Dissociating Automatic and Intentional Processes in Children's Eyewitness Suggestibility

Robyn Elizabeth Holliday

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I hereby certify that the work embodied in this thesis is the result of original research and has not been submitted for a higher degree to any other University or Institution.

(Signed) _____

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Publications arising from this research

One refereed journal article arising from this research has been accepted for publication.

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Abstract

The chief aim of this dissertation was to establish the respective contributions of automatic and intentional memory processes to misinformation effects in 5-, 8-, and 9-year-old children. In the first two experiments children were presented with a picture story followed by misleading post-event details that were either read to participants, or were self-generated in response to semantic and perceptual hints. Children were then presented with original and suggested items and given a yes / no recognition test under inclusion or exclusion instructions. The application of Jacoby's (1991) process dissociation procedure to children's recognition performance revealed that the contribution of intentional processing to misinformation acceptance increased following the self-generation of suggestions. Automatic processing made a strong contribution to misinformation effects regardless of the way that misinformation was encoded. Experiment 3 extended this general pattern of results to a forced choice recognition paradigm. Experiment 4 examined the role of social demand factors in children's suggestibility using Belli's (1989) yes / no retrieval paradigm. Little evidence of an influence of social demand on children's suggestible responses was found with automatic processes again the predominant factor determining suggestibility. In the final experiment, the temporal order of the original and post-event phases was reversed such that 5-year-olds were initially presented with a post-event summary containing misinformation, followed by a witnessed event. The results of this study confirmed that children's suggestions were unlikely to be the result of trace alteration or social demand. The implications of the findings for theoretical accounts of the misinformation effect in children's recognition and for children's eyewitness testimony are discussed.

Chapter 1

General Introduction

1.1 General background and overview

In the last decade researchers investigating children's suggestibility have directed considerable attention to the identification of the conditions under which children are adversely affected by the introduction of misleading information after viewing or experiencing an event. This recent escalation in research interest follows an increase in participation of young children in the legal system. Increasingly, children are required to testify in family court matters such as custody and access disputes, or in criminal cases such as sexual and physical abuse or domestic violence (Ceci & Bruck, 1995). If a child is the sole witness, the credibility of the child's testimony is of immense importance in determining the outcome of legal proceedings (Spencer & Flin, 1993).

The consensus in the literature is that under certain circumstances young children are influenced by misleading suggestions, with very young children disproportionately affected (Bruck & Ceci, 1999; Bruck, Ceci & Melnyk, 1997; Ceci & Bruck, 1993; Ceci, Crossman, Gilstrap & Scullin, 1998). However, the issues of whether or not there exist age-related differences in the magnitude of misinformation effects in older children, and the nature of the underlying mechanisms responsible for these effects continue to be debated (Brown, Scheflin, & Hammond, 1998; Bruck & Ceci, 1997; Bruck et al., 1997; Ceci & Bruck, 1993; Ceci et al., 1998).

Much of the literature examining misinformation in children has assessed such effects using a recognition memory paradigm in which children first witness an event,

then receive misinformation about some of the details in that original event, and are finally given a recognition test on their memories for the original event details (e.g., Ceci, Ross & Toglia, 1987b; Holliday, Douglas & Hayes, 1999; Lindsay, Gonzales & Eso, 1995; Newcombe & Siegal, 1997; Pezdek & Roe, 1995; Welch-Ross, in press; Zaragoza, 1991). However, despite the widespread assumption that changes to recognition processes are involved in children's misinformation, relatively little attention has been given to identifying the specific processes involved in the act of recognition and how these processes contribute to misinformation effects in children.

Many contemporary models of recognition memory assume that performance on memory tasks is determined by a number of dissociable processes, (e.g., Brainerd, Stein, & Reyna, 1998; Jacoby, 1991; Roediger, Weldon, & Challis, 1989). Jacoby (1991), for example, developed a process dissociation procedure as a way of separating the relative contributions of intentional / conscious recollection and automatic / unconscious memory processes to recognition memory performance. Support for the independent contribution of these two processes to recognition memory performance has been provided by a number of researchers (see Jacoby, Yonelinas, & Jennings, 1997; Reingold & Toth, 1996 for reviews).

The research reported in this thesis, therefore, aimed to examine the causal mechanisms that give rise to suggestible responding in children. In particular, given the evidence indicating that recognition memory performance is the joint product of automatic and intentional processes, this thesis aimed to establish the respective contributions of each of these processes to misinformation effects in children's recognition. A further aim was to examine whether the contribution of each process undergoes developmental change across early to mid childhood.

It should also be noted that existing theories of misinformation make assumptions about the respective roles of intentional and automatic memory processes. For example, storage-based models such as trace-alteration / overwriting (Loftus, Miller & Burns, 1978) or partial trace degradation (Belli & Loftus, 1996) imply that the misinformation effect can be explained as an unconscious or automatic memory process whereas trace strength models (e.g., fuzzy-trace theory, Brainerd & Reyna, 1993a, 1998; Brainerd, Reyna, & Mojardin, 1999) suggest that both conscious recollection and unconscious automatic memory processes contribute to misinformation effects. The research described in this thesis aims to contribute to the evaluation of these competing models of misinformation by identifying the automatic and / or intentional bases of children's acceptance of misinformation and through the application of novel experimental designs (e.g., reversed suggestibility procedure) to the study of misinformation effects in children.

In order to understand the rationale and aims of this research program it is first necessary to review the existing literature on suggestibility in children. This review will concentrate on three key aspects of suggestibility research. First, existing empirical work relating to suggestibility and current theories about the mechanisms that give rise to suggestibility effects will be reviewed in some depth. Second, the evidence regarding the contribution of intentional recollection and automatic processes to recognition responses will be examined. Finally, the review will examine how the processes of intentional recollection and automaticity may contribute to children's suggestible responses.

1.2 The misinformation paradigm

Traditionally the *suggestibility* or *misinformation effect* has been defined as "the extent to which individuals come to accept and subsequently incorporate post-event information into their memory recollections" (Ceci & Bruck, 1993, p. 404-405). This narrow definition implies that misinformation effects arise solely as a result of changes in memory processes, and that such effects occur only when misleading details are given after viewing the original event (Ceci & Bruck, 1993). The current thesis adopts a broader definition of suggestibility, as recommended by Ceci and Bruck (1993), that incorporates a number of social and psychological factors affecting "children's encoding, storage, retrieval, and reporting of events" (p. 404). This general definition of suggestibility encompasses situations in which individuals may remember both the suggested and the original details but, nevertheless, report the suggested detail due to compliance with the social demands of the memory test (Zaragoza, 1991). This definition also allows for misinformation effects that occur when misleading suggestions are presented prior to the original event, (e.g., Lindsay & Johnson, 1989b; Rantzen & Markham, 1992).

Much of the recent evidence concerning the mechanisms that underlie children's misinformation has been collected using an adaptation of the "standard" three-stage paradigm introduced by Loftus et al. (1978). This paradigm is illustrated in Table 1 using stimulus examples taken from Ceci et al. (1987b). In the first phase participants are read a story with accompanying pictures; for example, they are presented with a story describing a boy's first plane ride in which they see the boy wearing a "red" hat (original event information). During the second phase, participants in an

experimental group are read a summary of the witnessed event with some of the critical details changed; for example, they are told that the boy was wearing a "green" hat (post-event information), while the control group receives neutral information. In the third phase, all participants are given a two alternative forced-choice recognition memory test (e.g., "red" hat vs. "green" hat) on their memories for the originally witnessed event.

Table 1

The Standard and Modified Testing Paradigms

Experimental condition	Phase 1 Original detail	Phase 2 Post-event misinformation	Standard test	Modified test
Control	(e.g., red hat)	(e.g., a hat)	(e.g., red hat vs. green hat)	(e.g., red hat vs. blue hat)
Misled	(e.g., red hat)	(e.g., green hat)	(e.g., red hat vs. green hat)	(e.g., red hat vs. blue hat)

When asked to choose between the original event and the post-event misleading details, research with adults (Belli & Loftus, 1996; Loftus, Donders, Hoffman & Schooler, 1989; Loftus et al., 1978) and children (Ceci et al., 1987b; Holliday et al., 1999; Lampinen & Smith, 1995; Newcombe & Siegal, 1996; Siegal & Peterson, 1995; Zaragoza, 1987, 1991) has consistently found that misled participants are significantly more likely than controls who have not been misled to mistakenly select the misleading suggestions. This paradigm has come to be termed the "standard" test of recognition memory in both the adult and child misinformation literature. Experimental support for the misinformation effect in children seems quite robust and

has been provided by numerous researchers across different laboratories and in different countries although the relative magnitude of such effects may change with age. (See Section 1.3.3 and Bruck & Ceci, 1997, 1999; Ceci & Bruck, 1995; Quas, Qin, Schaaf, & Goodman, 1997 for recent reviews).

1.3 Theoretical interpretations of the misinformation effect

A variety of cognitive and social factors have been proposed as causal mechanisms to explain the effects of post-event suggestions. Even though empirical support for the misinformation effect as demonstrated by the standard paradigm is robust, there exists considerable disagreement over the mechanisms that give rise to this phenomenon (cf. Brainerd & Reyna, 1998; Bruck & Ceci, 1997, 1999; Bruck, Ceci, & Hembrooke, 1998). Specifically, the fate of memories of the original event, has yet to be resolved. Explanations of the misinformation effect may generally be classified as belonging to one of two alternative approaches: memory interference hypotheses, or response bias / social demand hypotheses. The assumptions made by each of these theoretical interpretations are quite distinct. In the former case it is assumed that the presentation of misinformation interferes with the storage and / or retrieval process of event details, while the latter account assumes no memory interference at all. Rather, social demand factors and response biases inherent in the misinformation experimental paradigm are seen to be responsible for the misinformation effect. In the following sections these theoretical accounts are described in detail along with evidence for and against each model.

1.3.1 Memory interference hypotheses

Trace alteration hypotheses

Loftus and her colleagues (e.g., Loftus, 1979, 1995, 1997; Loftus & Hoffman, 1989; Loftus, Hoffman & Wagenaar, 1992; Loftus et al., 1978) have proposed a strong version of a trace alteration account of misinformation. This account holds that the presentation of misleading suggestions overwrites or interferes with the storage of the original memory trace or updates it, rendering that trace unavailable for subsequent recognition, resulting in permanent erasure of the original details from storage. A more moderate version of the trace alteration model, the partial degradation hypothesis (Belli & Loftus, 1996), proposes that misleading suggestions partially degrade or destroy the memory trace of the original event (e.g., Brainerd & Reyna, 1988; Loftus, Donders, Hoffman, & Schooler, 1989; Metcalfe, 1990; Toglia, Ross, Ceci & Hembrooke, 1992; Tversky & Tuchin, 1989). Support for trace alteration was provided by Metcalfe (1990) who applied a distributed model of memory CHARM (Composite Holographic Associative Recall Model) to simulated responses in a misinformation paradigm. She found evidence that memory traces for original and post-event misinformation could be blended or superimposed on each other.

Reported findings of misinformation effects using a reversed misinformation paradigm (e.g., Lindsay & Johnson, 1989b; Rantzen & Markham, 1992), however, have raised problems for a trace-alteration explanation of the misinformation effect. In this design, phases 1 and 2 of the Loftus et al. (1978) procedure (see Table 1) are reversed; that is, misleading suggestions are presented *before* the original event information as opposed to *after* the original event information. If the original event

details are altered or updated by the more recently presented misinformation, there should be no evidence of suggestibility when the original event information is presented after the misleading suggestions. Results obtained using this design do not support a trace-alteration account of misinformation. For example, in Lindsay and Johnson's (1989b) study adults in a misled condition were read a summary containing misleading suggestions that referred to a visual scene, prior to viewing this scene. Lindsay and Johnson found evidence of a misinformation effect such that misled participants were more likely to subsequently report the suggested information in comparison to those in a control condition.

Trace-strength models

An alternative memory interference account explains the misinformation effect in terms of changes to memory trace strength. A number of researchers (e.g., Brainerd & Poole, 1997; Brainerd & Reyna, 1993a, 1998; Brainerd, Reyna, Howe & Kingma, 1990; Ceci, Toglia & Ross, 1988; Holliday et al., 1999; Marche, 1999; Reyna & Titcomb, 1997) hold the view that the presence or strength of the misinformation effect obtained with children of various ages may be related to conditions which affect the relative "trace strengths" of memories for the original and suggested items. Fuzzy-trace theory (e.g., Brainerd & Reyna, 1998), for example, incorporates the notions of trace fading or trace decay. Fuzzy-trace theory's core assumption is that memories are composed of two distinct traces, a verbatim trace of a target's surface form, and a gist trace representing a target's semantic, relational, and elaborative characteristics (Brainerd & Reyna, 1998). At initial encoding, verbatim and gist traces are stored in parallel, are functionally independent, and are differentially affected by various factors (e.g., age, length of retention interval, encoding

manipulations). Young children, for example, are thought to be more reliant than older children on rapidly decaying verbatim traces, whereas older children are more reliant on gist (Reyna & Brainerd, 1998). Misinformation is thought to degrade memory by altering the trace or preventing its retrieval (or both), with the amount of degradation dependent upon the current strength of memory for the original event information. Holliday et al.'s (1999) finding that the level of suggestibility in 5- and 9-year-old children was jointly determined by the relative strengths of the original event and post-event misinformation provides some support for this view. Children were found to be most suggestible when the original trace was weak and the post-event trace was strong.

Retrieval interference models

Alternately, retrieval interference models argue that misinformation effects are due to competition between original and post-event traces at the point of retrieval (Bekerian & Bowers, 1983; Chandler, 1991; Christiaansen & Ochalek, 1983; Morton, 1991; Morton, Hammersley & Bekerian, 1985). For example, the co-existence hypothesis proposes that both the original and the post-event misinformation traces are retained but the original memory is suppressed or "blocked" by the more recently encoded misinformation. The original memory trace will be accessed and reported only if appropriate cues are provided at retrieval.

One such model, the headed records model of memory (Morton, 1991, 1994; Morton et al., 1985), assumes that memory is composed of discrete records each attached to a heading that contains a description of the contents of the corresponding record. For a record to be retrieved its description must be matched with its heading. In the case of the misinformation paradigm, both the original and post-event details

are represented in memory by two distinct unalterable headed records. As only one of these may be retrieved at a time, the record with the heading that most closely matches the retrieval cues present at memory testing will be the one retrieved. In other words, if test items are presented in an order that does not match the presentation order of the original information (cf. Bekerian & Bowers, 1983; Kroll, Ogawa, & Nieters, 1988) then the critical retrieval cues are absent and an incorrect record is retrieved (Morton et al., 1985).

Some support for the retrieval interference hypothesis was provided by Bekerian and Bowers (1983) who manipulated the retrieval cues available during recognition testing. No evidence of a misinformation effect was found when adults were presented with test slides in the same sequential order as the original event information in the first phase. However, when the test slides were shown in random order the misinformation effect reported by Loftus et al. (1978) was replicated. Bekerian and Bowers argued that their results provided strong evidence that both original and post-event misinformation traces co-existed in storage, and that retrieval difficulties rather than trace alteration accounted for the misinformation effect.

Likewise, Christiaansen and Ochalek (1983) showed that adults who were warned that a post-event misleading narrative contained some erroneous details were as accurate at final memory testing as those who were not misled, demonstrating that warned participants were able to recover their memories for the original event information. Similarly, Newcombe and Siegal (1996, 1997) reported that 4-year-old children given pragmatic cues at test were less likely to report misinformation, indicating that the original memories of these children were not permanently altered by the introduction of misleading suggestions.

Schooler, Foster, and Loftus (1988) also reported findings consistent with a retrieval interference account of misinformation. Instead of providing the misleading details in a post-event narrative, participants in a misled condition were given the target items in a forced-choice modified recognition test (cf. McCloskey & Zaragoza, 1985a) in which only incorrect items were presented as alternatives. Schooler et al. found that misled adults were significantly more likely than adults in a control group to choose the misled item that they had selected on the interpolated test in a second recognition test. They concluded that the act of committing to a misled item on the interpolated test interfered with retrieval of the original event information. Similarly, Schreiber and Sergent (1998) found that misled participants who committed to misinformation on an interpolated recognition test performed more poorly than those in a control group on a subsequent modified recognition test. Taken together, these sets of findings provide evidence in support of a retrieval interference account such that access to the original event memory is "blocked" by the misinformation.

Evidence against the co-existence hypothesis, however, was provided by Loftus et al. (1989) who measured the speed at which participants in a control or a misled condition responded to target items at recognition testing. Loftus et al. proposed that if the original and misinformation traces co-exist in memory then misled participants would take longer to respond at testing (because they must consider both the original and the misinformation traces) than participants in a control group. Control and misled groups, however, responded equally fast and with equal levels of confidence even though the misled group performed more poorly than the control group.

Hence, while retrieval interference models give a reasonable account of many empirical findings in the literature on adult and child suggestibility some researchers

have questioned whether such models provide a complete account of such effects. For example, Howe (1991) showed that when a formal trace-integrity model was applied to data from misinformation studies using recall tests children who were misled evidenced more storage-based forgetting than the control group. Howe showed that the small misinformation effects obtained were due to both rate of forgetting and retrieval interference with the former exerting a stronger influence on children's recall. Howe's modelling suggests that retrieval interference and trace alteration are not necessarily mutually exclusive processes; both may contribute to children's reporting of suggested information.

1.3.2 Criticisms of memory interference hypotheses: Social demands / response bias hypotheses

The view that misinformation effects can be explained in terms of changes to memory storage and / or retrieval processes has been challenged by McCloskey and Zaragoza (1985a, 1985b) and Zaragoza and McCloskey (1989) who argue that post-event misinformation does not necessarily alter or overwrite original traces, nor cause retrieval difficulties. Instead, these researchers see the misinformation effect as reflecting the social demands and response bias inherent in the "standard" testing procedure developed by Loftus et al. (1978) and employed by developmental researchers such as Ceci et al. (1987b). The demand characteristics hypothesis proposes that a misled participant who remembers both the original and the misleading details may incorrectly select the misled item because he or she perceives the researcher as a credible information source, or he or she may wish to be viewed favorably by the researcher and acquiesces with the suggestion (McCloskey & Zaragoza, 1985a, 1985b). The response bias argument asserts that in the standard misinformation paradigm many misled participants forget or fail to encode the

original event details but do remember the more recently presented misleading details. Such participants are biased, relative to participants in the control group, towards selecting the misled item at test (McCloskey & Zaragoza, 1985a). Control participants who fail to remember the original item will guess on the memory test and be expected to perform at chance levels, whereas misled participants who only remember the misleading suggestion are expected to perform at below chance levels (Zaragoza, 1987).

In order to address these issues, McCloskey and Zaragoza (1985a) developed a "modified" testing procedure that resembles the "standard" recognition paradigm except that in the final recognition memory test the misled item is replaced by a previously unseen novel item. Examples of both the "standard" (Loftus et al., 1978) and "modified" (McCloskey & Zaragoza, 1985a) testing paradigms with examples taken from Ceci et al. (1987b) are illustrated in Table 1. In the final phase of the "standard" test children choose between original and the misled item alternatives (e.g., red hat vs. green hat). In the "modified" recognition test, the misled alternative is replaced by a previously unseen novel item (e.g., blue hat).

McCloskey and Zaragoza (1985a) argued that if misinformation impaired original event memories, participants in a misled condition would choose the original event detail (e.g., red hat) less often than those in a control condition. In a series of experiments using modified recognition tests with adults, McCloskey and Zaragoza found no significant differences in recognition accuracy between misled and control groups, providing evidence against the memory impairment view. They concluded that misinformation effects detected in the "standard" testing paradigm were, in all

likelihood, due to demand factors and / or response biases, and did not reflect true memory alteration.

A number of researchers using adult participants have replicated McCloskey and Zaragoza's (1985a) finding that use of the modified test eliminates the misinformation effect (e.g., Belli, 1993; Belli, Lindsay, Gales & McCarthy, 1994; Bowman & Zaragoza, 1989; Chandler, 1989, 1991; Chandler & Gargano, 1998; Loftus et al., 1989). Others, however, have found a reduced but statistically reliable misinformation effect on the modified test (e.g., Belli, Windschitl, McCarthy & Winfrey, 1992; Schreiber & Sergent, 1998; Windschitl, 1996). This same pattern has been found in research with children, with a number of studies finding no misinformation effect on the modified test (e.g., Newcombe & Siegal, 1996, 1997; Toglia, Hembrooke, Ceci & Ross, 1994; Zaragoza, 1987, 1991; Zaragoza, Dahlgren & Muench, 1992), but others reporting that the modified test procedure attenuates but does not eliminate the effect (e.g., Ceci et al., 1987b; Delamothe & Taplin, 1992; Holliday et al., 1999; Toglia et al., 1992). The reasons for these discrepancies will be discussed in some detail in the next section.

1.3.3 Developmental research examining causal mechanisms and misinformation

Much of the evidence investigating the cognitive and social mechanisms that give rise to suggestibility in children (e.g., Ceci et al., 1987b; Holliday et al., 1999; Lampinen & Smith, 1995; Newcombe & Siegal, 1996; Siegal & Peterson, 1995; Toglia et al., 1992; Zaragoza, 1987, 1991) has been collected using adaptations of the standard three-phase paradigm introduced by Loftus et al. (1978) and the modified three-phase paradigm introduced by McCloskey and Zaragoza (1985a). As noted in the previous section such research employing the "standard" and "modified" tests has

produced mixed results regarding both the presence of misinformation and developmental changes in this effect.

In a widely cited series of studies with children, Ceci et al. (1987b) found evidence of a misinformation effect across the age range from 3 to 12 years of age, but the magnitude of this effect was larger for 3- and 4-year-olds than for older children. Suggestibility in this preschool group was reduced but not eliminated when a 7-year-old child rather than an adult provided suggestions, indicating that young children's suggestible responses are at least partly influenced by a belief in information provided by adult authority figures. Similarly, Lampinen and Smith (1995) found that children aged 3 to 5 years were suggestible only when the misinformation was provided by a credible adult and not when presented by a young child or a discredited adult. Moreover, Ceci et al. (1987b) found evidence of a significant misinformation effect on both standard and modified tests, but that the magnitude of the effect was reduced in the latter case. They concluded that the misinformation effect could best be explained as a joint product of social and memory factors. In other words, these researchers argued that both memory interference and social demand factors are implicated in misinformation effects in children.

Other researchers have also found a reduced but reliable misinformation effect in the modified testing paradigm (e.g., Delamothe & Taplin, 1992; Holliday et al., 1999; Toglia et al., 1992). Holliday et al., for example, investigated the relationship between memory trace strength of the original event details, post-event misinformation, and 5- and 9-year-old children's suggestible responding on either a standard or a modified forced-choice recognition test. Evidence was found of a

significant negative effect of misinformation on recognition accuracy in *both* test conditions.

A more marked difference in children's correct responding on standard and modified tests of the misinformation effect has been noted by Zaragoza (1987, 1991; Zaragoza et al., 1992). In a series of studies using 3- to 6-year-old children, Zaragoza and her colleagues found an effect of misinformation on recognition accuracy when children were assessed using a standard test but no such effect when children were tested using the modified version. These results were maintained even when the same stimulus materials that were used by Ceci et al. (1987b) were employed. Zaragoza and colleagues concluded that social demand factors and response biases inherent in the standard testing paradigm were responsible for the misinformation effect in children. Similarly, Newcombe and Siegal (1996) reported evidence of a misinformation effect when 4-year-old children were given a standard test but that this effect was eliminated when children were tested with the modified procedure.

One likely cause for this discrepancy between findings relating to a significant effect of misinformation on the modified test is the length of the retention interval between the three experimental phases in the respective studies. The experiments of Zaragoza (1987) and Zaragoza (1991, Experiments 1 & 2) were completed within a single 20 minute session, whereas in those carried out by Ceci et al. (1987b) and Holliday et al. (1999), all three experimental phases were conducted on different days. Notably, such a pattern suggests that some forgetting of original event information may be needed for a misinformation effect to occur (Belli & Loftus, 1996). Direct support for this argument comes from Belli et al. (1992) who found a misinformation effect with adults within a modified testing paradigm when a longer retention interval

(i.e., at least five days between presentations of original and post-event details) was used but not when a shorter interval (i.e., 15 minutes) was employed. Zaragoza (1991, Experiment 3) extended the retention interval to two days between presentations of original and post-event suggestions and still found no evidence of a misinformation effect. However, in her study children were misled immediately before memory testing. It is possible that this interference manipulation might have assisted recollection of original story details by preventing consolidation of the misleading details (Toglia, 1991).

The discrepant findings in regard to modified test performance may also be due to differences in the number of details used as target items. In the Zaragoza research (1987, 1991; Zaragoza et al., 1992) and the Newcombe and Siegal (1996) study, children were tested on only two items for which they had received misleading information. In contrast, children in Holliday et al. (1999) were tested on six control items and six items for which they had received misleading suggestions. The latter study thereby maximized the chance of detecting misinformation effects because of an increased potential for memory distortions.

It has also been suggested that detection of misinformation effects on the modified test is dependent on participants exhibiting high levels of accuracy on control items for which no suggestions are given (e.g., Chandler, 1989; Payne, Toglia & Anastasi, 1994). Payne et al. conducted a meta-analysis of 44 studies (12 employing children) in which the modified test was used and reported a significant relation between control item performance and the magnitude of the misinformation effect. Consistent with this trend, control item performance in the Ceci et al. (1987b) and Holliday et al. (1999) studies was higher than in the Zaragoza (1987, 1991) studies providing support

for Chandler's and Payne et al.'s observations. The discrepancy between the two sets of studies may be related to the length of exposure to target items in the original story phase. In Zaragoza's (1987, 1991) studies, for example, children viewed the original slides for 4 seconds and 8 seconds, respectively (Zaragoza et al., 1992). In contrast, the children in Holliday et al.'s study viewed the original story pictures for 60 seconds. Hence, the latter study maximised memories for the original event details. In sum, the detection of misinformation effects on the modified test appears to be dependent on relatively high hit rates and long retention intervals between the experimental phases (Belli et al., 1992; Payne et al., 1994).

Further evidence indicating that children remain suggestible when the social and pragmatic demands to accept misinformation are reduced has come from research employing a yes / no recognition test (e.g., Lindsay et al., 1995; Pezdek & Roe, 1995; Welch-Ross, Diecidue & Miller, 1997). In Pezdek and Roe's (1995) study, for example, 4- and 10-year-old children responded "yes" or "no" to recognition target sentences that described three types of information, control (original), misleading, and novel target details (cf. Tversky & Tuchin, 1989). Both groups of children were found to be equally suggestible when a comparison of control and misled responses was made.

A notion that is closely related to the "social demand" account of suggestibility (e.g., Zaragoza, 1991) is the argument that misinformation effects may arise because of children's misunderstanding of the test questions put to them by an experimenter (Ackerman, 1998; Mulder & Vrij, 1996; Newcombe & Siegal, 1996, 1997; Siegal & Peterson, 1995). This argument holds that young children are inexperienced with the conventions governing interactions between themselves and adults (Grice, 1975) and

are therefore likely to misinterpret the intent of the interviewer in tests of eyewitness memory (Newcombe & Siegal, 1996; Siegal & Peterson, 1995). Newcombe and Siegal (1996) proposed that, unlike older children and adults, young children might not realize that the purpose of misinformation experiments is to ignore misleading suggestions. To demonstrate this point they gave 4-year-old children a standard recognition test one week after exposure to a story with accompanying pictures. Newcombe and Siegal found that the magnitude of the misinformation effect was reduced for children who were explicitly questioned regarding the time of the presentation of the original story in the standard testing paradigm. Although such conclusions may hold for very young children, findings of a robust misinformation effect in children as old as 8 years (e.g., Ceci et al., 1987b; Lindsay et al., 1995) undermines the view that misinformation effects in all children arise because of a lack of experience with pragmatic conventions.

1.3.4 Methodological criticisms of the modified testing procedure

The claim that the absence of a misinformation effect in the modified testing paradigm is evidence that post-event misleading suggestions do not induce memory-based changes to the original event memory (e.g., Zaragoza & McCloskey, 1989) has fuelled intense debate. Several researchers have questioned whether the modified test is sensitive to detecting all types of memory impairment (Belli, 1989; Belli & Loftus, 1996). Specifically, criticism has been directed at the absence of the misled item as a choice on the modified test. Loftus et al. (1985), for example, demonstrated that participants could select the correct response by guessing when presented with the original item and a novel alternative item. Tversky and Tuchin (1989) suggested that participants could perform accurately on the modified test by correctly rejecting the

novel item without retaining any memory for the original item. Similarly, Loftus (1991) proposed that the omission of the misled item might inform participants that the misled item is incorrect.

Belli (1989) also argued that the modified test is insensitive to detecting retrieval-based memory impairment due to the omission of the misleading alternative. Absence of the misled item at test means that an assessment of memory impairment due to source misattribution, and an evaluation of the existence of preferential access to the misleading alternative cannot be made. Belli developed a yes / no retrieval test sensitive to both suggestibility arising from social demand and memory interference. In a study employing adult participants, Belli found that the presentation of misleading suggestions reduced subsequent correct responding of "yes" to control items and reduced "no" responding to novel items. He concluded that the results demonstrated evidence of misinformation interference in terms of either or both memory impairment and source misattribution. Zaragoza and McCloskey (1989), in reply to Belli (1989) and Tversky and Tuchin (1989), argued that the results obtained in these studies using yes / no recognition tests did not provide conclusive evidence of memory interference caused by misleading suggestions. Zaragoza and McCloskey pointed out that poorer misled than control performance could have occurred in these studies due to demand factors and source misattribution errors. (See Section 5.1.1 for a detailed discussion of this debate).

While the body of evidence that has been accumulated from experimental comparisons of performance on the standard and modified tests goes some way to answering questions about the mechanisms that give rise to children's suggestibility, it must be acknowledged that these paradigms contain certain methodological

weaknesses which limit the generality of conclusions that are based exclusively on recognition performance across these two types of tests. This suggests that any comprehensive analysis of the mechanisms underlying suggestibility effects must employ supplementary methods of examining children's suggestible responses. Hence, the research reported in this thesis will employ a number of different kinds of recognition tests to provide converging evidence on the issue of causal processes.

1.3.5 The source-monitoring hypothesis

An alternative account of the misinformation effect has centred on failures of source-monitoring (Johnson et al., 1993; Lindsay, 1994; Lindsay & Johnson, 1989a; Multhaup, de Leonardis, & Johnson, 1999). The source-monitoring view proposes that memories (i.e., perceptual and contextual details) of the original event and post-event misinformation are stored separately (Lindsay, 1994; Reyna & Lloyd, 1997). In this sense the source-monitoring hypothesis is similar to retrieval interference theories of misinformation that posit co-existence of original and post-event memory traces (e.g., Bekerian & Bowers, 1983; Christiaansen & Ochalek, 1983; Morton et al., 1985). According to the source-monitoring hypothesis, the misinformation effect occurs when participants make source misattribution errors such that they mistakenly attribute the source of their memories to the post-event misinformation instead of the original event (Johnson et al., 1993). Source misattributions can occur if there is no memory for the original event because it was not encoded or it has been forgotten (Lindsay & Johnson, 1989a). Johnson et al. argued that source confusions are more likely to occur when employing the Loftus et al. (1978) paradigm with a forced choice or a yes / no recognition test because the original and post-event items are typically semantically and temporally related and presented by the same researcher.

Participants, for the most part, adopt a response criterion of familiarity without considering the source of this familiarity (Johnson et al., 1993). In this sense, a test item is selected on the basis of its perceived prior occurrence or "familiarity" (cf. Mandler, 1980), without considering other sources of information such as perceptual details and encoding context (Johnson et al., 1993).

Support for the source-monitoring account of suggestibility has been reported by Lindsay and Johnson (1989a), Zaragoza and Koshminder (1989), and Multhaup et al. (1999) who found that misinformation effects were eliminated when misled participants were given a source-monitoring test that required them to distinguish between the sources of their memories. In contrast, when misled participants were given a yes / no recognition test they were more likely to report the suggested items at test. Lindsay and Johnson (1989a) concluded that if participants are instructed to use stricter criteria when making test responses, as specified in their source-monitoring instructions, misinformation effects could be eliminated.

A somewhat different set of results have been obtained by other researchers who have reported that misinformation effects persist in source-monitoring tests under certain conditions (e.g., Belli et al., 1994; Carris, Zaragoza & Lane, 1992; Lindsay, 1990; Zaragoza & Lane, 1994; Zaragoza & Muench, 1989). For example, Carris et al. (1992) found that participants who visualized suggested information as it was presented were more likely to report seeing the suggested details on a later test. In other words, participants who "imagined" suggestions made source-monitoring errors such that they misattributed such suggestions to the original event.

In summary, evidence has accumulated that participants often report misleading suggestions because they believe they *saw* such suggestions as part of the original

witnessed event. However, it is clear that misinformation effects can also occur independently of source-monitoring errors (e.g., see Lindsay & Johnson, 1989a; Zaragoza & Lane, 1994). The source-monitoring hypothesis gives an adequate account of the variables that give rise to source misattribution errors. However, unlike other theoretical accounts of the misinformation effect (e.g., trace alteration, "blocking", social demand / response bias), it lacks additional assumptions concerning the memory representations of the original event information and the post-event misinformation and the processes underlying these representations (Ayers & Reder, 1998). As such, the source-monitoring hypothesis adds little to the debate concerning the fate of the original memory trace following the presentation of misinformation.

1.4 Summary of causal mechanisms in the child misinformation effect

It is clear from the previous review of research that has examined misinformation effects in children that a number of cognitive and social factors are implicated. The findings, however, are inconsistent with regard to the relative importance of these factors in producing misinformation effects (Ceci & Bruck, 1995). A number of studies (e.g., Ceci et al., 1987b; Holliday et al., 1999) have compared the magnitude of misinformation effects obtained in the "standard" and the "modified" tests and have reported an attenuated effect in the modified testing paradigm. The finding of a misinformation effect in studies using a "modified" test (cf. McCloskey & Zaragoza, 1985a) which provides a stringent control on social demand factors and response biases, strongly suggests that memory changes of some kind contribute to many instances of the misinformation effect in children. However, it is hard to draw more specific conclusions about the nature of the memory changes that occur when

children accept misleading suggestions because little attention has been given to identifying the memory processes underlying the interference produced by the introduction of post-event misinformation. For example, even though several extant models of recognition memory hold the view that recognition performance reflects dissociable processes such as recollection and automatic memory processes (e.g., Brainerd et al., 1998; Jacoby, 1991; Roediger et al., 1989), the possibility that suggestibility can arise through the action of one or the other of such processes has rarely been considered. Hence it is essential to gain a better understanding of how the fundamental cognitive processes that govern memory are linked to misinformation effects in children.

1.5 Multiple system and process models of memory

The belief that memory is not a single, unitary system was first noted by Descartes in the seventeenth century when he wrote that memory of an unpleasant childhood event can remain outside awareness for a life time but still affect our behaviour (Schacter, 1987). Many modern models also view memory as divided into multiple interacting components. Some have conceptualized this in terms of multiple memory *systems* (e.g., implicit vs. explicit) while others have conceived of memory operating as a single system composed of different kinds of memory *processes* (e.g., automatic vs. intentional) contributing to responses on tests of memory.

Before beginning a review of the relevant literature, a clarification of terminology is needed. Specifically, the terms "implicit" and "explicit" have been employed variously by researchers to describe types of tests, memory systems, memory processes, and memory states (see Kelley & Lindsay, 1996; Reingold & Toth, 1996). Graf and Schacter (1985) introduced the concepts of "explicit" memory and

"implicit" memory to describe dissociations between performances on direct (e.g., recall and recognition) and indirect (e.g., word completion) tests of memory. They proposed that "implicit memory is revealed when performance on a task is facilitated in the absence of conscious recollection; explicit memory is revealed when performance on a task requires conscious recollection of previous experiences" (p. 501). The assumption that performance on a particular task denotes evidence of underlying memory processes has been extensively debated (see e.g., Brainerd et al., 1998; Dunn & Kirsner, 1989; Jacoby, 1991) and is discussed in detail in Section 1.9.2.

Following Kelley and Lindsay (1996) this thesis has adopted the terms "direct" and "indirect" to describe respectively *tests of memory* that include or do not include instructions to respond on the bases of studied items. Further, in accordance with Kelley and Lindsay, the terms "explicit" and "implicit" will be used to refer to the influences of an event experienced with or without awareness of remembering respectively.

1.5.1 Dissociations between performance on direct and indirect tests of memory

There are now many demonstrations in the literature of individuals with amnesia showing intact long-term verbal memory on indirect tests of memory in the context of profound deficits in performance on direct memory tests (e.g., Graf, Squire & Mandler, 1984; Graf & Schacter, 1985; Moscovitch, Goshen-Gottstein & Vriezen, 1994; Warrington & Weiskrantz, 1970). Warrington and Weiskrantz (1970), for example, compared amnesic and control subjects' memory for words under a number of test conditions. On a direct test (e.g., yes / no recognition) in which subjects were asked to identify previously studied words, the amnesic patients performed more

poorly than the control patients. In contrast, on an indirect test (e.g., word-fragment identification and word-stem completion) in which subjects supplied the first word that came to mind the amnesic and control subjects performed equally well.

Task-based dissociations in performance on direct and indirect memory tests have also been reported in numerous studies involving individuals with normal memory function (e.g, Graf & Mandler, 1984; Jacoby & Dallas, 1981; Light & Singh, 1987; Mitchell, 1993). In such studies task manipulations have been shown to affect performance on one type of memory test but to leave performance on the other type of test unaffected. Reliable dissociations of this sort have been established with a variety of experimental manipulations including elaborative or semantic processing of study material (e.g., Flory & Pring, 1995; Graf & Mandler, 1984; Graf & Schacter, 1985; Isingrini, Vazou & Leroy, 1995; Jacoby, 1983; Jacoby & Dallas, 1981; E. R. Smith & Branscombe, 1988), study-test delays and study-test modality shifts (e.g., McClelland & Pring, 1991; Srinivas, 1993).

Crossover or reversed dissociations between performances on direct and indirect tests have also been reported (e.g., Graf & Mandler, 1984; Jacoby, 1983). In a study by Jacoby (1983), for example, participants were instructed to read aloud words both in (e.g., "…- *cold*") and out of context (e.g., "*cold*") and to generate words from the context (e.g., "hot-*cold*"). Subsequent recognition test accuracy was superior for words that were generated from the context at encoding, with decreased accuracy for words read in context and words read out of context, respectively. In contrast, on a perceptual identification test, priming was greatest for words read out of context at encoding, followed by words read in context, with words generated in context demonstrating the lowest levels of priming (Jacoby, 1983).

1.5.2 Developmental dissociations on direct and indirect memory tests

Some attention has also been given to differences in the developmental course of performance on direct and indirect memory tests. Explicit memory performance as measured on tests of recognition, cued recall, and free recall improves markedly from two years of age to adolescence (Anooshian, 1997; Carroll, Byrne & Kirsner, 1985; Greenbaum & Graf, 1989; Hayes & Hennessy, 1996; Holliday et al., 1999; Naito, 1990; Parkin & Streete, 1988; Perruchet, Frazier & Lautrey, 1995; Russo, Nichelli, Gibertoni & Cornia, 1995). Such improvement is due, in part, to increased use of explicit or intentional memory strategies such as rehearsal, use of mnemonics (Bjorklund & Douglas, 1997), increases in metamemorial competence (Kail, 1990; Sodian, Schneider, & Perlmutter, 1986), and greater proficiency in processing and storing information (Kail, 1990; Perlmutter, Schork & Lewis, 1982). In contrast, developmental investigations of indirect memory performance have found few differences in the magnitude of perceptual priming effects in children across the age range from preschool to adolescence (Anooshian, 1997; Carroll et al., 1985; Drummey & Newcombe, 1995; Ellis, Ellis & Hosie, 1993; Greenbaum & Graf, 1989; Hayes & Hennessy, 1996; Komatsu, Naito, & Fuke, 1996; Perez & Peynircioglu, 1998). For example, in Hayes and Hennessy's (1996) study 4-, 5- and 10-year-old children first named objects from either picture fragments or named complete pictures of the same objects and answered questions. Results from picture fragment completion and recognition memory tests presented two days later showed that while explicit memory accuracy improved with age, there was no evidence of developmental change in priming. These findings have been interpreted as supporting the view that the systems and / or processes which subserve indirect memory

performance emerge and reach an asymptotic state of development at an earlier point in the lifespan than do conscious or explicit memory processes (Parkin, 1989; Schacter, 1996; Schacter & Moscovitch, 1984).

While this pattern of results holds for indirect memory tests such as picture completion and word-stem completion that engage primarily perceptual or data driven processing (cf. Roediger et al., 1989), two recent studies suggest that this may not be the case for indirect tests based on conceptually driven processing. For example, Perruchet et al. (1995) reported that 9-year-olds outperformed 7-year-olds in terms of priming on a category-exemplar generation task when target items were atypical of their categories. When target items were typical of their categories, however, no evidence of developmental change was found. Similarly, Komatsu et al. (1996) found an increase in priming across the age range of 7 to 11 years when the encoding task required generation of the target word in response to a definition. In contrast, no age-related changes in priming were observed when participants "read" the target word presented in a sentence. Hence, Komatsu et al. proposed that implicit memory has two components, one that is developmentally invariant based on perceptual processing, and a second that is dependent on conceptual processing and which increases with age.

