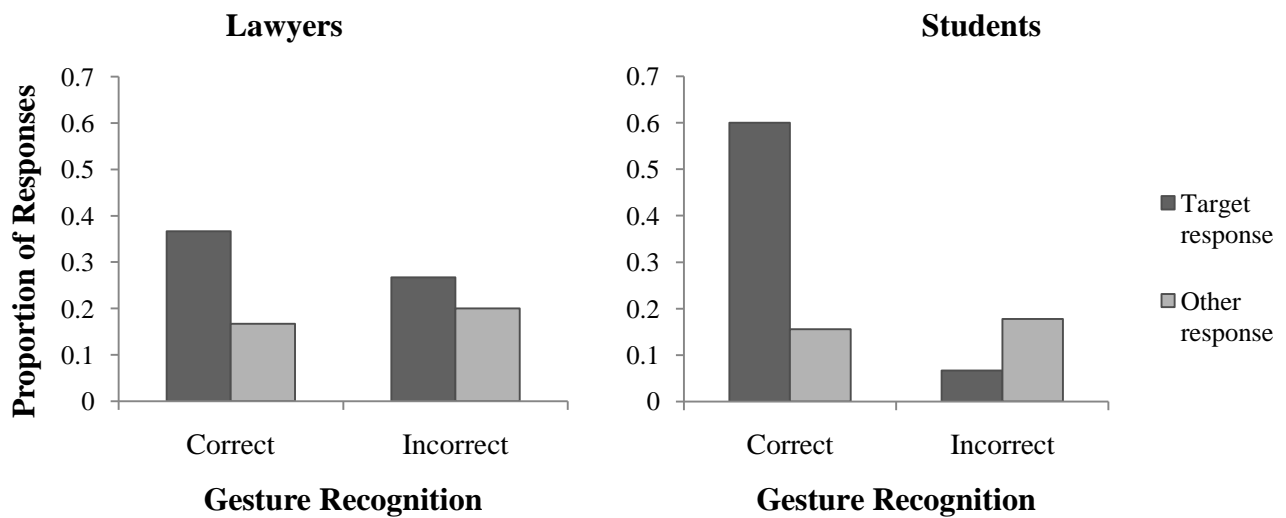


Figure 4.7: Associations between response and gesture recognition by group

In total, 53.3% lawyers that gave the target response to the question went on to recognise the 'police' questioner's gesture that conveyed that information afterwards. Comparatively, 75.6% of students that gave a target response recognised the gesture. For the lawyers, the type of response given (either a target or other response) did not appear to vary by their gesture recognition; 68.8% of those that recognised that gesture had given the target response compared to 57.1% that did not recognise the gesture. A 2x2 chi-square testing an association between response (target / other) and gesture recognition (correct / incorrect) did not retrieve a significant effect for lawyers;  $\chi^2 (1, N = 60) = .87, p=.352$ .

Comparatively, and in accordance with the results in experiment 1, student's responses did appear to differ according to their gesture recognition afterwards; 79.4% of those that

recognised the gesture had given the target response compared to 27.3% that did not identify the gesture afterwards. A chi-square confirmed an association for students;  $\chi^2 (1, N = 45) = 10.17, p=.001$ .

Finally, a loglinear analysis was conducted to test whether these associations differed by group. A final model, retaining all three variables (group, response, recognition) was just short of significance,  $\chi^2 (1, N = 105) = 3.82, p=.051$ . Therefore, while associations between gesture response and recognition appeared to differ between lawyers and students, this difference was not found to be significant.

### *Summary of Results*

- Lawyers gave responses that were conveyed to them through the 'police' questioner's gestures, with the 'beard' and 'watch' gestures prompting the most target responses. These responses were similar to those given by the students tested in experiment 1
- While lawyers, on average, were able to recall more gestures than students, the difference between them was not significant. However, students were significantly more likely to recognise the gestures than the lawyers
- Students that recognised the gesture correctly were more likely to have given the response conveyed to them through that gesture. This was also true of the lawyers though, unlike the students, those that did not recognise the gesture were also more likely to have given the target response.

## Discussion

The results of experiment 2 showed that the questioner's misleading gestures were able to skew the responses of lawyers as well as students. Thus, lawyers appeared to be just as susceptible to the misleading gestures as the students in experiment 1. Not only this, but the lawyers were not able to recognise as many gestures afterwards. These findings suggest that misleading gestures can influence people of a wider demographic group, including those educated in the legal profession.

Initially, the fact that lawyers were able to be misled under questioning may seem surprising given their expertise in law and understanding of legal proceedings. These results point to the suggestion that the influence of gestures may occur outside of the participant's awareness: If participants were aware that information was being suggested to them through gesture, they would perhaps be less inclined to give the responses conveyed by them. Lawyers, like students, were able to recall and recognise a variety of the gestures afterwards and, although not significant, lawyers were able to recall more gestures than students. The "gloves" gesture, possibly the most 'noticeable' of the gestures, was recalled considerably more by lawyers and subsequently was the response given least frequently, and less often than students. This may suggest that an awareness of this gesture, and an intention of conveying misleading information, prevented it from manipulating the response.

While lawyers responses and gesture recognition were similar to those of students, associations between these two variables appeared to differ (though not significantly) for the two groups. While the study confirmed an association between gesture recognition and response for students, lawyers that gave the target responses conveyed by gesture were less likely to be able to identify this gesture afterwards. This does not impair the argument that a gesture can influence subtly but, rather, suggests that gesture recognition is not necessarily a reliable indicator for when it has. While students could identify retrospectively a gesture that conveyed the information they gave for their response, lawyers were less able to do so. This failure to identify a gesture that conveyed information to them provides further support that gestures influence outside of their awareness.

The results of experiment 1 and 2 go some way to explaining whether witnesses are aware that they are being fed misleading information through gesture. Above all, the studies confirm that gestures can convey a message that is integrated with speech (Cassell, et al., 1999; Goldin-Meadow, 1998; Kelly, et al., 1999; McNeill, et al., 1994). While the two experiments together make inferences that gesture influence occurs outside of the participant's awareness, a more objective measure is needed to determine whether or not misleading gestures are attended to and whether this interacts with their likeliness of conveying information.

### Experiment 3

To what extent are gestures attended to? It is widely accepted that gestures play an important role in communication and are comprehended together with speech (Clark, 1996; Kendon, 2004; McNeill, 1992). The simultaneous comprehension of speech and gesture thus requires a 'cross-modal processing' of audio and visual information, with the visuospatial encoding of gesture and verbal processing of speech both requiring attentional resources (Kahneman, 1973; Thompson, et al., 2004). Although not much is understood about the amount of attention afforded to gesture in conversation (Goodwin, 1986; Kendon, 1990; Streeck & Knapp, 1992) research in this area has provided an insight into how gestural information is processed.

During conversation, much attention is directed to the face of the speaker (Bavelas, Coates, & Johnson, 2002; Fehr & Exline, 1987). Attending to the face has both practical and social implications; facilitating the comprehension of detailed linguistic phonetic information from the mouth (Thompson, et al., 2004), signalling interest and engagement (Argyle & Cook, 1976) and providing a 'biologically inherent' focal point (Farah, 2000). With much attention placed on the face, gestures can be thought of as 'background elements' to the scene (Henderson & Hollingworth, 1999) or as 'visual noise' (Gullberg & Holmqvist, 2006). This observation is in line with research stating that gestures do not serve as a primary function in communication but are performed to add clarification to speech (Langton, et al., 1996; McNeill, 1992). Research using eye-trackers confirms that gestures are rarely fixated by interlocutors in conversation, with fixations occurring on roughly 9% of all gestures (Gullberg & Holmqvist, 1999, 2006).

Gesture fixation could be affected by a number of factors, including the location of the gestures performance. McNeill (1992) describes how gesture space can be separated into two areas; namely, the 'central space' (bounded by the shoulders, elbows and waist of the speaker) and the 'peripheral space' (everything outside this area). Whilst gestures performed within the central space are visible to the interlocutor during eye contact, gestures performed in the peripheral area require a fixation to be processed. Consequently, peripherally-performed gestures attract more fixations than those performed within central space (Gullberg & Holmqvist, 1999; Nobe, Hayamizu, Hasegawa, & Takahashi, 1998). However, fixation on a gesture can also be determined by the speaker's behaviour. The speaker can encourage the addressee to attend to their hands through deictic expressions, such as "*he held it like this*"



(Nobe, et al., 1998; Streeck & Knapp, 1992) and also by using their own gaze to fixate on the gesture themselves (Goodwin, 1986; Streeck & Knapp, 1992) Addressees often conform to this speaker-fixation in order to avoid being socially inept (Gullberg & Holmqvist, 2006), and shifting gaze between the speaker's gesture and face can indicate that interlocutors are processing the gestural information presented to them (Goodwin, 1981; Streeck, 1993).

The extent to which attention to gesture can be measured though is unclear, and is confused further by an addressee's ability to fixate but not attend ("looking without seeing") and attend but not fixate ("seeing without looking"). Two theories provide an explanation as to how gestures can be processed: Bottom up, stimulus driven, theory posits that attention to gesture is an instinctive, automatic reflex to the hand movement that is not indicative of a higher cognitive function. In contrast, top-down, social driven, theory suggests that attention to gesture is the consequence of an intuitive understanding behind the goals of observing the gesture. The process through which gestures are attended to can be determined by the location and type of gesture performed. It has been thought that gestures occurring in the peripheral space are more likely to draw fixations of a mechanical, bottom-up selection of attention (Hoffman, 1998; Wolfe, 1998). In contrast, speaker-fixated gestures are thought to be more social in nature and that attention to these gestures is not automatic, but a socially mediated process (Gullberg & Kita, 2009).

It may appear then that information uptake from gesture could be reflective of the processing through which the fixation occurs. Gullberg & Kita (2009) however found no evidence of information uptake being associated with gesture fixation and claim that, even with overt visual attention, it cannot be assumed that the gesture is being processed for information. In contrary, previous research by Nobe, Hayamizu, Hasegawa & Takahashi (2000) found that all participants that fixated on gestures of an anthropomorphic agent were able to comprehend and reproduce all of them afterwards (although it is worth noting that the authors observed a considerably higher rate of 70-75% gesture fixation compared to other studies).

Many gesture studies place focus on spontaneous, conversational gestures that provide the listener with additional information to the verbal narrative, though little attention has been paid to situations when the gesture is the only source of semantic information (Kendon, 1980). If gesture material is completely novel and contains information that is absent from speech, it could be reasoned that different attentional demands would be placed on the listener in order for them to comprehend the information. This situation, where only the

gesture contains critical information, means that such information can only be learnt through processing of the gesture and, subsequently, may alter the fixation behaviour of the interlocutor and their ability to process the information contained within it.

The following experiment investigates whether such gestures are more likely to draw gaze and attention, and whether the fixation of these gestures is a prerequisite for information uptake. Participants were shown the same stimulus and questioning videos as in experiment 1: A 'police' interviewer asked questions to participants on-screen about the presence of certain details (i.e. jewellery) in the scene, performing gestures containing more specific, subordinate information (a watch). Eye-tracking apparatus was used to measure participant's fixation on the questioner throughout his questioning, and provided a measure of whether or not the participant had fixated on the gesture during its performance.

Information uptake has been measured in previous studies by simply asking participants to report what gestures they could remember seeing (1980; Nobe, et al., 2000) and by asking participants to depict what information they can remember from a story by illustrating it in a drawing (Gullberg & Kita, 2009). In this study, as well as measuring the response participants gave to the questioner (i.e. whether they gave an answer that was consistent with the information conveyed in gesture), participants also reported which gestures they could remember seeing. As before, participants were asked to freely recall which gestures they remembered the interviewer performing and then identified the gestures on a following recognition task. In addition, this experiment reintroduced the variable of confidence to ascertain how confidence in a response interacted with a participant's attention to the gesture.

The following experiment addresses the question of whether these critical gestures are attended to and whether fixation on these gestures is necessary to glean information from them. Moreover, the introduction of the gesture attention measure may add to understanding of whether misleading gestures can skew the responses of participants outside of their awareness. Measuring participant's ability to recall and recognise the gesture afterwards provides further insight into a link between the memory of the gesture and the attention placed on it. Most importantly, this would provide a greater understanding into how misleading gestures are processed by participants and able to influence their responses.

## Method

### *Design*

As in experiment 1, the study used three gesture conditions: A between subjects design split participants into the two experimental gesture groups and an additional control group (no gesture). The dependent variables in this study again considered the responses given by participants as well as the confidence they attributed to each response. Further measures considered whether participants felt influenced during the experiment, which gestures they could recall and recognise, and whether they attended to the gesture as it was being performed (as coded from the eye-tracking output).

### *Participants*

A sample of 37 adults (19 male, 18 female) were recruited opportunistically with a mean age of 26.76 ( $SD = 14.78$ ). No exclusion criterion was used, although participants who wore glasses for corrected vision were advised not to participate due to confounding the eye-tracking apparatus.

### *Materials & Apparatus*

The same stimulus video was used as in the previous two experiments. The eye-tracking equipment consisted of three parts: A pair of glasses fitted with a camera facing ahead (to record what the participant saw) and a camera pointing at the pupil (to track eye movement). The glasses were connected to a Sony DV video recorder which, in turn, was connected to a laptop loaded with the eye tracking software.

The software enabled calibrations of the eye movement and provided the experiment with an exported digital video file. This file was a recording of everything the participant saw during the experiment with a red marker overlay to show where the eye was focused (see figure 4.8).



Figure 4.8: A screenshot from the exported eye-tracking video

### *Coding*

The exported videos were loaded onto the Noldus Observer XT v8.0 software to be analysed. If the marker hovered over the hands of the 'police' questioner at any point while the gesture was performed, this was coded as an observation of the gesture. In accordance with the criteria set by previous eye-tracking gesture experiments, the marker was required to remain static on the gesture for a minimum of 120 ms (3 video frames) to qualify as a fixation (Gullberg & Kita, 2009; Melcher & Kowler, 2001). Two observers coded the responses as either 'attended to' or 'not' following this criterion. The observers coded the data independently and were found to agree on 84.34% of the data. The remaining data were resolved through discussion.

### *Procedure*

The eye tracking apparatus was fitted to the participant prior to the experiment. After a calibration test to check the equipment was working correctly, the participants were shown the stimulus CCTV footage and were instructed to watch it carefully. The participants then completed the distracter task and watched the same questioning videos as used in experiment 1 in the same order (see Appendix C). Participants were informed that the eye-tracking

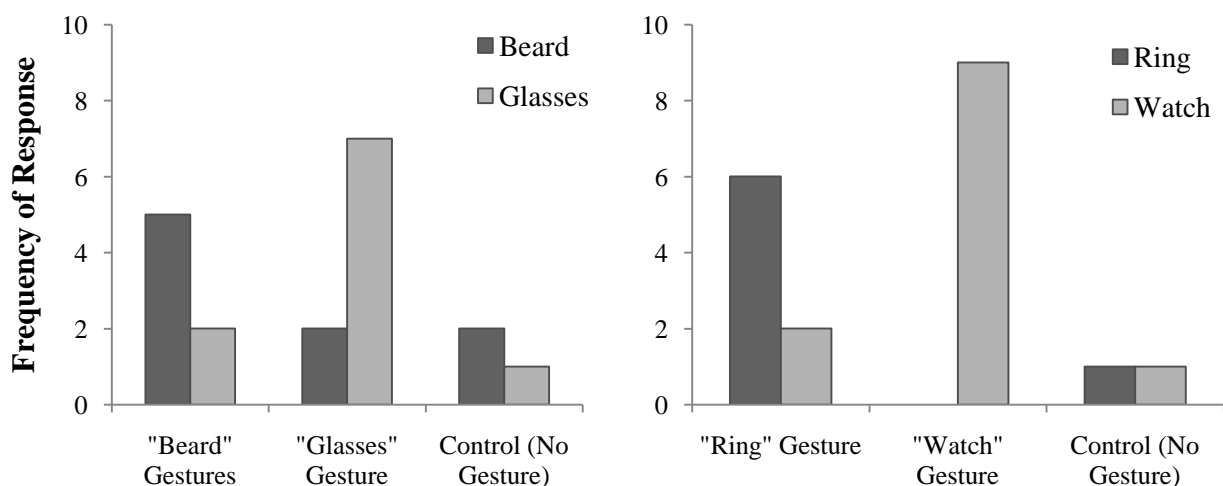
equipment would remain on until the end of the experiment. Participants in the control group followed the same procedure, but without the eye-tracking equipment fitted. As in experiments 1 & 2, participants in the experimental conditions were also required to complete the funnel-debrief questionnaire afterwards. The experiment lasted approximately 25 minutes with consent and briefing.

## Results

The study again considered the responses participants gave to the 'police' questioner, as well as the confidence attributed to each response and their ability to recall and recognise the gestures afterwards. In addition, this experiment also considered whether the participants attended to the gesture, and how attention to gesture interacted with their response and their ability to recall or recognise the gesture afterwards.

### *Responses*

Participants chose one response from a given answer set for the "distinguishing features", "jewellery" and "other clothing" questions. Figure 4.9 summarises the frequencies of positive responses given by participants for the three critical questions according to the gesture they saw.



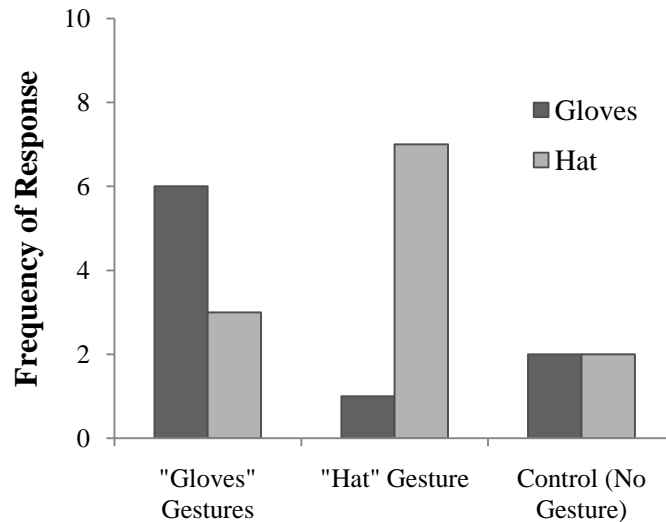


Figure 4.9: Frequency of responses for the "jewellery", "distinguishing features" and "other clothing" questions by condition

Participants were more likely to give a response if it was conveyed to them through the questioner's gesture. A series of chi-square tests compared the participants' response (e.g. 'ring', 'watch', or other) by condition (e.g. "ring" gesture, "watch" gesture, no gesture). Significant differences were found for the 'jewellery' question;  $\chi^2 (4, N = 37) = 27.94, p=.001$ , 'facial features';  $\chi^2 (4, N = 37) = 11.31, p=.023$ , and the 'other clothing' question;  $\chi^2 (4, N = 37) = 10.11, p=.039$ .

To increase statistical reliability, the data for all six gestures were collapsed into one experimental gesture group after being compared against the respective control group for that question. A 2x2 chi-square test compared condition (gesture, no gesture) with response (target response, other response) and retrieved a significant result;  $\chi^2 (1, N = 147) = 27.56, p=.001$ . An additional analysis considered the results of the control group as the expected frequencies. Thus, a 1x2 chi-square analysis tested whether the answer given by participants (target response / other response) different significantly from the expected controls. A significant association was found;  $\chi^2 (1, N = 147) = 221.04, p=.001$ .

A further Mann-Whitney U test was performed on the participants' responses. The data were scored according to how many 'target' responses participants gave (ranging from 0 to 3). The test revealed that those in the first misleading gesture group gave significantly more target responses than controls;  $U = 34.5, n_1 = 13, n_2 = 12, p = .010$ , as did and those in the second misleading gesture group;  $U = 14.0, n_1 = 12, n_2 = 12, p = .001$ .

### *Recall, Recognition & Attention of Gesture*

As before, participants were asked to recall any gestures they remembered seeing and identify these from the photographic stills in the recognition task. In addition, the eye-tracking apparatus provided a measure of whether the participant attended to the gesture or not. While all gestures on the video were thought to appear within the participant's visual field, the eye-tracking equipment enabled the experimenter to differentiate between those that had attended to a gesture (i.e. those whose eyes had fixated on the gesture for a minimum period of 120ms) and those that had not. A total of 84% (N = 21) participants had attended to at least one of the gestures performed by the 'police' questioner. This data is summarised in table 4.4.

*Table 4.4: Summary of gestures recalled, recognised and attended to by participants*

<b>Question</b>	<b>N</b>	<b>Gesture performed by police questioner</b>	<b>% Recalled gesture</b>	<b>% Recognised gesture</b>	<b>% Attended to gesture</b>
Jewellery	13	Pinching finger (ring)	30.77%	38.46%	38.46%
	12	Grasping wrist (watch)	33.33%	58.33%	41.67%
Facial features	13	Touching chin (beard)	7.69%	38.46%	76.92%
	12	Touching nose (glasses)	0.00%	41.67%	41.67%
Other clothing	13	Grasping hands (gloves)	15.38%	46.15%	61.54%
	12	Touching head (hat)	16.67%	33.33%	50.00%

Recall appeared to differ by gesture; the two 'facial features' gestures ('beard' and 'glasses') were least likely to be freely recalled, whilst the 'jewellery' gestures ('ring' and 'watch') were recalled most often. Gesture recognition however appeared to be consistent across all types of gesture but was always higher than gesture recall. There also appeared to be a variation in which gestures were attended to. The gestures that were attended to most often ('beard', 'hat' and 'gloves') were also gestures that involved the most movement from the 'police' questioner. In light of these observations, no pattern between gesture recall, recognition and attention was immediately obvious for the individual gestures.

### *Association between Gesture Recognition, Attention and Response*

The following analysis considers the responses participants gave to the questions, and tests an association between their recognition of the gesture afterwards and whether that had attended to it. Responses were qualified as being either answers conveyed in the questioner's gesture (i.e. if the participant responded with 'ring' after seeing the ring gesture) or answers not conveyed in the gesture (i.e. all other possible responses for the jewellery question). As in experiment 1, all "don't know"/other responses were excluded from the analysis.

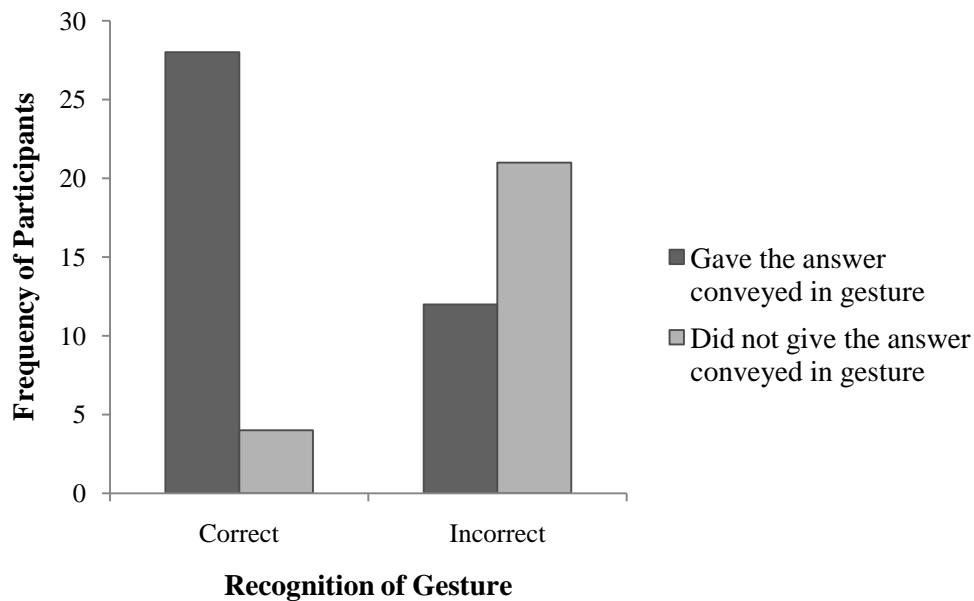


Figure 4.10: Comparison of participant's responses grouped by recognition of the gesture

In line with the results of experiment 1, the majority (70.0%) of participants that gave the answer conveyed in the questioner's gesture were able to recognise it afterwards. Most (84.0%) of the participants who did not give the answer conveyed through the gesture were unable to recognise it. A 2x2 chi-square measuring an association between response (answer conveyed in gesture / not) by gesture recognition (correct / incorrect) yielded a significant result;  $\chi^2 (1, N = 65) = 17.949, p = .001$ .

As in experiment 1, participants that were correct in their identification of the gesture were significantly more likely to have given the answer that was conveyed in it. To consider this further, an association between response and attention to gesture was tested to ascertain what effect attending to the gesture had on a participant's response.



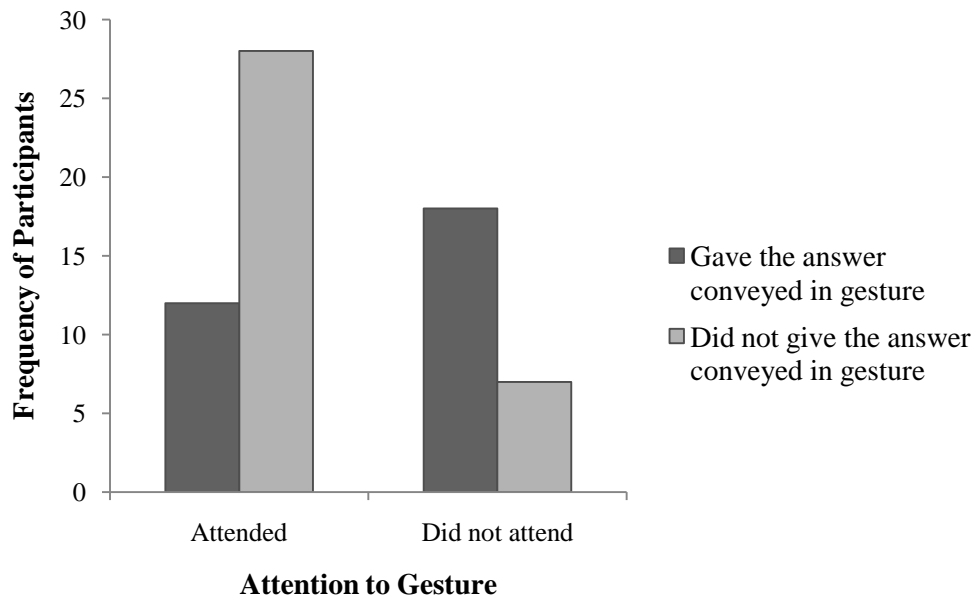
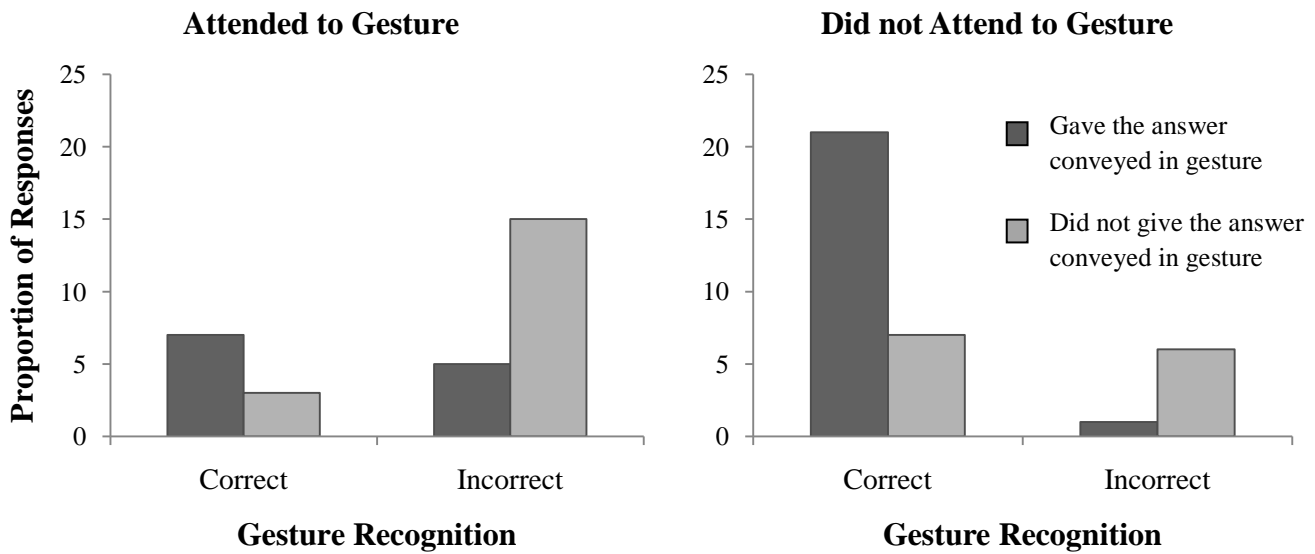


Figure 4.11: Comparison of participants' responses grouped by attention to gesture

Participants that had attended to the gesture were less likely (40.0%) to give the response conveyed by it, whereas those that did not attend to the gesture were more likely (80.0%) to give the conveyed, target response. A 2x2 chi-square revealed a significant association between response and attention to gesture;  $\chi^2 (1, N=65) = 10.920, p=.001$ .

To follow, an association between all three variables (response, recognition and attention) was tested. The data for recognition of gesture and response given were separated according to whether the participant had attended to the gesture or not. The data is displayed in figure 4.12.



*Figure 4.12: Associations between participants' response and gesture recognition grouped by attention to gesture*

The association between response and recognition of gesture differed according to whether participants attended to the gesture or not. A total of 23.3% of the participants that attended to the gesture had given the answer conveyed by it and were able to recognise it afterwards. In comparison, this was the case for 60.0% participants that had not attended to the gesture. Similarly, 50% of participants that attended to the gesture did not give the answer conveyed by it and were unable to recognise it afterwards. Comparatively, this figure dropped to 17.1% for participants that had not attended to the gesture.

A loglinear analysis tested an association between the 3 variables; response, recognition and attention to gesture. The final model did not retain all effects;  $\chi^2 (1, N=65) = .449, p=.503$ . However, separate 2x2 chi-square tests measuring associations between gesture recognition and response were found to be significant for both participants that attended to the gesture;  $\chi^2 (1, N=30) = 5.625, p=.018$ , and those that did not;  $\chi^2 (1, N=35) = 7.742, p=.003$ .

#### *Relationship between Confidence of Response and Gesture Attention & Recognition*

The final analysis considered how the confidence that participants attributed to their answers interacted with their attention to the gesture and their ability to recognise the gesture afterwards. Initially, comparisons were made within the two levels of each group by an

independent samples t-test. Participants that correctly identified the gesture in the recognition task were significantly more confident in their response to the police questioner ( $M = 3.389$ ,  $SD = .871$ ) than those that did not ( $M = 2.205$ ,  $SD = 1.056$ );  $t(73) = 5.271$ ,  $p < .001$ . Participants that attended to the gesture were significantly less confident in their responses ( $M = 2.359$ ,  $SD = 1.063$ ) than those that did not ( $M = 3.22$ ,  $SD = 1.045$ );  $t(73) = -3.541$ ,  $p = .001$ .

The data were then submitted to a two-way between-subjects analysis of variance (ANOVA) with response (gave answer conveyed in gesture / did not) and recognition of gesture (correct, incorrect) as the independent variables.

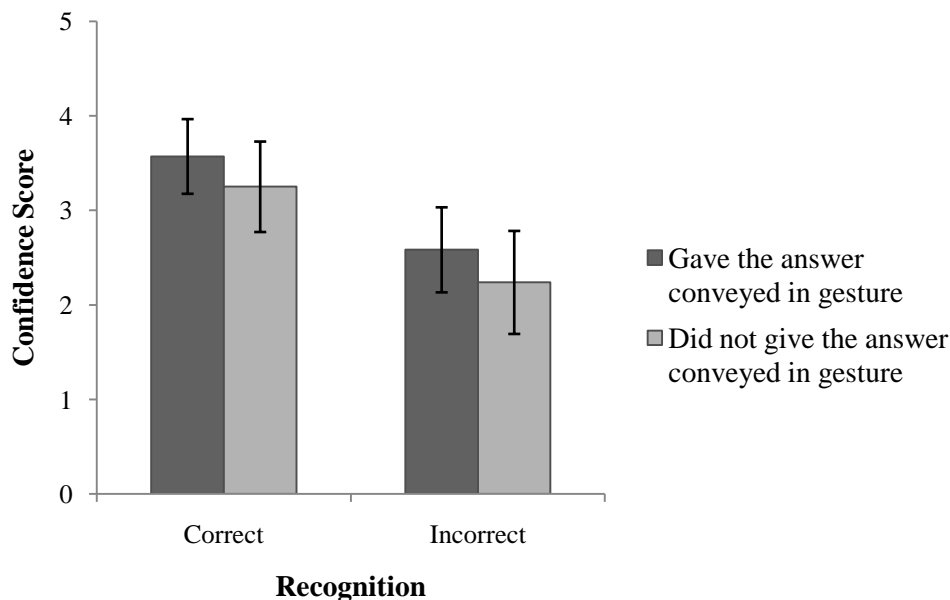


Figure 4.13: Confidence ratings in answers, grouped by response and recognition

Participants that were able to correctly recognise the gesture were more confident in the answers they had given to the 'police' questioner. Subsequently, both participants that were able to recognise the gesture and those that were not had attributed more confidence to answers that had been conveyed through gesture than other responses. A main effect was retrieved for recognition;  $F(1,61) = 11.190$ ,  $p = .001$ , but not for response;  $F(1,61) = 1.243$ ,  $p = .269$ . Similarly, no interaction effect was found between the two;  $F(2, 61) = .002$ ,  $p = .968$ .

A further 2x2 between subjects ANOVA considered the responses participants gave against their attention to the gesture. Figure 4.14 summarises this data.

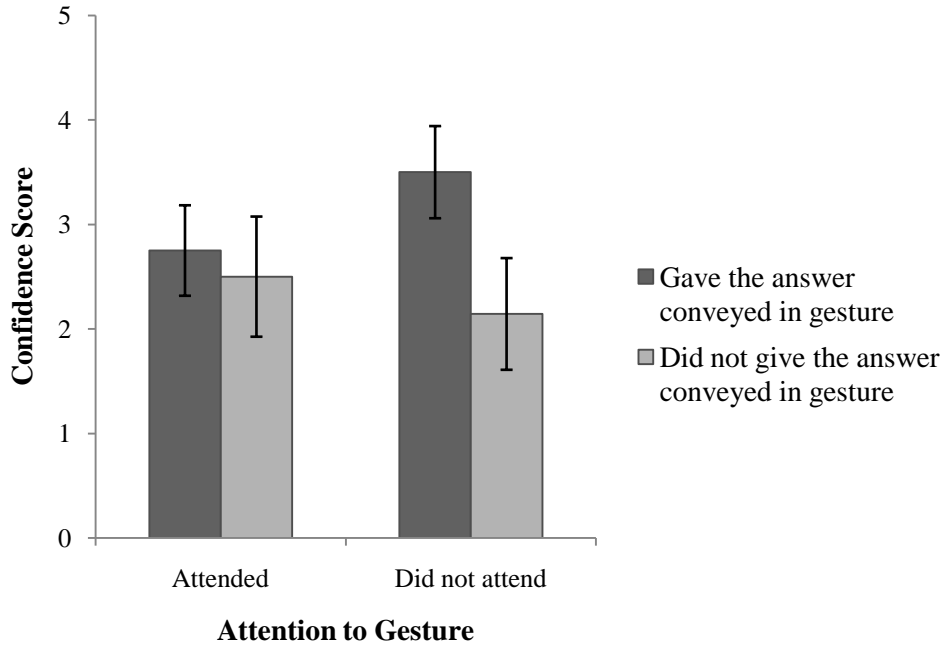


Figure 4.14: Confidence ratings in answers grouped by response and attention to gesture

Participants were most confident in responses that had been conveyed in the questioner's gesture but they did not attend to. In contrast, participants that did not attend to the gesture and did not give the answer conveyed by the questioner were least confident in their answers. A main effect was observed for response;  $F(1,61) = 8.47, p=.005$ , but not for attention;  $F(1,61) = .51, p=.480$ , and an interaction between the two was found;  $F(2,61) = 4.02, p=.049$ . To investigate this interaction further, an analysis of simple effects was conducted at each level of response and attention.

The first simple effects analysis considered the differences in confidence between those that attended to the gesture and those that did not at each level of response. A significant difference between attention was found for those that gave the answer conveyed in the gesture;  $F(1,61) = 4.92, p=.030$ , but not for those that did not give the conveyed answer;  $F(1,61) = -.67, p=0.417$ .

A further simple effects analysis considered the differences in confidence of response at the individual levels of attention. There was no significant difference in confidence between participants that gave the conveyed answer and those that did not for those that attended to the gesture;  $F(1,61) = 0.47, p=.500$ . However, a significant difference was found in the confidence of responses for those who had not attended to the gesture;  $F(1,61) = 10.73,$

$p=.002$ . Therefore, confidence in an answer conveyed by gesture only increased significantly when the person had not attended to the gesture.

### *Summary of Results*

- The responses given by participants concurred with the information conveyed in the police questioner's gestures. Those that had given their answer as a consequence of seeing the gesture were more confident in their responses.
- Participants that were able to recognise a gesture afterwards were more likely to have given the answer that was conveyed to them in that gesture. Participants were also more likely to have given the answer conveyed through gesture if they had not attended to it.
- Higher confidence was attributed to answers that had been conveyed through gesture, and participants that had attributed higher confidence to their answers were more likely to be able to recognise the gesture afterwards.
- Participants were generally less confident in their answers when they had attended to the gesture, but confidence in an answer that had been conveyed through gesture increased when the gesture was not attended to.

## Discussion

These results confirm those found for experiments 1 and 2; that participants responses concur with the information suggested to them through misleading hand gestures. Gesture recall and recognition varied by gesture and retrieved similar figures for the gesture recall and recognition rates for those in experiment 1. In addition, attention to gesture advanced an understanding of how participants attended to the gesture and whether information was extracted from the gestures outside of their awareness. The implications of these results are discussed here.

On average, participants fixated on 51.71% of the gestures; quite a contrast to the 9% fixations observed in previous research (Gullberg & Holmqvist, 1999, 2006). However, a

number of explanations arise for this; firstly, participants viewed the questioner through a video rather than in a live, conversational situation. When viewing a speaker talking on-screen, gesture fixations have been found to be considerably high (between 70-75%) (Nobe, et al., 1998) and vary with usage of an eye-tracker (Argyle & Graham, 1976). Additionally, a lot of gestures most attended to (for instance, "beard" and "hat") occurred outside the 'central' space of the speaker (McNeill, 1992) and such gestures attract more fixations from listeners than those occurring within this space (Gullberg & Holmqvist, 1999; Hoffman, 1998; Nobe, et al., 1998; Wolfe, 1998). Similarly, the "ring" and "watch" gestures involved a camera angle change over the questioner's shoulder, removing a differentiation between this 'central' and 'peripheral' space. Finally, the type of gestures used in this study conveyed information absent from speech, and were therefore the only source of semantic information. Research shows that gestures are less likely to be produced if the speaker and listener share a similar level of knowledge (Gerwing & Bavelas, 2004; Holler & Stevens, 2007) but gestures that contain 'novel' information are more likely to be attended to (Gullberg & Kita, 2009).

To reiterate the main finding of the experiment; participants that did not attend to the gesture were more likely to give the information it conveyed in their response. Subsequently, participants that attended to the gesture did not give the response conveyed by it. Here, it is possible that participants fixated on the gesture without gleaning information from it (Gullberg & Holmqvist, 1999); "looking without seeing", or that they did glean information from it, but were aware the information it conveyed was misleading and resisted it. The former explanation would imply a 'mechanical', bottom-up theory of gesture attention, i.e. participants were attracted to the movement of the gesture above an intuitive decision to process the information conveyed by it. This may well be true for participants that occurred within 'peripheral' space. However, a 'social-driven', top-down theory for gesture attention may seem more likely given that the gesture conveyed information absent from speech, and an understanding of this would facilitate a decision to attend to it. However, such behaviour would not suggest a subtle process of gesture influence and, since participants were able to glean information from gesture without attending to it (i.e. "seeing without looking") it holds that gestures can affect responses outside of their awareness.

Previous research states that attending to a gesture does not suggest the gesture is being processed for information (Gullberg & Kita, 2009). This was confirmed in this experiment through the discovery of a significant association between gesture fixation and gesture

recognition; participants that did not attend to the gesture were more likely to identify it afterwards.

The addition of the 'gesture response' variable give further insight into how gesture fixation and gesture recognition related to the participant's responses. The experiment replicated the previous experiments results by finding an association between response and gesture recognition (i.e. those that had given the target response were more likely to correctly identify the gesture afterwards). While this association did not differ significantly between those that attended to the gesture and those that did not, it was clear that participants who did not attend to the gesture were more likely to give the response conveyed by it and more likely to identify it afterwards. Therefore, this experiment confirms an association between gesture recognition and response but adds that this association is stronger when the gesture is not attended to. This is in line with the conclusions of experiments 1 and 2 which state that the gestures did mislead participants, though they could be made aware of the gesture by inviting them to recognise it afterwards.

The confidence that participants attributed to their responses also complemented these findings. Participants that attended to the gesture were less confident in their responses. This may suggest that participants who noticed the questioner was conveying information to them were made to feel unsure about their responses. Perhaps, if participants thought (correctly) that no jewellery was present, but they were aware that the questioner was suggesting a watch to them, the participant would be unsure about replying with either a 'watch' or 'no jewellery' response. That is, noticing the misleading gesture confounded their decision.

When considering an interaction in confidence between response and gesture attention, it was confirmed that there was little difference in confidence between target responses and other responses for those that attended to the gesture. However, for those that had not attended to the gesture, participants were considerably more confident when giving the target response. This provides further evidence that misleading gestures influence participants subtly and, here, made participants surer of their response when they do not attend to the gestures that conveyed this information to them. Thus, the influence of gestures appears most effective when participants do not attend to them.

An important issue to raise is whether fixating on the gesture inferred that it was consciously attended to. This brings the term 'attended' into question, and it should be noted that there may be a difference between a gesture being visually processed and consciously processed.

Gullbery & Kita (2009) explain that it is possible to 'look with seeing', thus some participants may have fixated the gesture, but not consciously processed it for information. Because of this, it may be difficult to draw conclusions into whether participants were consciously aware of the information in gesture and if they decided intuitively to accept or deny this information.

In summary, although the experiment was not without limitations, it provided promising evidence that a police questioner has the ability to manipulate the responses of eyewitness through misleading hand gestures. The introduction of gesture attention variable revealed that such influence is likely to occur outside the awareness of the witness and, when it does, not only are participants more likely to give responses conveyed through it, but are surer of their responses.

## General Discussion

The three experiments provided further evidence that a police questioner can manipulate an eyewitness's memory of a crime when using misleading hand gestures. Across all experiments, participant's responses tended to reflect the misleading information that was conveyed to them through the questioner's gestures. In addition, the study found support for the view that misleading gestures could influence the responses of witnesses outside of their awareness. Studying participants' retrospective recall and recognition of the gestures and their attention to the gesture furthered an understanding into how subtle the process of conveying misleading information to witnesses through gesture is. The results suggest that gestures are most effective at skewing the responses of participants when they do not attend to them, although can still identify that misleading information has been conveyed to them through gesture when prompted afterwards. The implications of these results are discussed here.

The questioner's misleading hand gestures were able to skew participants' responses, and this effect was consistent across all three experiments. The 'beard' gesture prompted the most responses in all experiments while the 'hat' gesture prompted the least. In relation to the previous studies of this thesis, the jewellery gestures ('ring' and 'watch') continued to be particularly effective at skewing responses. The addition of the 'ring' gesture as a misleading



gesture (rather than a confirmatory 'factual' gesture) confirmed it was possible to suggest the presence of a ring when one was absent from the scene. The fact that two gestures indicating different items of jewellery in separate conditions could manipulate participant's responses independent of each other confirmed that they can be a powerful influential tool.

The success of these gestures in misleading are owed to how they conveyed information to listeners. Many spontaneous speech-accompanying gestures convey information in line with speech (Beattie & Coughlan, 1999; Goldin-Meadow, 1993; Langton, et al., 1996; Thompson, 1995). Many speakers may not produce gestures with the intention of communicating information (Krauss, et al., 2000). As such, these gestures which appear to just 'build on' speech can be thought of as 'visual, background noise' in conversation (Gullberg & Holmqvist, 2006; Henderson & Hollingworth, 1999). Since gestures may be in competition with speech for attention in conversation (Thompson, et al., 2004), participants do not attend to gesture often (Gullberg & Holmqvist, 1999, 2006). However, while gestures that build on speech do not offer additional information outside speech, the gestures used in this study were quite different. These gestures followed those which convey important semantic information independent of speech (Kendon, 1980) and these gestures, which contain 'novel' information are attended to more often (Gullberg & Kita, 2009). Previous research has shown that participants are very good at gleaning information from these gestures, and can integrate the information from them into their memory of speech (Cassell, et al., 1999; Kelly, et al., 1999). A great deal of research confirms that speech and gesture function as an integrated system (Goldin-Meadow, 1998; Kendon, 2004; McNeill, 1992; McNeill, et al., 1994). This study investigated the integration between speech and gesture a stage further and found that participants could separate information conveyed through gesture and speech retrospectively; they could identify that misleading information was conveyed to them through gesture rather than speech. In summary, while speech and gesture appeared to be integrated at interpretation (Goldin-Meadow, 1998; Kelly, et al., 2004), some gestures convey additional information (Kendon, 1980) and, while these gestures can also become integrated with speech (Cassell, et al., 1999; Kelly, et al., 1999), this study finds that they can separated afterwards.