1.6 Theoretical explanations of dissociations on direct and indirect memory tests

This review shows that certain task variables can have different and sometimes opposite effects on memory performance in adults and children as revealed by the two types of tests (Richardson-Klavehn et al., 1996; Schacter et al., 1993). Task dissociations across direct and indirect tests have been noted in memory impaired

populations and across different age groups (e.g., Graf & Schacter, 1985; Warrington & Weiskrantz, 1970).

Three broad theoretical approaches have been proposed to explain such patterns of dissociation; (1) activation models (e.g., Graf & Mandler, 1984; Mandler, 1980), (2) multiple memory systems (e.g., Squire, 1987; Tulving, 1983, 1985b; Tulving & Schacter, 1990), and (3) processing models (e.g., Brainerd et al., 1999; Jacoby, 1991; Roediger et al., 1989). In the following sections each of these theoretical accounts will be discussed along with procedures for estimating the contribution of aware and unaware forms of memory to performance on tests in recognition memory.

1.7 Activation models

Activation theories (e.g., Graf & Mandler, 1984; Mandler, 1980) hold that retrieval of information on an indirect test of memory is attributable to activation or integration of the representative unit which is primarily reliant on perceptual representations of the study material. Activation/ integration is an automatic process that produces feelings of familiarity about the study material (Graf, 1994; Mandler, 1980). On the other hand, elaborative processing of the study material in context and the creation of associations between the studied material and context facilitates the retrieval of information on a direct test of memory (Graf, 1994; Kelly & Lindsay, 1996).

Several criticisms have been made of activation theories (see e.g., Kelley & Lindsay, 1996; Schacter, 1987 for reviews) many of which arise from findings with indirect tests of memory. In particular, perceptual priming effects have been reported to persist for long periods (days, weeks, and months) (e.g., Jacoby & Dallas, 1981; Tulving, Schacter, & Stark, 1982) while the central tenet of activation theories predicts that such activation should be temporary and of short duration (Schacter,

1987). Another major concern has been the finding that amnesics demonstrate priming for novel stimuli (e.g., Schacter, Cooper, Tharan, & Rubens, 1991). Such findings undermine the activation account's prediction that such subjects are unable to create new representations in memory (Kelley & Lindsay, 1996).

1.8 Multiple-systems models

Researchers advocating multiple-systems models (e.g., Fleischman, Vaidya, Lange, & Gabrieli, 1997; Hammann & Squire, 1997; Johnson, 1992; Johnson & Hirst, 1993; Schacter, 1989; Schacter & Moscovitch, 1984; Squire, 1987; Tulving, 1983, 1985b, 1993; Tulving & Schacter, 1990) have proposed that dissociations between performance on direct and indirect tests reflect the operations of distinct memory systems in the brain. Evidence to support these models has, for the most part, been derived from studies of amnesic individuals that have demonstrated impaired conscious recollection on direct tests along with relatively intact priming on indirect tests (see Greene, 1992, Schacter, 1987; Squire, 1987, for reviews). Tulving, for example, postulated three separate memory systems, episodic, semantic, and procedural. Conscious recollection or "remembering" on a direct test is a product of the episodic system; feelings of familiarity or "knowing" that an event has been experienced previously reflect the operation of the semantic system (Tulving, 1993).

In a similar vein, Squire (1987) proposed that dissociations between direct and indirect tests in brain-damaged patients confirm the operation of two distinct systems. The "declarative" system contains memories for facts and specific episodes, is directly available to conscious recollection, and accounts for amnesics' impaired performance on direct tests of retention. The "procedural" system which underlies motor and perceptual skills learning is unavailable for conscious recollection, and

accounts for intact performance on indirect tests of retention (Roediger, 1990a; Squire, 1987). Similarly, Schacter and Moscovitch (1984) hypothesized the existence of two functionally independent memory systems in infants each maturing at different rates during the first year. They proposed that the early developing system was analogous to the intact memory system displayed by amnesics on indirect memory tests, and the late developing system (first emerging at 8 - 9 months) corresponded to the impaired declarative memory in amnesics. This view has been recently criticized in the light of the substantial body evidence which indicates that infants as young as three months demonstrate *both* perceptual priming *and* explicit recognition on tasks analogous to those used in studies with children and adults (see Rovee-Collier, 1997 for a comprehensive review).

Moreover, certain recent findings have also presented difficulties for multiple-systems accounts of dissociations exhibited by brain-damaged subjects on direct and indirect tests of retention. For example, it has been reported that patients with amnesic-syndrome associated with organic brain disease of the Alzheimer, Parkinson, Huntington types do not demonstrate impaired conscious recollection on *all* direct memory tests, nor do they display intact priming on *all* indirect memory tests (Heindel, Salmon, Shults, Walicke, & Butters, 1989).

A more general criticism leveled at multiple-systems models is that theorists have failed to give a detailed description of the cognitive processes that are subserved by each of the component memory systems (Kelley & Lindsay, 1996). The "processing-model" approach, in contrast, places less emphasis on the identification of separate memory systems but instead seeks to describe the various functional processes that give rise to performance on direct and indirect tasks.

1.9 Dual-processing models

In contrast to multiple-systems models, processing models of memory (e.g., Blaxton, 1989; Roediger, 1990a; Roediger, Weldon, Challis, 1989) propose that functional dissociations between performance on direct and indirect tests are the manifestations of the operations of different memory processes. Roediger and his colleagues (Roediger, 1990a; Roediger et al., 1989), for example, noted that direct and indirect tasks demand different types of processing and introduced the "transfer-appropriate processing" framework to describe and predict when dissociations would arise. The main assumptions of this approach are as follows: Direct tests require semantic or meaning-based processing and are, for the most part, conceptually driven. Indirect tests, on the other hand, demand perceptual processing and are, for the most part, data driven (Roediger, 1990a). The transfer-appropriate processing model also incorporates the "encoding specificity principle" (Tulving & Thomson, 1973) such that memory performance is facilitated when the encoding and the retrieval conditions match. According to this approach, amnesics have impaired memory on direct tests that demand conceptually driven processing but preserved memory on indirect tests that require data driven processing (Roediger et al., 1989).

The findings of Jacoby (1983) have also been cited in support of the transfer-appropriate processing view (e.g., Greene, 1992; Roediger, 1990a). Jacoby found that recognition accuracy was dependent on two factors; whether a stimulus was "read" or "generated" at encoding, and on whether subjects were given a direct or indirect retention test. Accuracy was superior for words that were generated from the encoding context compared to words read aloud, whereas for priming tests the opposite pattern was obtained. In terms of the transfer-appropriate processing model,

generating a word in context requires elaboration that leads to superior accuracy on a

recognition test that is essentially conceptually driven. Reading a word

out of context on the other hand, is primarily a perceptual process that leads to greater

priming on a data-driven perceptual identification task (Roediger, 1990a).

The transfer-appropriate processing framework has proved useful in explaining

functional dissociations on direct and indirect tests (e.g., Cabeza, 1994; deWinstanley,

Bjork, & Bjork, 1996; Flory & Pring, 1995; McClelland & Pring, 1991; Mulligan &

Hartman, 1996). The approach has been criticized, however, for failing to account for

the findings of normal priming (e.g., Shimamura, 1986) on conceptually driven

indirect tests that ask subjects to produce words cued semantic associates or category

labels (Kelley & Lindsay, 1996). A further limitation is that there are no formal

procedures for specifying the nature of the processes engaged by direct and indirect

tasks (Jacoby, Levy, & Steinbach, 1992; Kelley & Lindsay, 1996).

1.9.1 Dual-process models of recognition: Automatic and intentional processing

Dual-process models of retrieval (e.g., Atkinson & Juola, 1974; Gardiner, 1988;

Jacoby, 1991; Jacoby & Dallas, 1981; Mandler, 1980) hold that there are two

qualitatively distinct and functionally independent mechanisms that give rise to

recognition of studied items. The first mechanism, "recollection", has been described

as an intentional, aware (e.g., Jacoby, 1991; Lindsay et al., 1995), and a conscious and

controlled process (e.g., Mandler, 1980; Schacter, 1989) that demands attention.

Intentional recollection is proposed to be vulnerable to interference effects and

forgetting (Brainerd et al., 1998; Jacoby, 1991) and invokes the use of memory

strategies such as elaboration, rehearsal, and semantic memory (Kail, 1990).

Familiarity, on the other hand, has been described as an automatic, fast (e.g., Hasher

& Zacks, 1979; Jacoby, 1991), unaware (Lindsay et al., 1995), and nonconscious

process that does not demand attention.

Mandler (1980), for example, proposed that two processes are invoked when a

recognition memory decision is made. The first, familiarity, is a fast automatic

process and is a prerequisite to the second process, retrieval of the encoding context.

Retrieval of the encoding context (recollection) produces explicit memories of target

events and is the product of elaborative processing at encoding. Familiarity, on the

other hand, supplies no explicit contextual or source details but rather, is the product

of intra-item activation / integration of sensory and perceptual characteristics.

Whether or not a test item is judged "familiar" is dependent on the level of activation

at encoding and the degree of perceptual correspondence between encoding and test

(Kelley & Lindsay, 1996).

Following Mandler (1980), Jacoby and his colleagues (Jacoby, 1991; Jacoby, Ste-

Marie, & Toth, 1993; Jacoby, Toth, & Yonelinas, 1993; Jacoby, Yonelinas, &

Jennings, 1997; Yonelinas, Dobbins, Szymanski, Dhaliwal, & King, 1996) also

argued that two distinct mechanisms contribute to recognition of test items,

intentional recollection and familiarity. For Jacoby (1991), "recollection" is defined

as "consciously controlled, intentional use of memory" (p. 516). Recollection reflects

a discrete "threshold" process based particular aspects of an item and the encoding

context (Yonelinas et al., 1996). The process of "familiarity", in contrast, is defined

as "relatively automatic…faster, less effortful, and less reliant on intention" (Jacoby,

1991: 516) than recollection. Jacoby (1991) redefined Mandler's (1980) description

of familiarity and proposed that familiarity judgements mirror the effects of the prior

processing of test items (i.e., whether test items have been encoded as anagrams or

read as the whole word) as well as the perceptual attributes of test items. Jacoby (1991) argued that "it is necessary to define familiarity in terms of the task in which a person is currently engaged [and] is better described as arising from relationships among items…rather than as an absolute characteristic of memory for an item" (p. 535). That is, consistent with global memory models (e.g., Gillund & Shiffrin, 1984), familiarity-based remembering is context specific.

Two methods for measuring the effects of conscious recollective and unconscious automatic processes on memory have been proposed, task-based separation (e.g., Gardiner, 1988; Graf & Schacter, 1985) and model-based separation (e.g., Brainerd et al., 1998; Jacoby, 1991).

1.9.2 Task-based methods for separating recollection and automatic memory processes

Two task-based methods have been employed to examine conscious recollection and automatic memory processes in recognition memory. In the remember/know procedure (Gardiner, 1988, Gardiner & Java, 1991, 1993; Gardiner, Ramponi, & Richardson-Klavehn, 1998; Mazzoni, Vannuchi, & Loftus, 1999; Tulving, 1985b), participants report on subjective states of awareness associated with recognition memory performance. "Remember" judgements are made if an item is consciously recollected from the encoding phase and "know" judgements are made if an item is familiar but its presentation at study cannot be recollected (Gardiner & Java, 1993). Gardiner and his colleagues have demonstrated that manipulation of variables such as levels of processing, read / generate encoding, retention interval (Gardiner, 1988), and divided / full attention (Gardiner & Parkin, 1990) have an effect on remember judgements but little influence on know judgments (see Rajarum & Roediger, 1997, for a review).

The remember / know procedure has been criticized, however, for its adoption of the assumption that the relation between subjective states of awareness is mutually exclusive (e.g., Jacoby, Begg, & Toth, 1997; Strack & Forster, 1995). Such an assumption asserts that remembering (conscious recollection) and knowing (automaticity) cannot occur together. Jacoby and his colleagues (e.g., Jacoby, 1991; Jacoby, Toth, & Yonelinas, 1993; Jacoby, Jones, & Dolan, 1998) and others (e.g., Gruppuso, Lindsay & Kelley, 1997; Ste-Marie, Jennings, & Finlayson, 1996) have provided substantial evidence that both conscious recollection and automatic memory processes can operate simultaneously to affect performance on a given task.

The remember / know procedure has also been criticized for its reliance on subjective states of awareness as the sole basis for measurement of conscious recollection (e.g., Jacoby, Ste-Marie, & Toth, 1993). Self-report data obtained using this paradigm should be viewed cautiously because it is subject to the influence of factors unrelated to awareness such as social demand and response biases (Reingold & Toth, 1996; Strack & Forster, 1995). That is, the subjective criterion that a participant uses to decide whether they consciously "remember" a previous episode will vary across testing occasions and contexts (Reingold & Toth, 1996).

The second task-based method for examining recollection and automatic memory processes in recognition makes the assumption that performance on direct and indirect tests reflects the operation of conscious recollection or unconscious automatic memory processes, respectively (e.g., Graf & Schacter, 1985; Light & Singh, 1987; Mitchell, 1993; Parkin & Streete, 1988; Richardson-Klavehn & Bjork, 1988; E. R. Smith & Branscombe, 1988). That is, it is claimed that performance on indirect tasks (e.g., word-stem completion) represents a measure of an underlying implicit and

unconscious memory process, while performance on a direct task (e.g., recognition) represents a measure of an underlying conscious intentional recollection process.

This assumption of a relatively transparent relationship between performance on a given task and the underlying process(es), however, has provoked considerable controversy (Jacoby, 1991; Jacoby, Toth, & Yonelinas, 1993; Merikle & Reingold, 1991; Rovee-Collier, 1997; Schacter et al., 1993). In particular, the assumption of "exclusiveness" (Reingold & Merikle, 1990), or "process-purity" (Jacoby, 1991) whereby direct and indirect tests are seen as providing qualitatively different measures of memory processes has been questioned (Brainerd et al., 1998; Dunn & Kirsner, 1989; Jennings & Jacoby, 1993; Reingold & Toth, 1996; Roediger & McDermott, 1993; Schacter, Bowers & Booker, 1989). One major problem with this assumption is that performance on indirect tests may reflect the *joint* operation of both automatic and conscious intentional processes (Brainerd et al., 1999; Jacoby, 1991; Toth, Reingold, & Jacoby, 1994). For example, performance on a nominally "indirect" task such as supplying the correct word-stem on a word-stem completion test can be accomplished by consciously remembering the word from the study phase (Toth et al., 1994).

Conversely, responding on direct tests can be affected by the operation of automatic processes of which the subject is relatively unaware (Isingrini et al., 1995). Another major difficulty with this approach is that performance on indirect and direct tests may not reflect the operation of different memory processes but instead be an artifact of task differences such as the type of cues available at retrieval (Reingold & Toth, 1996). Specifically, indirect tests such as word-stem and picture fragment

completion typically present test cues in a degraded form whereas recognition tests present such cues in entirety (Reingold & Toth, 1996).

Given that *both* conscious recollective and unconscious automatic processes have been found to operate on direct and indirect tests of retention there would appear to be a need for methods of assessing the relative contribution of each processes to performance on a given memory task. Such methods have been developed as part of the more general memory models reviewed in the next section.

1.9.3 Model-based separation of recognition memory processes: The process dissociation procedure

A major advantage of model-based approaches is that no assumption that measures obtained on direct and indirect tasks are "process-pure" (Jacoby, 1991; Jacoby, Toth, & Yonelinas, 1993; Reingold & Toth, 1996). In fact, quite the opposite view is taken; performance on each of these kinds of tasks is assumed to reflect the simultaneous operation of two processes, conscious recollection and unconscious automatic memory.

In order to overcome the serious limitations of the task dissociation approach Jacoby (1991; Jacoby, Toth, & Yonelinas, 1993) proposed a process dissociation procedure to assess the relative contributions of recollection and automatic processes to recognition memory performance. In this approach, it is assumed that performance on recognition memory tests reflects both recollective and automatic uses of memory and that each independently contribute to memory performance. The two processes are assumed to differ in the degree of conscious or intentional control that can be exerted over them. Conscious control, therefore, is operationally defined "as the difference between performance when a person is trying to as compared with trying not to use information from some particular source" (Jacoby, 1991, p. 527). The

process dissociation procedure is based on this principle. Typically it employs two tasks, an "inclusion" condition in which automatic and intentional processes work together, and an "exclusion" condition in which the two processes oppose each other. For example, Jacoby (1991) asked adults to memorize two word lists presented in different modalities. At test, a third list containing words from lists 1 and 2 as well as new words, was presented. In the inclusion condition, participants were instructed to respond "old" to previously presented words from either list. In the exclusion condition participants were told to exclude words from List 1. Hence, in the inclusion test condition, participants can respond on the basis of conscious recollection (R) alone, automatic (A) processes alone, or on the basis of both recollection and automatic processes. In the exclusion condition, recollection and automatic processes oppose each other. That is, conscious recollection is used to exclude words from List 1.

Estimates of the probabilities of recollection affecting performance can, therefore, be calculated by subtracting the probability of responding with an OLD word in the Exclusion condition from the probability of responding with an OLD word in the Inclusion condition (Jacoby, 1991; Jacoby, Toth, & Yonelinas, 1993):

R = P ("Old" | Inclusion) – P ("Old" | Exclusion).   (1)

Recollection is therefore operationally defined as the difference between intentionally remembering to report an item (Inclusion condition) and intentionally not reporting the item (Exclusion condition). Estimates of automaticity can be calculated by:

A = P ("Old" | Exclusion) / (1 - R).   (2)

Automaticity, therefore, is defined on the basis of the relation between performance in the Inclusion and Exclusion conditions and not in terms of self-reported lack of awareness (e.g., Bowers & Schacter, 1990; Gardiner & Java, 1991).

The process dissociation equations provide separate estimates of the probabilities of responding in a particular recognition memory test on the bases of both conscious recollection and automatic processes. The recollection estimate represents the probability of recognition responding on the basis of intentional or conscious memory of an item, and is assumed to be sensitive to contextual cues at study and at test. That is, conscious recollection is specific to the type of encoding and test conditions that obtain in a memory task (Kelley & Jacoby, 1998). The automaticity estimate represents the probability that material is retrieved automatically without conscious recollection, and is a product of the joint operation of the contextual cues provided at test and the encoding procedure (Jacoby, Toth, Lindsay, & Debner, 1992; Kelley & Jacoby, 1998).

1.9.4 Applications of the process dissociation procedure

The process dissociation procedure has been applied to assess the contribution of automatic and recollective memory processes to a wide variety of populations (e.g., memory-impaired and elderly participants) and tasks including the Stroop task (Lindsay & Jacoby, 1994), fame judgements (Jennings & Jacoby, 1993), divided attention (Schmitter-Edgecombe, 1996). For example, process dissociations have been reported in elderly participants (Hay & Jacoby, 1998; Jacoby, 1992; Jennings & Jacoby, 1997; Titov & Knight, 1997), in memory-impaired participants (Cermak, Verfaellie, Sweeney & Jacoby, 1992; Ste-Marie et al., 1996; Verfaellie & Treadwell, 1993), and in participants with dysphoric mood (Hertel, 1998), schizophrenia (Kazes,

Berthet, Danion, Amado, Willard, Robert, & Poirier, 1999), and multiple sclerosis (Scarrabelotti & Carroll, 1998).

In Titov and Knight's (1997) study, for example, young, middle-aged, and elderly adults given a word-stem completion test showed an age-related decline in the contribution of recollective memory processes which began in middle age. In contrast, the contribution of automatic memory processes was found to be age invariant. Analogous results have been reported concerning the effects of brain impairments on memory performance. Ste-Marie et al. (1996), for example, found evidence of reduced recollection estimates but invariant automaticity estimates when brain damaged participants who were required to complete word stems with previously learned words were compared to neurologically intact controls.

The process dissociation procedure may also be particularly useful as a diagnostic tool for the identification of deficits in intentional recollection (e.g., Jacoby, Jennings, & Hay, 1996; Jennings & Jacoby, 1993). Studies comparing healthy young and elderly adults have typically reported a decline in the ability of the older group to intentionally recollect studied words. Early signs of dementia, therefore, will be shown by a marked deficit in recollection (Jacoby et al., 1996). The process dissociation procedure has also been employed to improve intentional recollection in elderly adults. Jennings and Jacoby (1993), for example, found that participants given four daily training sessions over one week showed a significant improvement in their ability to intentionally recollect words.

1.9.5 Assumptions of the process dissociation procedure

A major assumption of the process dissociation procedure is that the processes of recollection and automaticity are independent (Jacoby, 1991, 1998; Jacoby, Toth, &

Yonelinas, 1993). That is, each process can occur with or without the other (Jacoby,

Yonelinas, & Jennings, 1997). Jacoby and his colleagues have argued that this

assumption is met when it can be demonstrated that task manipulations affect one of

these processes while leaving the other unaffected. Additionally, the estimation

procedure assumes that recollection and automaticity parameters are invariant across

inclusion and exclusion test conditions (Graf & Komatsu, 1994; Jacoby, 1998), and

that the criteria for responding (response bias) is also invariant across inclusion and

exclusion conditions (Buchner, Erdfelder & Vaterrodt-Plunnecke, 1995; Yonelinas,

Regehr & Jacoby, 1995).

   Support for the independence assumption has been provided under a variety of

experimental conditions including divided attention (Gruppuso et al., 1997; Jacoby,

1996; Jacoby, Toth, & Yonelinas, 1993; Schmitter-Edgecombe, 1996), the Stroop task

(Lindsay & Jacoby, 1994), fame judgements (Jennings & Jacoby, 1993), word-stem

completion (Debner & Jacoby, 1994; Jacoby, Toth, & Yonelinas, 1993; Toth et al.,

1994), and stimulus presentation duration (Jacoby, 1998). Jacoby, Toth, and

Yonelinas (1993), for example, investigated the effects of varying attention (full

versus divided) on participants' ability to recall words cued with word fragments.

They reported that, whereas recollection estimates were reduced under divided

attention, automaticity estimates were unaffected by this manipulation.

1.9.6 Violations of assumptions of the process dissociation procedure

   Notwithstanding this empirical support for the validity of the process dissociation

procedure, considerable debate surrounds the implications of possible violations of

the assumptions that underlie this approach. In particular, the assumption that

recollection and automaticity represent independent processes has attracted a great

deal of controversy (e.g., Brainerd et al., 1998; Curran & Hintzman, 1995, 1997; Dodson & Johnson, 1996; Gardiner & Java, 1993; Hintzman & Curran, 1997; Jacoby, 1998; Jacoby, Begg, & Toth, 1997b; Jacoby, McElree & Trainham, 1999; Jacoby et al., 1994; Jacoby & Shrout, 1997; Jacoby, Yonelinas, & Jennings, 1997; Joordens & Merikle, 1993; Mulligan & Hirshman, 1997; Ratcliff, Van Zandt & McKoon, 1995; Reingold & Toth, 1996; Russo & Andrade, 1995).

Curran and Hintzman (1995) argued that the process dissociation estimates that they derived from data in a series of word-stem completion experiments provided evidence of violations of the assumption of independence of recollective and automatic processes. Specifically, it was found that estimates of recollection increased with longer study time but that the opposite was the case for estimates of automaticity. Moreover, significant positive correlations were found between estimates of recollection and automaticity. Such between-subjects correlations were seen to result in an underestimation of the contribution of automaticity to recognition responding.

In reply, Jacoby, Yonelinas and Jennings (1997) proposed that Curran and Hintzman's estimates were more than likely produced by violations of the boundary conditions specified for the application of the process dissociation procedure. In particular, the Curran and Hintzman data were contaminated by floor effects on the exclusion test which result in automaticity estimates of zero, and the employment of generate-recognize strategies or a mixture of strategies following inclusion and exclusion test instructions (Jacoby, Yonelinas, & Jennings, 1997). Estimates of automaticity are underestimated given perfect scores in the exclusion condition (i.e., zero incorrect produces an A estimate of 0.0) (Jacoby, Toth, & Yonelinas, 1993).

Reliance on generate-recognize retrieval strategies (i.e., completing a word-stem with the first word that comes to mind *automatically*) rather than direct retrieval strategies (i.e., completing a word-stem with an earlier-studied word) results in an underestimation of intentional recollection and violates both the assumption that estimates of recollection are equivalent in the inclusion and exclusion conditions and the assumption of independence of recollection and automaticity (Jacoby, 1998).

In order to resolve this issue, Jacoby and Shrout (1997) conducted a psychometric analysis of the effects on the independence assumption when estimates of recollection and automaticity were positively correlated. They found that when the estimates of recollection and automaticity were calculated *within-participants* rather than *across participants or items* (cf. Curran & Hintzman, 1995), correlations between estimates did not affect the size of the estimates obtained (see Gruppuso et al., 1997, for a similar view). In most of the research reported in this thesis (i.e., Experiments 2, 3, 4, and 5), therefore, the estimates of automaticity and recollection were calculated within-subjects, and hence, the likelihood of problematic violations of the assumptions underlying the process dissociation procedure was reduced.

1.9.7 Problems of Response Bias

A further problem for the process independence assumption arises when there is a difference between levels of response bias in the inclusion and exclusion test conditions (e.g., Brainerd et al., 1998; Buchner et al., 1995; Erdfelder & Buchner, 1998; Yonelinas & Jacoby, 1996a; Yonelinas et al., 1995), or between participant groups being compared (e.g., Graf & Komatsu, 1994; Komatsu, Graf & Uttl, 1995; Roediger & McDermott, 1994). Under such conditions the effects of response bias may be erroneously attributed to either recollection or automatic memory processes.

In other words, when both recollection and automaticity fail, test items could be still reported on the basis of guessing, which in turn would be falsely ascribed to either intentional recollection and / or automatic processes (Buchner et al., 1995).

It may, however, be possible to arrive at valid estimates of recollection and automaticity under conditions where the independence assumption is violated. Two analytical approaches have been proposed to deal with this problem. "High-threshold" multinomial models (e.g., Buchner et al., 1995; Komatsu et al., 1995; McBride & Dosher, 1999; Roediger & McDermott, 1994), propose that correct recognition of a target item (a "hit") could be made either by exceeding a memory threshold or by guessing (a "false alarm") and recommended the algebraic removal of false alarm rates from hit rates so that a "pure" measure of memory could be obtained. Alternatively, Yonelinas et al. (1995) suggested that false alarms ("yes" response to a new item) are made on the basis of pre-experimental familiarity (automaticity) and not on the basis of overall recognition which, they argued, reflects the dual processes of automaticity *and* recollection. Yonelinas and colleagues (1994, 1997; Dobbins, Kroll, Yonelinas, & Liu, 1998; Yonelinas et al., 1996) proposed a dual-process model of recognition memory such that conscious recollection reflects a distinct retrieval process (a "threshold" process) and automaticity reflects an appraisal of a continuous dimension (a "signal-detection" process). Consistent with this argument, Yonelinas (1994) reported that automaticity, but not recollection, was sensitive to response bias such that, as the response criterion for automaticity judgements of target words was relaxed, estimates of automaticity increased. In order to deal with this problem Yonelinas et al. (1995) developed a logistic signal-detection procedure in which corrections for response bias are applied only to estimates of automaticity.

Yonelinas and Jacoby (1996a) compared Buchner et al.'s (1995) multinomial

model with their own logistic signal-detection method for estimating automaticity and

recollection process estimates under conditions of unequal response bias across

recognition tests. Using data from the Yonelinas (1994) study, Yonelinas and Jacoby

(1996a) demonstrated that the multinomial method had little effect in reducing

response bias and led to inflated estimates of recollection and automaticity.

Furthermore, a receiver-operating characteristics (ROC) analysis confirmed that the

multinomial model provided an unsatisfactory fit to the Yonelinas (1994) data. When

the logistic signal-detection model was applied to the same data, response bias was

significantly reduced and, more importantly, left the estimates of recollection and

automaticity unchanged. ROC analysis confirmed that that this model provided a

satisfactory fit to the original data. The research reported in this thesis, therefore,

applied the logistic-based correction model (cf. Yonelinas & Jacoby, 1996a) to

address the problem of possible response bias differences between experimental

conditions. The Yonelinas and Jacoby (1996a) equations used are presented and

explained in Appendix A. Equation (a1) was used to calculate estimates of

recollection and Equations (a2) and (a3) were used to calculate estimates of

familiarity (i.e., automaticity).

1.9.8 Developmental studies using the process dissociation procedure

Only a handful of studies to date have applied Jacoby's (1991) process dissociation

procedure to children's responses on memory tests (e.g., Anooshian, 1999; Anooshian

& Seibert, 1996; Lindsay et al., 1995). Anooshian and Siebert, for example,

examined the memory processes underlying picture recognition using a modified

version of the process dissociation procedure. Preschool children and adults

(Experiment 2) studied scenes taken from a cartoon video. They were then given a two-alternative forced choice recognition memory test for target items presented at study under both exclusion and inclusion test conditions. Application of the process dissociation procedure revealed no evidence of age differences in automatic uses of memory. Estimates of conscious recollection, however, were significantly lower in the preschool children.

Brainerd and colleagues (e.g., Brainerd et al., 1998; Brainerd et al., 1999) have recently developed a "conjoint recognition" procedure which, like process dissociation procedures, aims to evaluate the separate contributions of intentional and automatic processes to children's recognition. In the conjoint recognition paradigm children respond to three kinds of items: targets, related distractors and unrelated distractors (Brainerd et al., 1998). For example, on continuous word recognition task, 7- and 10-year-old children listened to a list of target words (e.g., "girl") and distractor words presented as rhymes related to the familiar words (e.g., "durl"), and made responses under one of two instruction conditions, "accept only target items" or "accept only related distractors" (Brainerd et al., 1998). They were informed that some of the words would be new and some would be the same or related to words previously presented. Brainerd et al. found that both recollection and automatic processing of target items increased with age. Further, whereas recollection for related distractors increased with age, no age differences in automatic memory for related distractors were found. These researchers also reported that estimates of recollection and automaticity did not vary according to the instruction manipulation.

1.10 The misinformation effect and process dissociations

It is clear that most theoretical explanations of the mechanisms underlying children's suggestibility have been based on data obtained across a variety of recognition tasks (e.g., "standard, "modified", "yes" / "no") (e.g., Ceci et al., 1987b; Holliday et al., 1999; Newcombe & Siegal, 1996; Pezdek & Roe, 1995; Zaragoza, 1991). Researchers generally agree that a number of social demand characteristics and memory factors are implicated (Bruck & Ceci, 1997, 1999; Ceci & Bruck, 1993; Ceci et al., 1998), and several theoretical views have been proposed and extensively debated along these lines. (See Section 1.3).

It is also clear that both automatic and recollective processes make separate contributions to recognition responding, and that Jacoby's (1991) process dissociation procedure (with possible modifications proposed by Yonelinas and Jacoby, 1996a) provides a way of measuring these contributions. (See Section 1.9). Notably, however, very few of these theoretical accounts has addressed the implication of dual-process models of recognition memory for misinformation effects in children (for a recent exception, see Brainerd & Reyna, 1998). This is most surprising given the evidence that performance on tests of recognition memory under a variety of experimental conditions reflects the joint product of conscious recollection and unconscious automatic processes (e.g., Anooshian & Siebert, 1996; Gruppuso et al., 1997; Jacoby, 1991; Jacoby, Toth, & Yonelinas, 1993; Lindsay et al., 1995).

There are at least three good reasons for evaluating the contribution of these memory processes to misinformation effects in children's recognition. First, knowledge of the relative contribution of conscious recollection and unconscious automatic processes to misinformation effects allows for a comprehensive evaluation

of the various theoretical approaches proposed to explain such effects. Second, an examination of developmental changes in the processes *underlying* suggestibility permits a more complete evaluation of the cognitive and social mechanisms that give rise to suggestibility in children of various ages. Third, if it can be shown that there is a large component of unconscious automatic memory in the misinformation effect then this means that professionals working with children in the forensic context need to be especially careful to avoid suggestive interviewing techniques because such automatic changes may be harder to reverse in the subsequent interviewing of the witness. These themes will be expanded in the following sections.

1.11 Models of misinformation and process dissociations

As pointed out in Section 1.3, existing theoretical accounts of the misinformation effect can generally be classified as either memory interference hypotheses (e.g., trace alteration, trace-strength, retrieval interference, source-monitoring) or social demands / response biases hypotheses. It could be argued that each of these theories of misinformation make certain assumptions about the respective roles of intentional recollection and automatic memory processes. These assumptions are summarized in Table 2.

As can be seen from the Table, storage-based models such as trace-alteration, trace overwriting, trace updating (Loftus, 1997; Loftus et al., 1978; Loftus et al., 1985) or partial trace degradation (Belli & Loftus, 1996), imply that the misinformation effect can be explained as an unconscious or automatic memory process. Post-event misinformation weakens or degrades the memory trace for original event details and then replaces, overwrites, or blends the original trace, rendering that trace unavailable for recognition and resulting in permanent removal from storage. Indeed, Loftus

(1997) recently wrote: "The new [post-event] information invades us, like a Trojan horse, precisely because we do not detect its influence" (p. 177).

Trace strength models such as fuzzy-trace theory (Brainerd & Reyna, 1993a, 1998; Brainerd et al., 1999), on the other hand, have proposed that suggestible responses can be made on the basis of conscious recollection of the surface form of presented items (i.e., verbatim) or on the basis of unconscious automatic memory of the semantic form of presented items (i.e., gist). Retrieval interference models view suggestible responding as reflecting competition between original and post-event traces at the point of retrieval (Bekerian & Bowers, 1983; Chandler & Gargano, 1998; Christiaansen & Ochalek, 1983; Morton, 1991; Morton et al., 1985). In this account, it is argued that the original and post-event misinformation traces co-exist and survive intact in memory. There is no automatic updating of the original memory trace. Nevertheless, the original trace is rendered less accessible by the more recently encoded post-event misinformation.

Although the extent to which such trace competition represents an "automatic" process operating outside of intentional control has not been explicitly addressed in many such models, at least one approach, the Headed records model of Morton and his colleagues (Morton, 1991; Morton et al., 1985; see Section 1.3), does suggest that trace competition at retrieval proceeds automatically. The processes underlying the retrieval of a particular record are specifically assumed to operate automatically and outside awareness (Morton, 1991).

Table 2

Automatic and intentional (recollection) memory processes and models of the

misinformation effect

Misinformation model	Automatic processing of suggestions?	Intentional processing of suggestions?
Trace-alteration (e.g., Loftus et al., 1978)	Yes	No
Trace strength (e.g., Brainerd & Reyna, 1988, 1998)	Yes	Yes
Trace competition (e.g., Bekerian & Bowers, 1983; Chandler & Gargano, 1998; Morton, 1991)	Yes	No
Social demands / Response bias (e.g., McCloskey & Zaragoza, 1985)	No	Yes
Source-monitoring (e.g., Johnson et al., 1993; Lindsay, 1994; Lindsay & Johnson, 1987, 1989a)	Yes	No[a]

Note. [a] Lindsay (1994) proposed that participants may intentionally deliberate the source of their memories.

Similarly, the source-monitoring hypothesis argues that misleading suggestions are

reported at test when individuals mistakenly misattribute the source of their memories

to the post-event misinformation (Johnson et al., 1993; Lindsay, 1994; Lindsay &

Johnson, 1987, 1989a). In other words, this approach explains children's acceptance

of misinformation in terms of confusions about the respective sources of original and post-event information. According to this view recognition responses in the traditional eyewitness paradigm are most often based on an assessment of an item's familiarity (Johnson et al., 1993; Lindsay, 1994; Lindsay & Johnson, 1989a; Mandler, 1980) without consideration of source or contextual. The concept of "familiarity" as characterised by the source-monitoring model refers to a relatively non-deliberate and rapid method of making a memory judgment "on the basis of qualitative characteristics of activated memories" (Johnson et al., 1993, p. 4). An activated memory is proposed to give rise to different kinds of phenomenal experiences "ranging in specificity from a vague feeling of familiarity to a vivid recollection of an event" (Dodson & Johnson, 1996, p. 181). In this sense, the source-monitoring view of recollection and familiarity resembles the "remember" / "know" procedure (e.g., Gardiner & Java, 1993) in that the two constructs are largely defined in terms of differences in participants' subjective states of awareness.

As discussed previously (see Section 1.9.2), such an approach has been criticised as being difficult to operationalise and because it makes an assumption that the relation between the two states of awareness is mutually exclusive (e.g., Jacoby, Yonelinas, & Jennings, 1997; Strack & Forster, 1995). Another important difference between the source-monitoring and process dissociation approaches is that familiarity in a source-monitoring model is to some degree under intentional control in that familiarity can sometimes be used strategically (Dodson & Johnson, 1996). Moreover, the source-monitoring model is concerned with the processes by which participants *decide to make a memory judgement* whereas the process dissociation procedure is

concerned with quantifying the processes *underlying* recognition memory judgements.

In contrast, the social demands hypothesis (McCloskey & Zaragoza, 1985a) maintains that both original and post-event misinformation traces remain intact in storage. In accordance with a trace competition account of misinformation, there is no automatic updating of the original memory trace. On the contrary, participants intentionally report misleading suggestions due to demand factors inherent in the experimental situation. Specifically, a misled participant who remembers both the original and the misleading details may consciously commit to the misled item under both inclusion and exclusion instructions, not because of memory-based changes to the original event memory trace (cf. Loftus, 1979), but because he or she perceives the researcher as a credible information source, or because he or she may wish to be viewed favourably by the researcher and acquiesces to the suggestion (Cassel, Roebers, & Bjorklund, 1996; Ceci et al., 1987b; Lampinen & Smith, 1995; Newcombe & Siegal, 1996, 1997; Siegal & Peterson, 1995; Thompson et al., 1997; Toglia et al., 1992). Moreover, a misled participant may remember the original item and its source, but nevertheless lose confidence in this memory when confronted with the misled item. Such participants may, therefore, consciously "deliberate" that the misled item is the correct item since it was presented by the experimenter who is perceived as a credible source of information (Belli & Loftus, 1996; Zaragoza & McCloskey, 1989). To the extent that such demands explicitly induce the reporting of misleading suggestions even when the original information is accessible, they imply a strong contribution of intentional processing to suggestibility.

1.12 Previous investigations of automatic and intentional influences on misinformation

As noted earlier, the misinformation effect in both adults and children has traditionally been measured using direct memory tests such as recall or recognition. Although it has been suggested that the presentation of misleading suggestions may lead to changes in aware or recollective *and* unaware or automatic memory processes only a handful of empirical examinations of this issue are extant (e.g., Lindsay, et al., 1995; Loftus, 1991; Loftus, Feldman, & Dashiell, 1995). Loftus (1991), for example, examined the impact of misleading suggestions on an "explicit" recognition test and an "implicit" category generation test. Misleading suggestions did interfere with category generation, suggesting some implicit or unaware acceptance of misleading information, but only for subjects who also showed evidence of suggestibility on the recognition test. However, given the evidence that both recollection and automatic processes influence performance on tasks such as category generation (e.g., Toth et al., 1994; Wagner & Gabrieli, 1998), the Loftus results must be regarded as inconclusive regarding the role of automatic processes in suggestibility.

A more direct examination of conscious recollection and automatic memory processes in children's suggestibility was carried out by Lindsay et al. (1995). Children were presented with a story accompanied by pictures (cf. Ceci et al., 1987b) and were then read a misleading narrative. All children were given three memory tests (free-recall, cued-recall, and forced-choice picture recognition) in one of two test instruction conditions. In the "standard" condition, a new experimenter asked children for details regarding the story. In the "opposition" condition, children were instructed to exclude all details presented in the post-event summary. Lindsay et al.

found that 5- and 8-year-olds were equally likely to select the suggested alternative to
the originally presented target item. Following application of the process dissociation
equations to recognition responses it was found that the contribution of aware
(recollection) and unaware (automatic) processes to acceptance of suggestions varied
developmentally. Specifically, aware memory processes made a larger contribution to
the misinformation effect in the 5-year-olds. However, for the 8-year-olds
suggestibility was more strongly influenced by automatic, unaware memory
processes.

   Although Lindsay et al.'s (1995) results suggest that both recollection and
automatic processes may be involved in children's suggestible responding there are a
number of problems with this study that undermine confidence in the conclusions.
First, the increase with age in the contribution of automatic memory processes to
suggestibility and the corresponding decrease in estimates of recollection runs
contrary to the developmental trends reported in many comparisons of implicit and
explicit memory performance (e.g., Carroll et al., 1985; Hayes & Hennessy, 1996;
Naito, 1990). In such studies, relatively few changes in implicit or unaware
responding have been found beyond 4 years of age whereas marked changes in
recollection continue to be reported until early adolescence. Although there is
certainly no simple correspondence between the implicit / explicit and automatic /
intentional distinctions (see Section 1.9.2), it is surprising that Lindsay et al.'s
application of the process dissociation procedure revealed a set of developmental
trends that diverge so markedly from those obtained on implicit tasks.

   Second, Lindsay et al.'s (1995) experimental design did not allow for assessment
of whether or not all the children followed the exclusion condition test instructions to

exclude only words remembered in the second phase of the experiment. The underlying assumptions of the process dissociation procedure are not satisfied unless target items are excluded *only* on the basis of conscious recollection (Jacoby, 1998).