An important aspect of this study was to investigate whether witnesses could give any indication that the response they gave was given as a consequence of seeing a misleading gesture. Initially, simply asking participants if they felt misled during the experiment provided a reliable measure of whether they had given a response conveyed to them.

(Associations between feeling misled and giving response conveyed by gesture were found in all three experiments.) This has important implications for eyewitness testimony research; if asking witnesses whether they felt misled gives a reliable measure of whether they had, it could be implemented into the questioning procedure very easily. However, whether participants can identify themselves that it was a gesture that they felt misled by is another issue. Recall of gestures in all experiments was quite low (considerably lower than the rate of gesture recognition), suggesting that if witnesses were left to their own devices, they would have greater difficulty in identifying that a gesture had misled them. Although it was found that participants could separate information conveyed to them through gesture when invited to recognise the gestures from screenshots afterwards, the circumstances allowing participants to do so were very unique. Practically, witnesses would not have the luxury of identifying gestures from photographic stills after questioning and confirm that information had been conveyed through them. Therefore, the main focus of this study was to ascertain how aware witnesses are of these misleading gestures.

Insights into whether gesture influence occurred outside participant's awareness were found in experiment 3 where an eye-tracker gave an objective measure of whether the questioners gestures had been attended to or not. The results confirmed that there was no link between attention to gesture and information uptake (Gullberg & Kita, 2009) with many participants attending to the gesture failing to give the response conveyed by it or recognising it afterwards. Research shows that gestures are only more likely to be produced when the speaker and listener do not share the same knowledge (Holler & Wilkin, 2009), and that gestures which contain novel information are more likely to be attended to (Gullberg & Kita, 2009). Under this situation, which would favour a more top-down, social-driven approach to gesture fixation (Yantis, 2000), it is likely that participants have an intuitive understanding that information has been conveyed to them in gesture. That is, participants were aware that the information they gained intuitively from attending to the gesture was in conflict with what they saw, and hence resisted it. It is worth highlighting again that visual processing of the gesture however does not necessary imply conscious processing. Although gestures may have been fixated, this does not infer that participants were consciously aware of them and processed them intuitively.

Interestingly, the relationship between gesture attention and information uptake fell in the opposite direction; participants that had not attended to the gesture were more likely to give

the response conveyed by it and be able to identify it afterwards. In this situation, the gesture could still be processed for information (i.e. 'seeing without looking') (Gullberg & Holmqvist, 2006), but this time through a less intuitive, more incidental bottom-up process (Yantis, 2000). This observation is in line with the view that information from gesture can be comprehended along with speech (Clark, 1996; Kelly, et al., 2004; Kendon, 2004; McNeill, 1992). It is possible that participants here were more 'engaged' with the questioner video and integrated the gesture with the speech together, as in previous studies (Cassell, et al., 1999; Kelly, et al., 1999). In summary, attending to the gesture appeared to 'disrupt' the process of subtle persuasion whereas those more engaged in the video were more oblivious to the fact that they were being presented with misleading information through gesture.

Further insight into whether gestures manipulated participants responses outside of their awareness are given through the study of the confidence ratings they attributed to their responses. In experiment 3, it was found that participants attributed higher confidence to target responses that were given when the gesture was not attended to. This observation builds on the theory of the previous study and considers whether studying confidence can help ascertain if responses were given as a consequence of seeing the gesture. In the previous study, it was found that participants who gave an incorrect response did so with more confidence when they had been presented with a gesture conveying this information. Here, it was reasoned that participants would only report greater confidence in their answer if they had reason to do so (i.e. they noticed and accepted the information conveyed to them through gesture). This is supported by previous research which states that participants only use nonverbal cues to increase confidence when there are aware of them (Davis & Markus, 2006).

Introducing a measure of gesture attention enabled a differentiation to be made between those that attended to the gesture and those that did not. Here, it was found the confidence in target responses only increased when the participant did not attend to the gesture. While these findings may appear to be in conflict with the research of Davis & Markus (2006), it is important to note that these gestures always conveyed misleading information. Therefore, if these gestures occurred within participants' awareness, it would be likely to make them more unsure of the correct answer. Subsequently, those that did not attend to the gesture were likely to have gleaned this information outside of their awareness. For the previous study, it was thought that if the gesture integrated itself into the participant's representation outside of

their awareness, the gesture would have little effect on their confidence. However, while attending to the gesture had very little effect on the confidence judgements of those that did not give the response conveyed by the gesture, those that gave the target response awarded higher confidence when they did not attend to the gesture than those that did. This may provide further evidence that the gesture had become integrated into the participant's representation outside of their awareness. Consequently, participants may attribute higher confidence to their response even though they cannot identify or justify such a confidence increase. This rather surprising, and perhaps worrying finding may suggest that a misleading gesture implants a false sense of certainty to participants.

To what extent are these findings transferable to a live interview situation? This study, like all studies conducted in this research to this point, have placed very specific social demands on participants. The participants in the previous three studies have been required to watch an on-screen questioner talking to them without making any contribution to the conversation themselves. Recent research has highlighted concerns about drawing inferences from gesture studies using videos of speakers and point out these results can differ to live conversations (Holler, Shovelton, & Beattie, 2009). Previous research has also explained how attention to the speaker varies between video and live conversations (Gullberg & Holmqvist, 2006) as well as with the usage of eye-tracking apparatus (Argyle & Graham, 1976).

When watching a live video, participants are not as 'engaged' in conversation. Due to this, there may be difference in the bottom-up and top-down approaches to gesture fixation between video and live situations (Yantis, 2000). Attention to gestures on a video adopt a more 'mechanical' bottom-up approach as participants are more attracted to the movement on screen. In contrast, being engaged in a conversation may favour the more socially-driven top-down approach, i.e. gestures are attended to intuitively and with an intention of gleaning information. As an example, speakers can use statements such as "*he held it like this*" as a deictic device to direct attention to the gesture (Nobe, et al., 1998; Streeck & Knapp, 1992). When speakers fixate on their own gestures, it prompts listeners to fixate on them too. This effect is stronger in live situations rather than in videos as, in a live conversation, not doing so would be socially inept (Gullberg & Holmqvist, 2006). Therefore, there appears to be a difference in the behaviour of listeners when watching videos and participating in live conversations. It is necessary therefore to apply the findings of this research to date to a new methodology, studying the use of misleading gestures in a live interview.

This study provided an insight into the implications of gleaning information from gesture and found promising evidence that a police questioner's hand gestures can manipulate the responses of participants outside of their awareness. These findings are given greater weight through the discovery that legal professionals appear just as susceptible to the effects of misleading gesture, and show similar patterns in their ability to recognise gestures afterwards. Overall, this study found that gestures, when not attended to, can not only manipulate participants' responses but also make them more confident in their answer. To assess how effective misleading gestures can be in a real interview situation, and increase the ecological validity of this research, it is now necessary to develop the methodology to accommodate the discussion points raised in this study. Are participants just as, or more, susceptible to misleading gestures in a live interview?

## Chapter 5 :

# Investigating the Influence of Misleading Gestures in a Live, Face-to-Face Interview

## Introduction

Are people more likely to glean information from gesture when interviewed live, face-to-face? Research has highlighted the sensitivity of eyewitnesses to leading questions and how their responses can be influenced by the way a question is worded (Harris, 1973; Loftus, 1975; Loftus & Palmer, 1974; Loftus & Zanni, 1975; Myers, et al., 1996). However, little attention has been given to the role of gestures in conveying biased or misleading information during interviews. Gestures can convey information to listeners (Goldin-Meadow, 1999; Graham & Argyle, 1975; Kendon, 1980) and that the 'extra' information contained in gesture can be integrated with speech (Cassell, et al., 1999; Kelly, et al., 1999). Moreover, gestures are more likely to be produced in face-to-face situations (Bavelas, et al., 2008) and are specifically tailored to the listener (Özyürek, 2002). The vast majority of gesture research (including those included in this thesis) have placed greater focus on situations where participants respond to pre-recorded videos of speakers rather than live, face-to-face interactions (Holler, et al., 2009). In order to draw conclusions about a gesture's potential to skew the responses of eyewitnesses in interviews, and to improve ecological validity, it is important to investigate whether the results of the previous studies of this research are replicated in a live, interview situation. Thus, the final question this research sought to answer was; do eyewitnesses continue to give responses conveyed by gesture when questioned face-to-face?

Research has highlighted differences in listener's behaviour when confronted with a speaker face-to-face, or through a piece of recorded video footage. Gullberg & Holmqvist (2002) found that, whilst eye gaze behaviour between the observation of a speaker live and through a video was similar, participants spent more time focusing on the face of the live speaker and fixated on more gestures. Subsequently, participants who saw the speaker through a video were more likely to focus on more immobile body parts (which are generally avoided in live conversations), although this effect was found to reduce when the video of the speaker was

life-size (Gullberg & Holmqvist, 2006). This observation was in conflict with the authors' original prediction which reasoned that, with no social demand to maintain eye contact, participants would have more liberty to fixate wherever they liked. An explanation for this result may be that, in a live situation, participants are more 'engaged' with the speaker than when observing them through a video and have greater social demand to interact with them.

Responding to a video of a speaker places a very unique social demand on the listener. Conversing with somebody live, face-to-face commands greater social interaction where listeners are naturally drawn to the face of the speaker (Bavelas, et al., 2002; Fehr & Exline, 1987; Gullberg & Holmqvist, 1998) and maintain eye contact to signal interest and engagement (Argyle & Cook, 1976). Further evidence of a social 'engagement' in live conversations comes from the research on speaker-fixated gestures. Here, the speaker fixates their own gesture while performing it and, in doing so, encourages the recipient to attend to the gesture too (Goodwin, 1986; Streeck & Knapp, 1992). This overt gaze following is a socially mediated process that is more powerful in live conversations than when observing a speaker through video (Gullberg & Holmqvist, 2006). It is suggested that when speakers fixate on their own gestures, it directs the listener to the gesture, and not co-fixating under this situation would be socially unacceptable (Gullberg & Kita, 2009). Gullberg & Kita (2009) report that, in live situations, participants fixate for longer on speaker-fixated gestures and that these fixations are not affected by the location of their performance (inside or outside the speakers 'central space'). This has become important implications, since following the gaze of speakers under these conditions supports a more intuitive 'top-down' approach to gesture attention (where the listener is encouraged to process the gesture for information) rather than a reflex-driven bottom-up approach (Yantis, 2000). That is, a speaker can override an automatic 'bottom-up' attraction to gestural movement with an intuitive, top-down direction to process the gesture when conversing with a listener live.

While these studies provide useful insights into how gestures are attended to across live and video conditions, they make little attempt to distinguish between their effectiveness of communicating information in each case. Gullberg & Kita (2009) report that the relationship between gesture fixation and information uptake is poor, even when gestures are overtly attended to. This was evident in the previous study of this research which found that participants who fixated on gestures were actually less likely to glean information from than those that did not. It remains an open question whether we can expect to find differences in

the acquisition of information from a speaker's gestures when observing them live, face-to-face than through a pre-recorded video.

Insight into this comes from a study by Holler, Shovelton & Beattie (2009) who measured the amount of information gleaned from a speaker's gestures when observed live (face-to-face), and through a video. Participants in their study were subjected to a speaker narrating three cartoon stories in one of four conditions; 'speech & gesture (face-to-face)', 'speech & gesture (video)', 'speech alone (video)' and 'gesture alone (video)'. Their results focused on the amount of accurate information participants were able to report on physical details of objects in the story (concerning size and position). The authors found that, overall, participants received more information conveyed in the speaker's gestures in the face-to-face condition than in the corresponding video condition. The results of the other two 'video' conditions confirmed that speech and gesture together conveyed more information than either speech or gesture alone. That is, gestures facilitate comprehension when accompanying speech (Beattie & Shovelton, 1999a; Goldin-Meadow, et al., 1993; Langton, et al., 1996). However, in the absence of a 'gesture alone (live)' and 'speech alone (live)' condition, it is difficult to ascertain whether the extra information gleaned from the speaker was due to their speech or gestures individually. Regardless, the study provides support that a speaker presented live, face-to-face can convey more information to a listener than when appearing through a recorded video.

This observation is relevant to the method used in interviewing witnesses. Given insights into the susceptibility of eyewitness to misleading questions (Harris, 1973; Loftus, 1975, 1979), the 'cognitive interview' technique was developed to probe the memory of witnesses in an unbiased way (Geiselman, et al., 1984). This interviewing technique has been widely used across the UK since 1992 and its effectiveness has been confirmed by police officers and forensic psychologists alike (Kebbell, et al., 1999; Köhnken, et al., 1999). The technique involves the interviewer summarising information provided by the witness in order to 'recreate' the original environment in which the memory was first constructed. By presenting this information to witnesses, they are able to 'relive' the moment of original coding, including any mental states and emotions they experienced at the time (Fisher, et al., 2002), resulting in accurate, unbiased memory retrieval (Tulving, 1974).

The *enhanced* cognitive interview developed this method further to address the possible overload of information witnesses face during an interview and to alleviate communication



problems (Fisher & Geiselman, 1992). Here, interviewers are explicitly encouraged to use body language to reduce feelings of intimidation and ease communication (Howitt, 2006). This becomes relevant to this research as, in the 'open-ended narrative' stage of the interview, interviewers use the information initially provided by witnesses and their prior knowledge to build a 'mental image' of the scene to facilitate memory recall. Witnesses are encouraged to use this mental image to recall important aspects of the witnessed event, including details of significant objects such as weapons. This is of particular interest, as gestures can provide listeners with additional information (Goldin-Meadow, 1999; Kelly, et al., 1999; Kendon, 1980) to facilitate story comprehension (Riseborough, 1981). In light of research on communicative gestures and susceptibility to information provided under questioning (Loftus, 1975, 1979), it is possible that, even under this formal interviewing procedure, witnesses may have their memories skewed by the information conveyed to them in gesture.

One factor that could affect participant's likeliness of gleaning information from gesture is their own personal suggestibility. Post-experimental self reports of the previous experiments indicated that some participants were aware of the experimenter's intention to skew their responses, and hence resisted the information conveyed in gestures. It is possible therefore that some participants knowingly extracted the information from gesture but chose to reject it on the grounds that they realised it was misleading or biased. Measuring suggestibility as an individual difference may help identify those that are potentially more susceptible to the gesture and differentiate between those that are aware the gesture is misleading and those that are not. Consequently, such a measure could also be used to ascertain whether certain individuals are more susceptible to gestural influence than others.

The Gudjonsson Suggestibility Scale (GSS) (Gudjonsson, 1984) provides an objective measure of suggestibility that has been widely used and validated, assessing the reliability of verbal accounts given by victims, witnesses and suspects of crime during police questioning. The suggestibility scales have been found to be a reliable predictor of eyewitness performance across participants with different intellectual abilities (Gudjonsson, 1987; Henry & Gudjonsson, 2003; Smith & Gudjonsson, 1995), personality characteristics (Muris, Meesters, & Merckelbach, 2004; Smith & Gudjonsson, 1995) and in children as well as adults (Henry & Gudjonsson, 2003).

While research has revealed much about how the nature of a question can influence the responses of eyewitnesses (Harris, 1973; Loftus, 1975, 1979), Gudjonsson (1984) explains

that witness susceptibility can also be determined by the manner of the interview. Research confirms that the perceived expertise of an interviewer can have an effect on the witness susceptibility to misleading questions (Smith & Ellsworth, 1987) particularly when giving negative feedback (Bain & Baxter, 2000). Thus, Gudjonsson (1983) identifies two types of suggestibility; the tendency to give into leading questions (defined as 'yield') and sensitivity to the interviewer's feedback; or inclination to change their answer (defined as 'shift'). These measures of suggestibility are measured by the GSS1 (Gudjonsson, 1984) and the parallel GSS2 (Gudjonsson, 1997) suggestibility scales. These tests involve reading participants a short fictional story and asking 20 questions on the story afterwards (15 of which are misleading). After questioning, participants are told that they have made a number of errors (even if they have not) and that it is necessary to answer the questions again. The number of misleading questions endorsed to (yield) and the number of changed responses (shift) are scored together provide a 'total suggestibility' score. This score can be used to determine how suggestible an individual is in comparison to a population.

In summary, this study builds on previous research and asks whether gestures can skew witnesses' responses in a more ecologically valid interview situation. When confronted with a speaker live, participants fixate on more gestures (Gullberg & Holmqvist, 2002, 2006), which are more likely to be processed intuitively (Gullberg & Kita, 2009), and more information is gleaned from gestures live than through video (Holler, et al., 2009). Assuming that a live interview would cause participants to be more socially 'engaged' in conversation, this study predicts that participants will continue to have their responses skewed by gesture in a live interview. If found to be the case, this would have significant implications for police interviewers, who could skew the memory of eyewitnesses under questioning. Studying suggestibility will also give an insight into whether an objective measure can be used to determine participants' susceptibility to misleading gestures and, if so, whether this is comparable to susceptibility to misleading questions. Results of the previous study implied that gestures occurred outside of awareness, and those that fixated were more able to 'resist' misleading information. This study now seeks clarification for whether those that give skewed responses are more suggestible than others.

## Method

### *Design*

This study used a between-subjects design where condition was the gesture performed to the participant. The independent variable comprised two independent sets of gesture groups (gesture group A and gesture group B) with a third, control group (no gesture).

The dependent variables in the study were the participants' responses to the 'police' questioner's questions (whether or not their response was congruent with the information conveyed in the gesture) and the confidence they attributed to each response (measured on a 5-point scale). A debrief questionnaire provided measures of whether the participant had felt influenced or misled by the questioner, and which gestures they remembered seeing (measured as categorical responses). The Gudjonsson Suggestibility Scale (GSS2) provided a 'total suggestibility' score (calculated from 'yield' and 'shift' sub-scores).

### *Participants*

A sample of 90 participants (16 male, 74 female) were recruited opportunistically for the experiment and had a mean age of 19.76 ( $SD = 2.37$ ). The majority of participants were undergraduate or postgraduate psychology students from the University of Hertfordshire who were awarded participant credit for taking part.

### *Materials & Apparatus*

The materials in the study consisted of the stimulus video (showing 'CCTV' footage of a man stealing an object from an office) used in the previous study, a distracter task and a funnel debrief questionnaire (Appendix E). The questionnaire consisted of three questions, including "*did you guess the answer to any of the questions?*", "*did you feel influenced by the interviewer in any way?*" and "*which of his hand gestures do you remember seeing?*"

The Gudjonsson Suggestibility Scale (GSS2) administered to participants consisted of a short story accompanied by a 20-item questionnaire about its content. The story described a scenario where a small boy lost control of his bicycle when travelling down a hill and was helped by some neighbours. The questionnaire consisted of 20 questions, five of which asked

standard (non-leading) questions about the story and the remaining 15 asked leading questions that suggested content not included in the story. (For a full overview of the materials, see Gudjonsson, 1997.) The second (GSS2) Suggestibility scale was chosen over the former (GSS1) due to its inclusion of a question about a person's glasses. To avoid confounding this information with the 'glasses' gesture performed in one condition of the experiment, the GSS2 scale was used.

Apparatus in this study included a laptop with a 15" screen to present the stimulus video and two Sony DSR-PD150 video cameras were used to film the experiment.

### *Procedure*

The study took place in the Psychology Observation Lab at the University of Hertfordshire. Participants were asked to watch the 'CCTV' footage carefully and to then complete the distracter task. After consenting to the filming of the experiment, the participant then proceeded through to the 'interview room' which contained a round table with two chairs facing each other (approximately 1 metre apart). The room also contained two cameras; one facing the participant and one facing the interviewer. Although the camera was visible to participants, it was positioned in the corner of the room so to not cause distraction. When seated, participants were asked to complete a statement of what they saw in the video and were then told that they would be questioned by the interviewer to acquire some more specific details.

The interviewer followed a transcript of dialogue (Appendix F) to ask the questions. For each question, the interviewer would summarise details of the video (accompanied by a critical gesture), and would then ask a distracter question before posing the critical question. For instance, he would state "*you only really saw the back of the man, but at one point in the video he turned round and you got a glimpse of [his face]*" [beard/glasses gesture]. This was followed with the distracter question "*how old was the man?*" and the critical question "*did you notice any distinguishing features?*" The transcript continued to follow this format of 'summary, distracter question, critical question' throughout the interview (see Appendix F for the full transcript). The interviewer performed other, non-critical gestures throughout the interview so to not draw attention exclusively to the critical gestures (these are also summarised in the transcript). The interviewer also avoided deictic expressions (i.e. "*[like*

*this]*") and did not fixate on any of his gestures. Care was taken to avoid deviating from the transcript if participants interrupted or answered prematurely.

During the questioning, the interviewer was careful not to pressure the participant into believing there was always a definitive answer to the question. For instance, he would ask "*did you notice any additional clothing?*" as opposed to "*what additional clothing was he wearing?*" If a participant claimed they did not know, they were asked if they were sure before moving into the next question. After questioning, the interviewer clarified the answers with the participant during a summary of the interview. For the final part of the experiment, participants were given the funnel debrief questionnaire and completed it at their own pace before being fully debriefed on the purposes of the study afterwards.

The Gudjonsson Suggestibility Scale (GSS2) was also administered to participants during the experiment. The test required participants to listen to a short story and recall details of it immediately after hearing it, and after a delayed time interval (of approximately 30 minutes). The 'immediate' response was recorded on the participant's arrival and the 'delayed' response was recorded after the interview. The 20-item questionnaire was also completed after the interview, but before debriefing. At no point during the experiment were participants told that their suggestibility was being assessed. (For a full description of GSS administration, see Gudjonsson, 1997.)

## Results

Participants responded verbally to the interviewer's questions. After the interview, participants completed a funnel debrief questionnaire asking whether they felt misled by the interviewer and which of his gestures they could recall seeing during the interview. Participants then identified which gestures they could remember seeing as the interviewer demonstrated them afterwards. The Gudjonsson Suggestibility Scale (GSS2) was administered to obtain a suggestibility score for each participant. These results are reported below.

## Responses

The initial analysis focus on the responses participants gave to the interviewer's questions (regarding the man's facial features, what jewellery he was wearing, and what additional clothing he was wearing). The interviewer accompanied his questioning with a gesture conveying false information in two experimental (gesture) conditions and a further control (no gesture) group was tested. Any positive response was considered to be incorrect (the man had no distinguishing facial features and was wearing no jewellery or additional clothing). For these questions, participants gave a positive response in 30% of cases, 53.23% of which included responses conveyed by the interviewer's gesture. Figure 5.1 provides a breakdown of the positive responses given for each question (all "none" or "don't know" responses are not included).