Third, the "standard" condition of Lindsay et al.'s (1995) study was not an "inclusion" condition such as that employed in adult process dissociation research (e.g., Jacoby, 1991). Specifically, children in the "standard" condition were not asked to report on the bases of both the original and post-event information, but instead, were asked to report the original story details. A further limitation of the Lindsay et al. (1995) study was that no manipulation likely to impact differentially on recollection and automatic processing was employed (cf. Toth et al., 1994). Consequently, no test was made of one of the major assumptions of the process dissociation procedure, namely that recollection and automaticity independently contribute to recognition memory performance.

Moreover, in Lindsay et al.'s (1995) study, comparisons of recollection and automaticity estimates for each age group should be viewed cautiously as no comparison of the false alarm rates of the two groups were made. Inspection of Lindsay et al.'s data suggests that false alarm rates did differ both between age groups and between inclusion and exclusion test conditions. Such a pattern undermines the independence assumption for process dissociation (cf. Brainerd et al., 1998; Buchner et al., 1995; Graf & Komatsu, 1994; Yonelinas & Jacoby, 1996a) and compromises Lindsay et al.'s (1995) conclusions.

1.13 Rationale for the present set of studies

The research reported in this thesis, therefore, aimed to establish the contribution of automatic and intentional processes to misinformation effects in 5- to 9-year-old

children's recognition memory. To this end, the process dissociation equations of Jacoby (1991) and Lindsay et al. (1995) were adapted to apply to children's acceptance of misleading suggestions in a misinformation paradigm. It was assumed that acceptance of suggested items in the inclusion condition could be made on the bases of recollection (R) and automatic processes (A) (cf. Jacoby, 1991). In other words, in the inclusion condition children could accept misleading suggestions on the basis of intentional recollection (R) either because they remember the suggested item as having been presented, or because they wish to comply with the experimenter who is perceived as an authoritative and credible information source (cf. Zaragoza, 1991). Alternatively, children could accept misleading suggestions on the basis of automatic processes (A) (e.g., the familiarity of the item), without any conscious recollection of the suggested items. In the exclusion condition, children will accept misleading suggestions only if they come to mind automatically (cf. Jacoby et al., 1993) and if they do not remember that such suggestions were presented in the Phase 2 post-event narrative but believe that the suggested details were part of the original event (cf. Lindsay et al., 1995). The probabilities of children accepting misleading suggestions on the basis of recollection were calculated by subtracting the probabilities of accepting a misled item in the Exclusion condition from the probabilities of accepting a misled item in the Inclusion condition:

$$R = P \text{ (accept misled item | Inclusion)} - P \text{ (misled item | Exclusion)} \tag{3}$$

The probabilities of children accepting a suggestion on the basis of automatic processes were calculated by:

$$A = P \text{ (accept misled item | Exclusion)} / (1 - R) \tag{4}$$

The current research, however, also addressed a number of the limitations identified in previous investigations in this field (e.g., Lindsay et al., 1995). First, following Lindsay et al. (1995), 5-, 8- and 9-year-old children were included to enable a re-examination of their reported findings of a developmental increase in automatic responding and the corresponding decrease in conscious recollection. Both of these findings run contrary to the reported developmental increase in explicit memory performance from two years of age to adolescence (Anooshian, 1997; Carroll et al., 1985; Hayes & Hennessy, 1996; Mitchell, 1993; Parkin & Streete, 1988; Russo et al., 1995), and the reported developmental invariance of implicit memory from preschool to adolescence (Drummey & Newcombe, 1995; Greenbaum & Graf, 1989; Hayes & Hennessy, 1996; Komatsu et al., 1996).

Second, the present studies examined the implications of developmental differences in false alarm rates using a logistic-based dual process correction model proposed by Yonelinas and Jacoby (1996a) which produces valid estimates of recollection and automatic processes under conditions where the independence assumption is violated.

Third, the current research included two practice pictures to assess children's understanding of exclusion test instructions prior to memory testing. Jacoby and Shrout (1997) noted that the assumptions of the process dissociation procedure are satisfied only when participants follow the exclusion test instructions such that they exclude words recognized as "old" only on the basis of recollection and not if such words come to mind automatically. Failure to follow such instructions is likely to result in a reduction in estimates of recollection and, as a consequence, artificially increase the estimate of automaticity.

Finally, and perhaps most significantly, the current series of studies employed an encoding manipulation that aimed to differentially affect children's automatic and recollective processing of suggested items. In each of the reported studies, some suggested items were read out aloud to children in a fashion which closely parallels the way in which misleading narratives have been presented in many previous developmental studies of suggestibility (e.g., Ceci et al., 1987b; Zaragoza, 1991). In addition, however, children self-generated other misleading details in response to semantic cues given by the experimenter.

This manipulation was motivated, in part, by the extensive literature concerning the "generation effect"; that is, the memory advantage at test for words that have been self-generated at study as opposed to words that have simply been read or heard (Slamecka & Graf, 1978). This effect has been reported with a variety of stimuli (e.g., Crutcher & Healy, 1989; Gardiner, 1988; Hirshman & Bjork, 1988; Jacoby, 1983, 1991; Jacoby, Toth, & Yonelinas, 1993; Joordens & Merikle, 1993; Kinoshita, 1989; Mazzoni et al., 1999; McClelland & Pring, 1991; Nairne & Widner, 1988; Toth et al., 1994; Watkins & Sechler, 1988) and testing conditions (e.g., Beck & McBee, 1995; Eich, 1995; Eich & Metcalfe, 1989).

Although the generation effect has also been demonstrated with children (e.g., Ghatala, 1981; Komatsu et al., 1996; McFarland, Duncan & Bruno, 1983) there is still some debate concerning the precise point in development when children begin to show the memory advantage for generated items. For example, McFarland et al. reported an overall recognition memory advantage for self-generated category exemplars compared to read words, an effect that did not vary over the period from 7 to 13 years of age. In contrast, Komatsu et al. reported that 11-year-olds' free recall

was higher for items generated in response to definitions as compared to items read aloud, but found no memory advantage of generation for 7-year-old children. Similarly, McFarland et al. found a generation effect on recall for 9- to 13-year-old but not for 7-year-old children.

In one of the few applications of the read / generate manipulation to a task in which misleading information was given, Lane and Zaragoza (1996) found that adults who generated descriptions of suggested items were more likely to mistakenly attribute descriptions of suggested items to the original event than adults who simply read descriptions of suggested details.

Self-generation is generally believed to involve more conceptually driven and elaborative processing than simply hearing or reading an item (cf. Begg, Snider, Foley & Goddard, 1989; Buyer & Dominowski, 1989; deWinstanley et al., 1996; deWinstanley & Bjork, 1997; Flory & Pring, 1995; Gardiner, Gregg & Hampson, 1985; Jacoby, 1983; Smith & Healy, 1998). Several researchers have employed a read / generate encoding manipulation in conjunction with the process dissociation procedure (e.g., Jacoby, 1991; Jacoby, Toth, & Yonelinas, 1993; Joordens & Merikle, 1993; Toth et al., 1994). For example, Jacoby (1991, Experiment 3) found that estimates of recollection and automaticity varied according to encoding manipulation. Study list words presented as anagrams held an advantage over read words in terms of both recollection and automaticity, with the greatest task difference being shown in recollection. Toth et al. reported that generating a word from a sentence in which the first letter of the target word was presented at study produced a generation advantage in participants given a word-stem completion test. Further, Toth et al. found that the read / generate encoding manipulation differentially affected underlying memory

processes. Specifically, whereas generating produced a larger estimate of conscious recollection in comparison to reading, the opposite was the case for automatic uses of memory. Estimates of automatic memory for "read" words were greater than those for "generated" words. Toth et al. concluded that both conscious recollection and automatic memory processes contribute to performance on tests of implicit memory.

In the present series of experiments the read / generate encoding manipulation served two purposes. First, there are good reasons to believe that this manipulation will have a differential effect on conscious recollection and automatic processes in children's suggestible responding (Brainerd et al., 1998; Toth et al., 1994). That is, the contribution of conscious recollection to suggestibility may be potentiated when children are encouraged to self-generate suggestions than when these suggestions are simply read to them. Following Toth et al. (1994), the same manipulation, however, should have little effect on suggestibility that is mediated by automatic processing. Second, the manipulation has some relevance to children's reports of witnessed events in forensic settings. Witnesses are frequently required to generate descriptions of places, people, and events that they have witnessed, and it has become common for clients in some therapy sessions to be encouraged to generate descriptions of remote memories (Ceci & Loftus, 1994). The research reviewed above suggests that the generation of an erroneous detail may increase the likelihood of the subsequent reporting of that detail as one that has actually been witnessed.

1.13.1 Developmental considerations and the age range studied

Numerous studies have reported that children in a very wide age band are adversely affected by misleading post-event suggestions (see Bruck et al., 1997; Ceci & Bruck, 1993, 1995, for reviews). However, the precise nature of developmental

changes in suggestibility continues to be debated. Over the last decade studies that have included preschool children in developmental comparisons with older children have generally found that very young preschoolers (3- to 4-year-olds) are disproportionately affected by misleading post-event suggestions (Bruck & Ceci, 1999; Bruck et al., 1997, 1998; Ceci & Bruck, 1993; Ceci et al., 1998). Ceci and Bruck (1993) reviewed the literature and concluded that misinformation effects were larger for preschool children in over 80% of the studies that included this group in developmental comparisons with older children and adults. Studies published since Ceci and Bruck's (1993) review have generally supported their conclusions (Bruck & Ceci, 1999; Bruck et al., 1998; Ceci et al., 1998).

While the evidence for young preschoolers is reasonably clear cut, a consensus with regard to differences in suggestibility for children aged from 5 to 12 years has yet to be reached (Bruck & Ceci, 1999; Cassel & Bjorklund, 1995; Ceci et al., 1998; Cole & Loftus, 1987). Several studies have reported developmental differences in suggestibility with young school-aged children (i.e., 6-year-olds) being the most adversely affected (e.g., Ackil & Zaragoza, 1995; Cassel & Bjorklund, 1995; Cassel, Roebers & Bjorklund, 1996; Cohen & Harnick, 1980; King & Yuille, 1987; Mazzoni, 1998; Warren, Hulse-Trotter & Tubbs, 1991). For example, King and Yuille (1987) questioned children regarding their memories of a stranger's visit and found that 6-year-olds were more susceptible to misleading questions than older children. Warren et al. (1991) presented children and adults with a story followed by a number of misleading and non-misleading questions. They found that 7-year-olds were more likely to comply with the misleading questions and recalled less of the story in comparison to 12-year-olds and adults.

In contrast to these findings are studies that have reported young school-aged children to be no more suggestible and, in some cases, even less suggestible than older children and adults (e.g., Ceci et al., 1987b; Delamothe & Taplin, 1992; Duncan, Whitney, & Kunen, 1982; Flin, Boon, Knox, & Bull, 1992; Holliday et al., 1999; Lindsay et al., 1995; Marin, Holmes, Guth, & Kovac, 1979). For example, Marin et al. (1979) presented 5-, 8-, and 12-year-old children and college students with a staged live event of an argument between two adults. After a short delay, all participants gave an account of the event and were then asked non-misleading questions and one misleading question concerning their memories of the argument. No evidence of age differences in the magnitude of the misinformation effect was found. Similarly, in Experiment 1 of the series reported by Ceci et al. (1987b) there was no evidence of age-related differences in suggestibility among children aged 5 to 10 years.

Duncan et al. (1982) has found that young school children are sometimes *less* suggestible than older children and adults. Six-, 8-, and 10-year-old children and college students were shown slides of a cartoon and asked objective and misleading questions about their memories of the slides. Duncan et al. reported that the younger school aged children were less susceptible to the negative effects of misleading details than the older children and adults.

Hence, the issue of the pattern of age-related changes in suggestibility beyond the preschool period remains unclear. Furthermore, it is difficult to reconcile the results from these studies reviewed above because of marked inconsistencies in the methodology. The studies differed considerably with regard to the age of participants,

sample size, the type of test materials (e.g., staged live event, video, story with pictures), presentation mode of the misleading information (e.g., leading questions, narrative), the linguistic complexity and number of misleading suggestions, length of retention intervals between each experimental phase (e.g., 20 minutes, one week, one month), and the methods used to test children's memories (e.g., free and cued recall, recognition).

The studies reported here, therefore, included children aged 5, 8, and 9 years of age. These age groups were selected because they closely matched the groups who participated in Lindsay et al.'s (1995) research, and because most previous investigations indicate that changes in conscious recollection could be expected across this developmental span (e.g., Drummey & Newcombe, 1995; Hayes & Hennessey, 1996). These age groups were also chosen because it has been suggested that developmental studies comparing very young children (under 5 years of age) with older children (8 years and over) and adults may underestimate misinformation effects in the older participants (Bruck et al., 1997). For example, Bruck et al. commented that such studies are typically designed, in terms of interest level and difficulty, for the very young children rather than the older children. Hence, older children may "see through" the purpose of the experiment and resist suggestion. The use of items suited for preschoolers may also increase the probability of ceiling levels of performance in older children (see Ceci et al., 1987b, Experiment 4). With these comments in mind, the research reported in this thesis developed stimulus materials suitable for both 5- and 8- to 9-year-old children.

With regard to process dissociations and the misinformation effect, the examination of the developmental course of recollection and automaticity addresses

the question of whether these processes follow the same developmental trends as suggestibility that is indexed only by measures of recognition errors. Examining such age-related changes in recollection and automaticity using Jacoby's (1991) process dissociation paradigm avoids relying on the assumption that recognition tests provide a direct index of aware or explicit memory processes (Dunn & Kirsner, 1989; Jacoby, 1991). Moreover, this methodology allows for an examination of the possibility that the *processes* underlying suggestibility may change even under conditions where the overall magnitude of the misinformation effect, as measured by recognition error rates, undergoes little age-related change.

1.14 Outline of studies

Experiment 1

The initial study was designed to examine the relative contribution of recollective and automatic memory processes to misinformation effects in school-age children. Misinformation was presented in two ways; "read" aloud to each child or "generated" in response to semantic and linguistic cues that were supplied by the experimenter. Children were then given a yes / no recognition test under one of two conditions. In the inclusion condition children reported whether they remembered items from either of the previous phases whereas in the exclusion condition children were instructed to exclude the post-event misinformation. Following Jacoby (1991) and Lindsay et al. (1995), estimates of recollection and automatic memory processes were calculated between-participants.

Experiment 2

In this study, the process dissociation procedure was extended to a design that allowed for separate estimates of conscious recollection and automatic memory

processes to be calculated within-participants. This extension allowed for the application of inferential analyses to examine changes in recollective and automatic processes due to encoding manipulations and age.

Experiment 3

Having established in the first two studies that both conscious recollection and automatic memory processes contributed to misinformation effects, the focus of the research in the remaining studies turned to evaluating the implications of these findings for theories of misinformation (e.g., trace alteration, trace-strength, retrieval competition, social demands and response biases) using a number of different recognition memory paradigms. Process dissociation analyses were carried out in all of the subsequent studies.

In Experiments 1 and 2 children responded "yes" (remembered the target item) or "no" (did not remember target item) to original (control), misled (read and generate), and new (novel) target items. However, a large proportion of the research investigating the causal mechanisms underlying children's suggestibility has examined such effects using forced-choice recognition tests such as the standard (e.g., Ceci et al., 1987b) or the modified (e.g., Zaragoza, 1991). Accordingly, in the third experiment, the yes / no recognition test used in the first two experiments was replaced by the standard and modified forced-choice recognition tests. Process dissociation analyses were then applied to recognition data on each of these types of test.

Experiment 4

This study was designed to follow-up on a particular finding obtained in Experiment 3, namely the attenuation of the misinformation effect found on the modified test compared to the standard test. Such a result indicates that responses on the standard test may be influenced by social demand factors and response biases (McCloskey & Zaragoza, 1985a). Nevertheless, it is clear that memory impairment of some kind (e.g., trace alteration, retrieval competition) also contributed to children's suggestibility. Researchers have questioned whether the modified test is sensitive to detecting all forms of misinformation impairment. Belli (1989), for example, argued that the absence of the misled item as a choice on the test means that the modified test is insensitive to detecting retrieval-based memory impairment such as preferential access to the misleading alternative (preclusion hypothesis). Accordingly, in the fourth experiment the standard and modified forced-choice recognition tests were replaced by a yes / no retrieval test similar to that developed by Belli (1989) to measure both memory impairment and source misattribution and demand factors and response bias.

Experiment 5

In order to further investigate memory interference explanations of children's suggestibility, the final study employed a reversed misinformation paradigm (cf. Lindsay & Johnson, 1989b; Rantzen & Markham, 1992) in which misleading suggestions were presented *before* the original event (e.g., story) as opposed to *after* the original event information as in the standard misinformation paradigm (cf. Loftus et al., 1978). This design allows for an evaluation of several memory interference hypotheses; namely, a strong version of the trace-alteration account (e.g., Loftus et al.,

1978), retrieval interference in terms of blocking (e.g., Chandler & Gargano, 1998;

Morton et al., 1985), and source-monitoring (e.g., Ackil & Zaragoza, 1995; Johnson

et al., 1993; Lindsay, 1994).

Chapter 2

Deriving estimates of automatic and intentional processes

to children's acceptance of misleading suggestions

2.1 Introduction to Experiment 1

This study examined the contribution of recollection and automaticity to 5- and 8-year-old children's acceptance of misinformation on a yes / no recognition memory test. These age groups were chosen to facilitate a re-examination of Lindsay et al.'s (1995) reported findings of a developmental increase in automatic responding and the corresponding decrease in recollection processes, both of which run contrary to developmental trends reported in the implicit / explicit memory literature (e.g., Carroll et al., 1985; Hayes & Hennessy, 1996).

In the first phase of the study, children were read a story accompanied by pictures. Two days later children were presented with a post-event summary of the story in which some of the details were different from the original story. Some of these misleading details were simply read aloud to the children while other details were generated by the children themselves in response to a semantic and a linguistic cue. Pictures of both original event and suggested items were then presented and a yes / no recognition memory test was administered under either inclusion or exclusion conditions (cf. Jacoby, 1991). Children were presented with each picture and asked to respond "yes" if they remembered seeing the original story item and "no" if they did not. The yes / no recognition memory test was selected because this procedure resembles most closely the response format employed in previous applications of the

process dissociation procedure (e.g., Jacoby, 1991; Jacoby, Toth, & Yonelinas, 1993; Lindsay et al., 1995). Moreover, this test is less likely to be influenced by demand characteristics or response bias than one in which children are forced to choose between original and suggested items (Belli, 1989; Tversky & Tuchin, 1989; Wright & Loftus, 1998).

In previous investigations of children's acceptance of misleading suggestions (e.g., Ceci et al., 1987b; Zaragoza, 1991), "suggestibility" is defined in terms of an increased likelihood of incorrectly recognising (i.e., saying "yes") a misled item following exposure to misleading post-event information relative to a baseline control in which no misleading information was presented. In this experiment, however, the process dissociation instructions for the inclusion condition require children to accept misleading items and then to exclude them in the exclusion condition. Therefore, "yes" responses to misled items in both the inclusion and exclusion conditions were compared. It was expected that children would be more likely to respond "yes" to control items than to items on which they had been given misleading information in both the inclusion and exclusion conditions. Moreover, because the exclusion test instructions explicitly require children to reject misleading information, it was expected that acceptance of misleading suggestions would be greater under inclusion test instructions.

As the current study involved young school-aged children, it was predicted that only a modest age change in the reporting of misinformation would be found (see Section 1.14.1; Ceci et al., 1987b, 1998; Cole & Loftus, 1987, Holliday et al., 1999). However, it should be noted that different theoretical accounts of suggestibility imply that the mechanisms which give rise to misinformation acceptance may change with

age (e.g., Brainerd & Reyna, 1998). For example, fuzzy trace theory predicts that younger children are more reliant than older children on verbatim traces that decay rapidly (see Section 1.3.1). It is possible, therefore, that even with only modest age changes in the level of misinformation acceptance, marked developmental differences in the memory processes underlying suggestibility may be revealed by the process dissociation procedure..

To the extent that the self-generating of misinformation should strengthen intentional processing (e.g., Begg et al., 1989; Brainerd et al., 1998; Lane & Zaragoza, 1996; Toglia, Neuschatz, & Goodwin, 1999), it was expected that, in the inclusion condition, such encoding would lead to greater acceptance of misinformation compared to when such misinformation was read aloud to the children. In contrast, in the exclusion condition it was expected that misinformation that was self-generated would be more likely to be correctly rejected than misinformation that was simply read to the children. With regard to process dissociation estimates, it was predicted that the read / generate encoding manipulation would result in larger recollection estimates for generated as compared to read items (cf. Jacoby, 1991; Joordens & Merikle, 1993; Toth et al., 1994).

In accordance with the review of existing suggestibility theories in Section 1.11, if memory and retrieval competition explanations are correct in that post-event misinformation alters, overwrites, or degrades the original memory trace (e.g., Ceci et al., 1988; Loftus et al., 1978), or "blocks" its retrieval (Christiaansen & Ochalek, 1983; Morton et al., 1985), then it is expected that automaticity will make a strong contribution to misinformation acceptance. Similarly, if children adopt a response criterion of familiarity without considering the source of the familiarity, as proposed

by the source-monitoring account (e.g., Johnson et al., 1993), then it is expected that misinformation acceptance will reflect, for the most part, automatic memory processes.

On the other hand, if the demand characteristics / response bias hypotheses are correct such that misleading suggestions are reported due to social demands of the experimental situation such as compliance (e.g., McCloskey & Zaragoza, 1985a; Newcombe & Siegal, 1997; Zaragoza, 1991), then it is expected that recollection will make a strong contribution to children's reporting of misled items.

In the current study, the estimates of intentional recollection and automaticity were calculated on between-groups data. This design maximises the number of data points contributing to the estimates and is the most commonly reported method of calculating process dissociation estimates (e.g., Buchner et al., 1995; Curran & Hintzman, 1995; Jacoby, 1991; Jacoby, Toth, & Yonelinas, 1993; Lindsay et al., 1995; Ricchiute, 1997; Russo & Andrade, 1995; Wagner et al., 1997). It does not, however, permit an inferential statistical comparison of the obtained group estimates. It was planned, therefore, that if interesting group trends for recollection and automaticity were found on the age and task factors, such trends would be followed up in subsequent studies by within-subjects experiments that allowed the application of standard inferential statistical techniques.

<div align="center">Method</div>

Participants

Fifty-six 5-year-olds ($\underline{M}$ = 5 years, 11 months, Range: 5 years, 3 months - 6 years, 6 months), including 30 males and 26 females, and forty-eight 8-year-olds ($\underline{M}$ = 8

years, 11 months, Range: 7 years, 7 months - 9 years, 7 months), including 21 males and 27 females participated in the study. All children attended public primary schools in predominantly middle-class areas of the New South Wales Central Coast, Australia. Children participated only if parental consent had been granted.

Materials

  A 1,200-word story was written which depicted events that were relatively novel and unpredictable. The story related the fortunes of an old lady who proceeded to make herself rich and famous selling peanut butter. The story is presented in Table 3. Thirty 20cm x 20cm coloured drawings were prepared to illustrate events in this story and were presented on laminated cardboard (see Appendix B for examples of the pictures used in this experiment). For twelve of these original pictures two alternatives were constructed, one depicting the misleading detail and one depicting a novel alternative. A list of all items is presented in Table 4.

Table 3

Phase 1 Text of original story

Miss Peabody Becomes Famous

  Let me tell you about the weirdest thing that happened in our town a few years ago. Now I'm just a normal kind of kid living in a normal house, in a normal street but what happened in the house (picture) down the road from mine was not exactly normal. What I'm going to tell you really did happen, honestly. This is how it all started. Old Miss Peabody was just a normal old lady. However, one day as she was looking in her letterbox a peanut came out of nowhere and hit her on the back of the head (picture). She looked around her to see where it came from before she picked it up, went inside, put it away (target item 1) and forgot about it.

  Time passed and word spread about some weird happenings in that house down the road. It all started when my friend Sally was sitting on the bus stop outside Miss Peabody's house. It was late

in the afternoon and Sally was looking forward to getting home so that she could help her mother

cook (target item 2). She was sitting quietly when she heard some strange noises coming from Miss

Peabody's house. She tiptoed up to the front window and peeped in. Guess what she saw! She saw

old Miss Peabody and her even older friend Miss Lilly jumping on the table and being very silly

(picture).

   The next thing that happened was even stranger. Every week my friend Billy delivered Miss

Peabody's groceries and then had breakfast with her. One day Billy was amazed to see that things

were different. The old lady had a number of strange friends with very strange habits. Billy said

he was quietly eating (target item 3) when he saw a pink pig and an enormous squirrel having

swimming races in Miss Peabody's swimming pool. And over by the garage there was a snowman

doing tricks on the clothesline (picture). Billy took a closer look at Miss Peabody. She looked

very different. Her nose had grown, she had warts on her face, and on the top of her head half buried

in her knotted hair sat a huge peacock. Boy did she look weird - kind of spooky - like a witch

(picture)! Billy didn't know what to think so he gobbled his food and raced out the door and down the

road to tell us kids. Poor Billy, he was never the same again and for many days he was sick (target

item 4) from eating too quickly.

   My friends and I started looking for more signs of witchcraft. While we were keeping watch we

noticed that every evening Miss Peabody strolled around her garden hand in hand with a shark

(picture). But more amazing than this was the day we spied her pet kangaroo Zippy talking in a very

loud voice to the postman (target item 5). And, to our great surprise, while they were talking that

walking shark jumped on the postman's bike and rode off down the hill (picture). Can you believe it?

Is it normal for these sorts of things to happen? Everyone including the postman did his best to keep

out of Miss Peabody's way after this happened.

   Sometime later we heard that old witch Peabody had cooked up a batch of peanut butter that when

eaten daily could make people smart - really smart - top of the class smart! You get the picture - super

smart! Well, Miss Peabody knew she was on a winner with this. She set about making herself rich and

famous. In her factory down by the helicopter pad in the backyard (picture) she made lots and lots of

peanut butter. All day and all night she and her friends worked very very hard (target item 6). She sold

peanut butter to all sorts of people and animals and everyone gave her gifts because they all wanted to

find out the recipe for the smart peanut butter (picture). One day a phone call came from a man who wanted to make a movie about her life so Miss Peabody quickly got ready (target item 7) and flew to America in her helicopter. She soon got herself a movie star husband and the two of them went to live on a beautiful island where they *thought* they would live happily ever after (picture).

Meanwhile, back at the factory Zippy was trying very hard to keep up the world demand for smart peanut butter. His helper, a bright young fox called Felix, served all the customers while Zippy made the peanut butter. Lots of people and animals tried to get hold of the recipe but Felix was built like Arnold Swarzenegger and had been able to keep all the baddies away (picture). Looking back on it now what happened next was to be expected with all those millions of people and animals desperate to be smart. A couple of smooth looking gorillas wearing sunglasses pushed past Felix and searched the building until they found Zippy (target item 8). Quick as a flash one of them ripped off his gold chain, tied it to poor Zippy's collar and hauled him off down the road and up the hill and through the deep dark woods to where their plane was hidden (picture).

What happened to Zippy next is not quite clear because he is not quite the kangaroo he used to be. But what we do know is that the kangaroo-napping was headline news all over the world (picture). Of course Miss Peabody was very upset and as soon as possible she and her new super-smart husband who could count backwards from 100 in 5 seconds (isn't that smart?) raced home (target item 9). But before they got there the supply of peanut butter ran out. Well, what a disaster! How could such smart people let something like this happen? Crowds built up everyday outside Miss Peabody's house. Kings, queens, princesses, and princes arrived in their coaches. Us kids decided to set up a shop (target item 10) and we were kept very busy. As the days passed everyone became very impatient and late one afternoon the police had to be called when a mob of angry chickens wouldn't stop chanting "We want peanut butter!" (picture).

Meanwhile, there was no word about the whereabouts of Zippy. We heard later that the kangaroo-nappers took him away to a secret location at the North Pole. For the first few days they looked after him very well (target item 11). He was quite enjoying himself, but as the days passed he began to miss all his friends, so he tried to run away. But he didn't get far. The kangaroo-nappers caught him and tied him to an ironing board (picture) and asked him lots and lots of questions about the secret smart peanut butter recipe. But Zippy wouldn't tell them anything. He wasn't going to give away Miss

Peabody's secret. These cool smooth-looking hunks were not very smart. Remember I *didn't* say that

they had taken some of the smart peanut butter with them, did I? Well they didn't. These were pretty

silly kangaroo-nappers. What they didn't realise was that every day Zippy needed special food and

smart peanut butter (target item 12) so he could talk. If he missed out on this and couldn't talk how

could he tell them Miss Peabody's secret recipe?

   But Zippy's luck was about to change. A huge brown bear found the secret hideaway up at the

North Pole. When he saw what was going on he pulled out a toothbrush and scared the life out of the

kangaroo-nappers who fell unconscious to the ground (picture). This smart bear, the last surviving

smart bear in the world then tied Zippy's tail to the end of a kite and set him free. He soared over the

North Pole, down over the ocean (picture) and a few days later landed back in Miss Peabody's front

yard. Everyone was so pleased to see him they forgot about the smart peanut butter. In fact, they

couldn't even remember why he had been away. It was as if the whole thing had never happened.

Perhaps it was because they were no longer super-smart. Anyway, Miss Peabody and her animal

friends lived happily ever after in the old house down the road from mine and life returned to normal

(picture). *Note.* "picture" refers to a picture of the scene as depicted in the text.

Table 4

Items employed in Experiment 1

Item	Response alternatives		
1.	kitchen / bedroom / bathroom	7.	hat / coat / shoes
2.	biscuits / cakes / chocolate crackles	8.	knife / fork / spoon
3.	eggs / cereal / toast	9.	dog / cat / rabbit
4.	headache / stomachache / throat	10.	chips / lollies / drin ks
5.	doll / ball / truck	11.	green / red / yellow
6.	hands / feet / legs	12.	banana /apple / orange

Two practice pictures, one shown before the original story and the other prior to the post-event narrative, were used to assess children's understanding of test instructions (see Appendix B).

The post-event narratives were brief summaries (300 words) of the original story and were presented as post-event information. For counterbalancing purposes, four post-event narratives were used in order to control any differences in difficulty between the items chosen as control, misled-read, and misled-generate. Narrative 1 contained three misleading items which were "read", three misleading items which were "generated", and neutral information about the other six picture items (control items). The remaining three narratives were generated by rotating the control, misled-read, and misled-generate items. For example, Item 4 "stomachache" was a misled-generate item in Narrative 1, a misled-read item in Narrative 2, a control item in Narratives 3 and 4. Narrative 1 is given in Table 5. For the recognition test phase, three versions of each of the six target items that varied only concerning the particular detail were constructed (see Table 4 for the list of alternatives).

Table 5

Phase 2 post-event Narrative version 1

A peanut hit Miss Peabody on the head while she was looking in her letterbox. She picked it up, put it away (*kitchen* - control item 1) and forgot about it. Sally was thinking about helping her mother cook (*biscuits* - control item 2) while waiting for the bus. She saw the two old ladies jumping on the table. Billy was eating breakfast (*eggs* - control item 3) with Miss Peabody when he noticed she looked like a witch. He ate so quickly that he got a *stomachache* (misled-generate item 1). The kids saw Zippy with his *ball* (misled-generate item 2) talking to the postman while the shark stole the bicycle. Miss Peabody and her friends made smart peanut butter in the factory and they worked very hard and got sore *feet* (misled-generate item 3). She became rich and famous. When a movie producer

rang she got ready (*coat* - control item 4) and flew to America. The gorillas burst into the factory and found Zippy (*knife* - control item 5) and took him away. Miss Peabody raced home with her new friends (*dog* - control item 6). But the supply of smart peanut butter had already run out. The kids set up a shop and sold *lollies* (misled-read item 1) to the crowd. The kangaroo-nappers fed Zippy *red* (misled-read item 2) jellybeans so that he would tell them the secret smart peanut butter recipe. They didn't know he needed peanut butter and *apple* (misled-read item 3) so he could talk. A bear rescued Zippy and set him free. Everyone was so happy to see him they forgot about the smart peanut butter and lived happily ever after.

Procedure

All children were tested on three separate occasions in a quiet room at their school. In groups of 10 to 12, children were first shown a picture of "Koko" the clown (Practice picture 1), and were read the story and shown the picture corresponding to the story details (each viewed for approximately one minute) with the experimenter pointing to each target item.

Two days later, a second experimenter tested each child individually. She began the session by introducing a new clown picture ("Bozo" Practice picture 2, misled) before presenting one of the four versions of the post-event narratives in which the story details followed the same temporal order as the original story. In each narrative there were 12 items; three misled-read, three misled-generate, and six control items for which neutral information was presented (e.g., "away"). All the suggested items were consistent with the syntactic and semantic context of the original story. The narrative, including all neutral and misled-read items, was read aloud to the participants. For the misled-generate items, the words preceding the item were read and the experimenter then gave the hint for the suggested word containing a semantic and linguistic cue. For example, for the misled item "*cereal*", the experimenter read:

"Billy was eating …". At this point the first hint was provided; *"this is what you put milk on and eat for breakfast, it starts with **c.....**"*. If the child was unable to produce the word the experimenter gave a second hint containing additional semantic information, for example, *"Weetbix, Cornflakes, and Rice Bubbles are all these kinds of things"*; the experimenter then continued to read the rest of the sentence aloud. In the event the word was not produced after the second hint the experimenter supplied it. The total number of hints given was recorded for each participant. (A list of all hints used in this phase and the experimental instructions for each phase are given in Appendix B.)

Immediately following the post-event narrative the first experimenter returned and administered a recognition memory test in which children were presented with 18 pictures, 6 original (control) from Phase 1, 6 pictures of items on which misleading suggestions were given at Phase 2 (3 misled-read and 3 misled-generate), and 6 novel items that had not been shown or mentioned in either of the previous phases.

Half the participants were administered an inclusion test in which they were informed that they would be shown pictures, some of which were new and some of which were old. Children were first asked if they remembered the picture story about Miss Peabody *and* the summary read to them by the second experimenter. They were then informed that they would be shown some pictures, some "old" and some "new", and that they should respond "yes" if they remembered *seeing* the picture and "no" if they did not. Before commencing the test, the practice "clown" pictures were shown to ascertain whether the child understood the instructions to respond on the basis of information from the original story or the post-event narrative. A participant was judged to have understood the inclusion test instructions if they responded "yes" to

both the "Koko" picture shown by the first experimenter (original story, control) <u>and</u>

to the "Bozo" clown picture shown by the second experimenter (post-event narrative,

misled). If a child failed this test the experimenter repeated the instructions and

administered the practice pictures again until the child demonstrated an understanding

of the instructions.

The remaining participants were individually administered an exclusion

recognition test. Children in this condition were informed that the second

experimenter had made some mistakes with the post-event summary and were

instructed to forget about what they had been told by this experimenter. The

remainder of the test instructions followed those in the inclusion condition. Before

commencing the test the practice "clown" pictures were shown to determine whether

the child understood the instructions to disregard the narrative presented by the

second experimenter. A participant was judged to have understood the test

instructions if they responded "yes" to the "Koko" picture shown by the first

experimenter (control) and if they responded "no" to the "Bozo" clown picture shown

by the second experimenter (misled). If a child failed this test on the first try the

experimenter repeated the instructions and administered the practice pictures again

until the child demonstrated an understanding of the instructions. If a child repeatedly

failed this task then testing was terminated.

Results

In the both the inclusion and exclusion test conditions the proportion of "yes"

responses to original, misled, and new items was calculated for each item type. A

preliminary analysis revealed that the narrative version did not influence performance

on control, new, misled-read, and misled-generate items. That is, performance on

control, new, misled-read, and misled-generate items did not depend on the specific

narrative or items used during testing. Therefore, all subsequent analyses were

performed after collapsing across narrative types. (See Appendix C for all statistical

analyses in this experiment). The mean number of hints given at the encoding of

misled-generate items across items was 1.45 for the 5-year-old children and 1.31 for

the 8-year-old children. This difference between age groups was not statistically

reliable, $\underline{t}$ (102)= 1.92, $\underline{p}$ > .05.

Table 6 shows the proportion of "yes" responses to control, new, and misled items

for the two age groups in each experimental condition. A 2 (age) x 2 (test) x (3) (item

type: control, misled-read, misled-generate) analysis of variance with repeated

measures on the last factor was performed on this data. Two contrasts were planned

to examine specific comparisons between item types. These were control compared

to all misled items and misled-read compared to misled-generate items. Because two

of these contrasts were not orthogonal a Bonferroni adjustment was used to maintain a

family wise error rate at $\alpha = 0.05$ (cf. Hall & Bird, 1986). The significance level for

Tukey's post-hoc tests was $\underline{p}$ < .05.

Table 6

Mean Proportion of "yes" responses (and standard deviations) as a Function of

Experimental Condition and Age

	Inclusion		Exclusion	
	5-year-olds	8-year-olds	5-year-olds	8-year-olds

Item type

Control	.65 (.18)	.69 (.17)	.63 (.19)	.69 (.17)
New	.48 (.24)	.36 (.11)	.42 (.19)	.31 (.12)
Misled-Read	.55 (.24)	.42 (.24)	.43 (.27)	.43 (.23)
Misled-Generate	.69 (.20)	.60 (.24)	.41 (.27)	.29 (.20)

Mean Proportion of "yes" responses* (corrected) for Suggested Items and New Items

New	.48 (.21)	.38 (.10)	.43 (.17)	.34 (.11)
Misled-Read	.54 (.18)	.44 (.18)	.45 (.20)	.45 (.17)
Misled-Generate	.64 (.15)	.57 (.18)	.43 (.21)	.34 (.15)

Note. Snodgrass & Corwin's (1988) correction method was applied to individual participant's "yes"

responses on new and suggested items.

Note. *Misled-Read and Misled-Generate* refer to test items depicting the misleading details given in

Phase 2.

The analysis revealed a significant main effect for test condition, F (1, 100) = 15.10, $\underline{MSE}$ = .63, $\underline{p}$ < .01. Across age and item types, acceptance of items ("yes" response) in the inclusion condition ($\underline{M}$ = .60) was higher than that in the exclusion condition ($\underline{M}$ = .48). There was also a significant effect for the contrast comparing "yes" responses to control and misled items, F (1, 100) = 85.24, $\underline{MSE}$ = 2.36, $\underline{p}$ < .001. Across age and test conditions, the probability of responding "yes" to control items ($\underline{M}$ = .66) was higher than for misled items ($\underline{M}$ = .48). This effect was qualified, however, by a significant interaction with age, F (1, 100) = 11.02, $\underline{MSE}$ = .31, $\underline{p}$ < .01. Figure 1 shows that the difference between responding "yes" to control and misled items was larger for the 8-year-olds ($\underline{M}_{control} - \underline{M}_{misled}$ = .26) than for the 5-year-olds ($\underline{M}_{control} - \underline{M}_{misled}$ = .13). The Figure also suggests that this difference was due to both the "yes" response rate for control items being higher for the 8-year-olds and the likelihood of falsely recognizing the misled items being lower for this age group.

There was a significant two-way interaction between test condition and the comparison between control and misled items across age groups, F (1, 100) = 15.97, $\underline{MSE}$ = .44, $\underline{p}$ < .01. Figure 2 shows that the acceptance of control and misled items varied according to test condition. Tukey's post-hoc tests confirmed that while "yes" responding to control items in the inclusion and exclusion test conditions did not differ significantly ($\underline{M}_{inclusion}$ = .67; $\underline{M}_{exclusion}$ = .65), children were more likely to accept misled items in the inclusion condition than in the exclusion condition ($\underline{M}_{inclusion}$ = .56; $\underline{M}_{exclusion}$ = .39). No other interactions reached significance.

Figure 1. Mean Proportion Acceptance of Control and Misled Items as a Function of Age
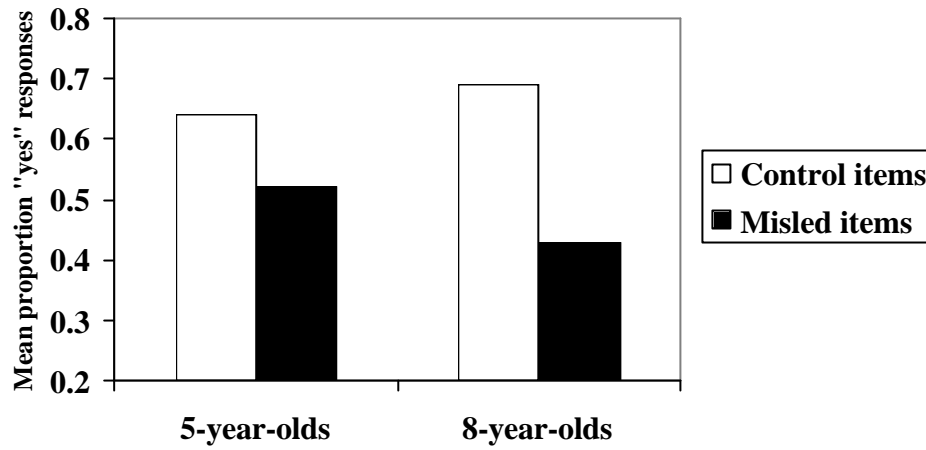
Figure 2. Mean Proportion Acceptance of Control and Misled Items as Function of Test Condition
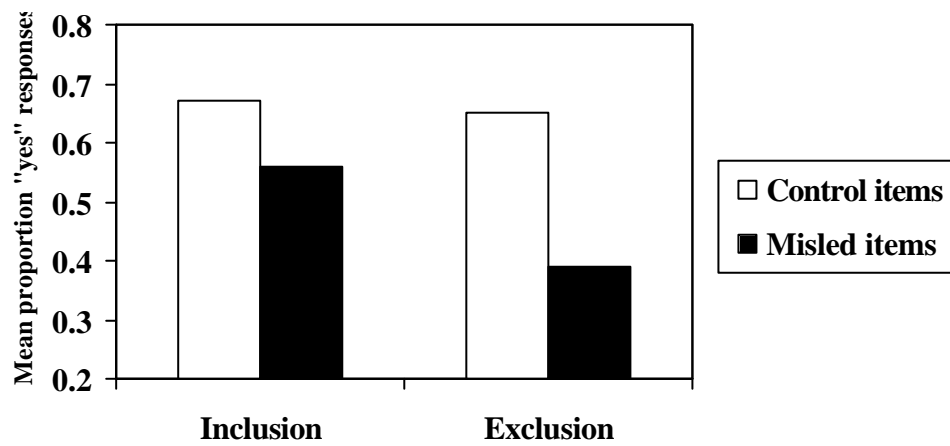
A planned comparison examined the probability of saying "yes" to the two types of misleading items. The two-way interaction between test condition and misled-read and misled-generate item types was significant, $F(1, 100) = 11.69$, $\underline{MSE} = .78$, $\underline{p} < .01$. Children in the inclusion test condition were more likely to say that they had seen pictures corresponding to the self-generated misled detail ($\underline{M} = .65$) than pictures that corresponded to misleading suggestions that were simply read aloud ($\underline{M} = .49$). The opposite was the case in the exclusion test where children were more likely to accept read items ($\underline{M} = .43$) than generate items ($\underline{M} = .35$). Tukey's post-hoc tests revealed that while "yes" responding was significantly greater on generate as compared to read items in the inclusion test condition, no significant difference was found between "yes" responding on read and generate items in the exclusion test condition. No other main effects or interactions reached significance.

The process dissociation procedure assumes that false alarm rates for neutral items are equal across inclusion and exclusion test conditions and all other groups whose process estimates are to be compared. Therefore, a 2 (age) x (2) (test: new inclusion, new exclusion) analysis of variance was performed on "yes" responses to new items. There was a main effect of age, $\underline{F}(1, 100) = 9.34$, $\underline{MSE} = .31$, $\underline{p} < .01$, but no main effect of test condition, $\underline{F}(1, 100) = 2.23$, $\underline{MSE} = .07$, $\underline{p} > .05$. Five-year-olds produced more false alarms, responding "yes" more often to new items ($\underline{M} = .45$) than the 8-year-olds ($\underline{M} = .34$). False alarm rates did not vary across the two encoding conditions.

Estimates of Recollection and Automaticity

The process dissociation equations (3) and (4) (see Section 1.14) were used to calculate separate estimates of the contribution of the processes of recollection and

automaticity to responding on misled-read and misled-generate item types.
Participants' individual proportions of "yes" responses for misled-read and misled-
generate items were first corrected using Snodgrass and Corwin's (1988) procedure
(cf. Hayes & Hennessy, 1996) to eliminate the problem of "yes" responses of one or
zero. In this procedure 0.5 is added to individual proportions incorrect ("yes"
response) which are then divided by $N + 1$, where N is the number of misled-read or
misled-generate items. Table 6 shows the corrected proportions of "yes" responses to
suggested items. Equations (3) and (4) adapted from Jacoby (1991) were then applied
to the corrected response rates to calculate the probabilities of responding on the bases
of recollection and automaticity for each age group.

Table 7 shows that estimates of recollection for misled-generate items were larger
than for misled-read items. While recollection for misled-generate items did not vary
developmentally, there was a larger contribution of recollection to responding on
misled-read items in 5-year-olds as compared to 8-year-olds. Further, there was a
trend for automaticity estimates to be larger for 5-year-olds compared to 8-year-olds
for both misled-read and misled-generate item types.

A major assumption underlying the process dissociation procedure is that base
rates for responding "yes" or "no" are equal across task or subject conditions.
However, the 5-year-olds tested in this study were more likely to false alarm to new
items than the 8-year-olds. Developmental comparisons in estimates of automaticity
and recollection could consequently be compromised (cf. Brainerd et al., 1998;
Buchner et al., 1995; Reingold & Toth, 1996). The logistic-based dual-process
correction model developed by Yonelinas and Jacoby (1996a) for incorporating
response bias was, therefore, applied to the data. The correction model equations are

given in Appendix A. False alarms to new items were first corrected using Snodgrass

and Corwin's (1988) correction method and are shown in Table 6.

Table 7

Estimates of the Contribution of Recollection and Automaticity for Read and

Generate Item Types as a Function of Age

	Recollection		Automaticity	
	5-year-olds	8-year-olds	5-year-olds	8-year-olds
Misled-Read	.10	-.02	.49	.44
Misled-Generate	.21	.23	.54	.44

Estimates of Recollection and Automaticity for Read and Generate Item Types as a

Function of Age using the correction procedure suggested by Yonelinas & Jacoby

(1996a)

	Recollection		Automaticity	
	5-year-olds	8-year-olds	5-year-olds	8-year-olds
Misled-Read	.05	-.08	.48	.43
Misled-Generate	.17	.20	.54	.43

Table 7 shows the probability of recollection and automaticity for each age group

after correction for response bias. In general, the obtained pattern of findings

resembled that obtained with the Jacoby (1991) method. Across age groups

recollection estimates were larger for misled-generate than for misled-read and control items. Further, in the misled-read condition only, recollection made a larger contribution to the responding of 5-year-olds than for 8-year-olds.

Automaticity estimates were larger than recollection estimates for both misled item types. Moreover, whereas the contribution of automaticity to responding did not vary between misled-read and misled-generate items there was, however, a trend for estimates of automaticity for both misled-read and misled-generate misled items to decrease with age.

Discussion

In this experiment it was found that, as predicted, the relative probability of accepting (i.e., saying "yes") to control and test items was influenced by the age of the participants, the type of test instructions administered, and the way in which the suggested material was encoded in the post-event phase. Evidence was found of an age-related change in the acceptance of control and misled items such that the difference between responding "yes" to control and misled items was greater for the 8-year-old children. This finding is consistent with previous research that has found older school-aged children to be less likely than younger children to accept misleading suggestions (e.g., Cassel & Bjorklund, 1995; King & Yuille, 1987).

It was also found that the difference in the probability of saying "yes" to control and misled items varied with the type of test instructions presented. Children in inclusion and exclusion conditions showed similar levels of recognition of control items but those given inclusion instructions were more likely to erroneously accept the misled item as having been presented in the original picture story.

Moreover, it was found that misinformation acceptance varied according to both the encoding of misleading suggestions and recognition test instructions. In the inclusion condition children were more likely to report that they had seen pictures corresponding to the self-generated misled detail than pictures that corresponded to misleading suggestions that were simply read aloud. The opposite was the case in the exclusion test condition. In some respects these results resemble the more general effect of "generation" on recognition memory performance that has been reported under a variety of experimental conditions with both adults and children (Jacoby, 1991; McFarland et al., 1983; Slamecka & Graf, 1978). McFarland et al., for example, found an overall recognition memory advantage for self-generated category exemplars compared to read words, an effect that did not vary over the period from 7 to 13 years of age.

In the current study, generating a suggestion in response to semantic and linguistic cues made children in both age groups more likely to say "yes" to suggested items, but also made them more likely to reject suggestions when exclusion instructions were given. Hence, the self-generating of misleading suggestions can either potentiate or attenuate the misinformation effect depending on the instructions that children are given at the point of retrieval. This finding supports the view that the generation effect involves greater elaborative conceptual processing compared to words that are simply heard (e.g., Begg et al., 1991; Flory & Pring, 1995).

A major aim of this first experiment was to assess the contributions of recollective and automatic memory processes across two forms of encoding of suggested details. In terms of the contributions of recollection and automaticity to suggestibility, it was found, after correcting for differences in false alarm rates, that automaticity made a

stronger contribution to children's responses than recollection. Such results are consistent with memory-impairment accounts, retrieval competition, and the source-monitoring hypothesis, in that all assume that automatic memory processes make a strong contribution to misinformation acceptance. It was also expected, following Jacoby (1991), Joordens and Merikle (1993) and Toth et al. (1994), that different encoding tasks would produce changes in recollection estimates. We found that the probability of responding on the basis of recollection was greater for misled-generate as compared to misled-read items. Hence, these results also provide support for the role of intentional memory processes in the acceptance of misinformation. The probability of responding on the basis of automatic processing did not vary according to whether suggestions were read or generated.

With regard to developmental changes in recollection and automaticity, there was a trend for the automaticity estimates for misled-read and misled-generate items of 5-year-olds to be larger than those of 8-year-olds. Importantly these findings suggest that, in comparison to older children, misinformation acceptance in young children is more automatically driven and, therefore, may be less preventable (see Section 1.10).

Somewhat unexpectedly, recollection estimates for 5-year-olds were larger than those of the older group, but only for the misled-read items. This trend, however, should be treated cautiously given the small absolute size of the recollection estimates in the misled-read condition.

This study suggests that, contrary to the assumptions made in many previous investigations of misinformation acceptance (e.g., Loftus et al., 1985), performance on explicit tests of recognition is not a direct measure of "conscious" or intentional memory, but rather, reflects both automatic and intentional memory processes

(Jacoby, 1991; Jacoby, Toth, & Yonelinas, 1993). Moreover, it was found that the probability of responding on the basis of recollection was differentially affected by a read / generate encoding manipulation of misleading suggestions, providing support for the process dissociation assumption of independence. Whereas automatic processes were unaffected by this manipulation, recollection estimates for self-generated suggestions were significantly greater than for misleading suggestions that were read aloud to the children.

The present findings only partially support the conclusions drawn by Lindsay et al. (1995). Like Lindsay et al., it was found that both automatic and intentional memory processes contributed to children's misinformation acceptance. Both this study and Lindsay et al. found no evidence of developmental differences in acceptance of misinformation from 5 to 8 years of age. Lindsay et al., however, reported that estimates of automaticity and recollection for misled items varied developmentally. They found that for the older children automatic uses of memory made a greater contribution to the misinformation effect. Further, the younger children's suggestible responses were more often due to intentional recollection. In contrast, in the present study younger children's suggestible responses were largely due to automatic memory processes.

These discrepant findings may be due, in part, to a number of procedural differences between the studies. First, the "standard" condition of Lindsay et al's (1995) study was not an "inclusion" condition such as that employed in adult process dissociation research (e.g., Jacoby, 1991). Specifically, children in the "standard" condition were not asked to report on the bases of both the original and post-event information, but instead, were asked to report the original story details. In the

"standard" condition, therefore, children would be less likely than children in the inclusion condition of the present study to include items for which they had been given misleading information. As a consequence estimates of recollection in Lindsay et al.'s study would be deflated and estimates of automaticity would be inflated. Second, the present research incorporated a greater number of misleading suggestions and, hence, was more likely to yield reliable parameter estimates compared to those obtained by Lindsay et al. (1995) who employed only two misleading details. Third, the current study included instructions that aimed to ensure all children understood what they were required to do in the exclusion test. It is less likely, therefore, that misled responses in the exclusion condition of the current study would have occurred through a misunderstanding of test instructions and hence also less likely that intentional processes would have contributed to the acceptance of misleading information in the exclusion condition (cf. Jacoby, 1991).

In summary, Experiment 1 demonstrated that both automatic and intentional memory processes contributed to misinformation acceptance on a yes- no recognition test in 5- and 8-year-old children. Moreover, some evidence was found that although the overall level of suggestible responding remained constant from 5 to 8 years the nature of the memory processes that underlie misinformation acceptance did change. Importantly, however, it was found that the probability of responding on the basis of recollection was greater for misled- generate as compared to misled-read items. The conclusions that can be drawn from these comparisons of group estimates of automaticity and recollection are necessarily limited, however, because these estimates were generated across participants who were tested under inclusion <u>or</u> exclusion conditions. Although this procedure for calculating estimates is entirely

consistent with much of the established practice in the literature (e.g., Buchner et al., 1995; Jacoby, 1991; Lindsay et al., 1995; Wagner et al., 1997), it prevents the application of standard inferential statistics for evaluating the reliability of apparent group differences in process parameter estimates. In order to address this problem, Experiment 2 made use of a procedure that permitted the calculation of estimates of process dissociation parameters for each individual participant.

Chapter 3

Refining the process dissociation estimates of children's acceptance of misleading suggestions

3.1 Introduction to Experiment 2

The estimates of recollection and automaticity generated in Experiment 1 indicate that both processes are involved in children's misinformation acceptance, and that they follow somewhat different developmental courses. It is notable however, that the estimates were derived from group recognition data and hence standard inferential data analyses techniques could not be applied. Without such analyses, it is difficult to know how to interpret the apparent age group differences between automaticity and recollection estimates. This same criticism can be leveled at many of the published adult studies that have made use of the process dissociation procedure (e.g., Buchner et al., 1995; Wagner et al., 1997).

In order to strengthen the conclusions that can be drawn about the contribution of automatic and intentional processes to acceptance of misinformation, a second study was designed in which inclusion and exclusion instructions for recognition testing were manipulated within-subjects (cf. Jacoby, Toth, & Yonelinas, 1993; Russo et al., 1998; Toth et al., 1994). This permitted the estimation of automaticity and recollection for individual children (cf. Anooshian, 1999; Anooshian & Seibert, 1996). These individual estimates were then entered into standard analysis of variance procedures to provide a more rigorous examination of the effects of encoding condition and age.

In most other respects this study resembled Experiment 1. The only other significant procedural alteration was a change in the retention interval between narrative presentation and recognition testing (from two days to one day), in order to provide for a more direct comparison between the current results and those of previous developmental studies of suggestibility (e.g., Ceci et al., 1987b; Toglia et al., 1992). As in Experiment 1, two groups of children aged 5 and 8 years were the participants. In accordance with Experiment 1, it was expected that children would be more likely to respond "yes" to control items than to items on which they had been given misleading information (Ceci et al., 1987b; Cole & Loftus, 1987).

Moreover, it was predicted that misinformation acceptance would be found under both read and generate encoding of misleading suggestions. However, it was thought that the generate manipulation would again result in greater misinformation acceptance (cf. Begg et al., 1989; Lane & Zaragoza, 1996). Moreover, following Experiment 1, it was expected that this encoding manipulation should lead to larger recollection estimates for generated as compared to read details (cf. Jacoby, 1991; Joordens & Merikle, 1993; Toth et al., 1994).

<div align="center">Method</div>

<u>Participants</u>

Ninety-three 5-year-olds ($\underline{M}$ = 5 years, 8 months, $\underline{SD}$ = 4 months, Range: 5 years, 1 month - 6 years, 3 months), including 49 males and 44 females, and eighty-six 8-year-olds ($\underline{M}$ = 8 years, 7 months, $\underline{SD}$ = 5 months, Range: 7 years, 6 months - 9 years, 6 months), including 46 males and 40 females, participated in the study. All children attended public primary schools in predominantly middle-class areas of the New

South Wales Central Coast, Australia. Children participated only if parental consent had been granted.

<u>Materials</u>

Two changes were made to the materials used in Experiment 1. First, four target items were eliminated to simplify the within-subject administration of the inclusion and exclusion recognition memory tests. The remaining eight target items and their alternate versions (one misleading and one novel) were the same as those used in Experiment 1. A full list target items and their alternative versions is presented in Table 8. Second, three versions of the original story were constructed to control for possible differences in the difficulty of the stimuli. For example, for Item 1 "room", one third of the children saw "kitchen" in the original story, one third saw "bedroom", and one third saw "bathroom". Four post-event narratives were constructed for each version of the original story (i.e., 12 versions of the narratives). The post-event narratives consisted of a summary of the original story and contained two misled-read and two misled-generate items and neutral information about the other four picture details (control items). The assignment of items to neutral and misled roles was counterbalanced across participants. For example, a child who saw "kitchen" in the original story (version 1) was misled with "bedroom" in the post-event narrative. A child who saw "bedroom" in the original story (version 2) was misled with "bathroom" in the post-event narrative. A child who saw "bathroom" in the original story (version 3) was misled with "kitchen" in the post-event narrative. (See Appendix D for the three original story versions and an example of a post-event narrative).

Table 8

Items employed in Experiment 2

----

1. kitchen, bedroom, bathroom

2. eggs, cereal, toast

3. headache, stomachache, sore throat

4.   hat, coat, shoes

5.   knife, fork, spoon

6. dog, cat, rabbit

7.   green, red, yellow

8.   banana, apple, orange

Procedure

As in Experiment 1, all children were tested on three occasions in a quiet room at their school. On the first day children were read the picture story by the first experimenter. The next day, a second experimenter read one of the 12 versions of the post-event narratives presenting the misled-read and misled-generate items in the same manner as Experiment 1. In each narrative there were 8 items; two misled-read, and two misled-generate, and four control items for which neutral information was presented. All of the suggested items were consistent with the syntactic and semantic context of the original story. The narrative, including all neutral and misled-read items, was read aloud to the participants. For the misled-generate items, the words preceding the item were read aloud and the experimenter then gave the hint for the suggested word containing a semantic and linguistic cue. For example, for the misled item "fork", the experimenter read: "The gorillas burst into the factory while Zippy

was washing up a ....." or [hint]. At this point the first hint was provided; "We use this to eat food with, it starts with f...". If the child was unable to produce the word the experimenter gave a second hint containing additional semantic information, for example, "this has prongs on it"; the experimenter then continued to read the rest of the sentence aloud. In the event the word was not produced after the second hint the experimenter supplied it. The total number of hints given was recorded for each participant. A list of all hints used in this phase is provided in Appendix B.

Immediately following the post-event narrative the first experimenter returned to administer two yes / no recognition memory tests to each child, an inclusion test followed by an exclusion test. The administration of these two tests was not counterbalanced for two reasons. First, in pilot testing it was found that younger children had considerable difficulty following the inclusion instructions when these were presented after exclusion instructions (i.e., after they had already been presented by experimenter two). Second, it was thought that if the exclusion instructions were presented first then this would be likely to increase the intentional monitoring of all subsequent test items, including those presented in the inclusion test. This would have the effect of artificially lowering the probability of responding "yes" in the inclusion test. Indeed, the data from the pilot study that presented the exclusion instructions prior to the inclusion instructions indicated that, contrary to the pattern expected in the process dissociation paradigm, 6-year-old children were equally likely to respond "yes" to test items in the exclusion and the inclusion condition (see Appendix E for raw data).

This problem of the order of presentation of inclusion and exclusion instructions is analogous to that of "process contamination" as discussed by implicit memory

researchers (e.g., Schacter, Bowers, & Booker, 1989) such that the presentation of an explicit test (e.g., recognition) prior to an implicit test (e.g., fragment completion) is seen to increase the chance that explicit strategies will be employed in solving the implicit task. As a consequence many researchers who have administered both kinds of tests to the same participants have administered them in a fixed order with the more implicit or automatic task presented first (e.g., Jacoby, Toth, & Yonelinas, 1993; Jennings & Jacoby, 1993; Rybash, DeLuca, & Rubenstein, 1995).

Each recognition trial contained 12 pictures; four original (control) from Phase 1, four pictures of items on which misleading suggestions were given at Phase 2 (misled), and four novel targets. There were three versions of each of the four target items that varied only with regard to the specific detail. The instructions preceding administration of the inclusion and exclusion memory tests were the same as those in Experiment 1. Children were first asked if they remembered the picture story about Miss Peabody *and* the summary read to them by the second experimenter. They were then informed that they would be shown some pictures, some "old" and some "new", and that they should respond "yes" if they remembered seeing the picture and "no" if they did not. Before commencing the test the practice clown pictures were shown to ascertain whether the child understood the instructions to include information from the original story and the post-event narrative. A participant was judged to have understood the inclusion test instructions if they responded "yes" to both the "Koko" picture shown by the first experimenter (original story, control) and to the "Bozo" clown picture shown by the second experimenter (post-event narrative, misled). If a child failed this test the experimenter repeated the instructions and administered the

practice pictures again. As in Experiment 1, if a child repeatedly failed this task then testing was terminated.

In the exclusion condition, children were informed that the second experimenter had made some mistakes with the post-event summary and were instructed to forget about what they had been told by this experimenter. The remainder of the test instructions followed those in the inclusion condition. Before commencing the test the practice clown pictures were shown to ascertain whether the child understood the instructions to disregard the narrative presented by the second experimenter. A participant was judged to have understood the test instructions if they responded "yes" to the "Koko" picture shown by the first experimenter (control) and if they responded "no" to the "Bozo" clown picture shown by the second experimenter (misled). If a child failed this test the experimenter repeated the instructions and administered the practice pictures again until the child demonstrated an understanding of the instructions.

Results

In the both the inclusion and exclusion test conditions the proportion of "yes" responses to original, misled, and new items was calculated for each item type. A preliminary analysis revealed that the original story and narrative versions did not influence performance on control, misled-read, and misled-generate items. Hence, all subsequent analyses were performed after collapsing across version and narrative types. (See Appendix E for all the statistical analyses for this experiment). The mean number of hints given at the encoding of the misled-generate items across items, was 1.05 for the 5-year-olds and .90 for the 8-year-olds. This difference between age groups was statistically reliable, $t(177) = 3.02$, $p < .05$.

Table 9 shows the proportion of "yes" responses to control, new, and misled items for the two age groups in each experimental condition. A 2 (age) x (2) (test type) x (3) (item type) analysis of variance with repeated measures on the test and item type factors was performed on this data. The two planned contrasts on the item factor used in Experiment 1 were also used in this analysis. These were control items compared to all misled items, and misled-read compared to misled-generate items. Bonferroni adjustments were again used to control a family wise rate at $\alpha = .05$. The significance level for Tukey's post-hoc tests was $\underline{p} < .05$.

The ANOVA revealed a significant main effect for test condition, $\underline{F}(1, 177) = 25.86$, $\underline{MSE} = 1.22$, $\underline{p} < .01$, with acceptance of items ("yes" response) greater in the inclusion condition ($\underline{M} = .59$) than in the exclusion condition ($\underline{M} = .50$). A significant main effect for the contrast comparing acceptance of control and misled items was also found, $\underline{F}(1, 177) = 41.03$, $\underline{MSE} = 3.05$, $\underline{p} < .01$.

Across age and test conditions, children were more likely to respond "yes" to control items ($\underline{M} = .62$) than to misled items ($\underline{M} = .51$). There was no evidence of age differences in this pattern of responding. However, there was a significant two-way interaction between test condition and the difference between responding to control and misled items, $\underline{F}(1, 177) = 23.71$, $\underline{MSE} = .93$, $\underline{p} < .01$. Tukey's post-hoc tests confirmed that while "yes" responding to control items in the inclusion and exclusion test conditions did not differ significantly ($\underline{M}_{inclusion} = .62$; $\underline{M}_{exclusion} = .61$), children were more likely to accept misled items in the inclusion condition than in the exclusion condition ($\underline{M}_{inclusion} = .57$; $\underline{M}_{exclusion} = .44$).

Table 9

Mean Proportion Acceptance of Items ("yes" response) (and standard deviations) as a

Function of Experimental Condition and Age

Item type	Inclusion		Exclusion	
	5-year-olds	8-year-olds	5-year-olds	8-year-olds
Control	.63 (.23)	.60 (.18)	.62 (.24)	.61 (.19)
New	.41 (.26)	.25 (.19)	.36 (.27)	.25 (.20)
Misled-Read	.51 (.35)	.42 (.29)	.51 (.37)	.45 (.31)
Misled-Generate	.69 (.36)	.65 (.33)	.43 (.34)	.36 (.32)

Mean Proportion Acceptance (Corrected) ("yes" response) for Suggested Items and

New Items

	5-year-olds	8-year-olds	5-year-olds	8-year-olds
New	.43 (.21)	.30 (.16)	.39 (.22)	.30 (.16)
Misled-Read	.50 (.23)	.46 (.20)	.51 (.24)	.48 (.21)
Misled-Generate	.63 (.23)	.60 (.22)	.45 (.23)	.41 (.21)

Note. Snodgrass & Corwin's (1988) correction method was applied to individual participant's "yes"

responses on new and suggested items.

Note. *Misled-Read and Misled-Generate* refer to test items depicting the misleading details given in

Phase 2.

A planned contrast compared the difference in the probability of "yes" responses between the two types of misleading items. This contrast interacted significantly with test condition, F (1, 177) = 44.24, $\underline{MSE}$ = 3.95, $\underline{p}$ < .01. Children in the inclusion condition were more likely to accept generate items ($\underline{M}$ = .67) than read items ($\underline{M}$ = .46), but the opposite was the case in the exclusion test condition (read: $\underline{M}$ = .48, generate: $\underline{M}$ = .39). Tukey's tests confirmed that while the probability of "yes" responding to generate as compared to read items was significantly higher in the inclusion test condition, the opposite was the case in the exclusion condition such that "yes" responding was significantly higher for read as compared to generate items. No other interactions involving this effect were significant.

The process dissociation procedure assumes that false alarm rates for neutral items are equal across the inclusion and exclusion test conditions. Therefore, a 2 (age) x (2) (test: new inclusion, new exclusion) analysis of variance was performed. A main effect of age was found, F (1, 177) = 19.33, $\underline{MSE}$ = 1.61, $\underline{p}$ < .01, such that 5-year-olds responded "yes" to new items ($\underline{M}$ = .39) more frequently than the 8-year-olds ($\underline{M}$ = .25). This indicates that, in general, the younger children had higher false alarm rates for neutral items than the older children. False alarm rates did not vary across the two encoding conditions or test conditions.

Estimates of Recollection and Automaticity

The process dissociation equations (3) and (4) (see Section 1.14) were again used to calculate separate estimates of the contribution of recollection and automaticity processes to responding on misled-read and misled-generate item types. Participants' individual proportions of "yes" responses for misled-read and misled-generate items were first corrected using Snodgrass and Corwin's (1988) procedure (cf. Hayes &

Hennessy, 1996) to eliminate the problem of "yes" responses of one or zero. Table 9 shows the corrected proportions of "yes" responses to suggested items. Equations (3) and (4) were then applied to the corrected response rates to calculate the probabilities of responding on the bases of recollection and automaticity for each age group (see Table 10).

Table 10

Mean Process Dissociation Estimates (and standard deviations) for Read and Generate Item Types as a Function of Age

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	Recollection		Automaticity	
	5-year-olds	8-year-olds	5-year-olds	8-year-olds
Misled-Read	-.01 (.27)	-.02 (.25)	.50 (.21)	.47 (.18)
Misled-Generate	.18 (.25)	.19 (.26)	.55 (.22)	.51 (.21)

Mean Process Dissociation Estimates (and standard deviations) for Read and Generate Item Types as a Function of Age using the Correction Method suggested by Yonelinas & Jacoby (1996a)

	Recollection		Automaticity	
	5-year-olds	8-year-olds	5-year-olds	8-year-olds
Misled-Read	-.18 (.66)	-.07 (.40)	.50 (.21)	.48 (.18)
Misled-Generate	.08 (.44)	.14 (.40)	.55 (.22)	.50 (.21)

A 2 (age) x (2) (item type) analysis of variance with repeated measures on the item type factor was performed on the recollection estimates. A main effect of item type was found, F (1, 177) = 49.21, $\underline{MSE}$ = 3.55, $\underline{p}$ < .01. Across age groups, recollection estimates for generated items ($\underline{M}$ = .19) were greater than those derived for read items ($\underline{M}$ = - .01). No other main effects or interactions reached significance.

A 2 (age) x (2) (item type) analysis of variance with repeated measures on the item type factor was performed on the automaticity estimates. There was a main effect of age, F (1, 177) = 4.37, $\underline{MSE}$ = .13, $\underline{p}$ < .05, such that across misled-read and misled-generated items, automaticity estimates for the 5-year-olds ($\underline{M}$ = .53) were larger than those for the 8-year-olds ($\underline{M}$ = .49).

A major assumption underlying the process dissociation procedure is that base rates for responding "yes" or "no" are equal across task or subject conditions. However, the 5-year-olds tested in this study were more likely to false alarm to new items than the 8-year-olds. Consequently, developmental comparisons of estimates of automaticity and recollection could be compromised (cf. Brainerd et al., 1998; Buchner et al., 1995; Reingold & Toth, 1996). Therefore, as in Experiment 1, the logistic-based dual-process correction model developed by Yonelinas and Jacoby (1996a) for incorporating response bias was applied to the data (see Appendix A for relevant equations). Table 10 shows the probabilities of responding on the bases of recollection and automaticity for each age group (cf. Yonelinas & Jacoby, 1996a).

A 2 (age) x (2) (item type) analysis of variance with repeated measures on the item type factor was performed on the recollection estimates. A main effect of item type was found, F (1, 177) = 45.03, $\underline{MSE}$ = 4.80, $\underline{p}$ < .01, such that across age groups,

recollection estimates for generated items ($\underline{M} = .11$) were larger than for read items ($\underline{M} = -.13$). No other main effects or interactions reached significance.

A 2 (age) x (2) (item type) analysis of variance with repeated measures on the item type factor was performed on the automaticity estimates. There was a main effect of age, $\underline{F}$ (1, 177) = 4.61, $\underline{MSE} = .13$, $\underline{p} < .05$. Across item types, automaticity estimates of 5-year-olds ($\underline{M} = .53$) were larger than those of the 8-year-olds ($\underline{M} = .49$). No other main effects or interactions reached significance.

Discussion

Replicating the findings of Experiment 1, 5- and 8-year-old children were more likely to say that they had witnessed control items than items for which they had received misleading suggestions in both the inclusion and exclusion conditions. Contrary to the findings of the previous experiment, no evidence was found of developmental differences in "yes" responding to control and misled items. In this respect the current findings are consistent with previous research in which few developmental differences in levels of misinformation acceptance have been found for elementary school-age children (e.g., Ceci et al., 1987b; Coxon & Valentine, 1997; Delamothe & Taplin, 1992; Holliday et al., 1999; Lindsay et al., 1995; Marin et al., 1979).

In general, as in Experiment 1, children in this study were more likely to say "yes" to misled items at test under inclusion than under exclusion instructions. Critically though, it was again found that misinformation acceptance varied according to the way that suggestions were encoded and the nature of test instructions given at retrieval. In the inclusion test condition, children more often accepted misled items that were "self-generated" than misled items that were "read" aloud to them. In

contrast, in the exclusion test condition, children were more likely to correctly reject misled items that were self-generated. Once again it was found that generating a suggestion in response to semantic and linguistic cues made children in both age groups more likely to accept suggested items when tested under inclusion instructions. However, generating a suggested item also made children more likely to reject suggested items when exclusion instructions were given. The findings from both experiments that self-generating suggestions has the potential to either increase or reduce misinformation acceptance depending upon the nature of test instructions at retrieval, therefore, appears to be quite robust.

This pattern of results is consistent with the view that generating an item at encoding involves greater elaborative and / or conceptual processing than simply listening to information read aloud (cf. Flory & Pring, 1995). Hence, items that are self-generated at encoding are more distinctive in memory (Begg et al., 1991) and are, therefore, more readily excluded when instructed to do so. Similarly, in terms of fuzzy-trace theory (e.g., Brainerd & Reyna, 1998) generating an item is more likely to result in the item being stored in terms of "gist" memory traces that represent the item's semantic, relational, and elaborative characteristics. Gist traces are more durable than rapidly decaying verbatim traces of an item's surface form. Generating an item is also more likely to result in stronger "verbatim" memory traces that are more resistant to decay than verbatim traces of items that have been heard (Brainerd, Reyna, & Kneer, 1995).

With regard to the relative contributions of recollection and automaticity to misinformation acceptance it was found that, after correcting for false alarm rate differences, both processes contributed to children's acceptance of self-generated

items. These findings are consistent with fuzzy-trace theory's predictions (e.g., Brainerd & Reyna, 1998; Brainerd et al., 1998; Reyna & Brainerd, 1998) that post-event misinformation can be reported on the basis of either conscious recollection (e.g., verbatim traces of misinformation) or unconscious automatic memory processes (e.g., gist). Hence, under generate conditions, it would appear that both deliberative, intentional processes (e.g., McCloskey & Zaragoza, 1985a) as well as automatic changes (e.g., Loftus et al., 1985; Morton et al., 1985) to memory affect children's misinformation acceptance in recognition.

Under the read encoding conditions, however, the dominant process that contributed to acceptance of misinformation was automatic in nature. This finding is particularly significant as the procedure used to present suggestions in the "read" condition closely approximated that used in many previous studies of the misinformation effect in children (e.g., Ceci et al., 1987b; Zaragoza, 1991). By extension, the current result suggests that many of these previous demonstrations of misinformation acceptance in children were mediated by automatic memory processes.

This study found, in line with past research (e.g., Jacoby, Toth, & Yonelinas, 1993) however, that the contribution of recollection to children's acceptance of items that were self-generated at encoding was rather small in comparison to the relative contribution of automatic processes to such responding. In support of Experiment 1 and memory-based explanations of misinformation acceptance (e.g., Loftus et al., 1978; Morton et al., 1985), this study found that automatic processes made a strong contribution to such effects in school-age children.

The view that, under certain conditions, misleading suggestions are "intentionally" reported due to social demand factors (e.g., Ackerman, 1998; Cassel et al., 1996; Lampinen & Smith, 1995; McCloskey & Zaragoza, 1985a; Newcombe & Siegal, 1997; Thompson et al., 1997; Zaragoza, 1987, 1991) was also supported to the extent that there was a larger intentional component for misled-generated items.

In contrast, in both this and the previous experiment the probability of responding to misled-read and misled-generate items on the basis of automaticity remained invariant across the encoding manipulation. These results are quite consistent with previous research in the adult memory field in which invariance in automaticity has been reported for words studied under a conceptual processing manipulation (e.g., Toth et al., 1994).

In support of the age-related change in automaticity demonstrated in Experiment 1, the second experiment found developmental differences in automatic uses of memory for suggested items such that estimates of the contribution of automaticity for the 5-year-olds were significantly greater than those based on the responses of the 8-year-old children. In other words, although the overall probability of accepting misleading suggestions did not differ across age groups, the nature of the processes which gave rise to these responses did undergo developmental change. According to the process dissociation analysis, misinformation acceptance in 5-year-olds was more likely to be the result of an automatic process such as trace alteration or competition.

Such results seem to contradict Lindsay et al. (1995) who found a developmental increase in the contribution of automatic processes to suggestibility over this same age span. Several methodological limitations of Lindsay et al's study were addressed by the first two experiments, namely; the incorporation of more misled items and an

evaluation of children's understanding of test instructions, the employment of a within-subjects design that enabled the application of inferential statistical procedures, and correction of process estimates for response bias. Failing to follow instructions to exclude misled items in the exclusion condition leads to an inflated estimate of automaticity (Jacoby, 1991) and response bias differences between groups can result in an inflated estimate of recollection (Brainerd et al., 1998; Buchner et al., 1995). Hence, Lindsay et al.'s (1995) finding of an age-related decrease in recollective processes could have been an artifact of response bias differences between the age groups tested. Similarly, their finding of an age-related increase in automatic uses of memory may be attributed to the older children not following the exclusion test instructions.

It is notable, however, that an age-related decrease in automaticity-based suggestibility was obtained in Experiment 2, despite the overall age invariance of misinformation acceptance. This finding further validates the application of the process dissociation procedure to the misinformation paradigm such that this approach can reveal developmental change in the causal mechanisms of suggestibility even when the total level of suggestible responding remains the same. On a more general level, the fact that an encoding manipulation and age produced *different sorts of changes* in the contribution of automaticity and intentional recollection supports the view of Jacoby and colleagues (e.g., Jacoby, 1991; Jacoby, Toth, & Yonelinas, 1993) that the two processes are dissociable.

Contrary to the findings of Experiment 1, there was no evidence that the probability of responding to misled-read items on the basis of recollection was greater

for 5-year-olds. Moreover, the finding in both Experiments 1 and 2 of a developmental decrease in the contribution of automatic processes to misinformation acceptance, stands in contrast to the developmental invariance in priming on tests of implicit memory reported across the age range from preschool to adolescence (e.g., Anooshian, 1997; Hayes & Hennessy, 1996; Russo et al., 1995). These previous findings have provided support to the view that implicit memory develops prior to explicit memory and is fully functional by the age of three years (Parkin, 1989). However, it must be noted that almost all these previous studies have not used the misinformation paradigm, but instead have focussed on recognition results for items for which there has been no post-event interference. In addition, the current study again demonstrates that performance on a recognition test which has traditionally been seen as governed by "explicit" or intentional memory processes (e.g., Light & Singh, 1987; Merikle & Reingold, 1991) is actually influenced by both mechanisms (Jacoby, 1991; Jacoby, Toth, & Yonelinas, 1993).

To summarise, Experiment 2 replicated and extended the main findings of Experiment 1 to a paradigm that allowed for within-subject computation of process dissociation estimates. Misinformation acceptance was found for both age groups and was influenced by both automatic and recollective memory processes in 5- and 8-year-old children. Furthermore, Experiment 2 confirmed that the relative contribution of automatic processes to acceptance of misinformation declined with age.

The first two experiments established that both intentional recollection and automatic memory processes contributed to misinformation acceptance. The research in Experiment 3, therefore, was directed toward clarifying the implications of these findings for theories of misinformation (e.g., trace alteration, retrieval competition,

social demands and response biases) using the standard (e.g., Ceci et al., 1987b) or the

modified (Zaragoza, 1991) forced-choice recognition test.

Chapter 4

Intentional recollection and automaticity in children's suggestibility: The standard and modified recognition tests

4.1 Introduction to Experiment 3

It was established in each of the previous experiments that both intentional recollection and automatic memory processes are implicated in children's acceptance of misinformation although the relative roles of these processes are modified by the way that suggestions are encoded. Experiments 1 and 2 found that, in general, automatic memory processes made a stronger contribution to children's acceptance of suggestions than intentional recollection. Such findings lend support to theoretical explanations of misinformation such as memory interference (e.g., Brainerd & Reyna, 1998; Loftus et al., 1978), retrieval competition (e.g., Bekerian & Bowers, 1983; Chandler & Gargano, 1998; Morton et al., 1985), and the source-monitoring hypothesis (e.g., Johnson et al., 1993; Lindsay, 1990; Lindsay & Johnson, 1989a), all of which imply that misinformation acceptance is due to automatic memory processes.

In Experiments 1 and 2 evidence was also found for a role of recollective memory processes in producing misinformation acceptance such that there was a larger intentional component for misled-generated items. This finding is consistent with the explanation that misinformation acceptance can be influenced by intentional factors such as compliance to the perceived wishes of the experimenter and misinterpreting

the intent of the experimental situation (e.g., McCloskey & Zaragoza, 1985a;

Newcombe & Siegal, 1997; Zaragoza, 1987, 1991).

In Experiment 3, the yes / no recognition test used in the first two experiments was

replaced by the standard and modified forced-choice recognition tests. The yes / no

recognition procedure (cf. Belli, 1989; Tversky & Tuchin, 1989) has been criticised

by Zaragoza and McCloskey (1989) who argued that misinformation effects obtained

using such procedures cannot unequivocally be attributed to interference with

memory for original event details. That is, performance on the yes / no test could be

influenced by source misattribution and response biases. Specifically, participants

who confuse the source of the original and post-event details may be more likely than

those who do not confuse the source to respond "yes" to items for which they had

received misinformation. Alternately, participants may remember both the original

event and post-event details but respond "no" to the original item because the post-

event detail has weakened participants' confidence in the accuracy of their memories

(Zaragoza & McCloskey, 1989). Although the modified test (cf. McCloskey &

Zaragoza, 1985a; Zaragoza, 1991) does not allow for a direct assessment of

misinformation due to source misattribution (Zaragoza & McCloskey, 1989), it does

enable an evaluation of the hypothesis that misinformation impairs memory (e.g.,

storage or retrieval interference) for original event details, and at the same time

provides strict controls on suggestible responses that are intentionally reported due

to social / motivational factors or response bias. A further major motivation for this

experiment was that examining the roles of automatic and intentional processes under

forced choice recognition test conditions rather than the yes / no procedure, permits

a more direct comparison of the findings with the majority of published studies of

children's suggestibility that have employed the former procedure (e.g., Ceci et al., 1987b; Holliday et al., 1999; Lampinen & Smith, 1995; Newcombe & Siegal, 1996; Toglia et al., 1992; Zaragoza, 1991; Zaragoza et al., 1992).

4.2 Aims and predictions

This experiment aimed to examine the contribution of recollection and automaticity to 5- and 9-year-old children's suggestible responses on both standard (cf. Ceci et al., 1987b) and modified (cf. Zaragoza, 1991) forced-choice recognition tests. Instead of responding "yes" or "no" to target items presented one at a time as in the previous experiments, children were asked to choose between an original event item and misled item in a standard test and between an original event item and a novel item in a modified test. The proportion of occasions on which children selected test pictures that corresponded with the misled details in the standard test in each instruction condition was then used to calculate the probabilities of responding on the bases of recollection and automaticity for each age group (cf. Jacoby, 1991; Lindsay et al., 1995). In the modified test, automatic and intentional influences on novel item selection were examined by substituting the proportion of novel item choices at test in place of the proportion of misled choices, into the process dissociation equations. The process dissociation equations (3) and (4) from Section 1.14 were used in these calculations but instead of using the proportion of "yes" responses as in the previous experiments, this experiment used the proportion of "misled" choices at test.