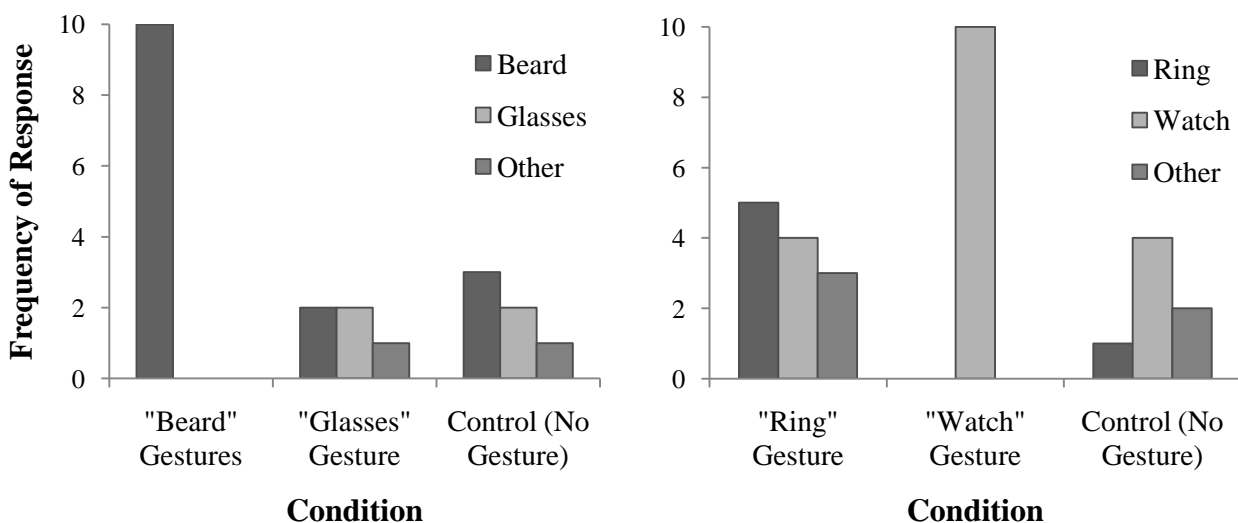


Figure 5.1: Frequency of responses to 'facial features' and 'jewellery' questions by condition

All positive responses given by participants that saw the "beard" gesture comprised of the answer 'beard', and this answer was given considerably more frequently than in other groups. In contrast, participants that saw the "glasses" gesture were no more likely to give 'glasses' as their answer than controls. While low in statistical reliability, a 3x3 chi-square testing an association between gesture (beard / glasses / none) and response (beard / glasses / other) did not reach significance,  $\chi^2 (4, N = 21) = 7.77, p = .100$ .

For the jewellery question, participants that saw the "ring" gesture were more likely to respond with 'ring' than controls, and all responses for the "watch" gesture comprised of the answer 'watch'. Thus, participants were more likely to give this response if they had been presented with the "watch" gesture. A 2x2 chi-square confirmed these responses differed significantly by condition,  $\chi^2 (4, N = 29) = 11.37, p=.023$ .

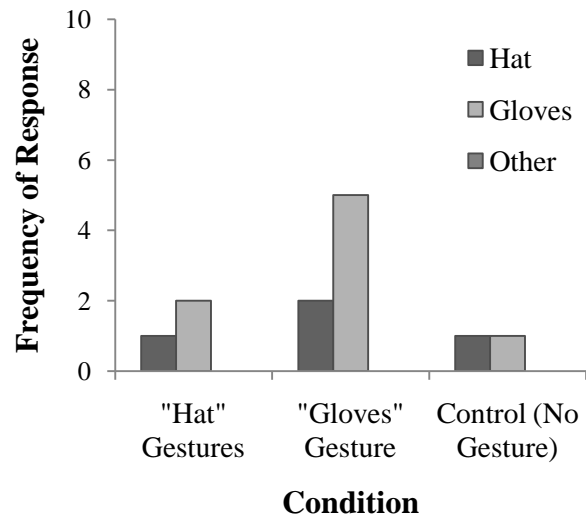


Figure 5.2: Frequency of responses to the 'other clothing' question by condition

Participants that saw the "hat" gesture were no more likely to respond with 'hat' than those in the other conditions. However, those that saw the "gloves" gesture responded with 'gloves' more than those in other conditions. A 3x3 chi-square found no significant association between condition and response,  $\chi^2 (4, N = 12) = .32, p=.852$ .

To improve statistical reliability, the data for all critical gestures were collapsed into one overall data set to form a 2x2 chi square testing an association between condition (saw critical gesture / no gesture) and response (gave critical response / did not). This data is summarised in Figure 5.3.

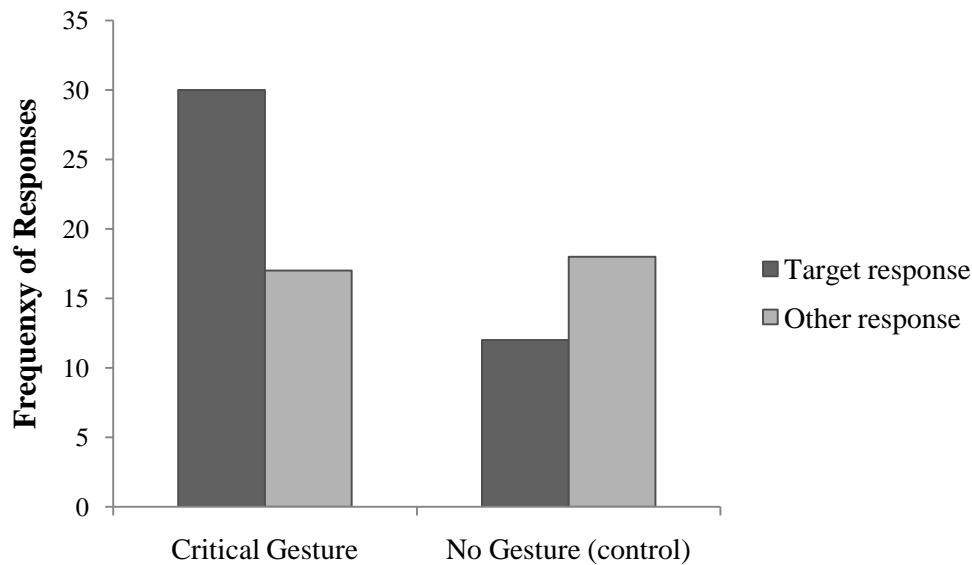


Figure 5.3: Frequency of target and other responses by gesture performed

Participants appeared equally likely to give other responses regardless of whether a critical gesture was presented to them. However, those that saw the critical gesture were more likely to give the target response it conveyed. A significant association was found between response and gesture condition,  $\chi^2 (1, N = 77) = 4.19, p=.041$ . Thus, participants that saw the interviewer accompanying the question with a hand gesture were more likely to give the response conveyed by this gesture.

A further Mann-Whitney U test considered the number of target responses participants gave between those that saw misleading gestures and controls. Considering the previous three critical questions, participants could have given either 0, 1, 2 or 3 target responses. The test revealed that saw the first set of misleading gestures gave significantly more of the target responses than controls;  $U = 307, n_1 = 30, n_2 = 30, p = .007$ , as did and those that saw the second set of misleading gestures;  $U = 340, n_1 = 30, n_2 = 30, p = .038$ .

In addition, a further question asked which jacket pocket the intruder put an item in. Unlike the previous questions, there was a definitive answer (the intruder did put the item in a pocket, though which pocket was unclear). Participants could choose from either his left or right pocket, and his inside or outside pocket. Figure 5.4 summarises this data.



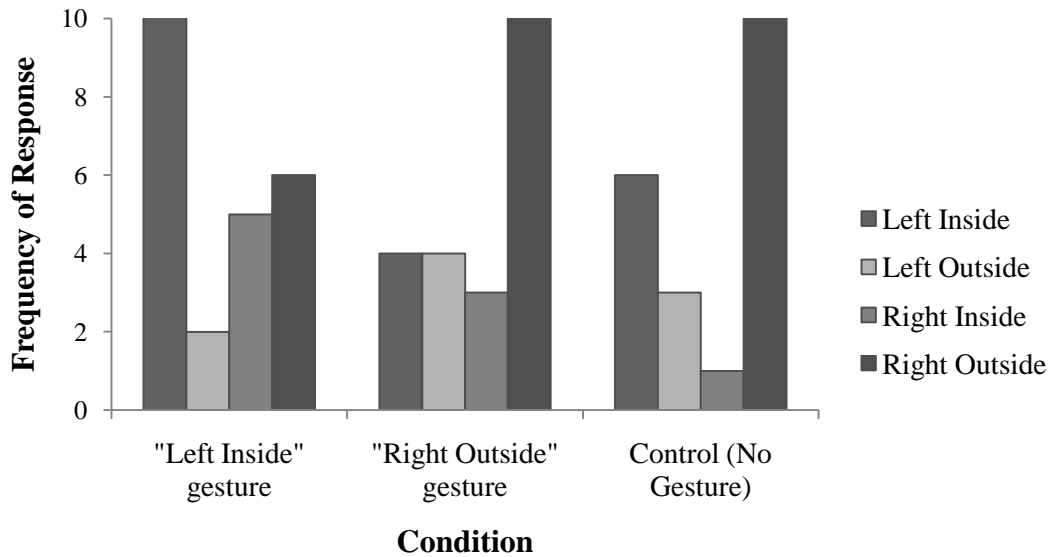


Figure 5.4: Frequency of responses to the 'jacket pocket' question by condition

Participants that saw the interviewer performing a "left inside" gesture were more likely to claim the item was put in his left inside pocket, whereas those that saw him perform the "right outside" gesture were more likely to give the 'right outside' response. The results of the control group were closely matched to that of the "right outside" gesture. Thus, the "left inside" gesture directed participants away from their natural tendency. The data were submitted to a 3x4 chi-square testing an association between condition ("left inside" / "right outside" / no gesture) and response (left inside / left outside / right inside / right outside) and retrieved a significant effect,  $\chi^2 (6, N = 78) = 13.47, p=.036$ . To investigate this further, another 3x2 chi-square collapsed the data by the right / left responses and the inside / outside responses independently. An effect was present for just the right / left responses,  $\chi^2 (2, N = 81) = 6.17, p=.046$ , and the inside / outside responses,  $\chi^2 (2, N = 78) = 12.27, p=.002$ .

### *Reports of Feeling Influenced*

When asked whether they felt influenced by the interviewer, 40 (48.8%) participants claimed they had. This figure comprised of 31 (59.6%) participants in the experimental gesture groups and 9 (30.0%) controls. A 2x2 chi square considering an association between condition (interviewer gesturing / not gesturing) and response to questionnaire (felt influenced / not) retrieved a significant effect,  $\chi^2 (1, N = 82) = 6.678, p=.010$ . Thus, participants that saw the

experimenter performing hand gestures whilst asking the questions were more likely to report feeling influenced during the experiment.

Of the 31 participants in the gesture groups that claimed to be influenced by the interviewer, 15 (48.4%) gave at least one answer that was conveyed to them through his gesture. In contrast, out of those claiming not to be influenced, 8 (38.1%) gave an answer conveyed to them in gesture. However, a 2x2 chi-square testing an association between feeling influenced (felt influenced / not) and response to question (gave an answer conveyed in gesture / not) did not retrieve a significant effect,  $\chi^2 (1, N = 52) = .538, p=.463$ . Thus, participants claims that they felt influenced was not a valid indicator for whether they had given their answer as a consequence of seeing the gesture.

### *Gesture Recall & Recognition*

Participants were asked whether they could freely recall any of the gestures that were performed by the interviewer during the interview and whether they could recognise the gestures once they had been demonstrated to them afterwards. Figure 5.5 summarises the frequency of recalls and recognitions for each gesture.

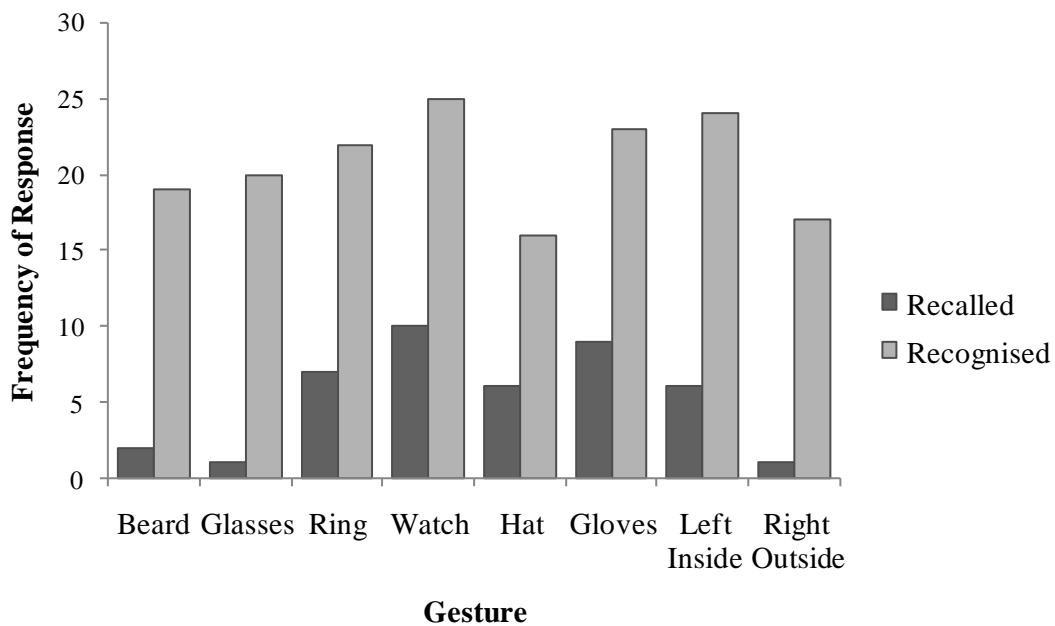


Figure 5.5: Summary of gestures recalled and recognised by participants

All gestures were recognised considerably more frequently than they were recalled. The mean frequency of gestures recalled across all participants in an experimental group ( $N = 30$ ) was 5.25 ( $SD = 3.54$ ) and the mean number of gestures recognised was 20.75 ( $SD = 3.28$ ). An independent t-test found this difference to be significant,  $t(14) = -9.09$ ,  $p < .001$ . All participants that recalled a gesture were able to recognise it afterwards, and of the gestures that were not recalled, 77.9% ( $N = 120$ ) were recognised. A 2x2 chi-square testing an association between recall and recognition retrieved a significant effect,  $\chi^2(1, N = 196) = 11.22$ ,  $p = .001$ .

The next analysis considered whether participants that recalled or recognised a gesture were more likely to have given the answer conveyed by it. The data from each participant was separated to consider each of the four questions as one observation each. Thus, the four questions from 60 of the participants in the experimental gesture groups comprised of 240 individual cases.

Participants that gave any response to the interviewer's question were less likely (13.9%) to recall seeing his gesture than those that did not (23.5%). Participants that gave a response were also less likely (79.4%) to recognise the gesture afterwards than those that did not (84.8%). Two 2x2 chi-squares testing an association with response (gave an answer / did not) were not significant for recall,  $\chi^2(1, N = 208) = 2.72$ ,  $p = .099$ , or recognition,  $\chi^2(1, N = 200) = .94$ ,  $p = .332$ .

The data for response was then broken down to two categories; responses that were conveyed by the interviewer's gesture or those that were not. Figure 5.6 summarises associations between response and gesture recall / recognition.

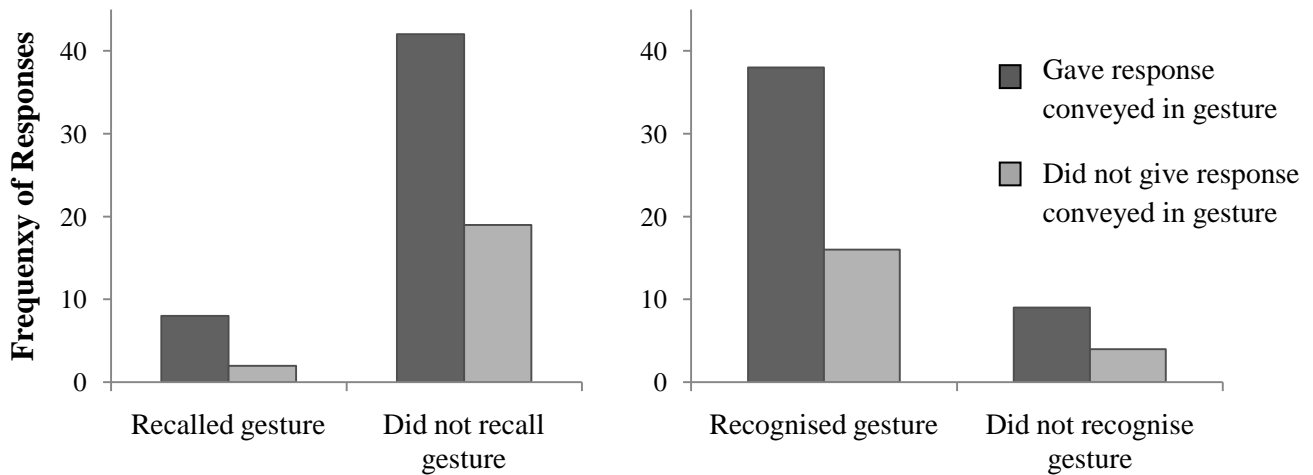


Figure 5.6: Associations between type of response with recall and recognition of gesture

Participants that gave a response conveyed by gesture were less likely to recall the gesture afterwards. Similarly, those that gave an alternative response were also less likely to recall it. A 2x2 chi-square testing an association between response (conveyed by gesture, not) and recall (recalled, not recalled) failed to retrieve a significant effect,  $\chi^2(1, N = 71) = .51, p = .474$ . In contrast, participants that gave responses conveyed by gesture were more likely to be able to recognise the gesture afterwards, although a similar pattern followed for those that gave alternative responses. A 2x2 chi-square testing response by recognition also failed to retrieve a significant effect,  $\chi^2(1, N = 67) = .01, p = .936$ . Thus, being able to recall or recognise a gesture did not give an accurate reflection of whether the gesture had affected the response.

### *Suggestibility and Response*

The Gudjonsson Suggestibility Scale (GSS2) attributed a 'total suggestibility' score out of 35 for each participant. The mean suggestibility score for all participants was 10.78 ( $SD = 5.72$ ); slightly higher than the mean and standard deviation of suggestibility scores of the general population ( $M = 7.5, SD = 5.3$ ), as reported by Gudjonsson Suggestibility Scales Manual (1997). Females ( $M = 11.03, SD = 5.29$ ) were more suggestible than males ( $M = 9.67, SD = 7.47$ ), but not significantly so;  $t(81) = 8.83, p = .407$ . An one-way ANOVA also confirmed that there were no differences in the suggestibility scores across participants in the three gesture conditions,  $F(1,2) = .83, p = .438$ .

Initially, the results considered whether those that scored highly on the suggestibility scale were more likely to have given the answers that were conveyed to them in gesture. For this analysis, the first three questions (facial features, jewellery and additional clothing) were included (i.e. the jacket pocket question was excluded from this analysis due to it having a definitive answer).

Participants that gave at least one response conveyed to them in gesture were more suggestible ( $M = 12.26$ ,  $SD = 5.52$ ) than those that did not ( $M = 10.47$ ,  $SD = 5.84$ ). An independent t-test however revealed no significant difference between these groups,  $t(51) = -1.14$ ,  $p = .262$ . A further, one-way analysis of variance (ANOVA) confirmed that the suggestibility scores increased with the number of questions a participant gave a gesture-conveyed response to (as the between subjects factor). Participants that did not give any of the answers conveyed in gesture scored lowest ( $M = 10.47$ ,  $SD = 5.84$ ), while those that gave one of the answers scored higher ( $M = 11.80$ ,  $SD = 6.10$ ) and those that gave two of the answers scored higher still ( $M = 13.13$ ,  $SD = 4.49$ ). The results from the ANOVA however found no significant difference,  $F(1,2) = .77$ ,  $p = .467$ . Figure 5.7 provides a breakdown of the suggestibility scores for the different responses given for each question.

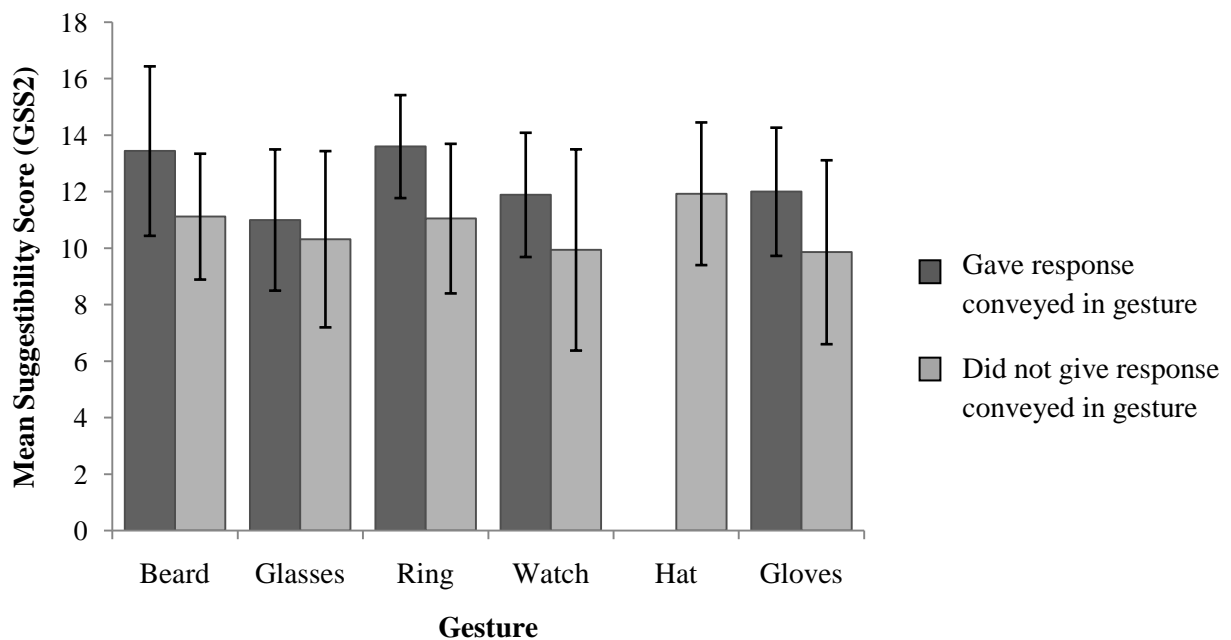


Figure 5.7: Mean suggestibility scores (using GSS2) by response for each question

The data for 'hat' was excluded due to it being based on only one observation. Participants that gave a response congruent with the information conveyed in gesture were more suggestible ( $M = 12.76$ ,  $SD = 4.79$ ) than those that did not ( $M = 10.87$ ,  $SD = 5.80$ ) across all questions. An independent sample t-test however did not retrieve a significant effect,  $t(157) = 1.652$ ,  $p = .103$ .