Experiments 1 and 2 found that 5- and 8-year-old children were more likely to accept control items than misled items in both the inclusion and exclusion instruction conditions. The current experiment followed previous investigations of children's acceptance of misleading suggestions (e.g., Ceci et al., 1987b; Zaragoza, 1991) in

which "suggestibility" is defined in terms of a reduction in the probability of correctly selecting an original detail following exposure to misleading information. In this experiment, therefore, it was expected that children would demonstrate evidence of a suggestibility effect; that is, they would be more accurate on control items than on items on which misleading suggestions were given in both the standard and modified recognition testing procedures (cf. Ceci et al., 1987b; Holliday et al., 1999), and that little evidence of age-related changes in suggestibility would be found on either test. Experiments 1 and 2 found that self-generated suggestions were more likely to be accepted than suggestions that were simply read to the participants in the inclusion condition *and* were more likely than "read" suggestions to be correctly rejected in the exclusion condition. It was expected, therefore, that the misled-generate encoding manipulation would lead to a stronger suggestibility effect in the inclusion condition than in the exclusion condition and that recollection estimates would be larger for misled-generated items than for misled-read items.

As indicated by the review of the literature in Section 1.3.3, a number of researchers (e.g., Ceci et al., 1987b; Ceci et al., 1998; Holliday et al., 1999; Newcombe & Siegal, 1996; Zaragoza, 1991) have proposed that children's suggestibility in the standard testing procedure is a combination of both memory change and social demand factors such as compliance to authority and pragmatics. It was predicted, therefore, that both recollection and automaticity would contribute to children's suggestible recognition choices on the standard test. In contrast, the modified test is designed to control for the effects of social demand factors and response bias (see Section 1.3.2) and is, therefore, far less likely to produce "intentional" suggestibility. Hence, it was predicted that the relative contribution of

recollective processes to selection of the novel alternative would be reduced on the modified test.

Experiments 1 and 2 reported a developmental decline in the contribution of automatic memory processes to acceptance of misleading suggestions despite the finding that the level of misinformation acceptance obtained in Experiment 2 was age invariant. It was expected, therefore, that there would be a larger automatic component to 5-year-old children's suggestible responses in comparison to that for the 9-year-olds on both the standard and modified tests.

Method

Participants

Eighty-four 5-year-olds ($\underline{M}$ = 5 years, 10 months, $\underline{SD}$ = 4 months; Range: 5 years, 1 month – 6 years, 10 months), including 44 males and 40 females, and seventy-eight 9-year-olds ($\underline{M}$ = 9 years, 1 month, $\underline{SD}$ = 5 months; Range: 8 years 2 months – 10 years, 3 months), including 38 males and 40 females participated in this study. All children attended public primary schools in predominantly middle-class areas of the New South Wales Central Coast, Australia. Children participated only if parental consent had been granted.

Materials

The twelve target items and their alternate versions (one misleading and one novel) used in Experiment 1 were again used in this experiment. (See Appendix F for a list of the target items and their alternatives). As in Experiment 2, three versions of the original story were constructed to control for stimulus difficulty, each shown to one third of the children. There were six post-event narratives for each version of the original story. (See Appendix F for the three original story versions and an example

of a post-event narrative). The post-event narratives consisted of a summary of the original story and contained *four* misled-read and *four* misled-generate items and neutral information about the other *four* picture details (control items). The assignment of items to neutral and misled roles was counterbalanced across participants. For example, a child who saw "kitchen" in the original story (version 1) was misled with "bedroom" in the post-event narrative and chose between "kitchen" and "bedroom" in the standard test condition or "kitchen" and "bathroom" in the modified test condition. A child who saw "bedroom" in the original story (version 2) was misled with "bathroom" in the post-event narrative and chose between "bedroom" and "bathroom" in the standard test condition and "bedroom" and "kitchen" in the modified test condition. A child who saw "bathroom" in the original story (version 3) was misled with "kitchen" in the post-event narrative and chose between "bathroom" and "kitchen" in the standard test condition and "bathroom" and "bedroom" in the modified test condition.

Two forced-choice recognition memory tests were used with test items presented in a randomized order. One was a standard test (e.g., Loftus et al., 1978) with six control and six misled item pictures as alternatives, and the other was a modified test (e.g., McCloskey & Zaragoza, 1985a) with six control and six novel item pictures presented as alternatives.

Procedure

As in the previous experiments children were tested on three separate occasions in a quiet room at their school. On the first day, the first experimenter read the picture story to groups of 10 to 12 children. The next day, a second experimenter read one of

the 18 versions of the post-event narratives presenting the misled-read and misled-generate items in the same manner as Experiments 1 and 2.

Immediately following the post-event narrative the first experimenter returned to administer two recognition memory tests to each child, an inclusion test followed by an exclusion test. The administration of these two tests was not counterbalanced for the reasons previously outlined in Chapter 3. Each recognition trial contained 24 pictures; 12 original (control) from Phase 1, six pictures of items on which misleading suggestions were given at Phase 2 (misled), and six novel items. For the "standard" test, six original (control) targets were paired with four pictures of items on which misleading suggestions were given at Phase 2 (two misled-read and two misled-generate) and two misled alternatives that had not been presented previously. For the "modified" test items, six original (control) targets were paired with four novel alternatives of misled items presented at Phase 2 and two novel alternatives that had not been presented previously. Table 11 shows the allocation of items to the standard and modified test conditions. (See Appendix F for allocation of items for the remaining conditions).

Pairs of pictures were placed directly in front of each child and the left-right positioning was randomized across items. The instructions preceding administration of the inclusion and exclusion test were identical to those in Experiments 1 and 2. In the inclusion condition, children were first asked if they remembered the picture story about Miss Peabody and the summary read to them by the second experimenter. They were then asked to choose the picture they remembered seeing in the original story.

Table 11

Allocation of items to the standard and modified test conditions (Original story version 1

post-event narrative version 1)

Standard Test

Original (e.g., kitchen) vs. control (e.g., bedroom)

Original (e.g., biscuits) vs. control (e.g., cakes)

Original (e.g., eggs) vs. misled-read (e.g., cereal)

Original (e.g., headache) vs. misled-read (e.g., stomachache)

Original (e.g., doll) vs. misled-generate (e.g., ball)

Original (e.g., hands) vs. misled-generate (e.g., feet)

Modified Test

Original (e.g., hat) vs. novel control (e.g., shoes)

Original (e.g., knife) vs. novel control (e.g., spoon)

Original (e.g., dog) vs. novel misled-read (e.g., cat)

Original (e.g., chips) vs. novel misled-read (e.g., lollies)

Original (e.g., green jellybeans) vs. novel-misled-generate (e.g., yellow jellybeans)

Original (e.g., banana) vs. novel misled-generate (e.g., orange)

Before commencing the test the practice clown pictures were shown to ascertain

whether the child understood the instructions to include information from the original

story and the post-event narrative. In the exclusion condition children were informed

that the second experimenter had made some mistakes with the post-event summary

and were instructed to forget about what they had been told by this experimenter and

not to choose a picture corresponding to details the second experimenter had read

them. The remainder of the test instructions followed those in the inclusion condition.

As in the previous studies the test the practice clown pictures were first shown one by

one to ascertain whether the child understood the instructions to disregard the narrative presented by the second experimenter. If a child failed this test the experimenter repeated the instructions and administered the practice pictures again. A child who repeatedly failed this test was eliminated from the experiment.

<div align="center">Results</div>

<u>Standard Test</u>

In both instruction conditions the proportion of correct responses was calculated for control, misled-read, and misled-generate items. A preliminary analysis revealed that the original story and narrative versions did not influence performance on control, misled-read, and misled-generate items. Hence, all subsequent analyses were performed after collapsing across version and narrative types. (See Appendix G for all the statistical analyses for this experiment). The mean number of hints given at the encoding of the misled-generate items was 1.02 for the 5-year-olds and .93 for the 9-year-olds. This difference between age groups was not statistically reliable, $\underline{t}$ (160) = 1.64, $\underline{p}$ > .05.

Table 12 illustrates the mean proportion correct for the two age groups in each experimental condition. A 2 (age) x (2) (test type) x (3) (item type) analysis of variance with repeated measures on the test and item type factors was performed on this data.

Table 12

Standard Test: Mean Proportion Correct Recognition (and standard deviations) as a

Function of Experimental Condition and Age

	Inclusion		Exclusion	
	5-year-olds	9-year-olds	5-year-olds	9-year-olds
Item type				
Control	.71 (.28)	.67 (.36)	.70 (.26)	.69 (.36)
Misled-Read	.58 (.31)	.53 (.36)	.61 (.29)	.62 (.36)
Misled-Generate	.38 (.30)	.36 (.35)	.68 (.32)	.60 (.37)

Standard Test: Mean Proportion Incorrect Recognition (Corrected) (and standard

deviations) for Suggested Items and Control Items

Control	.37 (.17)	.38 (.24)	.36 (.19)	.39 (.24)
Misled-Read	.45 (.21)	.48 (.24)	.43 (.19)	.42 (.24)
Misled-Generate	.58 (.20)	.60 (.23)	.38 (.22)	.44 (.25)

Note. Corrected proportions were computed by applying Snodgrass & Corwin's (1988) correction

method to individual participants' proportion of incorrect responses on the suggested items and control

items.

Following the practice of many previous studies of children's suggestibility (e.g., Ceci et al., 1987b; Newcombe & Siegal, 1997; Zaragoza, 1991) performance on the two types of misled items was compared with control item performance. Hence, two planned contrasts on the item factor were used comparing control items with misled-read items and misled-generate items, respectively. Bonferroni adjustments were used to control a family wise rate at $\alpha = 0.05$ (cf. Hall & Bird, 1986). The significance level for Tukey's post-hoc tests was $\underline{p} < .05$.

A significant main effect for test condition was found across age and item type, $\underline{F}(1, 160) = 39.81$, $\underline{MSE} = 2.95$, $\underline{p} < .01$, with children more likely to choose the original item in the exclusion test condition ($\underline{M} = .65$) than in the inclusion test condition ($\underline{M} = .54$). Across items, recognition accuracy in the inclusion and exclusion conditions was significantly greater than chance.

A significant effect was found for the contrast comparing control and misled-read items, $\underline{F}(1, 160) = 13.54$, $\underline{MSE} = 1.88$, $\underline{p} < .01$. Across test conditions, children were more accurate on control items ($\underline{M} = .69$) as compared to misled-read items ($\underline{M} = .58$). In general, recognition accuracy was also found to be superior on control items ($\underline{M} = .69$) compared to misled-generate items ($\underline{M} = .50$), $\underline{F}(1, 160) = 40.73$, $\underline{MSE} = 5.76$, $\underline{p} < .01$. This contrast, however, interacted significantly with test condition, $\underline{F}(1, 160) = 39.36$, $\underline{MSE} = 2.81$, $\underline{p} < .01$. Figure 3 illustrates this effect. Tukey's post-hoc tests revealed that whereas the difference between accuracy on control and misled-generate items in the inclusion test condition was significant ($\underline{M}_{control} - \underline{M}_{generate} = .32$) this was not the case in the exclusion test condition ($\underline{M}_{control} - \underline{M}_{generate} = .05$). No other main effects or interactions were significant.

Figure 3. Proportion of correct responses as a function of item type and test condition
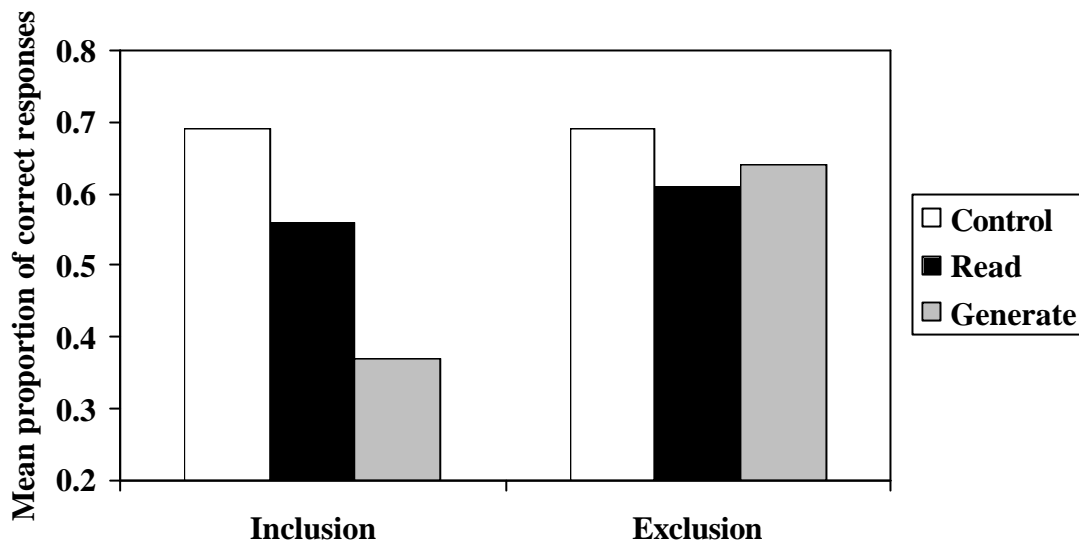
Estimates of recollection and automaticity

The process dissociation equations (3) and (4) (see Section 1.14) were used to calculate separate estimates of the contribution of the processes of recollection and automaticity to responding to misled-read and misled-generate item types. Participants' individual proportions incorrect for misled-read and misled-generate items were first corrected using Snodgrass and Corwin's (1988) procedure to eliminate the problem of total response proportions of one or zero. Table 12 shows the corrected proportions responses to suggested items. Equations (3) and (4) were then applied to the corrected response rates to calculate the probabilities of responding on the bases of recollection and automaticity for each age group. The probabilities of responding on the bases of recollection and automaticity for each age group are presented in Table 13.

A 2 (age) x (2) (item type) analysis of variance with repeated measures on the item type factor was performed on the recollection estimates. There was a significant main effect of item type, $\underline{F}$ (1, 160) = 26.08, $\underline{MSE}$ = 1.54, $\underline{p}$ < .001. Across age, recollection estimates for misled-generate items ($\underline{M}$ = .18) were greater than those for misled-read items ($\underline{M}$ = .04). No other main effects or interactions reached significance.

A 2 (age) x (2) (item type) analysis of variance with repeated measures on the item type factor was also performed on the automaticity estimates. There was a main effect of item type, $\underline{F}$ (1, 160) = 7.01, $\underline{MSE}$ = .21, $\underline{p}$ < .01. Automaticity estimates for misled-generate items ($\underline{M}$ = .49) were greater than those for misled-read items ($\underline{M}$ = .44). No other main effects or interactions were significant.

Table 13

Standard Test: Mean Process Dissociation Estimates (and standard deviations) for Read and Generate Item Types as a Function of Age

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	Recollection		Automaticity	
	5-year-olds	9-year-olds	5-year-olds	9-year-olds
Misled-Read	.02 (.29)	.06 (.22)	.44 (.16)	.45 (.22)
Misled-Generate	.20 (.31)	.16 (.26)	.47 (.18)	.52 (.22)

In order to check the equivalence of false alarm rates across inclusion and exclusion conditions, participants' proportions of incorrect choices of items on which no suggestions were given (i.e., novel alternatives to control targets) were examined.

For example, when Item 1 was a control target, the detail shown in Phase 1 (Version 1) was "kitchen"; neutral information was provided in the post-event narrative at Phase 2, and on the standard test children chose between "kitchen" and "bedroom" (the misled alternative). The item "bedroom" was not presented at any phase other than at test and is, therefore, a "new" item. The mean false alarm rates for these items are given in the top row of Table 12.

A 2 (age) x (2) (test: control inclusion, control exclusion) analysis of variance with repeated measures on the test type factor was performed on this false alarm data. Neither a main effect of age, $\underline{F}$ (1, 160) = .55, $\underline{MSE}$ = .04, $\underline{p}$ > .05, nor a main effect of test condition, $\underline{F}$ (1, 160) = .03, $\underline{MSE}$ = .00, $\underline{p}$ > .05, was found. Five-year-olds were no more likely to choose novel items over original items ($\underline{M}$ = .36) than were the 9-year-olds ($\underline{M}$ = .38), nor did false alarms vary across the two encoding conditions ($\underline{M}_{inclusion}$ = .37; $\underline{M}_{exclusion}$ = .37). The logistic dual-process model for incorporating response bias (cf. Yonelinas & Jacoby, 1996a) used in Experiments 1 and 2 was not, therefore, applied to the data because base rates for choosing a completely novel item were equivalent across task and age conditions.

Modified Test

In both instruction conditions the proportion of correct responses was calculated for control, misled-read, and misled-generate items. A preliminary analysis revealed that the original story and narrative versions did not influence performance on control, misled-read, and misled-generate items. (See Appendix G for all statistical analyses for this experiment). Hence, all subsequent analyses were performed after collapsing across version and narrative types. The mean number of hints given at the encoding of the misled-generate items, across items, was 1.05 for the 5-year-olds and .94 for the

9-year-olds which was not a statistically reliable difference, $\underline{t}$ (160) = 1.95, $\underline{p}$ > .05.

Table 14 illustrates the mean proportion correct for the two age groups in each experimental condition. A 2 (age) x (2) (test type) x (3) (item type) analysis of variance with repeated measures on the test and item type factors was performed on this data. As for the standard condition, two contrasts were planned that compared performance on control items with that on misled-read items and misled-generate items, respectively. Bonferroni adjustments were used to control a family wise rate of α = .05. The significance level for Tukey's post-hoc tests was $\underline{p}$ < .05.

There was a significant main effect for age such that the accuracy of the 9-year-olds on the modified test ($\underline{M}$ = .70) was superior to that of the 5-year-olds ($\underline{M}$ = .64), $\underline{F}$ (1, 160) = 5.49, $\underline{MSE}$ = .86, $\underline{p}$ < .05.

There was no main effect found in the comparison of control and misled-read items, but this contrast did interact significantly with test condition, $\underline{F}$ (1, 160) = 6.00, $\underline{MSE}$ = .29, $\underline{p}$ < .05, and is shown in Figure 4. Tukey's post-hoc tests revealed that whereas the difference between control and misled-read items was significant in the inclusion condition ($\underline{M}_{control} - \underline{M}_{read}$ = .10), this was not the case in the exclusion condition ($\underline{M}_{control} - \underline{M}_{read}$ = .01). A reliable misinformation effect for misled-read encoding, therefore, was only found in the inclusion test condition. This effect did not vary across age groups, $\underline{F}$ (1, 160) = 1.79, $\underline{MSE}$ = .09, $\underline{p}$ > .05.

Table 14

Modified Test: Mean Proportion Correct (and standard deviations) as a Function of

Experimental Condition and Age

	Inclusion		Exclusion	
	-------------------------------------		-------------------------------------	
	5-year-olds	9-year-olds	5-year-olds	9-year-olds
Item type				
Control	.73 (.29)	.72 (.30)	.69 (.35)	.71 (.30)
Misled-Read	.57 (.27)	.68 (.36)	.67 (.28)	.71 (.30)
Misled-Generate	.55 (.29)	.71 (.31)	.61 (.31)	.65 (.32)

Modified Test: Mean Proportion Incorrect Recognition (Corrected) (and standard

deviations) for Suggested Items and Control Items

Control	.35 (.19)	.36 (.20)	.37 (.24)	.36 (.20)
Misled-Read	.45 (.18)	.38 (.24)	.39 (.19)	.36 (.20)
Misled-Generate	.47 (.19)	.36 (.20)	.43 (.21)	.40 (.22)

Note. Corrected proportions were computed by first applying Snodgrass & Corwin's (1988) correction

method to individual participants' proportion of incorrect responses on the suggested items and the

control items.

Figure 4. Proportion of correct responses as a function of read item type and test condition
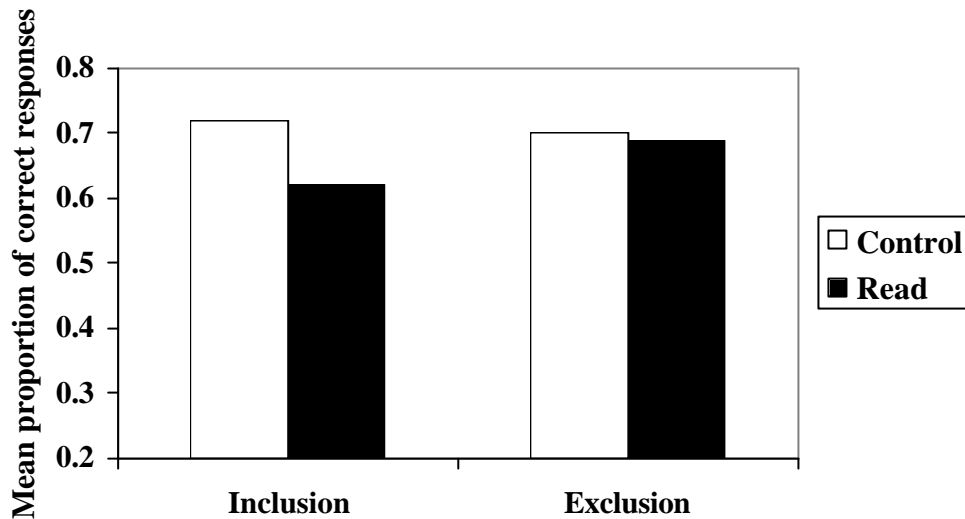
A significant effect was found for the contrast comparing control and misled-generate items, $\underline{F}$ (1, 160) = 7.51, $\underline{MSE}$ = 1.0, $\underline{p}$ < .05. Across test conditions and age, recognition accuracy on control items ($\underline{M}$ = .71) was superior to that on misled-generate items ($\underline{M}$ = .63). The three-way interaction between control and misled-generate item types, test condition and age also reached significance, $\underline{F}$ (1, 160) = 4.06, $\underline{MSE}$ = .18, $\underline{p}$ < .05. Tukey's post-hoc tests confirmed that for the 5-year-olds, the difference between control and misled-generate items was significant in the inclusion condition ($\underline{M}_{control} - \underline{M}_{generate}$ = .18) but not in the exclusion condition ($\underline{M}_{control} - \underline{M}_{generate}$ = .08). In contrast, for the 9-year-olds performance on control and misled-generate items did not differ significantly in the inclusion ($\underline{M}_{control} - \underline{M}_{generate}$ = .01) or in the exclusion condition ($\underline{M}_{control} - \underline{M}_{generate}$ = .06). In other words, only 5-

year-olds in the inclusion condition showed evidence of a reliable misinformation effect for misled-generate items.

Estimates of recollection and automaticity

The process dissociation equations (3) and (4) (see Section 1.14) were used to calculate separate estimates of the contribution of the processes of recollection and automaticity to choosing a novel instead of an original test picture following the presentation of misleading suggestions. Participants' individual proportions of "novel" item choices for misled-read and misled-generate items were first corrected using Snodgrass and Corwin's (1988) procedure to eliminate the problem of total response proportions of one or zero.

Table 14 shows the corrected response proportions for suggested items. Equations (3) and (4) were then applied to the corrected response rates to calculate the probabilities of responding on the bases of recollection and automaticity for each age group. The probabilities of making a novel item choice on the bases of recollection and automaticity for each age group are given in Table 15.

A 2 (age) x (2) (item type) analysis of variance with repeated measures on the item type factor was performed on the recollection estimates. There was a significant main effect of age, $\underline{F}$ (1, 160) = 5.60, $\underline{MSE}$ = .29, $\underline{p}$ < .05. Across item type, recollection estimates for 5-year-olds ($\underline{M}$ = .05) were greater than for 9-year-olds ($\underline{M}$ = - .01). This result must be interpreted cautiously, however, as the 9-year-olds were suggestible only in the misled-read condition. No other main effects or interactions reached significance.

Table 15

Modified Test: Mean Process Dissociation Estimates (and standard deviations) for

"Novel Item" Choices on Misled Items as a Function of Age

	Recollection		Automaticity	
	5-year-olds	9-year-olds	5-year-olds	9-year-olds
Misled-Read	.06 (.23)	.02 (.21)	.41 (.16)	.38 (.20)
Misled-Generate	.04 (.22)	- .04* (.23)	.44 (.18)	.38* (.18)

Note. Estimates marked with an asterisk * were calculated in conditions in which no suggestibility

as measured by differences in control and misled item responding was apparent.

A 2 (age) x (2) (item type) analysis of variance with repeated measures on the item

type factor was also performed on the automaticity estimates. There was a main

effect for age, $\underline{F}$ (1, 160) = 4.94, $\underline{MSE}$ = .17, $\underline{p}$ <. 05. Across item type, automaticity

estimates for 5-year-olds ($\underline{M}$ = .42) were greater than those of 9-year-olds ($\underline{M}$ = .38).

In order to check the process dissociation assumption of equivalence of false alarm

rates across inclusion and exclusion conditions, we examined participants'

proportions of incorrect choice of novel test picture on items on which no suggestions

were given. For example, when Item 1 was a control item, the detail shown in Phase

1 (Version 1) was "kitchen"; neutral information was provided in the post-event

narrative at Phase 2; and on the modified test children chose between "kitchen" and

"bathroom" (the misled alternative). The item "bathroom" was not presented at any

phase other than at test and was, therefore, a "new" item. The mean proportions of

such false alarms are illustrated in Table 14. A 2 (age) x (2) (test: control inclusion, control exclusion) analysis of variance with repeated measures on the test type factor was performed on this data. Neither a main effect of age, F (1, 160) = .01, MSE = .00, p > .05, nor a main effect of test condition, F (1, 160) = 1.11, MSE = .02, p > .05, was found. Five-year-olds were no more likely to false alarm when no misleading suggestions were given (M = .36) than were the 9-year-olds (M = .36), nor did false alarms vary across the two encoding conditions ($M_{inclusion}$ = .35; $M_{exclusion}$ = .37). The logistic dual-process model for incorporating response biases (cf. Yonelinas & Jacoby, 1996a) was not, therefore, applied to this data set.

Discussion

In this study 5- and 9-year-old children given a standard recognition test were found to be suggestible in that they were less likely to select the correct original detail on items for which they had received misleading suggestions than on control items. These findings extend the results obtained on a yes / no procedure in the first two experiments to a forced choice recognition paradigm. Further, unlike Experiments 1 and 2, the index of suggestibility was very similar to that used in a large proportion of the published studies of misinformation effects in children (Ceci & Bruck, 1993). The results obtained using the "standard" test are also consistent with a number of prior studies that have demonstrated suggestibility in young children using similar forced-choice tests (Ceci et al., 1987b; Holliday et al., 1999; Newcombe & Siegal, 1996; Siegal & Peterson, 1995; Zaragoza, 1987, 1991; Zaragoza et al., 1992).

Moreover, as in many previous studies using children of the same ages as those tested here (e.g., Ceci et al., 1987b; Holliday et al., 1999; Pezdek & Roe, 1995),

the suggestibility effect obtained on the standard test was age invariant. Ceci et al. (1987b), for example, reported that there was no evidence of developmental differences in suggestibility when children aged 5 to 10 years were given misleading suggestions about a picture story. Table 16 summarises the suggestibility findings on both the standard and modified tests.

Table 16

Summary of suggestibility effects by misled item type, test condition, and age

	Misled-read		Misled-generate	
	Inclusion	Exclusion	Inclusion	Exclusion
Standard Test				
5-year-olds	Yes	Yes	Yes	No
9-year-olds	Yes	Yes	Yes	No
Modified Test				
5-year-olds	Yes	No	Yes	No
9-year-olds	Yes	No	No	No

The inclusion test condition used here resembles in many ways the testing procedure frequently employed in previous tests of children's suggestibility (e.g., Ceci et al., 1987b; Holliday et al., 1999). In this test, children are required to make a forced choice between the original event information presented in Phase 1 *or* the post-event suggestions presented in Phase 2. In this study, children in the inclusion condition performed more poorly on the standard test for items on which misleading suggestions had been given than for control items. Moreover, children in this condition were just as likely to select the misled alternative at test when it was read

aloud to them as when it was "self-generated" in response to semantic and linguistic hints.

In the inclusion condition of the modified test, children's test performance in terms of accurate selection of the original story detail was still influenced by misinformation that was read aloud to them in Phase 2. That is, both 5- and 9-year-old children were adversely influenced by suggestions that were read to them under inclusion testing instructions. When misleading suggestions were self-generated, however, an age-related change in suggestibility was found, such that only 5-year-old children were adversely affected by exposure to the misleading information. In other words, for the 5-year-olds, misinformation effects were found for both types of encoding of misleading information whereas for the 9-year-olds, a misinformation effect was found only for the misled-read items.

The exclusion instruction condition is one that requires children to make recognition judgements on the basis of the original event information presented in Phase 1. That is, in this condition children are asked not to respond on the basis the misinformation given in Phase 2. In the exclusion condition of the standard test, suggestibility levels were differentially affected by the mode of encoding of the misleading suggestions. On this test, children successfully excluded misled details that were self-generated but not those which were simply read aloud to them. Under exclusion conditions in the modified test, however, all misinformation effects were eliminated. That is, it has again been shown that generating a misled detail can either increase or decrease the size of the misinformation effect depending on the instructions children are given at retrieval. In broad terms then, these results reinforce the conclusions of the previous two experiments that generating a misleading item

involves more elaborative and conceptual processing of the material than simply listening to material read aloud (cf. Begg et al., 1989).

This interpretation is further supported by the process dissociation estimates for the standard test which showed that intentional processing made a stronger contribution to suggestible responses following generate-encoding than following read-encoding. The consequence of this more intentional, elaborative encoding of suggestions was to increase children's selection of the misleading alternative on the standard test when test instructions resembled those in most previous developmental investigations of suggestibility (i.e., the inclusion instruction condition). In contrast, when exclusion instructions that promoted intentional monitoring of test items were given children showed an increased ability to reject the misleading alternative.

These findings are also consistent with retrieval interference models of suggestibility which posit the co-existence of both the original and the post-event traces in storage (e.g., Bekerian & Bowers, 1983; Chandler & Gargano, 1998; Christiaansen & Ochalek, 1983; Morton et al., 1985). These models propose that the more recently presented misinformation suppresses or "blocks" the original event information. The "generate" encoding of misinformation in the current study potentiated this "blocking" effect; the misled-generate items were more distinctive in memory thereby increasing the likelihood that they would be selected in the inclusion test condition, but more readily excluded when instructed to do so. Moreover, the evidence of the co-existence of original and post-event traces, together with the fact that children can exclude self-generated suggestions, indicates that memory traces are not permanently altered or updated by the introduction of misleading suggestions (cf. Loftus, 1979, 1997; Loftus et al., 1978).

Additional evidence in support of the co-existence of original and post-event misinformation traces was found in the modified testing paradigm. On this test it was found that 5- and 9-year-old children's suggestibility levels varied according to the "read" encoding of misleading suggestions and test instructions. In the inclusion condition, children were more likely to select a novel alternative to a misled item that was read aloud to them than the correct original item presented at Phase 1. In the exclusion condition, however, performance on suggested items was equivalent across control items when children were instructed to exclude misleading suggestions that were "read" to them.

Misleading details that were "self-generated" adversely affected the test performance of 5-year-olds in the modified test under inclusion instructions. When told to exclude Phase 2 suggestions, however, the negative effects of such suggestions on modified test performance were eliminated. These findings run in parallel to those obtained on the standard test in that, for the younger age group, exclusion instructions produced a more marked improvement in recognition performance following self-generated suggestions. Hence, again it has been found that under exclusion instructions the magnitude of the misinformation effect is reduced when misleading details are generated. Moreover, these findings on the modified test extend those obtained on the standard test to situations where a novel alternative to the misleading item is presented as a test choice.

As has been found in previous studies that have employed both kinds of recognition test procedures (e.g., Ceci et al., 1987b; Holliday et al., 1999; Toglia et al., 1992), there was an improvement in recognition accuracy on misled items in the

modified condition relative to the standard condition (64% vs. 54% correct, $\underline{p} < .01$).

The fact that the size of the misinformation effect is reduced when children who have

been misled are asked to choose between a control and a novel picture indicates that

responses on the standard test may indeed be influenced by factors such as response

bias or social demands on children to comply with the perceived wishes or intent of

the experimenter (cf. Cassel et al., 1996; Newcombe & Siegal, 1996; Zaragoza, 1987,

1991). Nevertheless, the 9-year-olds tested in this experiment could be expected to

have had considerable experience in the correct use of language in social contexts

(Siegal, 1991). Hence, a robust misinformation effect found for this age group on

both the standard and modified tests undermines the view that misinformation effects

arise purely through lack of pragmatic competence (e.g., Newcombe & Siegal, 1996,

1997; Siegal & Peterson, 1995). The fact that a reliable suggestibility effect was still

obtained on the modified test, however, also indicates that this effect does reflect

changes in the accessibility of the memory trace at test through interference between

the original and post-event traces at retrieval (Bekerian & Bowers, 1983; Chandler &

Gargano, 1998; Christiaansen & Ochalek, 1983; McCloskey & Zaragoza, 1985a).

Hence, again it was found that misinformation effects in children reflect a

combination of social demand and memory-based factors (cf. Ceci & Bruck, 1993,

1995).

The current findings on the modified test in the inclusion test condition stand in

contrast to those reported by Zaragoza (1987, 1991; Zaragoza et al., 1992) who found

that 3- to 6-year-old children given the modified test showed no evidence of memory

impairment. This discrepancy may be due to differences in the number of details used

as target items. In the Zaragoza studies (1987, 1991; Zaragoza et al., 1992) children

were tested on only four of the original event items, the two items on which children

had been misled and two control items. In contrast, children in the present study were

tested on six control items and six items on which they had received misleading

suggestions. The design of the current study, thereby, maximised the chance of

detecting misinformation effects because of an increased potential for memory

distortions.

As in the previous experiments, the process dissociation equations adapted from

Jacoby (1991) and Lindsay et al. (1995) were applied to children's suggestible

responses on the standard and the modified tests. It should be noted, however, that in

this context the process estimates for the standard and modified tests measure

different things. For the standard test, estimates of automaticity and recollection

represent the probabilities of choosing a *suggested picture* based on automatic versus

recollective influences. The logic of these estimates, therefore, is roughly analogous

to saying "yes" to the misled picture in Experiments 1 and 2. For the modified test,

however, estimates of automaticity and recollection represent the probabilities of

choosing a *novel alternative picture* to a misleading suggestion. In the modified

testing procedure of this study, the analysis of raw recognition data failed to show any

evidence of a misinformation effect for 9-year-olds in the misled-generate condition

(see Table 14). Hence, the estimates obtained in this condition were not considered in

the discussion of the results.

It was again found that automaticity made a stronger contribution to children's

suggestible responses than recollection in the standard testing procedure. Further, as

expected from the results of Experiments 1 and 2, recollection estimates were larger

for misled-generate items than for misled-read items on the standard recognition test.

In the modified testing procedure, process dissociation estimates were calculated on the bases of the selection of a novel picture following the presentation of misleading suggestions. On this test both recollection and automatic processes contributed to the reporting of novel items on which suggestions had been given. Moreover, as predicted, the contribution of recollective processes was lower on the modified test relative to the standard test.

Implications for causal models of suggestibility

According to the social demands hypothesis children intentionally report misinformation due to compliance to adult authority figures and pragmatic concerns (e.g., Cassel et al., 1996; Newcombe & Siegal, 1997; Zaragoza, 1991) and not as a result of memory-based changes to the original event memories (e.g., Loftus et al., 1985). The response bias account (e.g., McCloskey & Zaragoza, 1985a) proposes that misled participants are biased, relative to participants in the control group, towards selecting the more recently presented misled item at testing. Both these accounts predict that the misinformation effect has a large recollective or intentional memory component in that children are seen to make a deliberate selection to report the suggested item based on the test situation and / or the pragmatic cues present at the time of testing. The current findings of a large automatic component to suggestibility are inconsistent with these models. In this study, in terms of absolute magnitude, the relative contribution of intentional processing to suggestibility was rather small in comparison to the contribution of automatic processes.

Nevertheless, the contribution of intentional processing to suggestibility was found to increase under "generate" conditions that promoted elaborative encoding of suggestions. Hence, the role of "intentional" suggestibility that may be due to social

and / or pragmatic influences seems to be dependent on the specific conditions that hold when suggestions are encoded and retrieved. The fact that only the 5-year-old children evidenced suggestibility on the modified test following the generation of misleading items, and that this effect was most strongly influenced by automatic memory processes, clearly demonstrates that the social demands of the experimental context and response biases are not the only mechanisms contributing to misinformation effects in these children. In a procedure designed to minimize social demand and response biases, the 5-year-olds but not the 9-year-olds, were still adversely and largely unconsciously affected by misleading suggestions. The finding that the 5-year-old children were more likely to choose a novel alternative picture to a misled-generated suggestion than an original item, and that this process proceeds almost entirely automatically, seems most consistent with retrieval-based models of the misinformation effect.

The source-monitoring hypothesis holds that children mistakenly ascribe the source of their memories to the misleading information instead of to the original event information by a process of familiarity (Johnson et al., 1993). Although the present experiment was not specifically designed as a test of this hypothesis it did incorporate exclusion test instructions that discredited the source of the misinformation. The fact that children could intentionally exclude such details undermines an explanation of misinformation couched entirely in terms of source-monitoring errors (cf. Johnson et al., 1993). That is, the fact that children could successfully exclude misleading suggestions when given the appropriate instructions indicates that they were aware of the respective sources of original and post-event information. Hence, it seems unlikely that when children did accept suggestions (e.g., in the inclusion condition)

that this arose because of source confusions. The present findings do, however, correspond with a modified source-monitoring account of the misinformation effect that allows for the role of *both* recollective and automatic processes (e.g., Lindsay, 1994; see Table 2, Section 1.11).

Storage-based models such as trace-alteration (e.g., Loftus, 1979; Loftus et al., 1978) and retrieval interference models such as Headed Records (e.g., Morton, 1991; Morton et al., 1985) imply that the misinformation effect is due to intentional or automatic memory processes. In the latter model, response competition between the original and the misinformation traces at the point of retrieval proceeds automatically. The finding of a large automatic component in children's suggestibility accords with both these models. Nevertheless, the finding of an intentional recollective component to suggestions that were self-generated is inconsistent with both these accounts. Hence, neither a trace-alteration nor a response competition view adequately accounts for the data in all of the current experimental conditions.

Trace-strength models such as fuzzy-trace (e.g., Brainerd & Reyna, 1998; Brainerd et al, 1998) propose that post-event misinformation can be reported on the basis of either conscious recollection (e.g., verbatim traces of post-suggestions) or unconscious automatic memory processes (e.g., gist) and that manipulations that increase the ability to preserve verbatim details in storage will also increase the recollection component (Brainerd & Reyna, 1998). The current findings are consistent with this account in that both recollection and automatic processes contributed to children's suggestible responding on both the standard and modified tests. Moreover, it was found that the contribution of recollection to suggestibility was greater when the misinformation was generated in response to semantic and

linguistic cues. The present findings indicate that the self-generation of misinformation produces strong verbatim traces that are resistant to decay (cf. Brainerd & Reyna, 1998).

Based on the findings of the previous experiments it was expected that there would be a developmental decline in the contribution of automaticity to children's suggestible responses. Contrary to expectations, however, there was no evidence of such a decline in the standard testing procedure. An age-related decrease in automaticity-based suggestibility was found on the modified test although this age comparison is compromised by the lack of a suggestibility effect for the 9-year-old children in the misled-generate condition. Developmental comparisons, therefore, can only be made for the misled-read items. For these items, there was a weak trend such that the contribution of automaticity to suggestibility for the 5-year-olds ($\underline{M}$ = .41) was slightly larger than that for the 9-year-olds ($\underline{M}$ = .38).

This discrepancy between this finding and the results obtained in Experiments 1 and 2 may be explained on the basis that the forced choice procedure is likely to be more conservative with regard to automaticity-based estimates relative to the "yes" / "no" procedure. An examination of "exclusion" errors on the yes / no test in Experiment 2 (i.e., "yes" responses to misled-read and misled-generate items, see Table 6) and on the standard test in the present experiment (i.e., incorrect selection of misled-read and misled-generate items, see Table 12), reveals that the higher the rate of exclusion errors, the higher the estimate of automaticity. In Experiment 2, the mean exclusion error was .48 for the 5-year-olds and .45 for the 8-year-olds, with automaticity estimates of .53 and .46 for 5- and 8-year-olds, respectively. In the current experiment, the mean exclusion error was .41 for the 5-year-olds and .43 for

the 9-year-olds, with automaticity estimates of .46 and .45 for 5- and 9-year-olds, respectively. In other words, in the current study there was little evidence of age changes in exclusion errors and hence, little evidence of age changes in automaticity. In contrast, exclusion errors for the 5-year-olds in Experiment 2 were higher than in the current study. That is, the 5-year-old children made fewer exclusion errors (i.e., incorrectly accepted the misled items under exclusion instructions) in a forced choice task than in a yes / no procedure. Such findings may be explained on the basis that in the forced-choice procedure children are prompted to consciously or intentionally compare the two alternative memory traces (i.e., the original and misled items). This would have the effect of reducing acceptance of misleading information based on a criterion of familiarity relative to a yes / no procedure. Moreover, by providing two test alternatives, the standard test reminds children that one item *is* incorrect and hence is consistent with test instructions to "exclude" post-event. The yes / no procedure, in contrast, provides no such prompts for exclusion and therefore is more likely to lead to erroneous acceptance of the responding on the basis of familiarity or guessing.

On the standard test, estimates of automaticity varied according to the way that the misleading suggestions were encoded. Unexpectedly, automaticity estimates for generated suggestions were larger than for suggestions that were read. These results stand in contrast to those obtained in both Experiments 1 and 2 when children were administered a yes / no recognition test. This parallel increase in automaticity and recollection as a result of the misled-generate encoding manipulation could be seen as evidence of a violation of the independence assumption of process dissociation (e.g.,

Curran & Hintzman, 1995). However, this seems unlikely given that other aspects of this assumption (e.g., equivalent false alarm rates across groups being compared) were met.

Alternately, it may be that generate encoding can affect both the elaborative processing of a suggested item and automatic strengthening of the trace to some degree. This line of reasoning accords with fuzzy-trace theory (e.g., Brainerd & Reyna, 1998) which proposes that item details are encoded in two parallel forms, a verbatim trace of the surface form and a gist trace of the semantic form. Moreover, fuzzy-trace theory proposes that suggestible responses can be made on the basis of recollection of the surface form of presented items (i.e., verbatim) or on the basis of automatic memory of the semantic form of presented items (i.e., gist). It could be that the degree of automatic strengthening of the misled-generate trace is small enough so that it exerts no measurable effect on performance when children simply have to look at control and misled items *separately* and make a recognition decision. When they have to choose *between them*, however, the small increment in automaticity caused by the generate instructions is enough to favour the misled trace and so contribute to suggestibility on the standard test.

In summary, in the standard testing paradigm it was found that, in support of Experiments 1 and 2, both intentional recollection and automatic memory processes contributed to suggestibility effects in children aged 5 and 9 years. Moreover, on the standard test recollection estimates were larger for misled items that were self-generated, an effect that was eliminated when children were given a modified test. Suggestibility effects on the standard test were for the most part attributable to

automatic memory processes. Both the raw data and the pattern of recollective processes support the notion that suggestibility on the standard test (like that on the yes / no tests in Experiments 1 and 2) is influenced by both intentional recollection and automatic processes (cf. Ceci et al., 1998), but with automaticity making the greatest contribution.

This experiment found that the suggestibility effect on the standard test was reduced when children were given a modified test indicating that suggestibility in the standard testing paradigm is also influenced by social demand and response bias factors (cf. McCloskey & Zaragoza, 1985a; Newcombe & Siegal, 1996; Zaragoza, 1991).

The fact that a reliable suggestibility effect was still obtained on the modified test, and that such effects in the younger children were most strongly influenced by automatic processes, however, also indicates that the misinformation effect reflects memory-based changes. The powerful effects of the retrieval instructions (inclusion vs. exclusion) found in the current study are inconsistent with the view that post-event misinformation alters or overwrites the original memory trace (e.g., Loftus, 1979; Loftus et al; 1978). The fourth experiment was designed to more carefully examine the respective roles of social demand / response bias factors and memory interference using a variant of the yes / no paradigm developed in Experiments 1 and 2.

Chapter 5

Intentional recollection and automaticity in acceptance of misinformation: The yes / no retrieval test

5.1 Introduction to Experiment 4

The findings from the first three experiments demonstrate that suggestibility effects in children are for the most part driven by automatic processes, whereas the contribution of intentional processes to suggestibility is dependent upon the particular conditions under which suggestions are encoded and retrieved. In general, these results have been shown under both yes / no and forced choice recognition paradigms. Experiments 1 to 3 have suggested trends that may be seen as more or less consistent with certain existing causal models of children's suggestibility. However, the designs of the studies and data do not allow definite conclusions to be drawn regarding the particular roles of memory interference (e.g., trace alteration, trace competition, source misattribution) and social demand factors (e.g., compliance, pragmatics). The current study, therefore, aimed to examine the relative contribution of recollection and automaticity to children's acceptance of misinformation using an adaptation of Belli's (1989) yes / no recognition paradigm that permits a more careful comparison of memory-based and social demand / response biases hypotheses.

5.1.1 Limitations of the Modified Testing paradigm

McCloskey and Zaragoza (1985a) developed the modified testing procedure as a control on the effects of social demand and response biases which they argued were

inherent in the standard testing paradigm (cf. Loftus et al., 1985). In this paradigm the misleading information is never presented as a test choice but is replaced by a previously unseen "novel" alternative. However, there has been considerable debate concerning the ability of the modified test to measure all types of changes to memory in suggestibility (e.g., Belli, 1989; Belli & Loftus, 1996; Loftus, 1991; Loftus et al., 1985; Tversky & Tuchin, 1989; Zaragoza & McCloskey, 1989). In particular, criticism has been directed at the absence of the misled item at test. Loftus et al. (1985), for example, proposed that when presented with a control and a novel item, 50% of the participants could choose the correct response by guessing. They provided support for their argument using a recognition memory test in the format of a betting-form. When choosing a test item adult subjects were required to divide one hundred probability points among four alternatives according to their confidence levels regarding each alternative's inclusion in the original event in either the "standard" Loftus et al. (1978) paradigm or McCloskey and Zaragoza's (1985a) "modified" paradigm. Loftus et al. (1985) found a small but significant misinformation effect on the modified test such that participants assigned fewer probability points to the original test item when they had received misleading information for such items.

A related critique of the modified testing paradigm has been offered by Tversky and Tuchin (1989) who argue that participants can be accurate on this test by either correctly rejecting the novel item or by correctly accepting the original (control) item. Hence, memory impairment in the form of partial degradation of the original memory trace (Belli & Loftus, 1996) would go undetected because participants could respond

correctly on the basis of the partial memory trace. Tversky and Tuchin (1989) developed a yes / no recognition testing procedure in which participants were required to respond to all three information types, that is, control (original), misled, and novel items. Evidence of a memory-based misinformation effect was found such that misled participants performed more poorly and were twice as likely to respond "yes" to more than one of the three test alternatives than those in a control group who were not misled. Tversky and Tuchin (1989) argued that this latter finding was consistent with the co-existence of the original and misleading information traces in memory (cf. Christiaansen & Ochalek, 1983).

Hence, Belli (1989) concluded that findings obtained on the modified test could not be used to rule out the existence of changes to memory in suggestibility because this testing paradigm is insensitive to detecting memory-based suggestibility (e.g., memory impairment, trace competition at retrieval, and source misattribution). Moreover, Belli proposed that null effects on the modified test do not provide conclusive evidence that misinformation effects obtained in the standard testing paradigm are only due to the influence of social demand factors (e.g., compliance to adult authority figures and pragmatics) and response biases.

5.1.2 The modified forced-choice recognition test and the yes / no retrieval test

In response to the limitations of the modified recognition test, Belli (1989) developed a yes / no retrieval test that measured both memory-based suggestibility and the influence of social demand factors and response biases. Belli employed this yes / no test under two types of post-event conditions (see Table 17). In the "event" condition, the item presented at test is the same original item that was presented at Phase 1. In contrast, in the "novel" condition, the test item is a novel alternative to

the original item shown in Phase 1. At test, participants are asked to respond "yes" if

they remember the test item and "no" if they do not. Critically, the misleading post-

event detail is not presented at all during the recognition test.

Table 17

Summary of Experiment 4's test procedures (cf. Belli, 1989)

Post-event condition	Phase 1: Original	Phase 2: Post-event	Test item
Event information			
Control	(e.g., kitchen)	---------	(e.g., kitchen)
Misled	(e.g., kitchen)	(e.g., bedroom)	(e.g., kitchen)
Novel information			
Control	(e.g., kitchen)	-------	(e.g., bathroom)
Misled	(e.g., kitchen)	(e.g., bedroom)	(e.g., bathroom)

According to Belli (1989), test performance in the event item condition permits an

evaluation of memory-based suggestibility. If misled participants respond on the

basis of memory-based changes to the original event trace, they will be likely to reject

the original item (i.e., "no" response to "kitchen") whereas control participants will

accept the original item (i.e., "yes" response to "kitchen"). In other words, if the

misinformation has interfered with the original memory but the misinformation is

remembered, the original item shown at test will be viewed as incorrect and, hence,

rejected.

The novel condition permits an evaluation of both memory-based and social

demand / response bias hypotheses. This condition examines the responding of

control and misled participants to a novel alternative item. If misled participants

respond on the basis of some change in the processing of original event memory, they will accept the novel alternative to the original item (i.e., give a "yes" response to "bathroom") *more often* than control participants will accept the same novel item because the misinformation has interfered with the original memory trace. Memory-based suggestibility in the novel condition, therefore, will be evident if the proportion of correct responses in the control condition is higher in comparison to the misled condition.

In contrast, if misled participants are responding on the basis of social demand factors (i.e., because they remember the misleading suggestion *and* the original item but wish to comply with the perceived wishes of the experimenter, they will also accept the novel alternative to the original item (i.e., give a "yes" response to "bathroom") *less often* than participants in the control item condition. If, on the other hand, children's recognition responses are being driven by the kinds of response biases described by Zaragoza and McCloskey (1989) (i.e., because they remember the more recently presented misleading suggestion but not the original item), then the probability of accepting the novel item in the misled condition should be at chance. That is, children in the misled condition will be *less likely* to say "yes" to the novel item than those in the control condition.

Belli (1989) also proposed a correction technique for the potential effects of demand / response bias based suggestibility. He argued that misleading information is likely to differentially affect responding in the event and novel information conditions such that "yes" responses increase in the event condition and decrease in the novel condition. Critically, the magnitude of these complementary effects was expected to be approximately equal. Hence, collapsing across event and novel item

conditions should adjust for the effects of demand / response bias based suggestibility in the event information condition because the decreased performance in the event condition will be compensated by the increase in performance in the novel condition (Zaragoza & McCloskey, 1989). If, however, acceptance of misled items is lower than for control items collapsed *across event and novel conditions* this would accord with the view that post-event misinformation interferes with memory for original event items by altering, overwriting, degrading, or blocking access to original memory traces (cf. Loftus et al., 1985), or by causing source confusions (cf. Johnson et al., 1993).

Belli (1989) presented college students with a series of slides followed by a narrative that contained misleading suggestions and a final yes / no sentence recognition test. Evidence was found of memory-based suggestibility across both event and novel conditions, such that recognition accuracy was higher for control items than for items where a misleading suggestion was provided. These findings were seen as consistent with a trace alteration or trace blending account of the misinformation effect (cf. Loftus et al., 1985) as well as with source-monitoring views (cf. Lindsay & Johnson, 1989a). Demand-based suggestibility was also found in the novel condition such that recognition accuracy was higher for misled items than for control items. Belli argued that this finding provided empirical support for the view that responding in a misinformation paradigm is also influenced by demand factors and response biases (cf. McCloskey & Zaragoza, 1985a). Belli (1989) concluded that *both* memory-based factors and social demand factors were implicated in the obtained misinformation effects, and in the effects demonstrated by past researchers (e.g., Loftus et al., 1985; McCloskey & Zaragoza, 1985a).

5.1.3 Aims and predictions

This experiment employed an adaptation of Belli's (1989) yes / no recognition design with the aims of comparing memory-based and social demand / response biases hypotheses, and to examine the contribution of recollection and automaticity to children's acceptance of "event" and "novel" information for which they had received misleading suggestions. Such a design was chosen for several reasons. First, the findings in Experiment 3 and in past research (e.g., Ceci et al., 1987b; Holliday et al.,1999) that misinformation effects in the standard test paradigm are reduced but not eliminated when children are given a modified test, suggest that both changes to memory, as well as social demand factors are implicated in the misinformation effect obtained in the standard testing paradigm. In order to integrate this result with those of the earlier experiments which used the yes / no test, the memory-based and social demand hypotheses need to be examined more directly in a study employing the yes / no paradigm. Second, the yes / no retrieval test offers an opportunity to refine our understanding of memory-based versus social demand hypotheses by addressing the criticisms made by Belli (1989) and others (e.g., Loftus et al., 1985; Tversky & Tuchin, 1989) that the modified test is insensitive to detecting some forms of memory-based suggestibility (e.g., preferential access to the misinformation and source misattribution). Finally, the yes / no retrieval design, in conjunction with the inclusion and exclusion instruction conditions of the process dissociation procedure, has the additional advantage of providing an evaluation of retrieval interference models that propose that the misinformation acceptance is due to competition between the original and post-event traces at the point of retrieval (e.g.,

Chandler & Gargano, 1998; Christiaansen & Ochalek, 1983; Morton et al., 1985). If it is found that children in a misled condition are *more* likely to correctly accept event items and *less* likely to incorrectly accept novel items when instructed to exclude the misinformation presented at Phase 2, this will provide evidence that both original and post-event misinformation traces co-exist at retrieval.

Following the findings of Experiments 1, 2, and 3, and Belli's (1989) findings, it was expected that post-event misinformation would interfere with memory for the original items by altering or preventing access to the original memory trace (cf. Chander & Gargano, 1998; Loftus et al., 1985; Morton et al., 1985), or by causing source confusions (cf. Johnson et al., 1993), such that "yes" responses to test items would be higher in the control condition than in the misled condition *across event and novel information conditions*. Similar predictions were made for children in the event and the novel conditions. If acceptance of misinformation is memory-based, it was expected that children would respond "yes" to event and novel information more often in a control condition than in a misled condition. On the other hand, if children accept misinformation due to social demand factors and response biases (cf. McCloskey & Zaragoza, 1985a; Zaragoza, 1991) it was expected that the proportion of "yes" responses to novel items on which children had been given misleading information would be higher in the misled condition than in the control condition.

Belli's (1989) yes / no retrieval test has not been used previously in the context of child suggestibility research. This design does, nevertheless, provide a more stringent test of the relative influences of demand factors and responses biases as opposed to memory-based changes on misinformation acceptance in children than either the standard or the modified testing procedures. Following the findings from

Experiments 1 and 2 that also employed a yes / no recognition test, and the findings of

Experiment 3 that used a standard and a modified test, as well as past research using

yes / no recognition tests with children of similar ages (e.g., Pezdek & Roe, 1995), it

was anticipated that only small developmental differences in misinformation

acceptance would be found in both the event and novel conditions.

It was also expected, following the findings of Experiments 1 and 2, that

acceptance of event and novel items in the misled condition would vary according to

the read / generate encoding of suggestions and test instructions such that children

would be more likely to accept event and novel items on which misleading

suggestions were generated in response to semantic and linguistic hints in the

inclusion condition, and would be more likely to *exclude* novel alternatives to such

items in the exclusion condition. For the event items, it was expected that children

would be more likely to *accept* the original item following instructions to exclude the

misleading suggestions given in Phase 2. Moreover, in accordance with Experiments

1, 2, and 3 it was expected that this encoding manipulation would lead to larger

recollection estimates than for suggestions simply read aloud (cf. Jacoby, 1991; Toth

et al., 1994).

Following the findings from the previous experiments, it was expected that both

intentional recollection and automatic processes would contribute to misinformation

acceptance in 5- and 8-year-old children in the event information condition. The

novel condition permits an evaluation of misinformation acceptance due to memory-

based changes to the original event memory and social demand factors. It was

expected, therefore, if memory-based misinformation acceptance was found in this

condition that estimates of both recollection and automatic processes would contribute

to this effect.

On the other hand, if children accept misinformation due to social demand and / or pragmatic factors (cf. Cassel et al., 1996; Newcombe & Siegal, 1997; Zaragoza, 1991), it was expected that evidence of an intentional / recollective contribution to the misinformation effect would be found. Experiments 1 and 2 found an age-related decrease in estimates of automaticity on a yes / no recognition testing paradigm. It was anticipated, therefore, that misinformation acceptance for the younger children would be more often based on automatic processes.

Following the procedure of the previous experiments, the inclusion and exclusion test instructions were again used to enable derivation of process dissociation estimates. In the inclusion condition children were reminded of the presentations of *both* the original story and the post-event summary. In the exclusion condition, children were asked *not* to select a picture depicting misleading suggestions presented in the post-event summary.

<div align="center">Method</div>

<u>Participants</u>

Ninety-eight 5-year-olds ($\underline{M}$ = 5 years, 7 months, $\underline{SD}$ = 4 months, Range: 4 years, 8 months - 6 years, 10 months), including 47 males and 51 females, and ninety-four 8-year-olds ($\underline{M}$ = 8 years, 8 months, $\underline{SD}$ = 4 months, Range: 7 years, 8 months - 9 years, 10 months), including 48 males and 46 females participated in this study. All children attended public primary schools in predominantly middle-class areas of the New South Wales Central Coast, Australia. Children participated only if parental consent had been granted.

Materials

 This experiment used the same materials as those in Experiment 3. The 12 target items and their alternate versions used in Experiments 1 and 3 were again used in this study. As in previous experiments, three versions of the original story were constructed to control for possible differences in the difficulty of specific stimuli with each shown to one third of the children. For example, for Item 6 one third of the children saw "feet" in the original story, one third saw "hands", and one third saw "legs". For counterbalancing purposes, six post-event narratives were used in order to control for stimulus effects. The post-event narratives consisted of a summary of the original story and contained two misled-read *event* and two misled-read *novel* items, two misled-generate *event* and two misled-generate *novel* items, and neutral information about the other four picture details (two control *event* and two control *novel* items). The assignment of items to neutral and misled roles was counterbalanced across participants as in Experiments 2 and 3. Again, two practice pictures, one shown before the original story and the other prior to the post-event narrative, were used to assess understanding of test instructions. For the recognition test phase, three versions of each of the 12 target items that varied only concerning the targeted detail were constructed. Table 18 shows an example of the allocation of target items given at test in the event and novel conditions for the original story version 1 post-event narrative version 1. (See Appendix H for the original story versions and an example of a post-event narrative).

Table 18

Yes / No recognition test: Allocation of target items in the event and novel

information conditions (e.g., original story version 1 post-event narrative version 1)

Event information	Novel information
Control-event (e.g., kitchen)	Control-novel (e.g., shoes)
Control-event (e.g., biscuits)	Control-novel (e.g., spoon)
Read-event (e.g., eggs)	Read-novel (e.g., cat)
Read-event (e.g., headache)	Read-novel (e.g., drinks)
Generate-event (e.g., doll)	Generate-novel (e.g., yellow jellybeans)
Generate-event (e.g., hands)	Generate-novel (e.g., orange)

Procedure

As in previous experiments, all children were tested on three separate occasions in a quiet room at their school. First, an experimenter read the picture story to groups of 10 to 12 children. The next day, a second experimenter read one of the 18 versions of the post-event narratives presenting the neutral, misled-read, and misled-generate items in the same manner as in the previous experiments.

Immediately following the post-event narrative the first experimenter administered two recognition memory tests, an inclusion test followed by an exclusion test. The administration of these two tests was not counterbalanced for the reasons outlined in Chapter 3.

Each recognition test contained 12 pictures, six original pictures from Phase 1(event information) including two control items, two misled-read items, two misled-generate items, and six novel pictures including two control items, two misled-read

items, two misled-generate items (novel information). The instructions preceding

administration of the inclusion and exclusion test were identical to those in

Experiments 1 and 2. In the inclusion condition, children were first asked if they

remembered the picture story about Miss Peabody *and* the summary read to them by

the second experimenter. They were then informed that they would be shown some

pictures, some "old" and some "new", and that they should respond "yes" if they

remembered seeing the picture and "no" if they did not. Before commencing the test

the practice clown pictures were shown one by one to ascertain whether the child

understood the instructions to include information from the original story and the

post-event narrative. A participant was judged to have understood the test

instructions if they responded "yes" to the "Koko" picture shown by the first

experimenter (original story) *and* to the "Bozo" clown picture shown by the second

experimenter (post-event narrative). If a child failed this test the experimenter

repeated the instructions and administered the practice pictures again. A child who

repeatedly failed this test was eliminated from the experiment. In the exclusion

condition, children were informed that the second experimenter had made some

mistakes with the post-event summary and were instructed to forget about what they

had been told by this experimenter. The remainder of the test instructions followed

those in the inclusion condition.

Results

In both inclusion and exclusion test conditions the proportion of "yes" responses to

event-control, event-read, event-generate, novel-control, novel-read, and novel-

generate items was calculated for each item type. A preliminary analysis revealed

that the original story and narrative versions did not influence performance on these

items. Therefore, all subsequent analyses were performed after collapsing across original story and narrative versions. (See Appendix I for all the statistical analyses for this experiment). The mean number of hints given at the encoding of the misled-generate items was 1.40 for the 5-year-olds and 1.31 for the 8-year-olds. The difference between age groups was not statistically reliable, $\underline{t}$ (190) = 1.72, $\underline{p}$ > .05.

Table 19 shows the proportion of "yes" responses for event-control, event-read, event-generate, novel-control, novel-read, and novel-misled items for the two age groups in each experimental condition. An inspection of the means for event information items in the exclusion test condition revealed that, contrary to expectations and to the trends reported in all previous chapters, children were *more likely to exclude* the original item at test when given exclusion instructions than when given inclusion instructions. These results suggest that in the event condition of the current study children generally did not follow the test instructions to exclude the misleading suggestions given at Phase 2. If children had excluded the misleading suggestions as instructed, they would have been *more likely to accept* the original item at test. It appears instead that children were excluding *all* previously presented pictures. This serious flaw in the procedure comprises the calculation of process dissociation estimates based on exclusion condition data for the event condition and limits the interpretability of data collapsed across inclusion and exclusion conditions. Therefore, all subsequent analyses were performed on the data obtained in the inclusion test condition only.

Table 19

Mean Proportion of "Yes" responses (and standard deviations) as a Function of

Experimental Conditions and Age

	Inclusion instructions		Exclusion instructions	
	5-year-olds	8-year-olds	5-year-olds	8-year-olds
Condition				
Event information				
Control	.78 (.25)	.78 (.28)	.79 (.27)	.79 (.31)
Misled-Read	.29 (.32)	.31 (.31)	*.26 (.31)*	*.28 (.34)*
Misled-Generate	.46 (.40)	.38 (.36)	*.24 (.31)*	*.29 (.31)*
Novel information				
Control	.30 (.32)	.37 (.33)	.38 (.34)	.37 (.35)
Misled-Read	.61 (.34)	.60 (.31)	.64 (.34)	.59 (.33)
Misled-Generate	.67 (.32)	.64 (.31)	.63 (.32)	.58 (.29)

Note. *Misled-Read & Misled-Generate* refers to items for which misleading details were given in

Phase 2.

Note. Means depicted in italics represent conditions in which the instructions to "exclude" suggestions

given at Phase 2 were not followed.

A 2 (age) x (2) (information type) x (3) (item type) analysis of variance with repeated measures on the information type (event, novel) and item type (control, read, generate) factors was performed on the proportion of "yes" responses to all item types in the inclusion test condition. Two contrasts were planned to examine specific comparisons between different item types. These orthogonal contrasts included a comparison of performance on control as compared to all misled items, and a comparison of misled-read to misled-generate items. As in all previous studies the family-wise error rate was controlled at $\alpha = .05$. The significance level for Tukey's post-hoc tests was $p < .05$.

A significant effect was found for the contrast comparing "yes" responses in the control and misled conditions, $\underline{F}(1, 190) = 11.38$, $\underline{MSE} = 1.00$, $\underline{p} < .01$. Across age, and information type, the probability of responding "yes" to test items in the control condition ($\underline{M} = .58$) was higher than in the misled condition ($\underline{M} = .50$). This effect was qualified, however, by a significant two-way interaction with information type, $\underline{F}(1, 190) = 242.76$, $\underline{MSE} = 32.87$, $\underline{p} < .001$. Figure 5 shows that the acceptance of items in the control and misled conditions varied according to event and novel information. Children were more likely to accept event information (i.e., original Phase 1 pictures) in the control condition ($\underline{M} = .78$) than in the misled condition ($\underline{M} = .45$). The opposite was the case for the novel information such that children were more likely to accept a novel test item in the misled condition ($\underline{M} = .63$) than in the control condition ($\underline{M} = .34$).

Figure 5. Mean proportion acceptance of event and novel information as a function of control and misled conditions
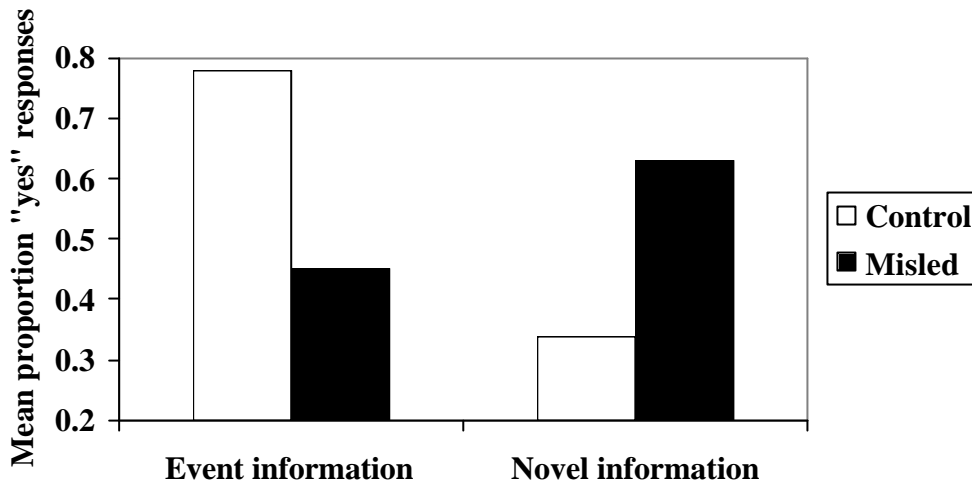
A significant main effect was found for the contrast that compared the difference in the probability of accepting event or novel test items for misleading suggestions that were generated or read in Phase 2, $F(1, 190) = 16.62$, $\underline{MSE} = 1.53$, $\underline{p} < .01$. Children were more likely to accept test items when they had generated suggestions ($\underline{M} = .54$) than when they had read suggestions ($\underline{M} = .45$). No other interactions involving this effect were significant. Tukey's post-hoc analyses were performed to examine the comparisons of "yes" responses to control and misled-read items and control and misled-generate items across event and novel information conditions. The analyses revealed a significant difference between control and misled-read items for both the 5-year-olds ($\underline{M}_{control} - \underline{M}_{read} = .10$) and the 8-year-olds ($\underline{M}_{control} - \underline{M}_{read} = .12$). No significant difference was found between control and misled-generate items for either the 5-year-olds ($\underline{M}_{control} - \underline{M}_{read} = .02$) or the 8-year-olds ($\underline{M}_{control} - \underline{M}_{read} = .07$).

To summarise, under inclusion test instructions evidence was found for:

(1) misinformation interference *across event and novel information conditions* such that children were more likely to respond "yes" to the original item items in the control condition than in the misled-read condition;

(2) misinformation interference in the *event information condition*; children were more likely to respond "yes" to the original item in the control condition than in the misled condition.

(3) misinformation interference in the *novel information condition*; children were more likely to respond "yes" to novel test items in the misled condition than in the control condition;

(4) *across event and novel conditions* children were more likely to accept the misinformation when it was "self-generated" than when it was "read".

Estimates of Recollection and Automaticity

The process dissociation equations (3) and (4) (see Section 1.14) adapted from Jacoby (1991) and Lindsay et al. (1995) were used to calculate separate estimates of the contribution of recollection and automaticity processes for "yes" responses to novel items in the novel condition following the presentation of misleading information. Because of the instruction failure in the exclusion event condition no estimates were calculated for "no" responses to original items on the event test.

Participants' individual proportions of "yes" responses for misled-read novel, and misled-generate novel items were first corrected using Snodgrass and Corwin's (1988) procedure. The corrected proportions of "yes" responses to alternatives to the suggested items given in Phase 2 are illustrated in Table 20. Equations (3) and (4) were then applied to the corrected response rates to calculate the probabilities of responding on the bases of recollection and automaticity for each age group. The

probabilities of making a novel item choice on the bases of recollection and automaticity for each age group are given in Table 21.

Table 20

Mean Proportion of "Yes" responses (Corrected) to Novel Information as a Function of Age

---

Condition	Inclusion instructions		Exclusion instructions	
	5-year-olds	8-year-olds	5-year-olds	8-year-olds
Control	.63 (.21)	.59 (.22)	.58 (.23)	.59 (.23)
Misled-Read	.57 (.23)	.56 (.22)	.60 (.22)	.56 (.22)
Misled-Generate	.62 (.21)	.59 (.21)	.59 (.21)	.55 (.20)

Note. Snodgrass & Corwin's (1988) correction method was applied to individual participant's "yes" responses to novel alternatives to the misled items.

Note. *Misled-Read* & *Misled-Generate* refers to items for which misleading details were given in Phase 2.

A 2 (age) x (2) (item type: read, generate) analysis of variance with repeated measures on the item type factor was performed on the recollection estimates. No main effects or interactions reached significance. An analogous 2 (age) x (2) (item type: read, generate) analysis of variance was also performed on the automaticity estimates. No main effects or interactions reached significance.

Table 21

Mean Process Dissociation Estimates (and standard deviations) for Novel Item

Choices on Misled Items as a Function of Age (cf. Jacoby, 1991)

	Recollection		Automaticity	
	5-year-olds	8-year-olds	5-year-olds	8-year-olds
Read	-.03 (.26)	.00 (.23)	.58 (.19)	.56 (.19)
Generate	.03 (.22)	.04 (.21)	.61 (.19)	.58 (.18)

In order to check the process dissociation assumption of equivalence of false alarm

rates across inclusion and exclusion conditions, participants' proportions of "yes"

responses to a novel test picture on items for which no suggestions were given were

examined. For these items, a "yes" response to a control-novel item on which no

suggestion was given was employed as a false alarm. For example, when Item 1 was

a control-novel target, the detail shown in Phase 1 (Version 1) was "kitchen"; neutral

information was provided in the post-event narrative at Phase 2; and on the

recognition test children responded yes / no to "bathroom". The target "bathroom"

had not been presented at any phase other than at test, and was, therefore, a "new"

item. The mean proportions of such incorrect responses are presented in Table 19.

A 2 (age) x (2) (test: control-novel inclusion, control-novel exclusion) analysis of

variance with repeated measures on the test type factor was performed on this false

alarm data. Neither a main effect of age, $F (1, 190) = .43$, $\underline{MSE} = .03$, $\underline{p} > .05$, nor a

main effect of test condition, $F (1, 190) = 2.61$, $\underline{MSE} = .06$, $\underline{p} > .05$, was found. Five-

year-olds were no more likely to choose items on which no suggestions were given ($\underline{M}$ = .61) than were the 9-year-olds ($\underline{M}$ = .59), nor did false alarms vary across the two encoding conditions ($\underline{M}_{inclusion}$ = .61; $\underline{M}_{exclusion}$ = .58). The logistic dual-process model for incorporating response biases (cf. Yonelinas & Jacoby, 1996a, Chapters 3 & 4) was not, therefore, applied to this data set.

Discussion

The current study employed a yes / no retrieval design patterned on that of Belli (1989) to examine the degree to which children's acceptance of misinformation was due to memory-based factors (e.g., trace alteration, trace competition, source misattribution) or social demand (e.g., compliance to adult authority figures and pragmatics) and response biases. In the "event" information condition, children in a control and a misled condition responded "yes" or "no" at test to the original item that was presented at Phase 1. In the "novel" information condition, children in a control and a misled condition responded "yes" or "no" at test to a novel alternative to the original item shown in Phase 1. In the misled condition, misleading suggestions were "self-generated" in response to semantic and linguistic hints or simply "read" aloud by the experimenter at Phase 2. Children also responded under two instruction conditions. In the inclusion condition, children were reminded of the original story and post-event summary presentations. In the exclusion condition, children were asked to exclude the misleading suggestions given in the post-event summary.

In the event information condition of this study, however, it was found that children did not follow the exclusion test instructions. Rather, contrary to expectations, children in a misled condition were more likely to reject the original test item in the exclusion condition than in the inclusion condition. All statistical analyses

were performed, therefore, on the inclusion test data only. Notably, this condition is the one that most closely resembles Belli's (1989) original experimental design.

The analysis of patterns of performance in the event information condition permits an evaluation of memory-based influences on original event memories (Belli, 1989). In this condition, children who have forgotten the original test item but do have a memory for the misled item are more likely to believe that the original item is incorrect and reject the original item at test. In this study, children in a control group were more likely to accept the original detail (e.g., "kitchen") than were children in a misled group. In other words, in accordance with memory-based accounts of suggestibility such as trace alteration, trace competition, and source-monitoring (e.g., Johnson et al., 1993; Loftus et al., 1985; Morton et al., 1985), children more often based their responses on the misleading suggestion and incorrectly rejected the original event item.

Belli (1989) proposed that social demand and response bias factors could not be ruled out as contributing to suggestibility on the basis of the event condition alone. The novel information condition allows an assessment of both memory-based and social demand / response biases hypotheses. In this condition, children in control and misled groups were presented with a novel alternative that had never been presented in either the original event or post-event phases. If post-event misinformation interferes with memory for the original event then children should be *more* likely to accept the novel items when misleading information had been presented than when no misleading details had been given. On the other hand, if children simply accepted the post-event misinformation due social demand factors they should be *less* likely to accept the novel items in the misled condition than in the

control condition. Similarly, if children responded on the basis of response bias they should also be *less* likely to accept these novel items in the misled condition than in the condition.

The current findings in both the novel condition and across event and novel conditions are consistent with memory-based explanations of the misinformation effect. Evidence was found of misinformation interference in the novel information condition such that 5- and 8-year-old children in a misled condition were more likely to accept the novel alternative to the original detail than were children in a control condition. Across event and novel item information conditions, 5- and 8-year-old children were found to be more likely to recognise correctly test items in a control condition where no misleading suggestions were given than in a condition where misleading post-event suggestions had been presented. In other words, in accordance with Belli's (1989) findings with adults, evidence was found that post-event misleading suggestions interfered with children's memories of the original event.

At this general level the results accord with a number of previous studies that have found young children to be quite likely to report misleading suggestions on eyewitness recognition memory tests (e.g., Ceci et al., 1987b; Holliday et al., 1999; Lindsay et al., 1995). These findings are also consistent with memory-based accounts of the suggestibility effect in that the misleading details presented in Phase 2 altered (Loftus et al., 1985), or "blocked" (Morton et al., 1985) children's memories of the original event items, or caused source-monitoring errors (Johnson et al., 1993).

In this experiment, no evidence was found that children's responding in the novel information condition was based on social demand and / or response biases. This result contrasts with the findings of Experiment 4 where misinformation effects were

reduced following the administration of a modified recognition test. These contrasting results are interesting given the possibility raised by Belli (1989) and others (e.g., Belli & Loftus, 1996; Loftus et al., 1985; Tversky & Tuchin, 1989) that the modified test is extremely conservative in regard to the detection of misinformation effects based on some form of memory interference. While social demand is likely to play some role in children's responses on standard forced choice tests of suggestibility, the results of the current study indicate that the modified test developed by McCloskey & Zaragoza (1985a) may underestimate the role played by memory-based factors. In particular, in the inclusion condition in this experiment both age groups were found to make fewer correct "yes" responses following the presentation of misinformation in "read" form. In contrast, in the inclusion condition of the modified test of Experiment 4 a misinformation effect in the older age group was limited to suggestions that were "read". The likelihood of detecting such suggestibility effects, therefore, seems related to the test method employed, with the yes / no test used here capable of detecting negative effects of misinformation in contexts where the modified test seems relatively insensitive.

As in Experiments 1, 2, and 3, the current study found that acceptance of misinformation varied according to the way the misleading suggestions were encoded. Across event and novel information conditions, generating a suggestion in response to semantic and linguistic cues in Phase 2 made children in both age groups more likely to accept an event (i.e., original item) or a novel alternative to the suggested item as having been part of the original story when tested under inclusion instructions. Hence, again it has been shown that the self-generating of misleading suggestions can potentiate children's acceptance of misinformation.

The process dissociation equations adapted from Jacoby (1991) and Lindsay et al. (1995) were applied to children's selection of novel information for which they had received misinformation that was self-generated or read. No estimates were calculated for responses in the event information condition because, as previously discussed, the data obtained in the exclusion condition was invalid due to a failure of compliance with test instructions.

For Experiments 1 and 2 the process dissociation estimates represent the probabilities of responding "yes" to a suggested picture based on automatic versus recollective influences. The novel information condition in the current study is, however, conceptually different from Experiments 1 and 2 in that what is being measured is the automatic and intentional influence on children's acceptance of a novel alternative picture following exposure to misleading suggestions. In the novel condition it was expected that predominently automatic processes would be evident if acceptance of a novel item was due to memory-based factors. On the other hand, if children accepted a novel item because of social demand it was expected that intentional recollection would contribute substantially to this effect.

In the novel information condition evidence was found of memory-based interference with the original memory in that children's selection of a novel alternative to a misled item was predominantly influenced by automatic processes. The contribution of intentional recollection to acceptance of a novel item after presentation of misleading suggestions was quite small, providing little evidence to support the social demand and / or response bias account of misinformation acceptance (e.g., Zaragoza, 1991).

Contrary to the findings of Experiments 1 and 2, the current study found no developmental differences in automatic uses of memory for novel items on which misleading suggestions were given in Phase 2. A comparison of the estimates of automaticity in the novel condition of the present study and the modified test cannot be made as there was no evidence of a misinformation effect for 9-year-old children in the generate condition of Experiment 3. The current study found evidence of a weak trend in the novel condition such that automaticity estimates were slightly larger for the 5-year-olds ($M = .60$) than for the 8-year-olds ($M = .57$). Taken together, the current findings and those of Experiments 1 and 2 suggest that in the "yes" / "no" paradigm models that posit "automatic" misinformation acceptance may be rather more relevant to explaining the responses of younger as opposed to older children.

To summarize, while Experiment 4 found some evidence for the contribution of intentional processes in the novel information condition, misinformation acceptance was, for the most part, attributable to automatic memory processes in both 5- and 8-year-olds. The present results, therefore, generally accord with the findings of the first three experiments.

Across event and novel item retrieval conditions, this experiment found evidence of memory-based changes to the original event memory in terms of trace alteration, trace competition, and / or source misattribution such that for event information children in a control condition were more likely to accept test items than children in a misled condition. Moreover, evidence was found of memory-based changes to the original memory trace in the novel information condition such that children in a misled condition were more likely to accept novel items than children in a control condition.

The results from this experiment are consistent with both a memory interference explanation of children's suggestible responding in terms of trace alteration (e.g., Loftus et al., 1978), retrieval competition (e.g., Chandler & Gargano, 1998; Christiaansen & Ochalek, 1983; Morton et al., 1985), or source misattribution (e.g., Johnson et al., 1993). Moreover, in a yes / no retrieval design that is more sensitive to detecting both memory-based suggestibility and demand-based suggestibility than the modified testing paradigm (cf. McCloskey & Zaragoza, 1985a), little evidence was found for the influence of social demand factors and response biases.

Whilst the findings from Experiments 3 and 4 were consistent with memory-based explanations of suggestibility effects in children, the recognition tests employed in these experiments did not permit an evaluation of individual memory interference hypotheses. The next experiment was designed, therefore, to compare competing memory interference theories such as trace-alteration (e.g., Loftus et al., 1978), retrieval interference in terms of "blocking" (e.g, Chandler & Gargano, 1998; Morton et al., 1985), and source-monitoring (e.g., Johnson et al., 1993; Lindsay, 1994).

Chapter 6

Estimates of intentional recollection and automaticity in a reversed misinformation paradigm

6.1 Introduction to Experiment 5

In accordance with the findings of the first three studies, Experiment 4 found that misinformation effects in 5- and 8-year-old children were predominantly attributable to automatic memory processes. However, under certain encoding conditions (i.e., self-generated suggestions) it was again found that intentional recollective processes also influenced acceptance of misinformation.

These findings are consistent with the view that post-event misinformation alters, overwrites, or weakens memories for the original event (cf. Loftus et al., 1978; Brainerd & Reyna, 1993, 1998), or blocks access to the original event memories (cf., Chandler & Gargano, 1998; Christiaansen & Ochalek, 1983; Morton et al., 1985), or causes source misattributions (e.g., Johnson et al., 1993; Lindsay & Johnson, 1989a; Lindsay, 1994). In contrast with the outcomes of Experiment 3 using the modified testing paradigm, Experiment 4 found little evidence to support the view that children report misinformation due to the demands of the experimental situation (e.g., Newcombe & Siegal, 1997; Zaragoza, 1987, 1991).

In order to strengthen the conclusions that can be drawn about memory-based changes in children's suggestibility, Experiment 5 employed a reversed misinformation design (cf. Lindsay & Johnson, 1989b; Rantzen & Markham, 1992) in

which the post-event misinformation was presented *prior* to the original event information. A major advantage of this design is that it permits the evaluation of a number of competing memory alteration accounts of the misinformation effect in children (e.g., trace alteration, "blocking", source-monitoring). In most other respects this study resembled Experiment 3 except that only 5-year-old children were recruited. Only one age group was targeted because Experiment 3 found no evidence of age-related changes in levels of suggestibility *or* process estimates when children were given a standard and a modified test. Children's memories for the original event were assessed using the standard (cf. Loftus et al., 1985) and the modified (cf. McCloskey & Zaragoza, 1985a) forced-choice recognition tests. The modified test was included as a strict control on social demand factors and response biases.