The next analysis considers whether participants that reported feeling influenced were more suggestible than those that did not. Participants that reported feeling influenced by the interviewer scored slightly higher ( $M = 10.98$ ,  $SD = 5.76$ ) than those that did not ( $M = 10.43$ ,  $SD = 5.69$ ), though this difference was not found to be significant in an independent samples t-test,  $t(80) = .43$ ,  $p = .667$ . Figure 5.8 below provides an overview of the suggestibility scores of participants that reported feeling influenced according to the response they gave.

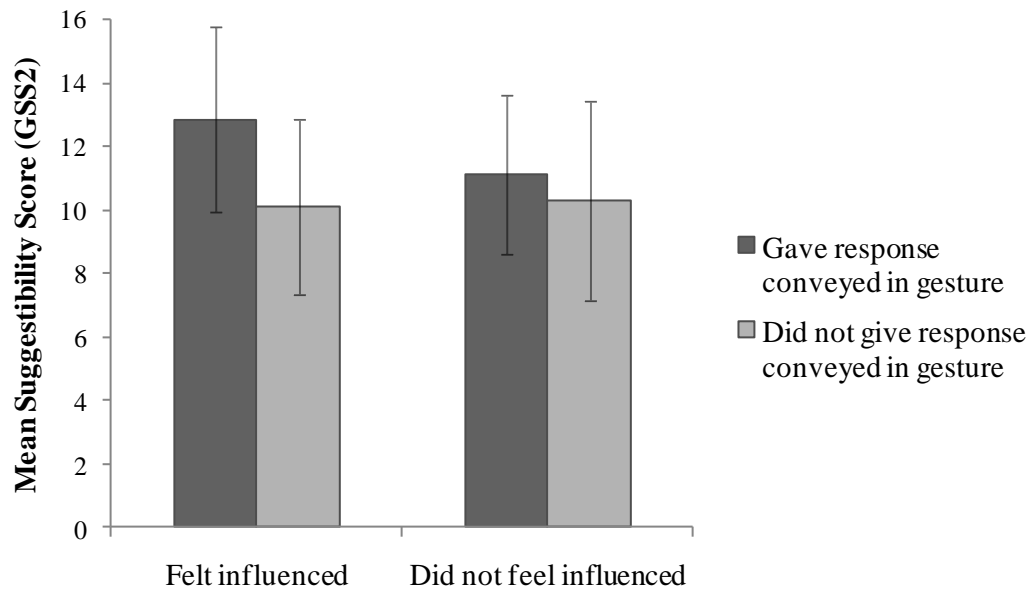


Figure 5.8: Mean suggestibility scores of participants that felt influenced by response

The data were submitted to a two-way analysis of variance (ANOVA) with reported influence (felt influenced / not) and response (gave response conveyed in gesture / not) as between-subjects variables. No main effect was found for influence,  $F(1,48) = .22$ ,  $p = .639$ , or for response,  $F(1,48) = 1.16$ ,  $p = .287$ , and there was no interaction between the two,  $F(1,48) = .34$ ,  $p = .563$ . Thus, in accordance with earlier results, reporting feeling influenced was not an accurate measure of how suggestible participants were.

### *Summary of Results*

- Participants were more likely to give responses when they were conveyed to them through the interviewer's hand gestures. The gestures of 'beard' and 'watch' prompted all responses in those conditions to consist of information conveyed in the gesture. Similarly, the gestures of 'ring' and 'gloves' prompted considerably more of those responses in their respective conditions. The interviewer's 'jacket pocket' gesture appeared to skew participants responses away from the norm, with many participants reporting that the man had put the item in his left inside pocket after seeing a 'left inside' gesture
- Participants' reports of feeling influenced by the interviewer were not an accurate reflection of whether they had given an answer conveyed to them in gesture
- Recognition of the gesture was much higher than recall, and an association was found between those that were able to recall and recognise the gesture. However, participants' recall or recollection of the gesture was not an indication of whether they had given a response conveyed by it
- There were no significant differences in suggestibility between participants who gave a gesture-conveyed response and those who did not

### Discussion

The results of this study confirmed that participants subjected to misleading gestures under questioning could have their responses skewed by the information conveyed in these gestures. This study provided support that such gestures can exert an influence and influence responses in a real-life interview situation. Further findings from this study provide insight into whether the influence occurs outside of a person's awareness and whether individuals that are highly suggestible to misleading questioning are subsequently more susceptible to these misleading gestures. These results are discussed below.

An effect of the interviewer's gestures was found. Over half of the positive responses given by participants consisted of information that was conveyed to them in the gestures. In every case, participants reported more target responses when conveyed to them in gesture than any other condition. Most notable are the 'beard' and 'watch' gestures, which made up all the

positive responses given in their respective conditions. It is worth noting also that, unlike the previous studies in this thesis, participants did not select their answer from a given answer set; any response they gave was generated by themselves. Thus, the gestures appeared to 'plant' information into the participant's representation, and they were then able to reiterate this information without any cueing from a possible answer set. Previous research has explained that gestures can provide additional visual information that accompanies speech (Goldin-Meadow, 1999; Graham & Argyle, 1975; Kendon, 1980) and, in previous studies, participants could have matched this information conveyed in gesture to the written answers on the answer sheet. However, here, the gesture was the only source of information and, without cueing from an answer set; any 'misled' responses given must have been a consequence of processing the gesture alone. This gives considerably more weight to the view that gestures can serve a powerful communicative function (Goldin-Meadow, 2005; Goldin-Meadow, et al., 1993) and that people can glean specific pieces of semantic information from gesture in the absence of speech (Kendon, 1980).

The most important aspect of this study was that the gestures were performed live, face-to-face in a more ecologically valid interview scenario as opposed to through video footage. It was found that, under these conditions, the communicative potential of gestures remained. In the absence of adopting a live vs. video method however, it is not possible to make direct comparisons between the effects of gestures when presented live and through a video. However, by considering the results of the previous studies, it would seem that the gestures were at least as effective when performed live as on video, in line with the results of Holler, Shovelton & Beattie (2009). Possible explanations for this arise from research which found that gestures performed live are more likely to draw fixations (Gullberg & Holmqvist, 2002, 2006) and be processed intuitively (Gullberg & Kita, 2009; Yantis, 2000). This may be because gestures are more noticeable live, and gestures are processed differently depending on the size and location at which they are presented (Gullberg & Holmqvist, 2006; McNeill, 1992) However, since gesture fixation does not infer information uptake (Gullberg & Kita, 2009), perhaps a better explanation is that participants were more socially 'engaged' with the speaker. It has been suggested that people are more likely to gesture in communicative situations (Beattie & Shovelton, 2002; Cohen & Harrison, 1973; Rime, 1982) and, in particular, in live face-to-face situations (Bavelas, et al., 2008). Perhaps listeners are simply more used to seeing gestures in live situations and respond to them more effectively when presented live.



The gestures may also have had a unique way of influencing participants. Interestingly, some participants 'reproduced' gestures that had been conveyed to them by the interviewer to help them answer the question. i.e. when asked "*which jacket pocket did the man put the item in?*" a small number of participants replicated the interviewer's gesture (perhaps unknowingly) to help form an answer. To clarify that this gesture was produced in response to the interviewer, the gesture they performed varied according to the gesture they observed. i.e. participants replicated the "left inside" or "right outside" gesture in their respective conditions. Figure 5.9 shows screenshots from the interview of participants replicating the interviewer's gestures.



Figure 5.9: Screenshots from interview showing participants' replication of the interviewer's "left inside" (left) and "right outside" (right) pocket gestures

This observation is in line with the study by Broaders & Goldin-Meadow (2010) who also found that participants replicated misleading gestures presented to them to form an answer. Repeating the gesture may enhance the representation conveyed by the gesture, enabling participants to experience it themselves, making it potentially a very powerful effect in live interviews.

The extent of an interviewer's influence through gesture remains an open question. In this study, the interviewer did not use any methods to draw attention to gestures; he used no deictic expressions (Nobe, et al., 1998; Streeck, 1993) or speaker-fixated gestures (Goodwin, 1986; Streeck, 1993). If such methods were used, participants would be expected to attend to the gestures more often (Goodwin, 1986; Gullberg & Kita, 2009). These gestures would also be more likely to be processed intuitively through a 'top-down' fixation (Gullberg & Kita, 2009) and, consequently, the participant may become more aware that the gesture conveys

critical information. As gesture can be the only source of specific information (Kendon, 1980), as they were in this study, gleaning information from them would have been necessary to acquiring the critical response. However, for this very reason, participants may also be more likely to reject this information on the grounds that they are aware it contains ambiguous or erroneous information, and suggesting information subtly is the most effective way to skew responses. The willingness or reluctance to accept information conveyed by gesture may also depend on the participant's receptivity to the interviewer. The effect of interviewer behaviour is discussed in more detail below.

One methodological limitation of this study concerned the lack of controls in relation to previous studies. While the interviewer made every attempt to keep his behaviour and questioning consistent during the experiment, there was no guarantee that all his gestures were performed identically to all participants (particularly as the study was conducted over a period of two months). However, the similarity in results to the previous study (that employed a more controlled method of keeping the gestures consistent for all participants) would suggest the lack of controls did not impair the results. It could also be argued that slight differences in behaviour were necessary to accommodate for varying behaviour across participants, although the interviewer's behaviour was thought to be consistent throughout the whole experiment. The interviewer's gestures were also rehearsed and produced consciously and were therefore not akin to normal, speech-accompanying gestures. However, a number of studies have also studied the communicative effects of rehearsed gestures (Cassell, et al., 1999; Kelly, et al., 1999). It is worth considering also that meaning can be conveyed through spontaneous, speech-accompanying gestures even if they are not produced with communicative intent (Rauscher, et al., 1996).

Another limitation concerns the difficulty in replicating the pressure felt by witnesses to provide accurate eyewitness testimony in a real life situation. Participants were aware that they were taking part in a psychology experiment and, as such, were under no legal obligations to provide accurate information. It could be argued that, with no consequences for giving false information, participants would be more willing to comply with the information suggested to them in gestures knowing there would be no harm in doing so. However, the results suggested that participants who were aware of the gesture actively rejected the information conveyed by it. Moreover, witnesses in real interviews can be made to feel anxious or uncertain (Bain & Baxter, 2000) and, with perception of greater expertise (Smith & Ellsworth, 1987) and obedience to authority figures (Milgram, 1974), they may be more

sensitive to information provided by the interviewer (Semin & Poot, 1997). In this sense, the effects of the study may be understated. Participants that are aware the gesture is conveying ambiguous information may be more inclined to accept this information if it is delivered by a figure of authority rather than a psychologist whom they may believe is attempting to deceive them.

Further research explains that emotional distance between the interviewer and the witness has an effect on suggestibility (Baxter & Boon, 2000; Irving, 1980) and interviewers with a friendly demeanour are less influential than those that are more abrupt (Bain & Baxter, 2000). The cognitive interview technique highlights the importance of being welcoming to witnesses (Geiselman, et al., 1984). However, if witnesses are more likely to engage with the interviewer socially, while still respecting their authority, this may make them more vulnerable to suggestions from their gestures in an interview.

While much research has identified the susceptibility to witnesses to biased questioning (Fisher, et al., 1987; Harris, 1973; Loftus, 1975, 1979), the focus of this study was to investigate susceptibility to misleading gesture under the same conditions. The interview technique employed in this study resembled that of the cognitive interview (Geiselman, et al., 1984) and followed the guidelines of interview conduct in the UK today. In accordance with this method, participants were greeted by the interviewer and provided him with a statement of the crime they had witnessed. During the interview, the interviewer than 'reconstructed' the scene to the participant by repeating key observations, and interjected this with questions to cue memories of the scene throughout (Fisher, et al., 2002; Tulving, 1974). The use of gestures at this stage in the interview was important, as gestures can be used to build on information in speech (Goldin-Meadow, et al., 1993; Kendon, 1980; Langton, et al., 1996) and facilitate story comprehension (Riseborough, 1981). Moreover, information that is contained in gesture independently can be integrated with speech (Cassell, et al., 1999; Kelly, et al., 1999). So, while the speech of the interviewer may not contain leading information, the gestures that accompany it may still. This study highlights a situation when witnesses can be misled through gesture, even when the interviewer still appears to adhere to the correct interview protocol.

Unlike the previous studies, and in accordance with interview procedure, participants had the opportunity to review their responses during a summary of the interview. This allowed participants the opportunity to clarify their answer before committing to them. As a

consequence of this interview technique, the number of incorrect or false responses given by participants (containing information not conveyed by gesture) was relatively low (under 15%). This relatively low figure clarifies that the cognitive interview technique, in the absence of misleading gesturing, appears to facilitate accurate, unbiased testimony (Geiselman, et al., 1984; Kebbell, et al., 1999; Köhnken, et al., 1999). However, after seeing a misleading gesture the number of incorrect or skewed responses more than doubled (30%). Therefore, while the cognitive interview may reduce the effect of misleading questioning, witnesses still appear to be susceptible to misleading gestures from the interviewer.

Measures of participants' susceptibility to misleading gestures were given through the study of suggestibility scores obtained from the GSS2 Gudjonsson Suggestibility Scale (Gudjonsson, 1984, 1997). Initially, it was found that participants who endorsed the misleading gestures were more suggestible than those that did not. Although a trend was apparent, there was no significant distinction in suggestibility between participants that gave information conveyed by the gesture and those that did not. Hence, while suggestibility scores can be a reliable indicator of susceptibility to biased questioning (Henry & Gudjonsson, 2003; Muris, et al., 2004; Smith & Gudjonsson, 1995), this measure is not as effective at identifying susceptibility to misleading gestures.

Initially, the study confirmed findings of previous research regarding gesture recall and recognition: Participants that gave responses conveyed in gesture were less likely to recall or recognise the gesture afterwards than those that did not. This provides further evidence that the gesture is most effective at skewing judgements when occurring outside of a listener's awareness.

In summary, the results of the study show that adhering to the principles of a cognitive interview may reduce susceptibility to misleading questions (Geiselman, et al., 1984; Kebbell, et al., 1999; Köhnken, et al., 1999), but still leaves the 'witness' susceptible to misleading gestures. Further to this, while measures of suggestibility give insight into the reliability of witnesses (Henry & Gudjonsson, 2003; Muris, et al., 2004; Smith & Gudjonsson, 1995) and their likeliness of being skewed by misleading questions, these measures cannot predict susceptibility to gestural influence. The results of gesture recall and recognition in relation to witness suggestibility provide further evidence that gestures can convey critical information and often cannot be identified or separated from speech (Cassell,

et al., 1999; Goldin-Meadow, et al., 1992; Kelly, et al., 1999; Kelly & Church, 1998), implying that they do occur outside of the witness's awareness. In light of this, the study provides evidence that witnesses are still highly susceptible to, and unaware of, misleading gesture in interviews.

## Chapter 6 :

# Summary, Discussion & Conclusions

The aim of this thesis was to investigate the extent to which a police interviewer's hand gestures can skew the responses of an eyewitness under questioning. In addition, the research considered the process through which this influence occurs and how these findings related to previous research on misleading questioning. Study 1 initially approached this question by examining whether participants' responses could be influenced by a police questioner appearing to them on screen. The experiment examined whether participants' responses would concur with information conveyed to them in gesture, and studied which of his gestures in particular were most effective at skewing responses. Study 2 built on this by testing not only how participants' responses varied according to the gesture presented to them, but also how the gesture affected the confidence of their responses. This study used confidence scores as a way of understanding whether participants knowingly extracted information from gesture to formulate their responses. To explore further whether gestures skewed participants' responses outside of their awareness, study 3 investigated whether participants knowingly processed the gesture for information: Participant's ability to recall or recognise the gesture was measured, as well as whether they fixated on the gestures as they were performed. Finally, study 4 investigated whether the findings from the previous studies, with regards to influence, could be replicated in more ecologically valid face-to-face interview scenario. This study also investigated a possible relationship between an individual's suggestibility score and their susceptibility to misleading gestures. The results of these studies combined and their theoretical relevance are discussed in this chapter. The chapter will also locate these findings within the literature, discuss their implications and present directions for future study.

## Gestures as a form of influence

Can gestures influence witnesses? While much research has found that the testimony of eyewitnesses can be affected by information conveyed to them verbally (Harris, 1973; Loftus, 1975, 1979; Loftus & Palmer, 1974), the first aim of this research was to investigate whether

witnesses' responses could also be affected by information conveyed in gesture. A large body of research confirms that gestures are communicative (Kendon, 2004; McNeill, 1992) and can convey information that is absent from speech (Cassell, et al., 1999; Kelly, et al., 1999; Kendon, 1980). The results of all studies here find considerable support that this additional information from gesture can be conveyed to witnesses and subsequently affect their responses.

The results of study 1 found that participants were most susceptible to iconic gestures that conveyed information independent of speech. (i.e. a mimetic gesture of a hand pinching an opposing finger could be interpreted as meaning 'a ring' without any direction from speech.) In contrast, gestures that depended on speech for meaning were not as effective (i.e. an arbitrary gesture of two hands moving together quickly required speech describing how fast two cars were travelling to convey meaning). The former gesture concurs with the '*additive contribution hypothesis*' (Kelly, et al., 1999) which states that gestures are most effective at communicating information when they can be understood independently of speech. To confirm, similar observations were found in the following studies 3 and 4: The gestures in these experiments were able to suggest clear details of a man's physical appearance (by signalling a beard) and whether he was wearing additional clothing (signalling gloves).

A characteristic of these gestures is that they are highly semantic (and usually symbolic) in nature; they provided clear pictorial representations of physical items, rather than presenting abstract ideas or concepts. Neurological research demonstrates that meaningful iconic gestures are processed linguistically, much like speech (Decety, et al., 1997) unlike other, arbitrary hand movements (Hubbard, et al., 2009). Moreover, how a gesture is processed depends on its semantic context (Willems, et al., 2007); that is, observing more meaningful gestures activates the same brain regions as listening to speech. Therefore, the more meaningful a gesture alone is, the more likely it is to convey a message to listeners.

This study confirms that gestures can communicate information to listeners (Alibali, et al., 1997; Goldin-Meadow, 1999; Graham & Argyle, 1975) and that they can use the information from gesture and integrate it into their representation of speech (Cassell, et al., 1999; Kelly, et al., 1999). In the context of a conversation this effect is usually a positive one, enhancing the communication. However, this research has demonstrated that the effect can have detrimental consequences: In the context of eyewitness testimony, a questioner could convey false, misleading information to witnesses through gesture, altering their memory of the event and

causing them to report false information. From the significant findings obtained across all studies, this research concludes that misleading gestures can distort eyewitnesses testimony particularly when the gesture conveys meaningful information independent of speech.

## When gestures can influence

This section considers when gestures were most influential; in what situations did the gestures influence and who was most susceptible to them? The questioner's gestures were able to skew the responses of participants over a variety of scenarios. Firstly, gestures were able to confirm information about the scene (and cause more participants to report accurate information about what they saw in the video) and suggest false information (causing participants to report inaccurate information about the video). The 'ring' gesture prompted more participants to identify the ring correctly when it was present in the scene (studies 1 and 2) but also caused more people to incorrectly respond that they had seen a ring when none was present (studies 3 and 4). Thus, the gestures were able to both confirm accurate information about the scene and implant false information.

Across this research, a number of different methodologies were adopted to cater for experimental limitations. One limitation of this research was that it was not possible to replicate the experience of witnesses who are likely to feel anxious or uncertain under questioning (Bain & Baxter, 2000). Furthermore, another challenge to ensure the same ambiguous information was presented to all participants, as well as ensuring consistency in gesture presentation throughout. To address these points, the studies used standardised presentation and a controlled methodology to ensure all participants were subjected to the same questioning experience. This was achieved by using pre-recorded video footage for the stimuli and, for most studies (1 to 3), video footage of the 'police' questioner gesturing.

In the interest of balancing experimental controls with ecological validity, the extent to which gestures could influence responses was studied across different situations. The questioner's hand gestures continued to influence the responses of participants when they responded from their own free recall (studies 1 and 4) or in response to a given answer set (studies 2 and 3). Most significantly, participants continued to be influenced by the gestures when they were performed by a questioner live, face-to-face (study 4) as well as through the pre-recorded videos (studies 1 to 3). The persistence of the effect of gestures on participants' responses



across these situations implies that the effect is robust and is not limited to a single, novel scenario.

This research also considered, in part, who was most susceptible to the misleading gestures. Participants from a range of demographic groups (including different genders and age ranges) were influenced and those working in the legal profession were similarly affected. Study 3 discovered that trainee lawyers appeared to be just as susceptible to the effects of misleading gestures, despite their knowledge of the law and training into the use of nonverbal communication in their work. Individual differences in suggestibility did not appear to account for the effects either. Study 4 found no significant difference in suggestibility scores, measured by the Gudjonsson Suggestibility Scale (Gudjonsson, 1984, 1997), between those who were influenced by the gesture and those that were not. Previous research has shown that suggestibility scores can predict susceptibility to verbal suggestions from the interviewer (Gudjonsson, 1987; Henry & Gudjonsson, 2003; Smith & Gudjonsson, 1995), though this effect does not appear to extend to gestures. (Thus, current suggestibility measures may only account for verbal influence, rather than considering suggestibility as a global construct.) This evidence suggests that gestural influence can affect a wide range of people, and is not limited to those vigilant against verbal suggestion. This also raises questions into how subtle gesture influence is, and whether gestures can influence listeners outside of their awareness. This topic will be discussed in more detail later.

## Validity of research

All of the studies in this thesis provide evidence that a witnesses' response can be skewed by gesture. The previous sections highlight that this effect can extend to different situations, however, there may also be other factors which contribute to susceptibility to gesture. Therefore, these effects might only be capturing a small part of what could be an even larger effect, and the findings of this research may be understated.