6.1.1 The Reversed Misinformation Paradigm

In a conventional three-stage misinformation paradigm (cf. Loftus et al., 1978), children first view an event, are then read a summary of this event that contains misleading details and, finally, are given a forced-choice recognition test on their memories of the original event (see Table 1, Section 1.2). In a reversed misinformation design, however, the presentation order of phases 1 and 2 of the Loftus et al. (1978) procedure is reversed; that is, misleading suggestions are presented *before* the original event. An example of the "reversed" (e.g., Lindsay & Johnson, 1989b) misinformation paradigm is illustrated in Table 22.

Three memory interference accounts of suggestibility, namely a strong version of trace alteration (e.g., Loftus, 1979, 1995; Loftus & Hoffman, 1989; Loftus et al., 1992; Loftus et al., 1978), retrieval interference in terms of "blocking" (e.g., Bekerian & Bowers, 1983; Chandler & Gargano, 1998; Christiaansen & Ochalek, 1983; Morton

et al., 1985), and source-monitoring (e.g., Johnson et al., 1993; Lindsay & Johnson, 1989a), can be evaluated using the reversed paradigm. The trace alteration / trace overwriting hypothesis, for example, proposes that misinformation overwrites or updates the original event memory trace making that trace unavailable for subsequent recognition, resulting in permanent erasure of the original details from storage. If the misinformation effect is due to alteration of the initial memory trace by the presentation of new details there should be no indication of a suggestibility effect when the misinformation is presented before the original event information.

Table 22

The Reversed Misinformation Paradigm

	Phase 1	Phase 2	Test items
Control	(e.g., generic)	*(e.g., kitchen)*	(e.g., kitchen vs bedroom)
Misled	(e.g., bedroom)	*(e.g., kitchen)*	(e.g., kitchen vs bedroom)

Note. Items presented in the original story are italicised.

Retrieval interference models such as the co-existence hypothesis (e.g., Bekerian & Bowers, 1983; Christiaansen & Ochalek, 1983) assume the retention of both the original event as well as the misinformation memory traces, and that access to the original memory is "blocked" by the more recently presented misinformation. If the misinformation effect is due to participants simply reporting the most recently presented details then this effect should be eliminated when the misinformation precedes the original event details. The source-monitoring account also assumes the co-existence of the original event and the post-event misinformation memory traces.

According to this view, participants make source misattribution errors such that they mistakenly attribute the source of their memories to the post-event misinformation instead of to the original event. Because the post-event misinformation co-exists with rather than replaces (e.g., Loftus, 1991) the original event, source misattributions can occur irrespective of the presentation order of these stimuli. Consequently, the effect should still be evident when the misinformation is presented *before* the original event details (Lindsay & Johnson, 1989b).

Reported findings employing a reversed misinformation paradigm with adult participants (e.g., Lindsay & Johnson, 1989b; Rantzen & Markham, 1992) do not support either a strong version of trace-alteration or a blocking account of the misinformation effect. In Lindsay and Johnson's (1989b) study, for example, college students were read a narrative that included misleading suggestions about a visual scene prior to viewing the scene. They found no evidence to support either the trace alteration or the "blocking" accounts of the misinformation effect in that misled participants were more likely than controls to report the suggested information. Lindsay and Johnson argued that their findings were consistent with the view that the misinformation effect reflects failures of source-monitoring.

6.2 Aims and predictions

This experiment aimed to evaluate several opposing memory-based theoretical explanations of the misinformation effect in 5-year-old children using both the standard (cf. Ceci et al., 1987b) and the modified (cf. Zaragoza, 1991) forced-choice recognition memory tests in a reversed misinformation paradigm. An additional aim was to examine the contribution of intentional recollection and automatic memory processes to children's suggestible responses. As in Experiment 3, children were

asked to choose between an original event item (control) and a misled item in a

standard test and between an original event item (control) and a novel item

in a modified test. The experimental procedure is illustrated in Table 23.

Table 23

Summary of the procedure of Experiment 5

Experimental condition	Phase 1: Post-event misinformation	Phase 2: Original Standard test detail	Phase 3: Modified test
Control	(e.g., generic)	(e.g., kitchen)	(e.g., kitchen vs bedroom) (e.g., kitchen vs bathroom)
Misled	(e.g., bedroom)	(e.g., kitchen)	(e.g., kitchen vs bedroom) (e.g., kitchen vs bathroom)

While the reversed eyewitness design has not been used previously in the context

of children's suggestibility, it has the unique potential to differentiate between the

predictions made by a number of theories of the processes underlying misinformation

effects. It was expected that if misinformation alters or overwrites memories for the

original event details (cf. Loftus, 1979; Loftus et al., 1978), or blocks access to the

original event details (cf. Bekerian & Bowers, 1983; Chandler & Gargano, 1998;

Morton et al., 1985), there would be no evidence of a suggestibility effect when the

misinformation was given *before* the original event. That is, children would be no

more accurate on control items than on items for which misleading suggestions had

been given in both the standard and the modified recognition testing procedures. On

the other hand, if children report the misleading details because they misidentify the

sources of their memories (cf. Lindsay & Johnson, 1989a; Lindsay et al., 1991;

Roberts & Blades, 1998), or because of changes to memory trace-strength (e.g., Brainerd & Reyna, 1998; Reyna & Brainerd, 1998), it was expected that a suggestibility effect would be found such that children would be more accurate on control items than on items where a misleading suggestion was given on the standard test.

A number of researchers (e.g., McCloskey & Zaragoza, 1985a,b; Newcombe & Siegal, 1997; Zaragoza, 1991) have proposed that suggestibility effects obtained in the standard testing paradigm are due to social demand factors (see Section 1.3.2). Hence, in a reversed design, if children report misinformation due to compliance with the perceived wishes of the experimenter (e.g., Zaragoza, 1991), or to misinterpretation of the intent of the questioner (e.g., Newcombe & Siegal, 1997) even though they remember the original event details, then it was expected that they would still be more likely to select the misled item than the original item.

Notably, in most previous investigations (i.e., all comparisons of standard vs. modified performance such as Ceci et al., 1987b; Zaragoza, 1991, and Experiment 3) the social demand and response bias hypotheses make identical predictions. The reversed misinformation paradigm, however, allows for the separate testing of the two accounts. The response bias hypothesis (e.g., McCloskey & Zaragoza, 1985a,b) holds that in the standard testing paradigm misled participants are biased, relative to participants in the control group, towards selecting the more recently presented misled item at test. In other words, misled participants who have forgotten or failed to encode the original event information will report the misled item at test. If this account is correct, then it is expected that no evidence of misinformation effects will

be found in the standard test when children are misled before the presentation of the original event.

The modified test has not been used previously in a reversed misinformation design with adults or children. Nevertheless, following the findings of Experiment 3 and of others (e.g., Ceci et al., 1987b) that misinformation effects obtained in the standard testing paradigm are attenuated when children are given a modified test (cf. Zaragoza, 1991), it was expected that the magnitude the misinformation effect would be smaller on the modified test relative to the standard test.

In accordance with the findings of the previous experiments it was predicted that if a misinformation effect was found on the standard test, the misled-generate encoding manipulation would lead to a stronger suggestibility effect in the inclusion condition than in the exclusion condition, and that estimates of intentional recollection would be larger for self-generated suggestions than for suggestions that are simply read aloud.

Following the findings from Experiment 3, it was also expected that if a suggestibility effect were found on the standard test, children's suggestible responses would reflect both intentional recollection and automatic processes. The modified test was included to control for social demand factors and response biases and, as such, is unlikely to produce evidence of intentional suggestibility. Indeed, Experiment 3 found little evidence that 5-year-old children's suggestible responses were due to intentional recollection. Hence, it was predicted that the relative contribution of recollective processes to suggestibility would be reduced on the modified test relative to the standard test.

Method

Participants

Fifty-nine 5-year-olds ($\underline{M}$ = 5 years, 11 months, $\underline{SD}$ = 4 months, Range: 5 years, 4 months – 6 years, 9 months), including 27 males and 32 females participated in this study. All children attended public primary schools in predominantly middle-class areas of the New South Wales Central Coast, Australia. Children participated only if parental consent had been granted.

Materials

The twelve target items and their alternate versions (one misleading and one novel) used in Experiments 1 and 3 were again used in this experiment. As in Experiment 3, there were three versions of the original story to control for possible differences in the difficulty of target items chosen as control, misled-read, and misled-generate, and six pre-event narratives for each version of the original story. The pre-event narratives consisted of a summary of the original story and contained *four* misled-read and *four* misled-generate items and neutral information about the other *four* picture details (control items). The assignment of items to neutral and misled roles was counterbalanced across participants. (See Appendix J for the three original story versions and an example of a pre-event narrative version).

Two forced-choice recognition memory tests were used again used with test items presented in a randomized order. One was a standard test (e.g., Loftus et al., 1978) with six control and six misled item pictures as alternatives, and the other was a modified test (e.g., McCloskey & Zaragoza, 1985a) with six control and six novel item pictures presented as alternatives.

Procedure

One significant change was made to the procedure used in the previous four experiments. Contrary to the previous experiments in which the misinformation was presented one day *after* the presentation of the original story, in this experiment the narrative containing the misleading suggestions was presented one day *prior* to the original story and recognition testing.

The first experimenter commenced by introducing a clown picture ("Bozo" Practice picture 1) and then read one of the versions of the post-event narratives presenting the misled-read and misled-generate items in the same manner as in the previous experiments. The next day a second experimenter presented the original story to groups of 10 to 12 children in the same manner as the previous experiments. The children were first shown a picture of "Koko" the clown (Practice picture 2), and were then given read the picture story.

Immediately following the original story presentation the second experimenter administered two recognition memory tests, an inclusion test followed by an exclusion test. Each test contained 12 original items from Phase 2, and six misled and six novel targets corresponding to the narrative version presented at Phase 1. For the "standard" test, six original items were paired with four pictures of items on which misleading suggestions were given at Phase 1 (two misled-read and two misled-generate), and two misled alternatives that had not been presented previously (control items). For the "modified" test items, six original items were paired with four novel alternatives of misled items presented at Phase 1, and two novel alternatives (control items). (See Appendix J for an example of the allocation of items).

The instructions preceding the recognition tests were the same as those used in Experiment 3. As in the previous studies, children completed the forced choice recognition following inclusion instructions and then again under exclusion instructions. (See *Procedure* of Experiment 3).

<div align="center">Results</div>

Standard Test

In both instruction conditions the proportion of correct responses was calculated for control, misled-read, and misled-generate items. The mean number of hints given at the encoding of the misled-generate items was 1.08. A preliminary analysis revealed that the original story and narrative versions did not influence performance on control, misled-read, and misled-generate items. (See Appendix K for all the statistical analyses for this experiment). Hence, all subsequent analyses were performed after collapsing across version and narrative types.

Table 24 illustrates the mean proportion correct in each experimental condition. A (2) (test type) x (3) (item type) analysis of variance with repeated measures on the test and item type factors was performed on this data. Following the practice of Experiment 3 and many previous studies of children's suggestibility (e.g., Ceci et al., 1987b; Newcombe & Siegal, 1997; Zaragoza, 1991) performance on the two types of misled items was compared with control item performance. Hence, two planned contrasts on the item factor were used, comparing control items with misled-read items and misled-generate items, respectively. Bonferroni adjustments were used to control a family wise rate at $\alpha = .05$ (cf. Hall & Bird, 1986). The significance level for Tukey's post-hoc tests was $p < .05$.

Table 24

Standard Test: Mean Proportion Correct Recognition (and standard deviations) as a

Function of Experimental Condition

	Inclusion	Exclusion
Item type		
Control	.79 (.32)	.80 (.26)
Misled-Read	.64 (.37)	.64 (.36)
Misled-Generate	.58 (.35)	.75 (.30)

Standard Test: Mean Proportion Incorrect Recognition (Corrected) (and standard

deviations) for Suggested Items and Control Items

Control	.31 (.21)	.30 (.17)
Misled-Read	.40 (.24)	.40 (.23)
Misled-Generate	.44 (.24)	.33 (.20)

Note. Corrected proportions were computed by applying Snodgrass & Corwin's (1988) correction

method to individual participant's proportion incorrect response on the suggested items and control

items.

A significant main effect for test condition was found across item type, F (1, 58)

= 7.23, $\underline{MSE}$ = .34, $\underline{p}$ < .05, with children more likely to choose the original item in

the exclusion test condition ($\underline{M}$ = .74) than in the inclusion test condition ($\underline{M}$ = .68).

Across items, recognition accuracy in the inclusion and exclusion conditions was significantly greater than chance.

There was a significant effect for the contrast comparing recognition accuracy on control and misled-read items, $\underline{F}$ (1, 58) = 6.76, $\underline{MSE}$ = 1.30, $\underline{p}$ < .05. Across test conditions, children were more accurate on control items ($\underline{M}$ = .79) than on misled-read items ($\underline{M}$ = .65). Across test conditions, recognition accuracy was also found to be superior on control ($\underline{M}$ = .79) compared to misled-generate item types ($\underline{M}$ = .67), $\underline{F}$ (1, 58) = 5.79, $\underline{MSE}$ = .95, $\underline{p}$ < .05. This contrast, however, interacted significantly with test condition, $\underline{F}$ (1, 58) = 7.99, $\underline{MSE}$ = .42, $\underline{p}$ < .05. Figure 6 shows this effect. Tukey's post-hoc tests revealed that the difference between control and misled-generate items was significant in the inclusion test condition ($\underline{M}_{control}$ - $\underline{M}_{generate}$ = .21) but not in the exclusion test condition ($\underline{M}_{control}$ - $\underline{M}_{generate}$ = .05).

Figure 6. Proportion of correct responses as a function of misled item type and test condition
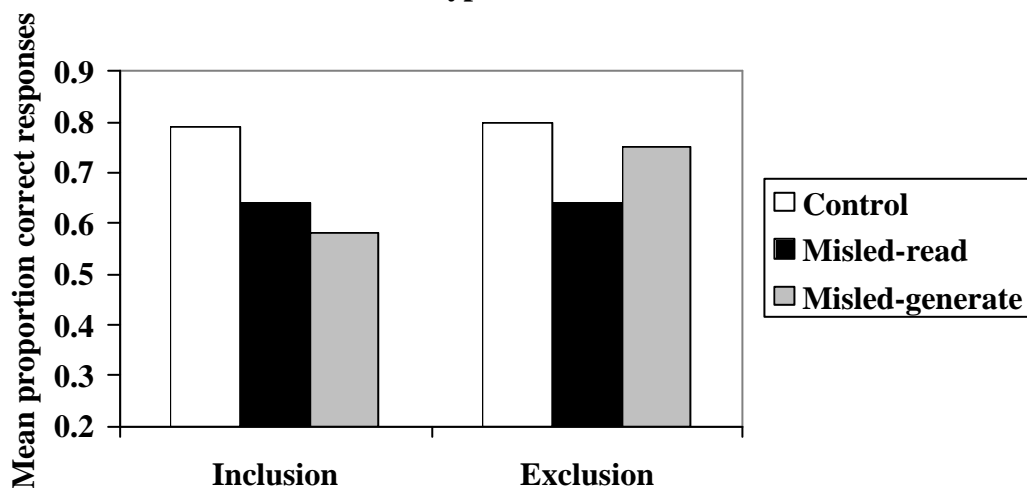
Estimates of Recollection and Automaticity

The process dissociation equations (3) and (4) (see Section 1.14) were again used to calculate separate estimates of the contribution of the processes of recollection and automaticity to responding to misled-read and misled-generate item types. Participants' individual proportions incorrect for misled-read and misled-generate items were first corrected using Snodgrass and Corwin's (1988) procedure to eliminate the problem of responses of one or zero. Table 24 shows the corrected proportions of errors to suggested items. Equations (3) and (4) were then applied to the corrected response rates to calculate the probabilities of responding on the bases of recollection and automaticity (see Table 25).

A one-way repeated measures analysis of variance was performed to examine the effect of encoding condition on the recollection estimates. There was a significant main effect of encoding, $\underline{F}$ (1, 58) = 11.84, $\underline{MSE}$ = .37, $\underline{p}$ < .01. Recollection estimates for misled-generate items ($\underline{M}$ = .11) were larger than for misled-read items ($\underline{M}$ = .00).

Table 25

Standard Test: Mean Process Dissociation Estimates (and standard deviations) for Read and Generate Items

	Recollection	Automaticity
Mislead-Read	.00 (.12)	.40 (.23)
Misled-Generate	.11 (.24)	.38 (.21)

An analogous one-way repeated measures analysis of variance was carried out on the automaticity estimates. No significant differences between automaticity estimates for the misled-read and misled-generate conditions were found.

In order to check the equivalence of false alarm rates across inclusion and exclusion conditions, participants' proportions of incorrect responses to items on which no suggestions were given (i.e., novel alternatives to original pictures ion control items) were examined. The mean proportions incorrect for these items are illustrated in Table 24. A (2) (test: novel inclusion, novel exclusion) within-subjects analysis of variance was performed. No main effect for test condition was found, F (1, 58) = .05, $\underline{MSE}$ = .00, p > .05. Children were no more likely to choose items on which no suggestions were given (novel targets) in the inclusion test condition (M = .31) than in the exclusion test condition (M = .30). The logistic dual-process model for incorporating response bias (cf. Yonelinas & Jacoby, 1996a) was not, therefore, applied to the data.

Modified Test

In both instruction conditions the proportion of correct responses was calculated for control, misled-read, and misled-generate items. A preliminary analysis revealed that the original story and narrative versions did not influence performance on control, misled-read, and misled-generate items. Therefore, all subsequent analyses were performed after collapsing across version and narrative types. (See Appendix K for all statistical analyses for this experiment). The mean number of hints given at the encoding of the misled-generate items was 1.06. Table 26 illustrates the mean proportion correct in each experimental condition.

Table 26

Modified Test: Mean Proportion Correct Recognition (and standard deviations)

as a Function of Experimental Condition

	Inclusion	Exclusion
Item type		
Control	.75 (.36)	.78 (.27)
Misled-Read	.67 (.35)	.71 (.34)
Misled-Generate	.72 (.32)	.72 (.34)

Modified Test: Mean Proportion Incorrect Recognition (Corrected) (and standard

deviations) for Suggested Items and Control Items

Control	.34 (.24)	.32 (.18)
Misled-Read	.39 (.24)	.36 (.22)
Misled-Generate	.35 (.22)	.36 (.22)

Note. Corrected proportions were computed by applying Snodgrass & Corwin's (1988) correction

method to individual participant's proportion incorrect response on the suggested items and control

items.

   A (2) (test type) x (3) (item type) analysis of variance with repeated measures on

the test and item type factors was performed on this data using the same two planned

that were applied in the analysis of the standard test. Bonferroni adjustments were used to control a family wise rate at $\alpha = .05$.

No significant main effect for test condition was found, $\underline{F}(1, 58) = 2.52$, $\underline{MSE} = .06$, $\underline{p} > .05$. Children were no more accurate in the exclusion test condition ($\underline{M} = .73$) than in the inclusion test condition ($\underline{M} = .71$). Further, the contrasts comparing recognition accuracy on control and misled-read items, $\underline{F}(1, 58) = 1.82$, $\underline{MSE} = .31$, $\underline{p} > .05$, and control and misled-generate items, $\underline{F}(1, 58) = .58$, $\underline{MSE} = .11$, $\underline{p} > .05$, failed to reach significance. Estimates of the contribution of recollection and automaticity to selection of novel responses following exposure to misleading suggestions were not calculated, therefore, because no evidence of a misinformation effect was found on this test.

Discussion

The present experiment employed a reversed misinformation design (cf. Lindsay & Johnson, 1989b) to examine the contribution of intentional recollection and automatic processes to 5-year-old children's suggestible recognition responses on both standard (cf. Loftus et al., 1978) and modified (cf. McCloskey & Zaragoza, 1985a) recognition tests. In this design, children were presented with the misinformation *before* being read the original story as opposed to *after* the original event details in a traditional misinformation paradigm (cf. Loftus et al., 1978).

This experiment again found evidence of a suggestibility effect such that on the standard test, 5-year-olds were less likely to choose the correct original detail on items for which they had received misleading suggestions than for control items. These results are consistent with the findings of Experiment 3 and of several previous studies that have reported suggestibility effects in children using a standard forced-

choice recognition test (e.g., Ceci et al., 1987b; Holliday et al., 1999; Newcombe & Siegal, 1997; Zaragoza, 1987, 1991; Zaragoza et al., 1992).

Significantly, however, the fact that this suggestibility effect was obtained when misleading suggestions *preceded* the presentation of event information poses problems for a strong version of the trace alteration hypothesis (e.g., Loftus, 1979; Loftus et al., 1978), a retrieval interference account in terms of "blocking" (e.g., Bekerian & Bowers, 1983; Morton et al., 1985), and a response bias account (e.g., McCloskey & Zaragoza, 1985a). For example, in the present study children were presented with the misled alternative (e.g., "bedroom") in Phase 1, followed by the correct alternative (e.g., "kitchen") in Phase 2. The trace alteration account argues that the new information (i.e., "kitchen") updates and replaces the previously presented information (i.e., "bedroom") resulting in permanent erasure from storage. The assumption made by this account is that the process of trace alteration proceeds automatically. Retrieval interference models propose that both the original event and misinformation memory traces are held in storage, but that the most recently presented information "blocks" access to the original memory trace preventing its retrieval. Similarly, a response bias account (e.g., McCloskey & Zaragoza, 1985a) argues that children given a "standard test" are biased toward selecting the more recently presented misleading information. According to each of these models, children would have been more likely to select the correct (original) information when it was presented just before recognition testing. The current findings are incompatible with all these explanations in that it was found that children were quite likely to select the misleading detail presented at Phase 1.

The finding that suggestibility levels on the standard test were again differentially affected by the mode of encoding of the misleading suggestions and the instruction conditions raises further problems for trace alteration models (e.g., Loftus, 1991) and "blocking" models of retrieval interference (e.g., Morton, 1991; Morton et al., 1985). In the inclusion condition, children were equally likely to correctly reject misleading suggestions that were "read" to them as they were misleading suggestions that were "self-generated". Moreover, suggestibility effects for misled items that were read to the children were invariant across the inclusion and exclusion instruction conditions. In the exclusion condition, however, children were more likely to correctly reject misled details that were self-generated. Generating a suggestion in response to semantic and linguistic cues led to a reduction in suggestibility levels under exclusion instruction conditions. The fact that children can exclude misleading suggestions that are self-generated, even when such suggestions are presented prior to the original event details, is further evidence that new information neither overwrites the old information (Loftus, 1979; Loftus et al., 1978), nor blocks its retrieval (Morton et al., 1985). Notably however, in this study, as in Experiments 2 and 3, the exclusion instructions did not eliminate suggestibility when the suggested details were read aloud. This interaction between the type of encoding of misleading items and the instructions given at retrieval indicates that the degree to which memory interference is implicated in suggestibility varies according to the specific encoding-retrieval conditions that obtain. When suggestions are encoded elaboratively as in the generate condition, participants are more likely to be conscious or aware of these suggested memories and hence be able to exclude then when given appropriate retrieval instructions. When, however, the suggestions were simply read aloud to children it

appears a more automatic (and less aware) form of processing of these suggestions was invoked such that, even when exclusion instructions are given these suggestions still had a negative effect on recognition performance.

The process dissociation estimates obtained for the standard test provide further support for this explanation. In accordance with the prediction and the findings of Experiment 3, estimates of intentional recollection were larger for misled-generate items than for misled-read items. Indeed, in this experiment there was no evidence that intentional recollection contributed to children's suggestible responding when such suggestions were simply read aloud. In contrast, it was again found that the contribution of automatic processes to suggestibility did not vary as a function of encoding procedure. That is, automatic processes were found to make a consistently strong contribution to children's incorrect selection of suggested items on the standard test regardless of the way in which the suggestions were encoded. However, the finding of a substantial intentional recollection component to children's responses to self-generated suggestions again demonstrates that the processes underlying trace competition at retrieval do not operate entirely automatically and outside of awareness as proposed by the trace alteration (e.g., Loftus, 1979) and retrieval competition models (e.g., Morton, 1991).

This current finding of a suggestibility effect in a reversed misinformation design is quite consistent with a source-monitoring account (e.g., Johnson et al., 1993; Lindsay & Johnson, 1989b). This view holds that misleading suggestions are reported at test when individuals erroneously attribute the source of their memories to the misinformation instead of to the original event information (Johnson et al., 1993; Lindsay, 1994; Lindsay & Johnson, 1987, 1989a). Moreover, children are equally

likely to select the misinformation when it is presented *before* the original event as when it is presented *after* the original event (Lindsay, 1994). The present findings on the standard test are consistent with this model's prediction that a suggestibility effect should be evident when the misinformation is presented before the original event details (Lindsay & Johnson, 1989b). The finding that children's suggestible responses were largely due to automatic memory processes is also consistent with Johnson et al.'s (1993) proposal that, on the standard test, subjects adopt an undifferentiated response criterion of familiarity and misattribute the source of their memories for the original event to the post-event misinformation. However, the finding of an intentional recollection component to misled-generate items also suggests that source misattribution is not entirely based on automatic memory processes.

Memory trace-strength accounts of the misinformation effect (e.g., Brainerd & Reyna, 1993a, 1998; Ceci et al., 1988; Holliday et al., 1999) propose that the presence or strength of the misinformation effect obtained with children of various ages may be related to conditions which affect the "trace strength" of the original and / or suggested memory traces. Fuzzy-trace theory (Brainerd & Reyna, 1998), for example, holds that in the traditional misinformation paradigm post-event suggestions degrade the original event memory trace with the amount of degradation being dependent upon the current strength of memory for the original details. According to this model, misinformation can be reported either intentionally on the basis of verbatim details of an item's surface features, or automatically on the basis of gist (Reyna & Brainerd, 1998). Moreover, manipulations that increase the ability to preserve details in storage (e.g., self-generation of suggestions) will also increase the

intentional recollection component. The current findings that suggestible responding in a reversed misinformation paradigm was due to both automatic and intentional processes, and that there was a larger recollective component to self-generated suggestions, are both compatible with the fuzzy trace account.

The modified testing procedure (cf. McCloskey & Zaragoza, 1985a) was employed to control for the influences of social demand and response biases on children's recognition choices. This test has not been used in previous evaluations of the misinformation effect using a reversed design (e.g., Lindsay & Johnson, 1989b; Rantzen & Markham, 1992). The current study found no evidence of a misinformation effect in that children were equally likely to select the correct original detail on items for which they had been given misleading suggestions as they were to select control items. As in Experiment 3 these findings indicate that responses on the standard test may be influenced by social demand. When the social and task demands to accept misinformation were reduced the suggestibility effect found on the standard test was diminished.

However, unlike Experiment 3 and many previous investigations (e.g., Ceci et al., 1987b; Holliday et al., 1999; Toglia et al., 1992), the misinformation effect in the modified test was not just attenuated but eliminated. The current study found only a weak trend towards suggestibility on the modified test such that children were slightly more likely to select the correct original detail on items for which they had received misleading suggestions than in the standard condition (70% vs. 66% correct, $\underline{p} > .05$, respectively). Clearly, the reversal of the order of presentation of stimulus materials is likely to be related to this discrepancy between the findings of this study and those of Experiment 3. In Experiment 3, the misleading suggestions were presented *one*

day after the original event details and *immediately before* the recognition test. In

contrast, in the current study the misleading suggestions were presented *one day*

before the original event presentation, which in turn, was immediately followed by the

recognition test. The latter design, therefore, maximises the strength of memory

traces for the original event details and suggests that some forgetting of original event

information is needed for a misinformation effect to occur on the modified test (Belli

& Loftus, 1996).

Proponents of social demand accounts of the misinformation effect argue that

children report misleading suggestions on the standard test due to the demands of the

experimental situation (Cassel et al., 1996; Ceci et al., 1987b; Lampinen & Smith,

1995; Zaragoza, 1991), or because they misinterpret the intent of the questioner at the

point of retrieval (Newcombe & Siegal, 1997). According to these views, children

intentionally report the suggested item based on the social context and / or pragmatic

cues present at the time of testing. Specifically, a misled participant who remembers

both the original and the misleading details may consciously commit to the misled

item because he or she perceives the experimenter as a credible information source, or

because he or she may wish to be viewed favorably by the experimenter. Moreover, a

misled participant may remember the original item and its' source, but nevertheless

lose confidence in this memory when confronted with the misled item. Such

participants may, therefore, consciously "deliberate" whether the misled item is the

correct item since it was presented by the experimenter who is perceived as a credible

source of information (Belli & Loftus, 1996; Zaragoza & McCloskey, 1989).

The fact that intentional recollection for misled-generate items in the standard

testing paradigm was eliminated when children were given the modified test is

consistent with these views. Hence, "intentional suggestibility" which may be due to social and / or pragmatic influences may be seen to be determined by the specific conditions which hold when suggestions are encoded and retrieved. The finding that the contribution of intentional recollection on the standard test was small in terms of absolute magnitude in comparison to the contribution of automatic processes, however, demonstrates that the mechanisms contributing to misinformation effects in children cannot be explained exclusively on the basis of the social and / or pragmatic effects of the experimental situation.

In summary, this experiment found that on the standard test using a reversed misinformation design, both intentional recollection and automatic memory processes contributed to suggestibility effects in 5-year-old children. Moreover, on the standard test, recollection estimates were again larger for misled items that were self-generated, an effect that was reduced when children were given a modified test designed to control for social demand factors and response biases. On this test, suggestibility effects were, for the most part, attributable to automatic memory processes.

This study found evidence of suggestibility on the standard test using a reversed misinformation paradigm. While these findings are inconsistent with a strong version of the trace alteration hypothesis (e.g., Loftus, 1979; Loftus et al., 1978), and a retrieval interference account in terms of "blocking" (e.g., Christiaansen & Ochalek, 1983; Morton et al., 1985), they are compatible with the source-monitoring hypothesis (e.g., Johnson et al., 1993; Lindsay & Johnson, 1989a, 1989b) and fuzzy trace theory (e.g., Brainerd & Reyna, 1998). The suggestibility effect obtained on the standard test was eliminated when children were given a modified test indicating that responses on

the standard test may be influenced by social demand factors and response biases (e.g., McCloskey & Zaragoza, 1985a).

The results from the current experiment again demonstrate that suggestibility effects found in the standard testing procedure are due to a combination of both social demand and response biases and changes to memory processes (cf. Bruck et al., 1997; Ceci et al., 1998). Moreover, the current findings favour a dual-process account of memory-based suggestibility in terms of changes to memory trace-strength of the original and / or misinformation traces (e.g., Brainerd & Reyna, 1998; Ceci et al., 1988; Holliday et al., 1999).

Chapter 7

General Discussion

7.1 Summary of major findings and conclusions

The main purpose of this series of studies was to evaluate competing models of misinformation by identifying the automatic and / or intentional bases of children's acceptance of misinformation. A further aim was to examine the extent to which the contribution of each these processes shows age-related change across early to mid childhood.

In this regard, a major finding from the present research was that *both* automatic and intentional recollection memory processes contributed to misinformation acceptance in children aged 5, 8, and 9 years across a range of recognition memory paradigms including yes / no testing (e.g., Belli, 1989, Tversky & Tuchin, 1989) and forced-choice recognition (e.g., Ceci et al., 1987b; Zaragoza, 1991). Although most prior research has evaluated children's acceptance of misleading suggestions using a recognition memory paradigm (Ceci & Bruck, 1993) this research has not, for the most part, been concerned with the identification of the underlying processes involved in the act of recognition, nor how these processes contribute to the reporting of misinformation. Following models of recognition memory that assume that recognition performance is determined by a number of dissociable memory processes (e.g., Brainerd & Reyna, 1998; Jacoby, 1991; Mandler, 1980), Jacoby's (1991) process dissociation procedure was applied to children's suggestible responses to obtain estimates of the contribution of intentional recollection and automatic processes. Notably, it was found that performance on a recognition test which has

traditionally been seen as governed by "explicit" or intentional memory processes (e.g., Light & Singh, 1987; Merikle & Reingold, 1991) is actually influenced by *both* mechanisms (Jacoby, 1991; Jacoby, Toth, & Yonelinas, 1993).

Although both automatic and intentional memory processes contributed to children's acceptance of misleading details in each experiment, the relative influence of these two processes varied according to the way that suggestions were encoded. Across the age range from 5 to 9 years, recollection estimates were greater for misled items that were generated by the children participating in comparison to misled items that were read aloud to the children. These results were found to be robust regardless of whether the parameter estimates were based on group or individual data.

These findings reinforce the conclusion drawn from the analysis of children's suggestible responses that generating misled items at encoding increases the influence of intentional or elaborative conceptual processing on subsequent recognition responses (e.g., Begg et al. 1991; Flory & Pring, 1995). More specifically, generating a misleading detail in response to a semantic and linguistic cue made children more likely to accept suggested items when tested under inclusion instructions. Under exclusion instructions, however, children were more likely to exclude the misleading detail when it had been generated than when it had simply been read aloud. Hence, the self-generating of misleading suggestions can either increase or decrease the acceptance of misinformation depending on the instructions children are given at the point of retrieval.

It is likely that misleading suggestions that are self-generated are more distinctive in memory (e.g., Begg et al., 1991), and are more likely to be stored as "gist" memory traces and strong "verbatim" traces than suggestions that are heard (Brainerd &

Reyna, 1998; Brainerd et al., 1995). Alternately, social demand factors such as compliance to the perceived wishes of the experimenter (cf. Ceci et al., 1998; Newcombe & Siegal, 1996) may account for the generation effect. Specifically, children may have believed that because they were asked to self-generate misleading suggestions (thereby drawing attention to these items), that the experimenter wished them to report these at test. When the experimenter told the children to exclude such items under the exclusion instruction condition, children were in fact "given permission" by the experimenter to reject these items. In contrast, the contribution of automaticity to recognition of suggested details was unaffected by the manner in which suggestions were encoded (but see Chapter 4 for an exceptional case). This general pattern of findings concerning the contributions of automatic and intentional processes was found to hold across a range of experimental and memory-testing procedures including yes / no recognition tests (Experiments 1, 2, & 4), forced-choice recognition tests (Experiments 3 & 5) and a reversed-suggestibility paradigm (Experiment 5).

To summarise the major findings then, automatic processing contributed to misinformation acceptance in children when suggestions were read or self-generated. This finding is particularly significant as the procedure used to present suggestions in the "read" condition closely approximated that used in many previous studies of the misinformation effect in children (e.g., Ceci et al., 1987b; Holliday et al., 1999; Zaragoza, 1991). By extension, the current findings suggest that many of these previous demonstrations of misinformation acceptance in children were mediated by automatic memory processes. On the other hand, the contribution of intentional processes to children's suggestibility depended on the way that suggestions were

encoded and retrieved. When this intentional component works towards acceptance of misinformation as in the inclusion condition, the likelihood of accepting suggested information is increased. When the intentional component works against acceptance of misinformation as in the exclusion condition, the likelihood of accepting misleading suggestions is reduced or is eliminated.

7.2 Theories of misinformation and recognition memory processes

Current theories of the misinformation effect in children and adults can be differentiated according to the assumptions they make about the roles of automatic and intentional processing. These assumptions were investigated in detail in Chapter 1 (see Section 1.11) and are revised in light of the findings of the current research in Table 27. One advantage of using the process dissociation procedure to discriminate between such models is that it permits an assessment of the simultaneous contribution of both automatic and intentional processes to children's acceptance of misinformation. This stands in contrast to other procedures that have been frequently employed to examine the mechanisms underlying misinformation effects in children (e.g., standard and modified recognition paradigms) which do not readily permit examination of the dual operation of these processes.

7.2.1 Trace-alteration models

Proponents of storage-based models such as trace-alteration / overwriting (e.g., Loftus, 1979, 1995, 1997; Loftus & Hoffman, 1989; Loftus et al., 1992; Loftus et al., 1978) argue that memory traces for originally witnessed events are altered, degraded, or updated by the introduction of misleading suggestions. In these models the misinformation effect can be explained as an unconscious or automatic memory process (e.g., Loftus, 1997). Misleading suggestions engender an automatic updating

of the original information resulting in permanent loss of this information from

storage.

Table 27

<u>Automatic and intentional (recollection) memory processes and models of the</u>

<u>misinformation effect</u>

Misinformation Model	Automatic / Intentional processing of suggestions?	Implications for Misinformation models
Trace-alteration (e.g., Loftus et al., 1978)	Automatic	Not supported
Trace strength (e.g., Brainerd & Reyna, 1998)	Automatic & Intentional	Supported
Trace competition (e.g., Bekerian & Bowers, 1983; Chandler & Gargano, 1998; Morton, 1991)	Automatic	Not supported
Social demands / Response bias (e.g., McCloskey & Zaragoza, 1985a)	Intentional	Not supported
Source-monitoring (e.g., Johnson et al., 1993)	Automatic (& intentional[a])	Not supported

<u>Note</u>. [a] Lindsay (1994) proposed that participants may intentionally deliberate the source of their

memories.

Although a large automatic component to suggestibility was found in all the studies,

the additional finding that children were able to intentionally exclude misleading

details demonstrates that the original event memory traces were not permanently affected. The fact that this effect was also demonstrated in a reversed misinformation design in which misleading suggestions were given *before* the original event details provides strong evidence against the proposal that new information alters or overwrites the old information.

7.2.2 Trace-strength models

Trace-strength models of the misinformation effect such as fuzzy-trace (e.g., Brainerd & Reyna, 1998; Brainerd et al, 1998: Reyna & Brainerd, 1998) hold the view that children report misleading suggestions on the basis of either intentional recollection (e.g., verbatim traces of a misled item's surface form) or automatic memory processes (e.g., gist traces representing a misled item's semantic, relational, and elaborative attributes). The strength of verbatim and gist traces are differentially affected by factors such as length of the retention interval, age, and encoding manipulations (Brainerd & Reyna, 1998). Manipulations that strengthen the level of the encoded features of the memory trace in storage will also increase the recollection component (Brainerd et al., 1998). The current findings of most of the experiments in this series are generally consistent with this view. Specifically, in *all* the current studies, it was found that both intentional recollection and automatic processes contributed to misinformation effects in children, and that the contribution of conscious recollection to such effects was greater when the misinformation was generated in response to semantic and linguistic cues.

Several researchers believe that the strength of the misinformation effect obtained in children is associated with conditions that affect trace strengths of the original event and post-event memory traces (e.g., Ceci et al., 1988; Holliday et al., 1999;

Marche, 1999). Children are more vulnerable to misleading suggestions when the original trace is weak and the post-event trace is strong (Holliday et al., 1999). The findings from the current research that generating misleading suggestions potentiated the misinformation effect accords with this account.

7.2.3 Retrieval interference models

These models explain the misinformation effect in terms of retrieval failure (Bekerian & Bowers, 1983; Chandler & Gargano, 1998; Christiaansen & Ochalek, 1983; Morton, 1991; Morton et al., 1985). The original memory trace is "blocked" by the presence of the more recently encoded misinformation. The headed records model of Morton and his colleagues (Morton, 1991; Morton et al., 1985) (see Section 1.3), assumes that both the original and post-event misinformation are represented in memory by two discrete permanent headed records. According to Morton (1991), retrieval of a specific record is an automatic process that occurs outside of awareness.

The finding of an intentional component to the acceptance of suggestions based on self-generated items in all of the current studies is not consistent with this account, and indicates that misinformation effects are not based entirely on automatic competition between traces at retrieval. Moreover, the finding of suggestibility effects in a reversed design is inconsistent with the view that that new information "blocks" retrieval of the original event details (Morton et al., 1985). However, the findings from the first four experiments that self-generated misinformation was more likely to be excluded by the children than read misinformation does support the general assumption that is shared by trace strength and retrieval interference models that the memory traces of both the original event and post-event memory traces co-exist at the point of retrieval.

7.2.4 The source-monitoring hypothesis

According to source-monitoring accounts of the misinformation effect (e.g., Ackil & Zaragoza, 1995; Johnson et al., 1993; Lindsay, 1994; Lindsay & Johnson, 1989a; Multhaup et al., 1999), children erroneously report misleading suggestions due to confusions of the sources of their memories. As mentioned earlier (see Section 1.11), the source-monitoring hypothesis and the process dissociation model are concerned with different aspects of recognition memory judgments. The source-monitoring model characterises decision-making strategies when making a recognition memory judgment, whereas the process dissociation procedure provides estimates of the distinct contributions of the memory processes underlying a recognition memory judgment.

The source-monitoring hypothesis proposes that whether participants adopt an undifferentiated or a strict decision criterion when making a source-monitoring judgment is dependent on the amount of source-specifying information about the target item and the encoding context (e.g., perceptual, spatial, temporal, semantic details) available in memory (Dodson & Johnson, 1996; Johnson et al., 1993; Multhaup et al., 1999). Participants will be less likely to accept misinformation if they are oriented toward source-monitoring judgements (Johnson et al., 1993, Lindsay & Johnson, 1989a) and when the sources of the original event and post-event suggestions are highly discriminable (Lindsay, 1990). The exclusion instruction condition of the process dissociation procedure resembles a source-monitoring test in that under exclusion instructions participants must identify the source of the misinformation in order to exclude it. Indeed, Johnson et al. (1993) and others (e.g., Buchner et al., 1997; Dodson & Johnson, 1996; Fyffe, 1997) have proposed that

participants will be less likely to report misinformation if they are directed toward making source-monitoring judgements on the basis of intentional recollection rather than on the basis of the familiarity of the information.