Firstly, this research focused mainly on well-educated individuals (university students, and lawyers) who may have possessed some knowledge of eyewitness suggestibility research and be more likely to have understood the intentions of the experiment. Witnesses to real life crimes are likely to be more naive to such influence and are not likely to approach an interview equipped with such knowledge and vigilance against being misled. Furthermore,

research highlights that witnesses are more sensitive to information suggested to them by a police interviewer (Semin & Poot, 1997; Smith & Ellsworth, 1987), with greater anxiety or uncertainty (Bain & Baxter, 2000) and pressure to provide useful testimony. Participants also signed up to the studies knowing they would be taking part in an eyewitness testimony experiment. Upon arrival, they were forewarned that they would see a piece of crime scene footage and were instructed that they would be questioned on it shortly afterwards. Under this unique situation, participants would be able to process the facts of the video intuitively and without the pressure that would be present in observing a real crime. Research in this area has shown that witnesses are less accurate at recalling details of a crime scene observed in real life than through video (Clifford & Hollin, 1981; Clifford & Scott, 1978; Ihlebæk, Løve, Eilertsen, & Magnussen, 2003; Yuille & Cutshall, 1986). In addition, participants were questioned immediately after seeing the 'crime scene' (albeit, separated with a short distracter task) though witnesses to real life crimes are not likely to be interviewed until a few days after the event occurred. This becomes a significant discussion point as witnesses become more susceptible to suggestions as their memory of the event decays (Kassin, Ellsworth, & Smith, 1989; Penrod, Loftus, & Winkler, 1982). Thus, the influence of gesture may become inflated with time.

The fact that significant results were obtained in light of these discussion points adds weight to the findings, and suggests that the effects observed in these studies are likely to be just as powerful in real-life interview situations as in an experimental setting. However, it is important also to consider factors which may mediate this effect. If participants were aware that information had been conveyed to them through gesture they may be more inclined to resist or reject it. The consequences of giving inaccurate testimony are far more serious in a real forensic interview than a psychology study and, as such, participants may be more cautious about giving testimonies they are unsure about. Despite this, suggestibility of witnesses under questioning can still be very powerful, and a large number of wrongful convictions have been given on the basis of inaccurate eyewitness testimony (Gross, et al., 2005). If verbal influence can result in inaccurate testimony in real life situations then, under the evidence presented in this research, nonverbal influence may also. Suggestions from questioning are thought to distort actual memories of the event, rather than the information witnesses report from them (Loftus, 1979; Loftus & Loftus, 1980). Thus, witness report what they believe actually happened, not what they believe they should.

The studies in this research created a novel situation where the questioner performed gestures with the intention of communicating misleading information, but could police questioners perform gestures that convey biased information to listeners in a real interview? While some gestures (i.e. symbolic gestures) are produced with the intention of conveying information to listeners (Ekman & Friesen, 1972; McNeill, 1992), many gestures are produced spontaneously with speech (McNeill, 1992; Rauscher, et al., 1996). These gestures can still convey critical, semantic information (Kendon, 1980) that becomes integrated into the speakers message (Cassell, et al., 1999; Kelly, et al., 1999). Gesturing is also habitual (de Ruiter, 2000) and they may not be produced for a communicate purpose but, rather, to benefit the speaker (Frick-Horbury, 2002; Goldin-Meadow, et al., 2001; Krauss, et al., 2000). However, in this situation, they may still communicate information to listeners *incidentally* (Rauscher, et al., 1996). In addition, more gestures are produced in face-to-face situations (Bavelas, et al., 2008; Cohen & Harrison, 1973) and people are usually unaware that they are generating them (Cassell, 1998). Police officers may be eager, albeit unconsciously, for witnesses to testify certain information (e.g. the physical features of a particular suspect, or details of objects used in the crime) and have difficulty suppressing preconceived ideas (Ceci & Bruck, 1993). Therefore, critical information may 'leak' out in gesture and subtly influence witnesses, without the need for any biased questioning.

## The process of gesture influence

The effects observed in these studies lead one to question the mechanism by which gestures were able to skew responses, and to attempt to integrate this with research into verbal influence in misleading questioning. The '*misinformation effect*' (Loftus & Hoffman, 1989) explains how post-event information suggested to witnesses through questioning can become integrated with their original memory of the event. Thus, witnesses can confuse information suggested to them verbally with their original encoded memory. As imagery ability is related to susceptibility to false-memory creation (Drivdahl & Zaragoza, 2001; Zaragoza, et al., 2007), gestures may facilitate the creation of false memories through presentation of (misleading) visual information: Gestures communicate detailed visual information that is not articulated in speech (Cassell, et al., 1999; Goldin-Meadow, 1999; Graham & Argyle, 1975; Kendon, 1980). In this case, critical visual details can be communicated more effectively (and more covertly) through gesture. Thus, the gesture may suggest the imagery of a scene and

cause witnesses to confuse the semantic details conveyed to them through gesture with those actually witnessed. In this sense, gestures have even greater potency than speech in that they portray information covertly. Gestures are not readily noticed by participants; they occur as 'background elements' in conversation (Henderson & Hollingworth, 1999). Despite this, gestures are a powerful tool in communication and, even when produced spontaneously without communicative intent, they can still convey meaning to listeners (Rauscher, et al., 1996). A large body of research has demonstrated that gestures can help communicate information to listeners (Beattie & Shovelton, 1999a; Church & Goldin-Meadow, 1986; Goldin-Meadow, 1999; Graham & Argyle, 1975; Kelly, et al., 1999; Kendon, 1980) and this has been confirmed by the studies presented here. Not only this, but the gestures could also suggest information to influence accurate eyewitness testimony. The covert nature of gesture, along with the difficulty in identifying them retrospectively, appears to make them well situated to skew the responses of eyewitnesses in interviews.

### Awareness of gesture influence

If witnesses do give information that is consistent with an observed gesture, it is important to understand whether or not they are aware of the source of this information, i.e. that it was extracted from gesture. This section builds on the understanding of how gestures were able to mislead and considers further whether they influence witnesses in a more covert manner than verbal questioning. Study 3 investigated participants' awareness of gesture by studying gesture recall and recognition, as well as whether they fixated on the gesture as it was performed. Across all experiments, it was found that participants who gave the response conveyed in the gesture were less likely to recognise the gesture afterwards. This observation that gestures could convey information to participants without them visually identifying it was confirmed with the measure of gesture fixations. Similarly, participants that gave the responses conveyed in gesture were less likely to have fixated on it as it was performed. In accordance with previous research, it appeared that it is possible to glean information from gesture without having fixated it (Gullberg & Kita, 2009).

While study 2 revealed that gestures could increase confidence in inaccurate responses, further insight into an interaction of confidence between response and gesture fixation was considered in study 3. This interaction revealed that confidence in ('skewed') responses

conveyed by misleading gestures only increased when participants did not attend to (or fixate) the gestures. Thus, while there is little difference in the confidence judgements between participants that gave or did not give the 'skewed' responses when gesture was attended to, differences in confidence judgements are magnified between participants that give or do not give 'skewed' responses when the gesture is not attended to. Therefore, the results of study 3 (experiment 3) confirm an interaction in confidence scores between responses, but further suggest that confidence scores are only affected when the gesture is not attended to. These results imply that misleading gestures are most influential when occurring outside the awareness of witnesses. Moreover, this confirms that the influence of gesture is covert and subtle with the potential to alter the underlying representation of the witnessed event, rather than influencing at the moment of recall.

The suggestibility scores studied in study 4 add further weight to this finding. These scores indicate that those of a higher suggestibility are less likely to notice the gestures initially (based on the observation that those of lower suggestibility were able to recall and recognise more gestures). That is, those of lower suggestibility are more likely to identify the gesture and are subsequently more likely to resist the information conveyed by it. This implies that, while the gesture may alter the underlying representation of the witnessed event, it only does so when the witness is not aware that this biased information in gesture can become integrated into their memory of the event. Thus, those that are aware of the gesture, and can identify it, appear to be resistant to its effect and prevent it altering their representation of the event.

In summary, the influence of gesture does appear to occur outside of a witnesses' awareness; however, those of higher suggestibility are less likely to notice the gestures, and hence be more vulnerable or susceptible to the information conveyed in them.

## Indicators of gesture influence

If gestures can influence the responses of witnesses outside their awareness, it is important to identify when responses may have been given as a consequence of seeing a misleading gesture. Being able to identify when gesture-congruent responses have been given would help assess the credibility to witness's statements and subsequently benefit accurate testimony. This is an important issue for consideration as witnesses may want to comply with gestural

information from the interviewer if they believe it is useful, credible information (Semin & Poot, 1997; Smith & Ellsworth, 1987) even though it may result in inaccurate testimony. This may be heightened in a real police interview situation rather than a psychology experiment where participants may be vigilant against such information and are more likely to resist or reject it. This section considers a range of indicators for when gestures skewed responses, including participants reports of feeling misled and their ability to identify gestures that had been presented to them afterwards (studies 3 and 4). The confidence ratings attributed to responses (study 2) and suggestibility scores were also considered to help address this question (study 4).

Initially, participants' self reported feelings of being misled by the questioner appeared to give an accurate reflection of whether their response had been skewed by gesture. Many participants that had given a response conveyed to them through gesture reported feeling misled by the questioner during the experiment (studies 3 and 4). However, participants' recall of gestures that had been presented to them was relatively poor. Thus, while participants could identify that they had been misled, there were unable to identify the gesture which had caused them to. (This supports the earlier observation that the gesture itself goes unnoticed by participants when they report the information conveyed by it.) While recognition of gestures was improved, it would not be feasible in real-life interviews to provide witnesses with images of gestures to recognise without video footage. Thus, relying on participants recall (or recognition) of gesture does not appear to be an appropriate method of identifying when misleading gestures have skewed responses.

Misleading gestures caused participants to be more confident in incorrect responses (study 2), confirming that a link between confidence and accuracy of testimony is unreliable (Brewer, et al., 2002; Deffenbacher, 1980; DePaulo, et al., 1997; Sporer, et al., 1995). Therefore, depending on confidence ratings to assess the legitimacy of a witness's testimony, or as an indicator that their answers have been influenced would not be advisable. The Gudjonsson Suggestibility scales have shown to be a reliable measure of witness susceptibility to misleading questioning (Gudjonsson, 1987; Henry & Gudjonsson, 2003; Muris, et al., 2004; Smith & Gudjonsson, 1995), though do not provide a reliable measure of witness susceptibility to misleading gestures (study 4). A trend between suggestibility scores and 'resistance' to misleading gesture is apparent, but not significant.

In summary, while there appears to be many potential indicators of when responses have been given as a consequence of a misleading gesture, these indicators only provide limited information about when a gesture has skewed a response. The inability to rely on such indicators to give information on whether gestures have affected witnesses' responses confirms their subtle nature in influence and highlight the need to consider video tape surveillance in witness interviews to identify when possible influence has occurred.

## Overall conclusions

This research asked whether eyewitnesses to a crime could have their memory and testimony skewed by a police interviewer's hand gestures during questioning. The results revealed that people often reported inaccurate information that had been conveyed to them through gesture, supporting the claim that gestures can affect accurate eyewitnesses testimony. Gestures were also found to increase confidence in the inaccurate responses they conveyed, presumably leaving a strong representation in memory. In addition, the process through which gestures skew responses appears more covert than the process of misleading witnesses through biased questioning, particularly as gestures were most influential when participants could not identify them. The present research has demonstrated that people often struggle to identify gestures retrospectively and that the influence of gesture is at its strongest when unnoticed. These observations lend support to the claim that gestures influence responses of witnesses outside of their awareness and highlight the difficulty in identifying when gestural influence has occurred. While suggestibility measures can give some insight into vulnerability to biased questioning, due to the covert nature of gesture influence, these should not be considered robust measures of susceptibility to misleading gesture. Overall, this research warns of the powerful influence gestures can exert on witnesses during questioning. Consequently, this research urges caution in the future of interview conduct, and argues for the use of video surveillance in interviews. The UK Police and Evidence Criminal Act (PACE) already issue guidelines for video-recording of interviews (PACE guidelines, Code F). However, at present, the guidelines concern only the interviewing of suspects (Point 3.1) rather than witnesses and, due to this, state that the camera should face away from the interviewer (Points 2.5 and 2.6) to protect their identify (Note 2E). At present, the guidelines do not take into consideration the role of hand gestures (or any nonverbal communication) during interviews. The evidence presented in this thesis provides a case for why this practice should

extend to interviewing witnesses and why a visual record of the questioner's gestures during the interview could have utility. If PACE guidelines would accommodate this, whenever there was any doubt over a witness's testimony, the videos could be analysed retrospectively for any gesture influence.

## Directions for future study

The research in this thesis brought together two major lines of research; the susceptibility of eyewitnesses to misleading questioning and the role of gestures in communication. By integrating these two areas, this thesis explored a unique research question of whether hand gestures could influence eyewitness under questioning. The studies here present considerable support that a witness's responses can concur with inaccurate information conveyed to them through a questioner's gesture. Given these results and their potential implications, there is an imperative to conduct further research, both to confirm the results reported here and to answer the outstanding questions generated by this research.

Initially, further research could explore what other information could be conveyed through gesture. Study 1 showed that gestures were particularly effective in suggesting the presence of physical objects above abstract concepts. This was confirmed in study 3, which found gestures could also suggest physical characteristics of a culprit. Gestures may also be able to suggest other critical features of suspects (perhaps a scar, a birthmark, or an earring), and consequently lead to an incorrect identification from an eyewitness. Gestures may also suggest the presence of significant objects (such as weapons) and, if actions could be suggested through gesture (Cassell, et al., 1999; Study 4), the way these objects may have been used.

Individual differences of witnesses could be explored further to ascertain what type of individual is most or least susceptible to gesture influence. Study 4 found that differences in suggestibility scores do not predict susceptibility to gesture, though a more thorough analysis could investigate differences in susceptibility between genders and ages or ethnic groups and their response to interviewers of different demographics. This research could focus on people who may be more 'vulnerable' to gesture influence, such as those with a low IQ or learning difficulties.



Secondly, research could investigate further the process through which gestures influence in a real interview situation. Is information from spontaneous gesture 'accepted' by witnesses when interviewed in a real life scenario, and would gestures continue to influence covertly? If witnesses attribute more trust to police interviewers that are credible (Semin & Poot, 1997; Smith & Ellsworth, 1987), they could direct attention to gestures through speaker-fixated gestures (Gullberg & Kita, 2009) or deictic expressions (Nobe, et al., 1998) and thus, may also be able to suggest information more overtly. However, if witnesses approach interviews with anxiety or uncertainty (Bain & Baxter, 2000) it is unclear at present whether this would enhance or reduce the effect of gesture influence.

This leads to the question of the robustness of a representation that has been suggested through gesture. If memories are constructed (Loftus & Hoffman, 1989) and information from gesture can become integrated into memory of a story (Cassell, et al., 1999), the representation held may not be so fragile. This is particularly likely given that false information conveyed through gesture is held with confidence (as found in study 2), much the same as false memories (Loftus, et al., 1989). To test how robust the representation left by gesture is, future research could confirm whether participants remember this information and retell the event with the conveyed information present in the story (Cassell, et al., 1999; Kelly, et al., 1999). Studies could also test how stable this representation is over time and whether it stands up to repeated interrogation.

Finally, research in this area could also study the benefits of gestures in an interview; in particular, the gestures performed by witnesses. People generate gestures to help them remember details of events that they have observed (Miller, Cho, & Bracey, 2005) and, while they may serve as a retrieval tool for the speaker, they may also communicate information to listeners (Krauss, et al., 2000; Rauscher, et al., 1996). Broaders & Goldin-Meadow (2010) highlight the importance of documenting these gestures in order to acquire more information from a witness when giving a statement. Gestures may convey additional, critical information that is not contained in their speech and hence not available in an audio transcript of the interview. Documenting these gestures could also clarify whether the idea was manifested by the interviewer or witness. So an interviewer asking "*did you see any glasses?*" in response to seeing a witness silently gesturing glasses to aid their recall could be mistaken as a leading question. (When presented with an audio transcript of this interview, it may seem that the interviewer has suggested the glasses, when the idea originated from the witness.) Research could study the gestures produced by witness when questioned, and see if useful, accurate

information can be acquired from them. If gestures can serve as cues to memory (Church, et al., 2007), could witnesses be encouraged to gesture, and would this benefit accurate testimony?

However, witnesses may also 'copy' misleading gestures performed to them and report the false information they convey, as found by previous research (Broaders & Goldin-Meadow, 2010) and study 4 reported here. To investigate this further, it would be important to understand the factors that influence this gesture mimicking (whether they are more likely to mimic speaker-fixated gestures, for instance) and the extent to which this may alter their representation of the witnessed event.

Ultimately, these points could be considered in light of the observations presented in this thesis. Findings from this current and future research could lead to revision of the UK PACE guidelines for interviewing witnesses, prompting documentation of gestures, in order to become more vigilant against the effects of misleading gesture in police interviews.

## References

- Alibali, M. W., Flevares, L. M., & Goldin-Meadow, S. (1997). Assessing knowledge conveyed in gesture: Do teachers have the upper hand? *Journal of Educational Psychology, 89*(1), 183-193.
- Alibali, M. W., Heath, D. C., & Myers, H. J. (2001). Effects of visibility between speaker and listener on gesture production: Some gestures are meant to be seen. *Journal of Memory and Language, 44*(2), 169-188.
- Alibali, M. W., Kita, S., & Young, A. J. (2000). Gesture and the process of speech production: We think, therefore we gesture. *Language and Cognitive Processes, 15*(6), 593-613.
- Andersen, R. (1995). Coordinate transformations and motor planning in posterior parietal cortex. *The Cognitive Neurosciences, 519-532*.
- Argyle, M., & Cook, M. (1976). *Gaze and Mutual Gaze*: Cambridge University Press Cambridge.
- Argyle, M., & Graham, J. (1976). The central Europe experiment: Looking at persons and looking at objects. *Journal of Nonverbal Behavior, 1*(1), 6-16.
- Baddeley, A. D. (1986). *Working Memory*. USA: Oxford University Press.
- Bain, S., & Baxter, J. (2000). Interrogative suggestibility: the role of interviewer behaviour. *Legal and Criminological Psychology, 5*(1), 123-133.
- Bates, E., Benigni, L., Bretherton, I., Camaioni, L., & Volterra, V. (1979). *The emergence of symbols: Cognition and communication in infancy*. New York: Academic Press.
- Bavelas, J., Coates, L., & Johnson, T. (2002). Listener responses as a collaborative process: The role of gaze. *Journal of Communication, 52*(3), 566-580.
- Bavelas, J., Gerwing, J., Sutton, C., & Prevost, D. (2008). Gesturing on the telephone: Independent effects of dialogue and visibility. *Journal of Memory and Language, 58*(2), 495-520.
- Baxter, J., & Boon, J. (2000). Interrogative suggestibility: The importance of being earnest. *Personality and Individual Differences, 28*(4), 753-762.
- Beattie, G., & Coughlan, J. (1999). An experimental investigation of the role of iconic gestures in lexical access using the tip-of-the-tongue phenomenon. *British Journal of Psychology, 90*(1), 35-56.

- Beattie, G., & Shovelton, H. (1999a). Do iconic hand gestures really contribute anything to the semantic information conveyed by speech? An experimental investigation. *Semiotica*, 123(1-2), 1-30.
- Beattie, G., & Shovelton, H. (1999b). Mapping the range of information contained in the iconic hand gestures that accompany spontaneous speech. *Journal of Language and Social Psychology*, 18(4), 438-462.
- Beattie, G., & Shovelton, H. (2002). An experimental investigation of some properties of individual iconic gestures that mediate their communicative power. *British Journal of Psychology*, 93, 179–192.
- Beattie, G., & Shovelton, H. (2005). Why the spontaneous images created by the hands during talk can help make TV advertisements more effective. *British Journal of Psychology*, 96(1), 21-37.
- Benton, T., Ross, D., Bradshaw, E., Thomas, W., & Bradshaw, G. (2006). Eyewitness memory is still not common sense: Comparing jurors, judges and law enforcement to eyewitness experts. *Applied Cognitive Psychology*, 20(1), 115-129.
- Berger, J. D., & Herring, L. G. (1991). Individual differences in eyewitness recall accuracy. *Journal of Social Psychology*, 131(6), 807-813.
- Bernardis, P., & Gentilucci, M. (2006). Speech and gesture share the same communication system. *Neuropsychologia*, 44(2), 178-190.
- Bernardis, P., Salillas, E., & Caramelli, N. (2008). Behavioural and neurophysiological evidence of semantic interaction between iconic gestures and words. *Cognitive Neuropsychology*, 25(7), 1114-1128.
- Bornstein, B. H., & Zickafoose, D. J. (1999). "I Know I Know It, I Know I Saw It": The Stability of the Confidence-Accuracy Relationship Across Domains. *Journal of Experimental Psychology Applied*, 5, 76-88.
- Bradfield, A. L., & Wells, G. L. (2000). The perceived validity of eyewitness identification testimony: A test of the five biggers criteria. *Law and Human Behavior*, 24(5), 581-594.
- Braun, K. A., Ellis, R., & Loftus, E. F. (2001). Make my memory: How advertising can change our memories of the past. *Psychology and Marketing*, 19(1), 1-23.
- Brewer, N., Keast, A., & Rishworth, A. (2002). The confidence-accuracy relationship in eyewitness identification: The effects of reflection and disconfirmation on correlation and calibration. *Journal of Experimental Psychology*, 8(1), 44-56.

- Brewer, N., Potter, R., Fisher, R. P., Bond, N. W., & Luszcz, M. A. (1999). Beliefs and data on the relationship between consistency and accuracy of eyewitness testimony. *Applied Cognitive Psychology, 13*, 297-313.
- Brigham, J. C. (1990). Target person distinctiveness and attractiveness as moderator variables in the confidence-accuracy relationship in eyewitness identifications. *Basic and Applied Social Psychology, 11*(1), 101-115.
- Broaders, S. C., & Goldin-Meadow, S. (2010). Truth is at hand: How gesture adds information during investigative interviews. *Psychological Science, 21*(5), 623-628.
- Brown, A. S. (1991). A review of the tip-of-the-tongue experience. *Psychological Bulletin, 109*(2), 204-223.
- Bruck, M., & Ceci, S. J. (1999). The suggestibility of children's memory. *Annual Review of Psychology, 50*(1), 419-439.
- Buccino, G., Lui, F., Canessa, N., Patteri, I., Lagravinese, G., Benuzzi, F., et al. (2004). Neural circuits involved in the recognition of actions performed by nonconpecifics: an fMRI study. *Journal of Cognitive Neuroscience, 16*(1), 114-126.
- Butcher, C., & Goldin-Meadow, S. (2000). Gesture and the transition from one-to two-word speech: When hand and mouth come together. *Language and Gesture, 28*(2), 235-257.
- Butterworth, B., & Hadar, U. (1989). Gesture, speech, and computational stages: a reply to McNeill. *Psychological Review, 96*(1), 168-174.
- Cassel, J. (2000). *Elements of Face-to-Face Conversation for Embodied Conversational Agents, Embodied Conversational Agents*: MIT Press.
- Cassell, J. (1998). A framework for gesture generation and interpretation. *Computer Vision in Human-Machine Interaction, 191-215*.
- Cassell, J., McNeill, D., & McCullough, K. E. (1999). Speech-gesture mismatches: Evidence for one underlying representation of linguistic and nonlinguistic information. *Pragmatics and Cognition, 7*, 1-34.
- Ceci, S. J., & Bruck, M. (1993). Suggestibility of the child witness: A historical review and synthesis. *Psychological Bulletin, 113*, 403-403.
- Chawla, P., & Krauss, R. M. (1994). Gesture and speech in spontaneous and rehearsed narratives. *Journal of Experimental Social Psychology, 30*(6), 580-601.
- Chu, M., & Kita, S. (2008). Spontaneous gestures during mental rotation tasks: Insights into the microdevelopment of the motor strategy. *Journal of Experimental Psychology: General, 137*(4), 18.

- Church, R. B., Garber, P., & Rogalski, K. (2007). The role of gesture in social communication and memory. *Gesture*, 7, 137-157.
- Church, R. B., & Goldin-Meadow, S. (1986). The mismatch between gesture and speech as an index of transitional knowledge. *Cognition*, 23(1), 43-71.
- Clark, H. H. (1996). *Using language*: Cambridge: Cambridge University Press.
- Clifford, B., & Hollin, C. (1981). Effects of the type of incident and the number of perpetrators on eyewitness memory. *Journal of Applied Psychology*, 66(3), 364-370.
- Clifford, B., & Scott, J. (1978). Individual and situational factors in eyewitness testimony. *Journal of Applied Psychology*, 63(3), 352-359.
- Cohen, A. A., & Harrison, R. P. (1973). Intentionality in the use of hand illustrators in face-to-face communication situations. *Journal of Personality and Social Psychology*, 28(2), 276-279.
- Connors, E. (1996). *Convicted by juries, exonerated by science: Case studies in the use of DNA evidence to establish innocence after trial*. Washington, DC: US Government Printing Office.
- Craik, F. I. M. (1979). Human memory. *Annual review of psychology*, 30(1), 63-102.
- Crombag, H., Wagenaar, W., & Van Koppen, P. (1999). Crashing memories and the problem of 'source monitoring'. *Applied Cognitive Psychology*, 10(2), 95-104.
- Cutler, B. L., & Penrod, S. D. (1989). Moderators of the confidence-accuracy correlation in face recognition: The role of information processing and base-rates. *Applied Cognitive Psychology*, 3(2), 95-107.
- Cutler, B. L., Penrod, S. D., & Dexter, H. R. (1990). Juror sensitivity to eyewitness identification evidence. *Law and Human Behavior*, 14(2), 185-191.
- Cutler, B. L., Penrod, S. D., & Stuve, T. E. (1988). Juror decision making in eyewitness identification cases. *Law and Human Behavior*, 12(1), 41-55.
- Davis, M., & Markus, K. A. (2006). Misleading cues, misplaced confidence: An analysis of deception detection patterns. *American Journal of Dance Therapy*, 28(2), 107-126.
- de Ruiter, J. P. (1995). Why do people gesture at the telephone. *Proceedings of the Center for Language Studies Opening Academic Year*, 96, 49-56.
- de Ruiter, J. P. (1998). *Gesture and speech production*. Nijmegen, The Netherlands: MPI Series in Psycholinguists.
- de Ruiter, J. P. (2000). The production of gesture and speech. In A. Kendon (Ed.), *Gesture: An emerging field* (pp. 284-311). New Haven: Yale University Press.

- Decety, J., & Grezes, J. (1999). Neural mechanisms subserving the perception of human actions. *Trends in Cognitive Sciences*, 3(5), 172-178.
- Decety, J., Grezes, J., Costes, N., Perani, D., Jeannerod, M., & Procyk, E. (1997). Brain activity during observation of actions. Influence of action content and subject's strategy. *Brain*, 120, 1763-1777.
- Deffenbacher, K. A. (1980). Eyewitness accuracy and confidence. *Law and Human Behavior*, 4(4), 243-260.
- Deffenbacher, K. A., & Loftus, E. F. (1982). Do jurors share a common understanding concerning eyewitness behavior? *Law and Human Behavior*, 6(1), 15-30.
- DePaulo, B. M., Charlton, K., Cooper, H., Lindsay, J. J., & Muhlenbruck, L. (1997). The accuracy-confidence correlation in the detection of deception. *Personality and Social Psychology Review*, 1(4), 346-357.
- Dittman, A. T., & Llewellyn, L. G. (1969). Body movements and speech rhythm in social conversation. *Journal of Personality and Social Psychology*, 11, 98-106.
- Dobson, M., & Markham, R. (1993). Imagery ability and source monitoring: Implications for eyewitness memory. *British Journal of Psychology*, 32, 111-118.
- Drivdahl, S., & Zaragoza, M. (2001). The role of perceptual elaboration and individual differences in the creation of false memories for suggested events. *Applied Cognitive Psychology*, 15(3), 265-281.
- Duncan, S. (1974). Some signals and rules for taking speaking turns in conversations. *Journal of Personality and Social Psychology*, 23, 283-292.
- Efron, D. (1972). *Gesture, race and culture; a tentative study of the spatio-temporal and "linguistic" aspects of the gestural behavior of eastern Jews and southern Italians in New York City, living under similar as well as different environmental conditions.* The Hague: Mouton.
- Ekman, P., & Friesen, W. V. (1969). The repertoire of nonverbal behavior: Categories, origins, usage, and coding. *Semiotica*, 1, 49-98.
- Ekman, P., & Friesen, W. V. (1972). Hand movements. *The Journal of Communication*, 22(4), 353-374.
- Fadiga, L., Craighero, L., Buccino, G., & Rizzolatti, G. (2002). Short communication speech listening specifically modulates the excitability of tongue muscles: a TMS study. *European Journal of Neuroscience*, 15, 399-402.
- Farah, M. (2000). *The cognitive neuroscience of vision*: Blackwell Publishing.

- Fehr, B., & Exline, R. (1987). Social visual interaction: A conceptual and literature review. *Nonverbal Behavior and Communication*, 2, 225-326.
- Feyereisen, P., Van de Wiele, M., & Dubois, F. (1988). The meaning of gestures: What can be understood without speech? *Cahiers de Psychologie Cognitive*, 8(1), 3-25.
- Fisher, R., Brennan, K., & McCauley, M. (2002). The cognitive interview method to enhance eyewitness recall. In M. Eisen, J. Quas & G. Goodman (Eds.), *Memory and Suggestibility in the Forensic Interview*. (pp. 265-286). Mahwah, New Jersey: Lawrence Erlbaum Associates.
- Fisher, R., & Geiselman, R. (1992). *Memory-enhancing techniques for investigative interviewing: The cognitive interview*. Springfield: Charles C. Thomas.
- Fisher, R., Geiselman, R., & Raymond, D. (1987). Critical analysis of police interview techniques. *Journal of Police Science and Administration*, 15(3), 177-185.
- Freedman, N., O'Hanlon, J., Oltman, P., & Witkin, H. (1972). The imprint of psychological differentiation on kinetic behavior in varying communicative contexts. *Journal of Abnormal Psychology*, 79(3), 239-258.
- French, J., & Raven, B. (1959). *The bases of social power*: University of Michigan Press. Ann Arbor.
- Frick-Horbury, D. (2002). The use of hand gestures as self-generated cues for recall of verbally associated targets. *American Journal of Psychology*, 115(1), 1-20.
- Frick-Horbury, D., & Guttentag, R. E. (1998). The effects of restricting hand gesture production on lexical retrieval and free recall. *American Journal of Psychology*, 111(1), 43-62.
- Frick, D. J. (1991). *The use of hand gestures as self-generated cues*. University of North Carolina at Greensboro.
- Funiyama, N. (2000). Gestural interaction between the instructor and the learner in origami instruction. *Language and gesture*, 99.
- Gallese, V., Fadiga, L., Fogassi, L., & Rizzolatti, G. (1996). Premotor cortex and the recognition of motor actions. *Cognitive Brain Research*, 3(2), 131-141.
- Garry, M., Manning, C. G., Loftus, E. F., & Sherman, S. J. (1996). Imagination inflation: Imagining a childhood event inflates confidence that it occurred. *Psychonomic Bulletin and Review*, 3, 208-214.
- Geiselman, R., Fisher, R., Firstenberg, I., Hutton, L., Sullivan, S., Avetissian, I., et al. (1984). Enhancement of eyewitness memory: An empirical evaluation of the cognitive interview. *Journal of Police Science and Administration*, 12(1), 74-80.



- Geiselman, R., Fisher, R., MacKinnon, D., & Holland, H. (1985). Eyewitness memory enhancement in the police interview: Cognitive retrieval mnemonics versus hypnosis. *Journal of Applied Psychology, 70*(2), 401-412.
- Gerwing, J., & Bavelas, J. (2004). Linguistic influences on gesture's form. *Gesture, 4*(2), 157-195.
- Goff, L., & Roediger, H. (1998). Imagination inflation for action events: Repeated imaginings lead to illusory recollections. *Memory & Cognition, 26*(1), 20.
- Goldin-Meadow, S. (1993). *When does gesture become language? A study of gesture used as a primary communication system by deaf children of hearing parents*. Cambridge, England: Cambridge University Press.
- Goldin-Meadow, S. (1998). The development of gesture and speech as an integrated system. *New Directions for Child Development, 79*, 29-42.
- Goldin-Meadow, S. (1999). The role of gesture in communication and thinking. *Trends in Cognitive Sciences, 3*(11), 419-429.
- Goldin-Meadow, S. (2005). *Hearing gesture: How our hands help us think*: Belknap Press.
- Goldin-Meadow, S., Alibali, M. W., & Church, R. B. (1993). Transitions in concept acquisition: Using the hand to read the mind. *Psychological Review, 100*(2), 279-297.
- Goldin-Meadow, S., McNeill, D., & Singleton, J. (1996). Silence is liberating: Removing the handcuffs on grammatical expression in the manual modality. *Psychological Review, 103*(1), 34-55.
- Goldin-Meadow, S., Nusbaum, H., Kelly, S. D., & Wagner, S. (2001). Explaining math: Gesturing lightens the load. *Psychological Science, 12*(6), 516-522.
- Goldin-Meadow, S., Wein, D., & Chang, C. (1992). Assessing knowledge through gesture: Using children's hands to read their minds. *Cognition and Instruction, 9*(3), 201-219.
- Goodwin, C. (1981). *Conversational organization: Interaction between speakers and hearers*. New York: Academic Press.
- Goodwin, C. (1986). Gestures as a resource for the organization of mutual orientation. *Semiotica, 62*(1-2), 29-50.
- Graham, J. A., & Argyle, M. (1975). A cross-cultural study of the communication of extra-verbal meaning by gesture. *International Journal of Psychology, 10*(1), 57-67.
- Graham, J. A., & Heywood, S. (1976). The effects of elimination of hand gestures and of verbal codability on speech performance. *European Journal of Social Psychology, 5*, 189-195.

- Greene, E., Flynn, M., & Loftus, E. (1982). Inducing resistance to misleading information. *Journal of Verbal Learning and Verbal Behavior*, 21(2), 207-219.
- Greenfield, P., & Smith, J. (1976). *The structure of communication in early language development*. New York: Academic Press.
- Grezes, J., Armony, J., Rowe, J., & Passingham, R. (2003). Activations related to “mirror” and “canonical” neurones in the human brain: an fMRI study. *Neuroimage*, 18, 928-937.
- Gross, S., Jacoby, K., Matheson, D., Montgomery, N., & Patil, S. (2005). Exonerations in the United States 1989 through 2003. *Journal of Criminal Law and Criminology*, 95(2), 523-560.
- Gudjonsson, G. (1983). Suggestibility, intelligence, memory recall and personality: an experimental study. *The British Journal of Psychiatry*, 142, 35-37.
- Gudjonsson, G. (1984). A new scale of interrogative suggestibility. *Personality and Individual Differences*, 5(3), 303-314.
- Gudjonsson, G. (1987). The relationship between memory and suggestibility. *Social Behaviour*, 2, 29-33.
- Gudjonsson, G. (1997). *The Gudjonsson Suggestibility Scales Manual*. London, UK: Psychology Press.
- Gullberg, M., & Holmqvist, K. (1998). *Focus on Gesture: Visual Attention Towards Gestures in Conversation*. LUCS, Lund: Department of Cognitive Science.
- Gullberg, M., & Holmqvist, K. (1999). Keeping an eye on gestures: Visual perception of gestures in face-to-face communication. *Pragmatics & Cognition*, 7(1), 35-63.
- Gullberg, M., & Holmqvist, K. (2002). Visual attention towards gestures in face-to-face interaction vs. on screen. *International Gesture Workshop*, 206-214.
- Gullberg, M., & Holmqvist, K. (2006). What speakers do and what addressees look at: Visual attention to gestures in human interaction live and on video. *Pragmatics & Cognition*, 14(1), 53-82.
- Gullberg, M., & Kita, S. (2009). Attention to speech-accompanying gestures: Eye movements and information uptake. *Journal of Nonverbal Behavior*, 1-27.
- Gwyer, P., & Clifford, B. R. (1997). The effects of the cognitive interview on recall, identification, confidence and the confidence/accuracy relationship. *Applied Cognitive Psychology*, 11, 121-145.
- Hadar, U. (1989). Two types of gesture and their role in speech production. *Journal of Language and Social Psychology*, 8(3-4), 221.

- Hadar, U., & Butterworth, B. (1997). Iconic gestures, imagery, and word retrieval in speech. *Semiotica*, 115(1-2), 147-172.
- Harris, R. J. (1973). Answering questions containing marked and unmarked adjectives and adverbs. *Journal of Experimental Psychology*, 97, 399-401.
- Hauk, O., Johnsrude, I., & Pulvermüller, F. (2004). Somatotopic representation of action words in human motor and premotor cortex. *Neuron*, 41(2), 301-307.
- Henderson, J., & Hollingworth, A. (1999). High-level scene perception. *Annual Review of Psychology*, 50(1), 243-271.
- Henry, L., & Gudjonsson, G. (2003). Eyewitness memory, suggestibility, and repeated recall sessions in children with mild and moderate intellectual disabilities. *Law and Human Behavior*, 27(5), 481-505.
- Highhouse, S., & Bottrill, K. (1995). The influence of social (mis) information on memory for behavior in an employment interview. *Organizational Behavior and Human Decision Processes*, 62(2), 220-229.
- Hinrichs, E., & Polanyi, L. (1986). Pointing the way: A unified treatment of referential gesture in interactive discourse. *Language*, 298-314.
- Hoffman, J. (1998). Visual attention and eye movements. In H. Pashler (Ed.), *Attention* (pp. 119-153). Hove: Psychology Press Ltd.
- Holle, H., & Gunter, T. C. (2007). The role of iconic gestures in speech disambiguation: ERP evidence. *Journal of Cognitive Neuroscience*, 19(7), 1175-1192.
- Holler, J., Shovelton, H., & Beattie, G. (2009). Do iconic hand gestures really contribute to the communication of semantic information in a face-to-face context? *Journal of Nonverbal Behavior*, 33(2), 73-88.
- Holler, J., & Stevens, R. (2007). The effect of common ground on how speakers use gesture and speech to represent size information. *Journal of Language and Social Psychology*, 26(1), 4.
- Holler, J., & Wilkin, K. (2009). Communicating common ground: How mutually shared knowledge influences speech and gesture in a narrative task. *Language and Cognitive Processes*, 24(2), 267-289.
- Hostetter, A., & Alibali, M. (2008). Visible embodiment: Gestures as simulated action. *Psychonomic Bulletin & Review*, 15(3), 495.
- Howitt, D. (2006). *Introduction to forensic and criminal psychology*: Pearson Publishing Ltd.

- Hubbard, A., Wilson, S., Callan, D., & Dapretto, M. (2009). Giving speech a hand: Gesture modulates activity in auditory cortex during speech perception. *Human Brain Mapping, 30*(3), 1028-1037.
- Hummels, C., & Stappers, P. J. (1998). Meaningful gestures for human computer interaction: beyond handpostures. *Automatic Face and Gesture Recognition, 591-596*.
- Hyman, I., & Pentland, J. (1996). The role of mental imagery in the creation of false childhood memories. *Journal of Memory and Language, 35*, 101-117.
- Ihlebaek, C., Løve, T., Eilertsen, D., & Magnussen, S. (2003). Memory for a staged criminal event witnessed live and on video. *Memory, 11*(3), 319-327.
- Irving, B. (1980). *Police Interrogation. A case study of current practice. Research studies No. 2*. London: HMSO.
- Iverson, J., & Goldin-Meadow, S. (2005). Gesture paves the way for language development. *Psychological Science, 16*(5), 367.
- Iverson, J. M., & Goldin-Meadow, S. (1998). Why people gesture when they speak. *Nature, 396*(6709), 228.
- Jacoby, L. L., Woloshyn, V., & Kelley, C. (1989). Becoming famous without being recognized: unconscious influences of memory produced by dividing attention. *Journal of Experimental Psychology, 118*(2), 115-125.
- Jarvella, R. J., & Herman, S. J. (1972). Clause structure of sentences and speech processing. *Perception and Psychophysics*.
- Johnson, M., Foley, M., Suengas, A., & Raye, C. (1988). Phenomenal characteristics of memories for perceived and imagined autobiographical events. *Journal of Experimental Psychology: General, 117*(4), 371-376.
- Johnson, M., Hashtroudi, S., & Lindsay, D. (1993). Source monitoring. *Psychological Bulletin, 114*, 3-3.
- Johnson, M. K., Bransford, J. D., & Solomon, S. K. (1973). Memory for tacit implications of sentences. *Journal of Experimental Psychology, 98*(1), 203-205.
- Kahneman, D. (1973). *Attention and effort*: Prentice Hall.
- Kassin, S., Ellsworth, P., & Smith, V. (1989). The "general acceptance" of psychological research on eyewitness testimony: A survey of the experts. *American Psychologist, 44*(8), 1089-1098.
- Kebbell, M., Milne, R., & Wagstaff, G. (1999). The cognitive interview: A survey of its forensic effectiveness. *Psychology, Crime & Law, 5*(1), 101-115.

- Kebbell, M. R., & Johnson, S. D. (2000). Lawyers' questioning: The effect of confusing questions on witness confidence and accuracy. *Law and Human Behavior, 24*(6), 629-641.
- Kebbell, M. R., Wagstaff, G. F., & Covey, J. A. (1996). The influence of item difficulty on the relationship between eyewitness confidence and accuracy. *British Journal of Psychology, 87*(4), 653-662.
- Keenan, J. M., MacWhinney, B., & Mayhew, D. (1977). Pragmatics in memory: A study of natural conversation. *Journal of Verbal Learning & Verbal Behavior, 16*(5), 549-560.
- Kelly, S., Barr, D., Church, R., & Lynch, K. (1999). Offering a hand to pragmatic understanding: The role of speech and gesture in comprehension and memory. *Journal of Memory and Language, 40*, 577-592.
- Kelly, S., & Church, R. (1998). A comparison between children's and adults' ability to detect conceptual information conveyed through representational gestures. *Child Development, 69*(1), 85-93.
- Kelly, S., Creigh, P., & Bartolotti, J. (2010). Integrating speech and iconic gestures in a stroop-like task: evidence for automatic processing. *Journal of Cognitive Neuroscience, 22*(4), 683-694.
- Kelly, S., Kravitz, C., & Hopkins, M. (2004). Neural correlates of bimodal speech and gesture comprehension\* 1. *Brain and Language, 89*(1), 253-260.
- Kelly, S. D., Özyürek, A., & Maris, E. (2010). Two Sides of the Same Coin. *Psychological Science, 21*(2), 260.
- Kelly, S. D., Ward, S., Creigh, P., & Bartolotti, J. (2007). An intentional stance modulates the integration of gesture and speech during comprehension. *Brain and Language, 101*(3), 222-233.
- Kendon, A. (1980). Gesticulation and speech: Two aspects of the process of utterance. *The Relationship of Verbal and Nonverbal Communication, 207-227*.
- Kendon, A. (1983). Gesture and speech: How they interact. *Nonverbal Interaction, 13-45*.
- Kendon, A. (1990). *Conducting Interaction: Patterns of behavior in focused encounters*. Cambridge, England: Cambridge University Press.
- Kendon, A. (1995). Gestures as illocutionary and discourse structure markers in Southern Italian conversation. *Journal of Pragmatics, 23*(3), 247-279.
- Kendon, A. (2004). *Gesture: Visible action as utterance*. Cambridge, England: Cambridge University Press.

- Kita, S. (2000). How representational gestures help speaking. In D. McNeill (Ed.), *Language and Gesture* (pp. 162-185). Cambridge, UK: Cambridge University Press.
- Kita, S., & Özyürek, A. (2003). What does cross-linguistic variation in semantic coordination of speech and gesture reveal?: Evidence for an interface representation of spatial thinking and speaking. *Journal of Memory and Language*, *48*(1), 16-32.
- Klatzky, R. L., Pellegrino, J. W., McCloskey, B. P., & Doherty, S. (1989). Can you squeeze a tomato? The role of motor representations in semantic sensibility judgments. *Journal of Memory and Language*, *28*(1), 56-77.
- Köhnken, G., Milne, R., Memon, A., & Bull, R. (1999). The cognitive interview: a meta-analysis. *Psychology, Crime & Law*, *5*(1), 3-27.
- Krauss, R. M. (1998). Why do we gesture when we speak? *Current Directions in Psychological Science*, *7*(2), 54-60.
- Krauss, R. M., Chen, Y., & Chawla, P. (1996). Nonverbal behavior and nonverbal communication: What do conversational hand gestures tell us. *Advances in Experimental Social Psychology*, *28*, 389-450.
- Krauss, R. M., Chen, Y., & Gottesman, R. F. (2000). Lexical gestures and lexical access: A process model. *Language and Gesture*, 261-283.
- Krauss, R. M., Dushay, R. A., Chen, Y., & Rauscher, F. (1995). The communicative value of conversational hand gesture. *Journal of Experimental Social Psychology*, *31*(6), 533-552.
- Krauss, R. M., & Hadar, U. (1999). The role of speech-related arm/hand gestures in word retrieval. *Gesture, Speech, and Sign*, 93-116.
- Krauss, R. M., Morrel-Samuels, P., & Colasante, C. (1991). Do conversational hand gestures communicate? *Journal of Personality and Social Psychology*, *61*(5), 743-754.
- Lampinen, J. M., Scott, J., Pratt, D., Leding, J. K., & Arnal, J. D. (2007). 'Good, you identified the suspect but please ignore this feedback': Can warnings eliminate the effects of post-identification feedback? *Applied Cognitive Psychology*, *21*(8), 1037-1056.
- Langton, S. R. H., O'Malley, C., & Bruce, V. (1996). Actions speak no louder than words: Symmetrical cross-modal interference effects in the processing of verbal and gestural information. *Journal of experimental psychology. Human perception and performance*, *22*(6), 1357-1375.

- Leippe, M. R. (1980). Effects of integrative memorial and cognitive processes on the correspondence of eyewitness accuracy and confidence. *Law and Human Behavior*, 4(4), 261-274.
- Leippe, M. R., & Eisenstadt, D. (2007). Eyewitness confidence and the confidence-accuracy relationship in memory for people. *The Handbook of Eyewitness Psychology: Volume II: Memory for People*, 377.
- Levelt, W. J. M. (1989). *Speaking: From Intention to Articulation*: MIT Press.
- Lickiss, K. P., & Wellens, A. R. (1978). Effects of visual accessibility and hand restraint on fluency of gesticulator and effectiveness of message. *Perceptual and Motor Skills*, 46, 925-926.
- Loftus, E. F. (1974). Reconstructing memory: The incredible eyewitness. *Psychology Today*, 8, 116-119.
- Loftus, E. F. (1975). Leading questions and the eyewitness report. *Cognitive Psychology*, 7(4), 560-572.
- Loftus, E. F. (1979). *Eyewitness testimony*. London: Harvard University Press.
- Loftus, E. F. (1986). Experimental psychologist as advocate or impartial educator. *Law and Human Behavior*, 10(1), 63-78.
- Loftus, E. F., Donders, K., Hoffman, H. G., & Schooler, J. W. (1989). Creating new memories that are quickly accessed and confidently held. *Memory and Cognition*, 17(5), 607-616.
- Loftus, E. F., & Hoffman, H. G. (1989). Misinformation and memory: The creation of new memories. *Journal of Experimental Psychology: General*, 118(1), 100-104.
- Loftus, E. F., & Loftus, G. (1980). On the permanence of stored information in the human brain. *American Psychologist*, 35(5), 409-420.
- Loftus, E. F., & Palmer, J. C. (1974). Reconstruction of automobile destruction: An example of the interaction between language and memory. *Journal of Verbal Learning and Verbal Behavior*, 13(5), 585-589.
- Loftus, E. F., & Zanni, G. (1975). Eyewitness testimony: The influence of the wording of a question. *Bulletin of the Psychonomic Society*, 5(1), 86-88.
- Luus, C. A. E., & Wells, G. L. (1994). Eyewitness identification confidence. *Adult Eyewitness Testimony: Current trends and developments*, 348-361.
- Marquis, K. H., Marshall, J., & Oskamp, S. (1972). Testimony validity as a function of question form, atmosphere, and item difficulty. *Journal of Applied Social Psychology*, 2(2), 167-186.

- Martin, A., & Chao, L. L. (2001). Semantic memory and the brain: structure and processes. *Current Opinion in Neurobiology*, 11(2), 194-201.
- McAuliff, B., & Kovera, M. (2007). Estimating the effects of misleading information on witness accuracy: can experts tell jurors something they don't already know? *Applied Cognitive Psychology*, 21(7), 849-870.
- McNeill, D. (1985). So you think gestures are nonverbal? *Psychological Review*, 92(3), 350-371.
- McNeill, D. (1992). *Hand and Mind: What gestures reveal about thought*. Chicago: University of Chicago Press.
- McNeill, D. (2000). *Language and gesture*. Cambridge, UK: Cambridge University Press.
- McNeill, D., Cassell, J., & McCullough, K. E. (1994). Communicative effects of speech-mismatched gestures. *Research on Language & Social Interaction*, 27(3), 223-237.
- Melcher, D., & Kowler, E. (2001). Visual scene memory and the guidance of saccadic eye movements. *Vision Research*, 41(25-26), 3597-3611.
- Melinger, A., & Levelt, W. (2004). Gesture and the communicative intention of the speaker. *Gesture*, 4(2), 119-141.
- Milgram, S. (1974). *Obedience to authority: An experimental view*: Taylor & Francis.
- Miller, P., Cho, G., & Bracey, J. (2005). Expanding the angle of vision on working-class children's stories. *Human Development*, 48(3), 151-154.
- Muris, P., Meesters, C., & Merckelbach, H. (2004). Correlates of the Gudjonsson suggestibility scale in delinquent adolescents. *Psychological reports*, 94(1), 264-266.
- Myers, J. E. B., Saywitz, K. J., & Goodman, G. S. (1996). Psychological research on children as witnesses: Practical implications for forensic interviews and courtroom testimony and courtroom testimony. *Pacific Law Journal*, 27, 1-82.
- Nobe, S., Hayamizu, S., Hasegawa, O., & Takahashi, H. (1998). Are listeners paying attention to the hand gestures of an anthropomorphic agent? An evaluation using a gaze tracking method. *Lecture Notes in Computer Science*, 49-60.
- Nobe, S., Hayamizu, S., Hasegawa, O., & Takahashi, H. (2000). Hand Gestures of an Anthropomorphic Agent: Listeners' Eye Fixation and Comprehension. *Cognitive Studies. Bulletin of the Japanese Cognitive Society*, 7(1), 86-92.
- Nolan, J., & Markham, R. (1998). The accuracy-confidence relationship in an eyewitness task: anxiety as a modifier. *Applied Cognitive Psychology*, 12(1), 43-54.
- Norman, D. A., & Bobrow, D. G. (1975). On data-limited and resource-limited processes. *Cognitive Psychology*, 7(1), 44-64.



- Odinot, G. (2008). *Eyewitness confidence: the relation between accuracy and confidence in episodic memory*. Department Cognitive Psychology, Nederlands Studiecentrum Criminaliteit en Rechtshandhaving (NSCR) Faculty of Social and Behavioural Sciences, Leiden University.
- Özyürek, A. (2002). Do speakers design their cospeech gestures for their addressees? The effects of addressee location on representational gestures. *Journal of Memory and Language*, 46(4), 688-704.
- Özyürek, A., & Kita, S. (1999). *Expressing manner and path in English and Turkish: Differences in speech, gesture, and conceptualization*.
- Özyürek, A., Willems, R., Kita, S., & Hagoort, P. (2007). On-line integration of semantic information from speech and gesture: Insights from event-related brain potentials. *Journal of Cognitive Neuroscience*, 19(4), 605-616.
- Penrod, S. D., Loftus, E. F., & Winkler, J. (1982). The reliability of eyewitness testimony: A psychological perspective. *The Psychology of the Courtroom*, 119-168.
- Perry, N. W., McAuliff, B. D., Tam, P., Claycomb, L., Dostal, C., & Flanagan, C. (1995). When lawyers question children. Is justice served? *Law and Human Behavior*, 19(6), 609-629.
- Pine, K., Bird, H., & Kirk, E. (2007). The effects of prohibiting gestures on children's lexical retrieval ability. *Developmental Science*, 10(6), 747-754.
- Pine, K., Gurney, D., & Fletcher, B. (2010). The semantic specificity hypothesis: When gestures do not depend upon the presence of a listener. *Journal of Nonverbal Behavior*, 34(3), 169-178.
- Pine, K., Lufkin, N., & Messer, D. (2004). More gestures than answers: Children learning about balance. *Developmental Psychology*, 40(6), 1059-1067.
- Pulvermüller, F. (1999). Words in the brain's language. *Behavioral and Brain Sciences*, 22(02), 253-279.
- Rauscher, F. H., Krauss, R. M., & Chen, Y. (1996). Gesture, speech, and lexical access: The role of lexical movements in speech production. *Psychological Science*, 7(4), 226-231.
- Rime, B. (1982). The elimination of visible behaviour from social interactions: Effects on verbal, nonverbal and interpersonal variables. *European Journal of Social Psychology*, 12(1), 1.

- Riseborough, M. G. (1981). Physiographic gestures as decoding facilitators: Three experiments exploring a neglected facet of communication. *Journal of Nonverbal Behavior*, 5(3), 172-183.
- Rizzolatti, G., Fadiga, L., Gallese, V., & Fogassi, L. (1996). Premotor cortex and the recognition of motor actions. *Cognitive Brain Research*, 3(2), 131-141.
- Robinson, M. D., Johnson, J. T., & Robertson, D. A. (2000). Process versus content in eyewitness metamemory monitoring. *Experimental Psychology*, 6(3), 207-221.
- Roebbers, C. (2002). Confidence judgments in children's and adult's event recall and suggestibility. *Developmental psychology*, 38(6), 1052-1067.
- Rogers, W. T. (1978). The contribution of kinesic illustrators toward the comprehension of verbal behaviour within utterances. *Human Communication Research*, 5(1), 54-62.
- Schacter, D. (1996). *Searching for memory: The brain, the mind, and the past*. New York: Basic Books.
- Scheck, B., Neufeld, P., & Dwyer, J. (2003). *Actual innocence: When justice goes wrong and how to make it right*. New York: New American Library.
- Schneider, S. L., & Laurion, S. K. (1993). Do we know we've learned from listening to the news? *Memory & Cognition*, 21(2), 198-209.
- Schwartz, D., & Black, J. (1996). Shuttling between depictive models and abstract rules: Induction and fallback. *Cognitive Science: A Multidisciplinary Journal*, 20(4), 457-497.
- Semin, G. R., & Poot, C. J. (1997). The question-answer paradigm: You might regret not noticing how a question is worded. *Journal of Personality and Social Psychology*, 73, 472-480.
- Shaw, J. S., McClure, K. A., & Dykstra, J. A. (2007). Eyewitness confidence from the witnessed event through trial. . In M. Toglia, J. Read, D. Ross & R. Lindsay (Eds.), *The handbook of eyewitness psychology, Vol I: Memory for events* (pp. 371-397). Mahwah, NJ: Lawrence Erlbaum.
- Shepherd, E., & Milne, R. (1999). Full and faithful: ensuring quality practice and integrity of outcome in witness interviews. In E. Shepherd, D. Wochover & L. B. o. Cornhill (Eds.), *Analysing Witness Testimony: Psychological, Investigative and Evidential Perspectives*. London: Blackstone Press.
- Sherman, S. J., Cialdini, R. B., Schwartzman, D. F., & Reynolds, K. D. (1985). Imagining can heighten or lower the perceived likelihood of contracting a disease: The mediating effect of ease of imagery. *Personality and Social Psychology Bulletin*, 11(1), 118.

- Short, J., Williams, E., & Christie, B. (1976). Communication modes and task performance. *Readings in Groupware and Computer Supported Cooperative Work*, 169-176.
- Singer, M., & Goldin-Meadow, S. (2005). Children learn when their teacher's gestures and speech differ. *Psychological Science*, 16(2), 85.
- Slama-Cazacu, T. (1976). Nonverbal components in message sequence: "Mixed syntax.". *Language and man: Anthropological issues*, 217-227.
- Smith, E., & Jonides, J. (1997). Working memory: A view from neuroimaging. *Cognitive Psychology*, 33(1), 5-42.
- Smith, P., & Gudjonsson, G. (1995). Confabulation among forensic inpatients and its relationship with memory, suggestibility, compliance, anxiety, and self-esteem. *Personality and Individual Differences*, 19(4), 517-523.
- Smith, V., & Ellsworth, P. (1987). The social psychology of eyewitness accuracy: Misleading questions and communicator expertise. *Journal of Applied Psychology*, 72(2), 294-300.
- Sporer, S. L., Penrod, S., Read, D., & Cutler, B. (1995). Choosing, confidence, and accuracy: A meta-analysis of the confidence-accuracy relation in eyewitness identification studies. *Psychological Bulletin*, 118(3), 315-315.
- Streeck, J. (1993). Gesture as communication. I: Its coordination with gaze and speech. *Communication Monographs*, 60(4), 275-299.
- Streeck, J., & Knapp, M. (1992). *The interaction of visual and verbal features in human communication*. Amsterdam: John Benjamins Publishing.
- Tanaka, S., & Inui, T. (2002). Cortical involvement for action imitation of hand/arm postures versus finger configurations: an fMRI study. *NeuroReport*, 13(13), 1599-1602.
- Thomas, A., Bulevich, J., & Loftus, E. (2003). Exploring the role of repetition and sensory elaboration in the imagination inflation effect. *Memory & Cognition*, 31(4), 630.
- Thompson, L. A. (1995). Encoding and memory for visible speech and gestures: A comparison between young and older adults. *Psychology and Aging*, 10, 215-215.
- Thompson, L. A., Malmberg, J., Goodell, N. K., & Boring, R. L. (2004). The distribution of attention across a talker's face. *Discourse Processes*, 38(1), 145-168.
- Thompson, L. A., & Massaro, D. W. (1986). Evaluation and integration of speech and pointing gestures during referential understanding. *Journal of Experimental Child Psychology*, 42(1), 144-168.
- Tulving, E. (1974). Cue-dependent forgetting. *American Scientist*, 62, 74-82.

- Tversky, A., & Kahneman, D. (1974). Judgment under uncertainty: Heuristics and biases. *Science*, 185(4157), 1124-1131.
- Underwood, J., & Pezdek, K. (1998). Memory suggestibility as an example of the sleeper effect. *Psychonomic Bulletin and Review*, 5, 449-453.
- Weingardt, K. R., Leonesio, R. J., & Loftus, E. F. (1994). Viewing eyewitness research from a metacognitive perspective. *Metacognition: Knowing about Knowing*, 157-184.
- Wells, G. L., & Bradfield, A. L. (1998). Good, you identified the suspect: Feedback to eyewitnesses distorts their reports of the witnessing experience. *Journal of Applied Psychology*, 83(3), 360-376.
- Wells, G. L., & Murray, D. M. (1984). Eyewitness confidence. *Eyewitness Testimony: Psychological perspectives*, 155-170.
- Wesp, R., Hesse, J., Keutmann, D., & Wheaton, K. (2001). Gestures maintain spatial imagery. *The American Journal of Psychology*, 114(4), 591-600.
- Wexelblat, A. D. (1994). *A feature-based approach to continuous-gesture analysis*. Massachusetts Institute of Technology.
- Willems, R., & Hagoort, P. (2007). Neural evidence for the interplay between language, gesture, and action: A review. *Brain and Language*, 101(3), 278-289.
- Willems, R., Ozyurek, A., & Hagoort, P. (2007). When language meets action: The neural integration of gesture and speech. *Cerebral Cortex*, 17(10), 2322-2333.
- Wolfe, J. (1998). Visual search. In H. Pashler (Ed.), *Attention* (pp. 13-73). Hove: Psychology Press Ltd.
- Wright, D. B., Loftus, E. F., & Hall, M. (2001). Now you see it; now you don't: Inhibiting recall and recognition of scenes. *Applied Cognitive Psychology*, 15(5), 471-482.
- Yantis, S. (2000). 3 goal-directed and stimulus-driven determinants of attentional control. *Control of cognitive processes: Attention and performance XVIII*, 73.
- Yuille, J., & Cutshall, J. (1986). A case study of eyewitness memory of a crime. *Journal of Applied Psychology*, 71(2), 291-301.
- Zaragoza, M., Belli, R., & Payment, K. (2007). *Misinformation effects and the suggestibility of eyewitness memory*: Erlbaum.
- Zwaan, R. A., & Taylor, L. J. (2006). Seeing, acting, understanding: Motor resonance in language comprehension. *Journal of Experimental Psychology: General*, 135(1), 1-11.

Appendix A :

## Summary of Questions in Studies 1-2

### Questions ('Knife Attack' video)

1. (Distracter) "You saw a man threaten another with a knife. There was also a woman present. Please write down how old you think that woman was."
2. (Distracter) "The victim was threatened with a knife held to his throat. Please write down how tall you thought the victim was."
3. (Critical) "The younger male was holding a [knife]. Please write down how big you thought that knife was."



Accurate "7 inch" gesture (left) and misleading "2 foot" gesture (right)

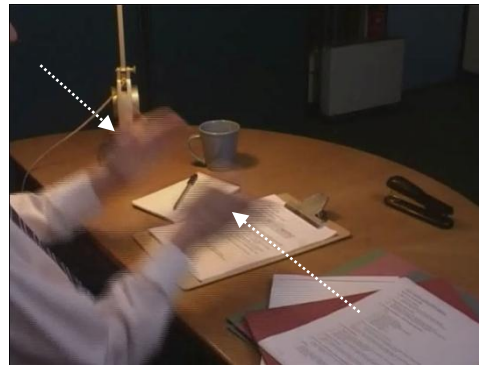
4. (Distracter) "The person with the knife was wearing a jacket. Can you recall what colour that jacket was?"
5. (Critical) "You may have noticed some [jewellery] worn by the victim, Please write down what jewellery you think we was wearing."



Accurate "ring" gesture (left) and misleading "watch" gesture (right)

## Questions ('Car Crash' video)

1. (Distracter) "One car was being chased by another. The first car was a large white vehicle. Can you recall how many doors it had?"
2. (Distracter) "The large white vehicle was chasing a smaller car. What colour was the smaller car?"
3. (Critical) "The two cars [collided]. At what speed would you say the first car was travelling when it hit the side of the second?"



Accurate "*moderate speed*" gesture (left) and misleading "*very fast*" gesture (right)

4. (Distracter) "How many people were inside the smaller car?"
5. (Critical) "At the end of the incident there were some [parked cars]. How many parked cars were there?"



Accurate "*2 cars*" gesture (left) and misleading "*many cars*" gesture (right)

Appendix B :

## Answer Sets for Questions in Study 2

### 'Knife Attack' video

1. "You saw a man threaten another with a knife. There was also a woman present. Please write down how old you think that woman was "

- 17 or under
- 18
- 19
- 20
- 21 or over

2. "The victim was threatened with a knife held to his throat. Please write down how tall you thought the victim was."

- Under 5'
- 5'0" - 5.4"
- 5'5" - 5'8"
- 5'9" - 5'12"
- Over 6'

3. "The younger male was holding a knife. Please write down how big you thought that knife was."

- Under 4"
- 4" - 5"
- 5" - 6"
- 6" - 7"
- 7" - 8"
- 8" - 9"
- 9" - 10"

4. "The person with the knife was wearing a jacket. Can you recall what colour that jacket was?"

- White
- Black
- Grey
- Brown

5. "You may have noticed some jewellery worn by the victim, Please write down what jewellery you think we was wearing."

- Ring
- Chain
- Watch
- Earring

## 'Car Crash' video

1. "One car was being chased by another. The first car was a large white vehicle. Can you recall how many doors it had?"

- 3 doors
- 5 doors

2. "The large white vehicle was chasing a smaller car. What colour was the smaller car?"

- Silver
- Black
- White
- Blue

3. "The two cars collided. At what speed would you say the first car was travelling when it hit the side of the second?"

- 25mph - 29mph
- 30mph - 34mph
- 35mph - 39mph
- 40mph - 44mph
- 45mph - 49mph
- 50mph - 54mph

4. "How many people were inside the smaller car?"

- 1
- 2
- 3
- 4
- 5

5. "At the end of the incident there were some parked cars. How many parked cars were there?"

- 0
- 1
- 2
- 3
- 4
- 5

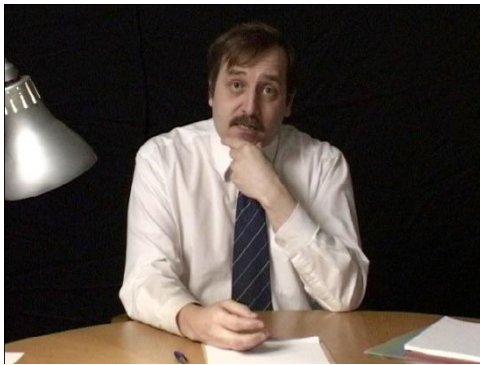


Appendix C :

## Summary of Questions in Study 3

### Questions (Office Theft' video)

1. (Distracter) "After a few seconds, a man entered the room. How tall would you say this man was?"
2. (Distracter) "The man started looking around the room. How old you say the man was?"
3. (Critical) "You got a glimpse of his [face] in the video. Do you remember any distinguishing features?"



**"Beard" gesture (left) and "glasses" gesture (right)**

4. (Critical) "Was the intruder wearing any [jewellery]? Please write down what jewellery you think he was wearing"



**"Ring" gesture (left) and "watch" gesture (right)**

5. (Critical) "Did you notice [anything else] he was wearing?"



**"Gloves" gesture (left) and "hat" gesture (right)**

6. (Distracter) "Was there a computer on the desk?"

7. (Distracter) "Which item did the man take from the table as he left?"

Appendix D :

## Answer Sets for Questions in Study 3

1. "After a few seconds, a man entered the room. How tall would you say this man was?"

- Under 5"
- 5'0" to 5'3"
- 5'4" to 5.8"
- 5.9" to 5.12"

2. "The man started looking around the room. How old you say the man was?"

- Under 7
- 18
- 19
- 20
- 21

3. "You got a glimpse of his face in the video. Do you remember any distinguishing features?"

- Glasses
- Freckles
- Beard / Stubble
- Scar
- Other / None

4. "Was the intruder wearing any jewellery? Please write down what jewellery you think he was wearing"

- Ring
- Watch
- Earring
- Chain
- Other / None

5. "Did you notice anything else he was wearing?"

- Hat
- Gloves
- Scarf
- Other / None

6. "Was there a computer on the desk?"

- Yes
- No

7. "Which item did the man take from the table as he left?"

- Laptop
- Bag
- Folder
- Other

Appendix E :

## Funnel Debrief Questionnaire for Studies 3 & 4

During this experiment, you were interviewed about a piece of CCTV footage you saw earlier.

For the final part of this experiment, I would like you to answer the following questions about the interview. Please answer each question in order before reading onto the next.

**1. Did you guess the answers to any of the questions?**

**2. Do you think the police interviewer influenced your decision in any way?**

**3. Do you remember seeing any of his hand gestures? (If so, please state which ones)**

Appendix F :

## Interview Transcript used in Study 4

*“You saw a man come into a room, and there was a [corner desk], [some drawers] and [a few items on the table] here. I want you to think about the man himself. Now, you only really saw the [back of him], but at one point in the video turned around and you got a **[glimpse of his face]**.*

- *So, my first question is: how old would you say the man was?*
- ***And is there any distinguishing features you think he may have had?***

*So, thinking about other details: As he was looking around the room you could see that he was wearing this [long sleeved jacket], and you may have noticed some **[jewellery]**.*

- *So, first of all, could you tell me if his jacket had a hood?*
- ***Is there any jewellery you think he could have been wearing?***

*OK, so let's think more about what he was wearing now. We know he had this [zip-up jacket], and you may have noticed some other **[additional clothing]**.*

- *Now, I know it was black and white, but can tell me what colour you think his jacket was?*
- ***And is there any other additional clothing you think he could have been wearing?***

*OK, so thinking about what he actually did: He started looking around the desk, and there some [drawers here], some [shelves up here] ... and the man [took an item from one of the drawers] and **[put it in his jacket]**.*

- *Can you tell me first of all which drawer you think he took the item from?*
- ***And which jacket pocket do you think he put the item in?***
- *Last question, what item did he take from the table as he left?*