In the present research, conditions were established that encouraged a high level of discrimination between sources. For example, a different experimenter was employed to provide misleading suggestions, and in Experiments 1 – 4, children were given the misleading suggestions one day after presentation of the original event. The current research found that children were more likely to intentionally exclude suggestions that were self-generated, providing some support for the source-monitoring account. These findings accord with previous research in which misinformation effects are eliminated when participants are given a source-monitoring test (e.g., Lindsay & Johnson, 1989a; Multhaup et al., 1999; Zaragoza & Koshminder, 1989). Importantly, however, in a misinformation paradigm that parallels traditional misinformation designs, the current research found that children were still more likely to accept suggestions that were "read" aloud to them even when they were explicitly asked to exclude such items, an effect that was almost entirely due to underlying automatic memory processes. As has been reported by other researchers (e.g., Belli et al., 1994; Carris et al., 1992; Lindsay, 1990; Zaragoza & Lane, 1994), therefore, the present research found that misinformation effects persist in tests that direct children to make source-monitoring judgements.

The current findings in a reversed misinformation design (i.e., Experiment 5) were consistent with a source-monitoring account of the misinformation effect. As predicted by the source-monitoring hypothesis, on the standard test it was found that children were just as likely to mistakenly attribute the source of their memories to the

misinformation instead of to the original event information when it was presented before the original event as to when it was presented after the original event information (Johnson et al., 1993; Lindsay & Johnson, 1989b). However, contrary to the predictions of the source-monitoring view an intentional recollection component was found for suggestions that were self-generated in a reversed misinformation design.

7.2.5 Social demands / response bias hypotheses

Alternate models of the misinformation effect in children argue that misleading suggestions are intentionally reported because of the social demands of the experimental situation such as compliance with the information provided by adult questioner who is perceived as an authoritative and trustworthy source (Bruck & Ceci, 1999; Cassel et al., 1996; Ceci et al., 1987b; Lampinen & Smith, 1995). Children may also report misleading suggestions due to response biases (i.e., because the misinformation is the most recently presented) inherent in the "standard" (Loftus et al., 1978) eyewitness memory paradigm (McCloskey & Zaragoza, 1985a). A related proposal is that young children report the misinformation because they wish their responses to be consistent with the perceived intent of the questioner rather than with their memories of the original event (Bruck & Ceci, 1999; Newcombe & Siegal, 1996, 1997). These views predict that the misinformation effect has a large recollective or intentional memory component in that children are seen to make a deliberate, conscious decision to report the suggested item based on the social context and / or pragmatic cues present at the time of testing. In other words, if young children believe that the experimenter is a reliable source of information, or if children wish to be viewed favourably by the experimenter, they may consciously "deliberate" that the

suggested item is the correct item.

In these experiments, the absolute magnitude of the contribution of intentional processing to acceptance of misleading suggestions was rather small in comparison to that of automatic processes. Nevertheless, the contribution of intentional processing to misinformation acceptance was found to increase under "generate" conditions that promoted elaborative encoding of suggestions. Hence, the present research demonstrates that "intentional suggestibility" which may be motivated by social and / or pragmatic influences may be determined by the specific conditions that hold when suggestions are encoded and retrieved. When children are directed to engage in more elaborative encoding of suggestions then the contribution of intentional processing to subsequent acceptance of suggestions increases.

Further evidence for the role of social demand factors in producing suggestibility was found in Experiment 3. For the 9-year-old children in this experiment, suggestibility effects found on the standard test were eliminated when these children were given a modified test (cf. Zaragoza, 1991). For the 5-year-old children, the contribution of intentional processing to suggestible responding was lower in the modified testing paradigm than in the standard testing paradigm. Suggestibility, however, was still evident in the younger children given a modified test, an effect that was, for the most part, due to automatic processes. When children were given a yes / no retrieval test (cf. Belli, 1989) in Experiment 4, however, no evidence was found for the role of social demand factors in producing suggestibility. This discrepancy between the two sets of findings suggests that social demand / response biases may play a greater role in the standard forced-choice testing paradigm than in a yes / no retrieval paradigm.

7.2.6 Conclusions concerning the existing models of suggestibility

To summarise then, the assumptions underlying the trace-alteration and the trace competition (i.e., "blocking") accounts concerning the role of memory processes in producing the misinformation effect are untenable in light of the current findings. Similarly, the notion that original event memory traces are automatically altered or "blocked" by the introduction of misinformation was not supported. However, the co-existence of original event and post-event memory traces at the point of retrieval, an assumption shared by both trace strength and retrieval interference models, was supported by the findings from the first four experiments such that children were more likely to exclude self-generated suggestions than read suggestions. The finding that self-generated suggestions potentiated children's acceptance of misinformation is consistent with a trace-strength account in that the magnitude of suggestibility effects obtained with children is related to conditions that affect the relative strength of original and post-event memory traces. A number of aspects of the current findings accord with a source-monitoring account of the misinformation effect, namely children's ability to exclude self-generated suggestions in an instruction condition that resembles a source-monitoring test, and the finding of a misinformation effect on the standard test in a reversed misinformation paradigm. However, other aspects of the current research are less consistent with the source-monitoring account. Even though experimental conditions were established that enhanced source discriminability, when suggestions were read to children, they remained suggestible even when expressly instructed to exclude such suggestions. Finally, the experiments reported here indicate that the social demand / response biases view is only tenable in certain situations (e.g., in the standard testing paradigm, and when the encoding conditions

promote the elaborative processing of suggestions) and is rarely the primary cause of recognition errors.

7.3 Developmental changes in memory processes underlying the misinformation effect

As discussed previously, it is commonly agreed that both social and memory-based factors are implicated in children's suggestibility. However, the issue of whether or not there exist developmental differences in the size of the misinformation effect and in the causal processes that underlie suggestibility in children of different ages continues to be debated (Bruck & Ceci, 1999; Bruck et al., 1997; Ceci et al., 1998). The design of the current research enabled the examination of *both*: (1) age-related changes in the size of the suggestibility effect, and (2) age-related changes in the underlying memory processes.

Consistent with previous research in which few developmental differences in levels of suggestibility have been found for elementary school-age children (e.g., Ceci et al., 1987b; Coxon & Valentine, 1997; Duncan et al., 1982; Holliday et al., 1999; Lindsay et al., 1995; Marin et al., 1979), the present research found only minimal evidence of age-related changes in 5-, 8- and 9-year-old children's suggestible responses across a wide range of recognition tests. In the modified testing paradigm, however, age-related changes in levels of suggestibility were found. Specifically, for misleading suggestions that were self-generated in response to semantic and linguistic cues, only the 5-year-old children demonstrated a misinformation effect. Because the modified test effectively eliminates the possibility of deliberate or intentional processes influencing suggestibility this set of findings suggests that the younger children are *more* likely than the older children to accept suggested items

automatically on the basis of familiarity.

Although the overall probability of accepting misinformation did not vary across the age range tested in Experiment 2, the process dissociation analysis did uncover an interesting developmental trend in the processes underlying children's reporting of suggestions. In both Experiments 1 and 2, the contribution of automatic processing to acceptance of misinformation declined with age while the role of intentional processing remained relatively stable. According to the process dissociation analysis, misinformation acceptance in 5-year-olds was more likely to be the result of an automatic process. This pattern of findings is particularly significant in that it shows that levels of misinformation acceptance, as indexed by "yes" responses on a yes / no recognition test which remain invariant across age can actually be mediated by different kinds of underlying memory processes. More importantly, this result demonstrates that there was still evidence of a developmental change in the cognitive processes underlying acceptance of suggestions despite the absence of such a pattern in the raw data. These findings should, however, be interpreted with some caution as this developmental decline in automatic contributions to suggestibility was not found in every recognition paradigm (see Experiments 3 & 4). Nevertheless, the findings of Experiments 1 and 2 do suggest that models that posit "automatic" acceptance of misleading suggestions may be somewhat more applicable to the recognition responses of younger as opposed to older children. The findings that, in general, young children are less efficient at encoding information (Bjorklund & Douglas, 1997; Loftus & Davies, 1984), forget information at a faster rate (Brainerd et al., 1990, Howe, 1991), and are less proficient at applying memory strategies than older

children (Kail, 1990), may contribute to this increased propensity for familiarity-based responding to suggested items at test.

Notably, the present research findings contradict the reported developmental invariance of implicit memory from preschool to adolescence (e.g., Anooshian, 1997, 1999; Hayes & Hennessey, 1996; Russo et al., 1995). As previously discussed, there has been extensive debate surrounding the assumption that performance on implicit and explicit tasks reflect "process-pure" measures of underlying automatic and intentional memory processes, respectively (e.g., Dunn & Kirsner, 1989; Jacoby, 1991). The current findings demonstrate that performance on nominally "explicit" tasks (e.g., recognition) reflects the joint operation of both automatic and intentional processes.

7.4 Limitations of the Process Dissociation Procedure

7.4.1 Validity of the independence assumption and the problem of response biases

As discussed earlier in this thesis (see Sections 1.9.6 & 1.9.7), the validity of certain assumptions of the process dissociation model has recently been questioned. In particular, the independence assumption of process dissociation holds that the criterion for responding is invariant across inclusion and exclusion conditions and / or between the participant groups being compared (Jacoby, Toth, & Yonelinas, 1993; Yonelinas et al., 1995). The current series of studies addressed these concerns by calculating process dissociation estimates within-participants (i.e., Experiments 2, 3, 4, & 5) (cf. Jacoby and Shrout, 1997), and by applying a logistic-based correction model (cf. Yonelinas & Jacoby, 1996a) when response bias differed between age groups.

Dodson and Johnson (1996) reported that estimates of automaticity obtained using the process dissociation procedure (cf. Jacoby, 1991) were affected by manipulations of attention (i.e., full versus divided), and the proportion of old items on the test. Such effects, they argued, were evidence of a violation of the assumption of the independent contribution of automaticity and intentional recollection to recognition. They proposed that their findings demonstrated that recognition on the basis of familiarity is not always an automatic process, but can also be made strategically; that is, on the basis of intentional control. Dodson and Johnson concluded that there was no basis for the existence of two distinct underlying processes in recognition. Instead, consistent with a source-monitoring account, recognition judgements were assumed to be made on the basis of a continuum of source specificity, ranging from memories that contain little source information that will be judged as "familiar" to memories that contain a great deal of source information that will be "recollected" (Dodson & Johnson, 1996; Gruppuso et al., 1997). In contrast to the procedure followed in Experiments 2 to 5 in the current series, Dodson and Johnson's findings were based on process dissociation estimates that were calculated between-subjects (cf. Curran & Hintzman, 1995). As previously mentioned (see Section 1.9.6), Jacoby and Shrout (1997) showed that process estimates which were calculated within-participants had no effect on the size of the obtained estimates (see also Gruppuso et al., 1997).

Dodson and Johnson (1996) also reported evidence of a violation of the process dissociation assumption that the contribution of recollection and automaticity to recognition is invariant across inclusion and exclusion conditions. They point out that Jacoby's (1991) process dissociation equations imply that a correct recognition on the exclusion test of an item for which no misinformation is given must be the result of

recollection alone or familiarity in the absence of recollection. More formally, in the current context:

P (correct recognition of original control item | exclusion test) = R + F (1-R)   (5)

This means that if the assumption of process independence is correct then the probability of correctly recognising control items in the inclusion condition should equal the probability of correctly recognising control items in the exclusion condition.

Dodson and Johnson (1996) found a violation of this prediction such that the correct recognition of words presented as anagrams was lower in an exclusion test condition than in an inclusion condition. In the current series of studies, however, the predicted equivalence of recognition of control items across inclusion and exclusion conditions was generally upheld. For example, in the yes / no recognition paradigm of Experiment 2 (see Chapter 3) correct acceptance of control items (seen in Phase 1 and heard in Phase 2) was identical for inclusion ($\underline{M}$ = .62) and exclusion conditions ($\underline{M}$ = .62). Similarly, in Experiment 3 correct recognition of control items on the standard forced choice test was similar in the inclusion condition ($\underline{M}$ = .69) and the exclusion condition ($\underline{M}$ = .70). The present research, therefore, found no evidence that the contribution of recollection and automaticity to recognition of control items varied according to inclusion and exclusion instruction conditions.

7.4.2 Floor and ceiling effects in recognition performance

A further concern in applications of the process dissociation procedure is the possibility that certain participants may exhibit "perfect" recollection of Phase 2 information in the inclusion and exclusion conditions leading to scores of one and zero across test items. No consensus yet exists amongst process dissociation researchers about how to deal with this problem. While a number of commentators

have expressed concerns about the inclusion of such participants in data analyses (e.g., Russo et al., 1998), others (e.g., Curran & Hintzman, 1995; Horton & Vaughan, 1999) have suggested that removing participants with perfect recollection on the inclusion and exclusion conditions (one and zero, respectively) in within-subjects designs results in biased process estimates. Because the deletion of children with scores of one or zero on inclusion or exclusion tests would have resulted in a significant attrition of participants from Experiments 2 - 5, in the present research we opted to include all children who complied with test instructions. Participants' individual scores were first "corrected" to set scores of one and zero just below one and just above zero, respectively (cf. Hayes & Hennessey, 1996; see also Horton & Vaughan, 1999). The fact that this practice did not result in a systematic bias in the derivation of automaticity and recollection estimates is indicated by the similarity between the estimates for Experiments 2 - 5 and the group-based estimates derived in Experiment 1 where the problem of individual ceiling-level performance did not arise.

7.4.3 Participant adherence to process dissociation instructions

Graf and Komatstu (1994) proposed that some participants could have difficulty in following the instructions to exclude test items presented in an earlier experimental phase. This issue was addressed in the present research by the inclusion of a set of practice pictures that assessed children's understanding of the test instructions prior to both the inclusion and exclusion retrieval tests. Despite this methodological innovation, children in Experiment 4 in the Event information condition appeared not to follow the instructions to exclude the misled details presented in Phase 2. However, in this particular experiment it is likely that children became confused when they were presented with the original item that had been previously shown in Phase 1.

In this condition, the practice pictures did not match the test situation. Apparently, these children interpreted test instructions such that they either excluded or included the *original detail* rather than the misled detail. Hence, process dissociation estimates were not calculated for the Event information condition.

Graf and Schacter (1994) and others (e.g., Buchner et al., 1995; Curran & Hintzman, 1995) have noted that difficulties in following test instructions are particularly problematic when inclusion and exclusion instructions are manipulated between-subjects. In all but the first study the current research program followed the recommendation of Yonelinas and Jacoby (1996a) and manipulated inclusion and exclusion instructions within-subjects. Hence, individual estimates of automaticity and recollection were entered into standard analysis of variance procedures to provide a more stringent analysis of the effects of age and the read / generate encoding of suggestions.

7.4.4 Missing capabilities

Brainerd et al. (1998) proposed that the process dissociation model is limited by a number of missing capabilities. Specifically, these researchers argued that because the model lacks a test of goodness-of-fit, there is no certainty that the dual-process estimates generated by the model could not have been generated by a single process (e.g., Ratcliff, Van Zandt, & McKoon, 1995). This problem will be examined in detail in a later section (see Section 7.5.1). Moreover, Brainerd et al. point out that the process dissociation model is unable to measure automatic and recollective processes for false alarms to new items (e.g., Brainerd, Reyna, & Brandse, 1995). The present research addressed this latter concern in Experiments 3 and 4. Specifically, in the modified testing paradigm of Experiment 3 and the novel

information condition in Experiment 4, children responded at test to "new" items that had not been previously seen or heard. In these conditions it was found that while both recollective and automatic processes contributed to children's acceptance of a novel alternative to a misled item, such acceptance was predominantly due to automatic processes.

7.4.5 Limitations of process dissociation as applied to misinformation paradigms

The current series of studies represent one of the first attempts to apply the process dissociation procedure to the misinformation paradigm. While such analyses have revealed much about automatic and recollective contributions to suggestibility the current experiments have also exposed some conceptual and procedural limitations.

On the conceptual side, while process dissociation analysis has helped to discriminate between assumptions of some established models of suggestibility (see Table 27), a process dissociation analysis *alone* cannot evaluate the validity of these theories. For example, in the current research program it was only possible to test different memory interference models using a combination of process dissociation and innovative experimental designs (e.g., reversed misinformation procedure). Further, use of the process dissociation procedure will not eliminate the need for careful design and analysis of "raw" recognition rates in part because there are certain conditions under which process dissociation procedures do not yield much interesting information (e.g., the modified tests of Experiments 3 & 5).

7.5 Relationship between the current approach and alternative models

7.5.1 Conjoint-recognition

Brainerd and colleagues (e.g., Brainerd & Reyna, 1998; Brainerd et al., 1998; Brainerd et al., 1999) developed a multinomial "conjoint-recognition" model with the aim of evaluating the independent contributions of intentional recollection and automatic processes to children's recognition. The model's core assumptions are incorporated in fuzzy trace theory's distinction of "identity-similarity" (Brainerd et al., 1999). Fuzzy-trace theory holds that verbatim memories (i.e., an item's surface form) and gist memories (i.e., an item's semantic and relational details) are stored in parallel (see Section 1.3.1). At test, recognition of a verbatim memory is made on the basis of identity (cf. recollection) and gives rise to a feeling of explicit remembering. In contrast, recognition of a gist memory is made on the basis of the similarity of target items to stored traces (cf. familiarity) (Brainerd et al., 1999).

This model has been evaluated with adult (Brainerd et al., 1999) and developmental data (Brainerd et al., 1998). For example, Brainerd et al. (1998) gave 7- and 10-year-old children a continuous yes / no word recognition task in which a response was made as each word was presented. Specifically, children listened to a list of concrete nouns and nonsense words and then responded under one of two instructional conditions; "accept only target items" or "accept only related items". Evidence was reported of validation of the model with regard to goodness-of-fit, invariance of estimates of recollection and automaticity both within and between conditions and invariance of such estimates according to instructional conditions. Brainerd et al. (1999) concluded that the conjoint-recognition model holds an

advantage over the process dissociation model because the former incorporates goodness-of-fit tests and can measure automatic and recollective processes for false alarms to new items (see Sections 1.10.7, & 7.4.4).

Brainerd and Reyna (1998) outlined a modified version of the conjoint-recognition model, "MISINFORM" for modelling data obtained from misinformation studies. In the conjoint-misinformation paradigm children respond yes" or "no" under three instruction conditions; "accept only target items (T) ", "accept only related items (R)", and "accept targets and related distractors" (T + R) (Brainerd et al., 1998). Traditional misinformation designs employ only the "T" instructions with the aim of examining children's acceptance of misinformation (Brainerd et al., 1998). Using simulated data generated from misinformation studies with children aged 4 and 10 years (i.e., Pezdek & Roe, 1995, 1997; Warren & Lane, 1995), Brainerd et al. (1998) showed that acceptance of misinformation was made on the bases of identity (cf. recollection) and similarity (cf. familiarity), and that similarity judgements increased with age.

There is little doubt that the conjoint-recognition paradigm is an innovative and valuable approach to examining children's recognition memory. However, further modification of the paradigm may be necessary before it can be applied to children under 7 years of age. First, in order to avoid high rates of forgetting, Brainerd et al. (1998) employed a continuous recognition paradigm in which children accepted or rejected a list of 200 words as each item was presented. Such a task would be developmentally inappropriate for very young children because of the large number of test items and the fact that a junior grade-school level of reading ability is assumed. Second, the "R" instructions, that is the instruction to give a "yes" response to a word

related to a previously presented word ("related distractor"), and a "no" response to a

word that is unrelated to a previously presented word ("unrelated distractor"), may

cause young children to become confused (Cowan, 1998). In essence, "R"

instructions require children to make judgements concerning an item's physical and

semantic relatedness to a target item (Brainerd et al., 1998). As Reyna and Brainerd

(1998) acknowledge, this task is considerably more difficult than simply judging

whether an item has been seen before or not. The current research found that 5-year-

olds had great difficulty following the test instructions to include items for which they

had been given misleading details (i.e., "yes" response to a misled item) when these

instructions were given *after* they had been informed that the experimenter had made

some errors in their post-event narrative (see Chapter 3). The effect of such

confusions is one of artificially lowering acceptance of misleading details in the

inclusion condition. Given these concerns, it is argued that at this point, the process

dissociation paradigm is a more suitable paradigm for understanding the processes

underlying recognition memory in younger children. Nevertheless, future research

using the conjoint recognition model, with modifications to the stimuli used and to the

test instructions, may supplement our understanding of the cognitive processes

underlying children's suggestibility.

7.5.2 Threshold-, signal-detection, and process dissociation models

As mentioned previously (see Section 1.10.3), Jacoby (1991) developed the

process dissociation model for separating the relative contributions of recollection and

automatic memory processes to recognition memory performance. In this model,

recollection and automaticity are defined in terms of the degree of intentional control;

the probability that an item is recollected is the difference between intentionally

reporting and intentionally not reporting an item. In contrast, an item will be recalled automatically if it cannot be intentionally recollected but is, nevertheless sufficiently familiar to be judged as having been seen before. The validity of process estimates obtained using this model relies on the assumption that participant's criterion for responding does not vary in the inclusion and exclusion conditions and / or between the groups being compared (see Section 1.10.7).

In order to address the problems of response bias, Yonelinas and colleagues (Yonelinas, 1997; Yonelinas & Jacoby, 1996a; Yonelinas et al., 1995) employed classic signal-detection theory in order that separate estimates of response bias could be obtained for the inclusion and exclusion conditions. Yonelinas and colleagues' dual-process signal-detection model redefines automaticity (familiarity) as a signal-detection process. In this model, the automaticity term in the original Jacoby (1991) equation (see Section 1.10.3) is replaced by a function that represents the probability that an item will be judged as familiar if it exceeds the response criterion set by participants (Yonelinas & Jacoby, 1996a).

The dual-process signal-detection model (e.g., Yonelinas & Jacoby, 1996a) combines aspects of *both* high-threshold (e.g., Batchelder & Riefer, 1990) and classic signal-detection (e.g., Green & Swets, 1966) theories of recognition memory. Intentional recollection reflects a "high-threshold" process based on qualitative aspects of an event such that recollection of a studied item is achieved by exceeding a memory threshold. Familiarity judgments, on the other hand, are made on the basis of a continuum of familiarity with previously presented items lying at the upper end of the continuum and new items lying at the lower end of the continuum (Yonelinas et al., 1996). Although the Yonelinas and Jacoby (1996a) generated parameter estimates

were different to those obtained with the Jacoby (1991) procedure, the two sets of parameters were found to be affected in very similar ways by manipulations of participant age and item encoding (see Experiments 1 & 2).

7.6 Implications for children's eyewitness testimony

The current finding that both automatic and intentional memory processes contributed to the acceptance of misleading suggestions has a number of important implications for children's testimony. First, the fact that automatic memory change following presentation of suggested items occurred more frequently for the younger children (i.e., in Experiments 1 and 2) indicates that professionals involved in questioning children about events in which they have been participants or witnesses need to be especially careful about the presentation of misleading information to these children. Evidence from specific cases (e.g., Ceci & Bruck, 1995) indicates that children can be exposed to repeated and / or suggestive questioning and negative feedback regarding their performance on multiple occasions by a variety of law enforcement officials, therapists, and legal representatives. The current finding that misinformation effects were strongly influenced by automatic processes, with the younger children disproportionately affected, indicates that warning such children to disregard leading questions may have only limited effectiveness in preventing the subsequent reporting of these suggestions. This notion is supported by the observation that when suggestions were read children remained suggestible even when they were explicitly instructed that the experimenter had made errors in the post-event narrative.

Importantly, the present research also suggests that questioning techniques that inadvertently encourage children to generate a suggested detail may be even more

detrimental to the accuracy of subsequent testimony than the overt provision of a

suggestion by the questioner. In a somewhat similar vein, researchers have found that

generating a mental image of events that *did not* occur in their childhood (e.g.,

breaking a window) increases the subjective likelihood that such events actually

occurred (Garry, Manning, Loftus, & Sherman, 1996; Hyman & Pentland, 1996).

The negative effects of asking children to generate memories of a witnessed event

on their subsequent memory reports are documented in several key criminal trials

involving sexual abuse in day-care centres in the United States (i.e., *Little Rascals,*

McMartin, Wee Care, Old Cutler) (Bruck & Ceci, 1999; Ceci & Bruck, 1995; Garven,

Wood, Malpass, & Shaw, 1998). Children in these cases were frequently subjected to

therapeutic interventions (e.g., imagery induction) and investigative techniques that

directed them to speculate or "think hard" about events that *might* have happened to

them (Ceci & Bruck, 1995). In the *McMartin Preschool* case, for example, these

techniques were most often employed when alternate means failed to result in

allegations of abuse. Researchers have reported that young children who are

repeatedly encouraged to imagine or visualise false events come to believe that such

events actually occurred and provide elaborate descriptions of the contextual and

emotional details surrounding these events (e.g., Ceci, Huffman, Smith, & Loftus,

1994; Ceci, Loftus, Leichtman, & Bruck, 1994).

The findings that children remained suggestible in a reversed misinformation

design in which misleading suggestions were presented *prior* to the original event

information is also somewhat analogous to the situation faced by many child

eyewitnesses. In a similar vein, Leichtman and Ceci (1995) examined the effect of

stereotypes on 3- to 6-year-old children's memories of a subsequent visit by "Sam

Stone". At weekly intervals *before* Sam's visit, children were read stories that

portrayed Sam as a good-hearted but awkward person. Ten weeks *after* Sam's visit,

children were given a interview that included two leading questions about actions that

Sam did not perform (e.g., destroying a book, dirtying a teddy bear). Significantly,

over 30% of the children reported that Sam performed at least one of these actions. In

other words, children's false reports were based on their negative stereotypes of

"Sam" induced *before* he actually visited the preschool.

   In the forensic context, the impact of negative stereotypes on children's reports of

an event can be seen in allegations of sexual abuse made by preschool children in the

Little Rascals Day Care and the *McMartin Preschool* cases, and in the 1987 death

row case of *Frederico Macias* in Texas (see Ceci & Bruck, 1995, for an extensive

review). In the latter case, for example, it was clear that the child's eyewitness reports

of a murder were influenced by negative information about the suspect provided to

the child by her parents *prior* to the episode which the child was alleged to have

witnessed.

   The finding that 5-year-old children's memories of a witnessed event were

deleteriously affected by the introduction of misleading suggestions *before* a

witnessed event indicates that professionals should be especially careful to avoid

questioning that could result in the induction of negative stereotypes (Ceci &

deBruyn, 1993; Leichtman & Ceci, 1995) in young children. Moreover, this research

demonstrates that memory change following the presentation of misleading

suggestions before a witnessed event was, for the most part, attributable to automatic

processes. Such findings imply that warning children to discount misinformation and

pre-existing stereotypes may be an insufficient measure to prevent the subsequent

reporting of these suggestions.

7.7 Future directions

7.7.1 Process dissociations and preschool children

The consensus in the misinformation literature is that children, especially very

children (i.e., 3- and 4-year-olds), are disproportionately affected by the introduction

of post-event misinformation (e.g., Ceci et al., 1987b). However, the nature of the

mechanisms responsible for these effects continues to be debated. The current

research uncovered evidence of age-related changes in the cognitive processes

underlying acceptance of suggestions in the absence of any change in the probabilities

of reporting such suggestions. It would be extremely useful, therefore, for future

research to employ the process dissociation methodology with the aim of identifying

the relative contribution of basic memory processes to suggestibility effects in 3- and

4-year-old children as compared to older children. This would permit an examination

of whether the elevated levels of suggestibility shown by such children are mediated

by the same memory processes as the acceptance of suggestions by the age groups

tested in the current series of studies. In particular, it would be of much interest to

examine whether such increased suggestibility to suggestion is mediated by an

increase in the automatic processing of suggestions, as implied by the age trends

observed in Experiments 1 and 2.

7.7.2 Process dissociation and cued-recall tests

Only a relatively small number of misinformation studies with children have

employed cued-recall tests (e.g., Hayes & Delamothe, 1996; Howe, 1991; Howie,

Booyens, Cooke, & Gibbs, 1996; Laumann & Elliott, 1992; Ochsner, Zaragoza, &

Mitchell, 1999). In these studies, children are presented with non-leading and misleading questions about their memories for a witnessed event. In order to adapt the current research methodology to a cued-recall paradigm, the process dissociation equations could be applied to responses to questions for which children had received misleading suggestions such as: "What colour jellybeans did the kangaroo-nappers feed Zippy?" The base rate for finding a misinformation effect in a cued-recall paradigm is likely to be low (cf. Howe, 1991) in comparison to the current series that employed recognition tasks. However, the process dissociation paradigm would permit an examination of whether there are differences in the level of automatic and intentional processing of suggestions in recognition and cued-recall paradigms. Moreover, a cued-recall paradigm would be more ecologically valid than a recognition paradigm in that it would more closely resemble the forensic context in which children are questioned following a witnessed event.

7.7.3 Intentional and automatic processes and other memory distortions

In a recent series of studies, Mazzoni and her colleagues (e.g., Mazzoni & Loftus, 1996; Mazzoni, Loftus, Seitz, & Lynn, 1999) examined whether information from dreams can be mistakenly recollected as having occurred in real life. Mazzoni and Loftus (1996), for example, presented college students with a list of words, then the next day gave students another word list that incorporated words from a self-reported dream. One day later, students were given a list containing words from both previous experimental phases and were instructed to report only words that were in the original list. Participants also made "remember" judgements if a word was consciously recollected and "know" judgements if a word appeared familiar but could not be consciously recollected (cf. Gardiner, 1988). Mazzoni and Loftus found evidence of a

substantial misinformation effect such that "dream" words were incorrectly reported as often as the original list words. Moreover, the majority of these words were assigned "remember" judgements.

Mazzoni and Loftus (1996) suggest that perhaps the dream words elicit a greater sense of familiarity which is at odds with the view that "remember" and "know" judgements reflect conscious recollection and familiarity, respectively (e.g., Gardiner & Java, 1993). It is suggested that the process dissociation paradigm (cf. Jacoby, 1991; Jacoby et al., 1993) would throw some additional light on these findings especially given the limitations of the remember / know procedure including the reliance on subjective states of awareness as the sole measure of conscious recollection and the assumption that remembering and knowing are mutually exclusive processes. As discussed previously (see Section 1.10.2), self-reported states of awareness are influenced by social demand factors and as such, will vary across test sessions and contexts (Reingold & Toth, 1996; Strack & Forster, 1995). Moreover, Jacoby and others (e.g., Gruppuso et al., 1997; Jacoby, 1991; Jacoby et al., 1999) have demonstrated that performance on a given task reflects the simultaneous operation of both conscious recollection and automatic memory processes.

7.8 Summary and conclusions

It is well established that the misinformation effect in children frequently arises because of some change in the way that children process the memory traces of witnessed and suggested information (Ceci & Bruck, 1993, 1999). Hence, recent developments in memory theory such as the advent of the process dissociation procedure are likely to inform and extend our understanding of the causal processes that lead to suggestibility. The present research demonstrates the usefulness of

applying process dissociation methodology to studying children's acceptance of misinformation. Such a procedure allows for estimations of the contribution of automatic (e.g., automatic updating) and intentional (e.g., demand bias, pragmatic effects) processes in children's suggestible recognition responses. Even more importantly, this method allows one to examine how the contribution of these processes varies across age and particular encoding and retrieval conditions. Misinformation research has identified certain conditions that affect the magnitude of obtained suggestibility effects (e.g., retention interval, whether "standard" or "modified" tests are given, repeated suggestions, repeated questioning, and memory trace strength of original and post-event details). Future research in this field, therefore, should focus on applying the process dissociation methodology to such variables that are known to affect misinformation acceptance in children. Another important point demonstrated here is that although there may be no overall change with age in the probability of reporting a suggestion there *may still* be developmental change in the cognitive processes underlying acceptance of suggestions. Future investigations, therefore, should not just focus on whether misinformation acceptance changes with age but also whether the mechanisms that give rise to acceptance of misinformation undergo change.

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Appendix A

Process dissociation equations for unequal base rates (cf. Yonelinas & Jacoby, 1996a)

These are designed to calculate independent estimates of recollection and familiarity when base rates for saying "old" are unequal across Inclusion and Exclusion conditions (i.e., when false alarm rates for these two groups are not equivalent).

$$R = - (O_e - O_i - 1)/2 - \{(O_e - O_i - 1)^2 - 4[O_i (1 - O_e) - O_e (1 - O_i)N_i(1 - N_e)/N_e(1 - N_i)]\}^{1/2}/2 \quad (a1)$$

$$F = \ln[(O_i - R)(1 - N_i)/(N_i(1 - Oi)] = \ln[O_e(1 - N_e)/N_e(1 - R - O_e)] \quad (a2)$$

where

O_i = Probability of saying "yes" to a suggested item on a yes / no test or selecting a suggested item on a forced choice test in the inclusion condition

O_e = Probability of saying "yes" to a suggested item on a yes / no test or selecting a suggested item on a forced choice test in the exclusion condition

N_i = Probability of accepting a new item in the inclusion condition

N_e = Probability of accepting a new item in the exclusion condition

The probability of choosing a suggested item on the basis of familiarity given a false-alarm rate of x is:

$$(xe^\mu) / (1 + xe^\mu - x) \text{ where } e \text{ refers to the base of the natural logarithm.} \quad (a3)$$

Using these equations R appears as a simple probability and F is measured as the logistic equivalent of d′ (i.e., can be > 1.0).

Appendix B

<u>Stimulus materials for Experiment 1</u>

<u>Practice pictures and an example of target item pictures used in Experiments 1-5</u>

The complete set of colour pictures are available from the author.

Hints for Misled Items Generated at Phase 2 in Experiments 1-4 and at Phase 1 in Experiment 5

1. kitchen: This is the room people cook in; the stove is in here

   bedroom: This is the room you sleep in at night; your bed is in there

   bathroom: This the room you have a bath in; you wash yourself in here

2. cakes: These are round and have icing on them; they have birthday candles on them

   biscuits: These are yummy like cakes but are crunchy; these taste good when covered in chocolate

   chocolate crackles: These are made of chocolate and Rice Bubbles; kids eat these at birthday
   parties

3. cereal: It is what you put milk on and eat for breakfast; Weetbix, Cornflakes, and Rice Bubbles are
   these kinds of things

   toast: This is what you put jam or vegemite on and eat for breakfast; this is what you get when you
   cook bread in the toaster

   eggs: Chickens lay these; the Easter Bunny brings these

4. stomachache: You can get this if you eat too much food; this is also called a tummy ache

   headache: This is a pain in the head; you get this pain when you bang your head

   sore throat: When you are sick with a cold this is sometimes sore, this hurts when you swallow
   food if it is sore

5. ball: It is something you throw and catch; it is round and bounces

   doll: Girls like playing with this; "Barbie" is one of these

   truck: This is big and noisy and goes on the road; boys like playing in the sand and dirt with this

6. feet: We put shoes on these; we have two of these

   hands: We have two of these and we hold things in them; we have fingers on these

   legs: We walk on these; sometimes kids fall over and break one of these

7. hat: You wear this on your head; you put it on before going in the sun

   coat: You wear this when it is cold; when it is raining kids wear this kind of coat

   shoes: We put these on our feet after we put socks on; these can have laces

8. fork: We use this to eat food with; this has prongs on it

   knife: We use this to cut our food; we use this to put jam on bread

   spoon: We use this to eat ice cream; we can use this to eat yogurt

9. rabbit: This is an animal that has long ears and hops; it is often called a bunny

   cat: This is an animal that meows; this animal chases birds

   dog: This is an animal that barks; this animal chases cats

10. lollies: These are sticky and sweet and stick to your teeth; kids eat them at parties

    chips: These are made of potato and come in packets; some taste like salt and vinegar or chicken

    drinks: These come in cans; Coke and lemonade are these

11. red: This is the colour of a fire engine; this colour means STOP at traffic lights

green: This is the colour of trees; this colour means GO at traffic lights

yellow: This is the color of the sun; wattle is this colour

12. banana: Monkeys eat these; these are yellow and are fruit

apple: This is a red or green fruit that grows on trees; you can put toffee on it and eat it

orange: We squeeze this fruit to make juice; these are like lemons

Experiments 1, 2, and 4: Instructions provided for children and experimenters

Instructions for children

Phase 1 (Original story)

Here is Koko the clown. (Show practice picture 1). He's going to tell you a story and show you some pictures. Listen carefully and at the end tell me whether you liked the story.

Phase 2 (Post-event narrative)

Do you remember the story that Bozo the clown told you the other day? (Show practice picture 2). I am going to read you a short summary of that story and ask you some questions about it. Please do not speak unless I ask you a question. Do you understand? Listen carefully.

Instructions for the experimenter

Start at the beginning of the narrative, reading aloud the generic information (control) and misled-read items. For the misled-generate items, read the words preceding the item and then give the first hint, for example for Item 1 "bedroom" say" "This is the room you sleep in at night, b……. If the child is unable to provide the item give the second hint. If the child is unable to supply the item after all hints are given tell the child the correct answer.

Phase 3 (Recognition test)

Instructions for children and the experimenter

Inclusion test

Remember the picture story about Miss Peabody and the summary and questions Mrs. C. read you today? Now, I am going to show you some pictures one by one. Some of the pictures are NEW and you've never seen them before, like when you get something new from the shop, and some are OLD, like your favorite old pair of shoes. I want you to say NO if you don't remember a picture and YES if you do remember a picture. Do you think you understand or will I say it again? Here is a practice picture - say YES if you remember the picture; say NO if you don't remember the picture (SHOW BOTH PRACTICE PICTURES Koko and Bozo). If the child gets both practice pictures correct proceed with the recognition test, if not, repeat the practice picture test.

Exclusion test

Remember the picture story about Miss Peabody and the summary and questions Mrs. C. read you today? Well, you know what? I think Mrs. C. made some mistakes. I think she read you the wrong story. So I want you to forget all about what she told you. Now, I am going to show you some pictures one by one. Some pictures are NEW and you've never seen them before, like when you get something new from the shop, and some are OLD, like you favorite old pair of shoes. If you remember a picture

from the first story I want you to say YES. If you do not remember a picture from the first story I want you to say NO. Here is a practice picture from the first story (SHOW BOTH PRACTICE PICTURES Koko and Bozo) - say YES if you remember the picture; say NO if you don't remember the picture or if it is one of the wrong ones Mrs. C. told you about today. If the child gets both practice pictures correct proceed with recognition test, if not, repeat practice picture test.

Appendix C

Statistical analyses for Experiment 1

Anova summary table: 4 (post-event narrative) x (4) (item type) (*p < .05)

Source	SS	DF	MS	F
Between				
Post-event narrative	0.04	3	0.01	0.24
Error	5.04	100	0.05	
Within				
Item type	1.54	3	0.51	9.70*
Post-event narr. x item type	0.45	9	0.05	0.94
Error	15.93	300	0.05	

ANOVA summary table: 2 (age) x 2 (test) x (3) (item type)(*p < .05)

Source	SS	DF	MS	F
Between				
Age	0.001	1	0.001	0.027
Test condition	0.629	1	0.629	15.101*
Age x test condition	0.024	1	0.024	0.566
Error	4.167	100	0.042	
Within				
Control x misled	2.359	1	2.359	85.236*
Age x control, misled	0.305	1	0.305	11.024*
Control, misled x test	0.442	1	0.442	15.968*
Age, test x control, misled	0.007	1	0.007	0.258
Error	2.768	100	0.028	
Misled-read x Misled-generate	0.084	1	0.084	1.269
Age x misled-read, misled-generate	0.020	1	0.020	0.304
Test x misled-read, misled-generate	0.777	1	0.777	11.692*
Age, test x misled-read, misled-generate	0.080	1	0.080	1.197
Error	6.649	100	0.066	

ANOVA summary table: 2 (age) x 2 (test condition: New inclusion, New exclusion) (*p < .05)

Source	SS	DF	MS	F
Main effects	.39	2	.19	5.79
Age	.31	1	.31	9.34*
Test condition	.07	1	.07	2.23
2-Way Interactions	.00	1	.00	0.03
Age x Test condition	.00	1	.00	0.03
Explained	.39	3	.13	3.88
Residual	3.33	100	.03	
Total	3.72	103	.04	

Calculations of Critical F values

Bonferroni adjustment to control family wise error of α =.05. Using this adjustment the critical $\underline{F}$ for the family of item effects and for interactions involving these effects was 5.20.

Tukey's (HSD) post-hoc analyses

Interaction: Test condition (inclusion, exclusion) x control, misled (*p < .05)

	Inclusion-control $\underline{M} = .67$	Inclusion-misled $\underline{M} = .56$	Exclusion-control $\underline{M} = .65$	Exclusion-misled $\underline{M} = .39$
Inclusion-control $\underline{M} = .67$		.11*	.02	.28*
Inclusion-misled $\underline{M} = .56$			.09*	.17*
Exclusion-control $\underline{M} = .65$				.26*
Exclusion-misled $\underline{M} = .39$				
Tukey's HSD = .09				

Interaction: Test condition (inclusion, exclusion) x misled-read, misled-generate (*p < .05)

	Inclusion-read $\underline{M} = .49$	Inclusion-generate $\underline{M} = .65$	Exclusion-read $\underline{M} = .43$	Exclusion-generate $\underline{M} = .35$
Inclusion-read $\underline{M} = .49$		.16*	.06	.14*
Inclusion-generate $\underline{M} = .65$			.22*	.30*
Exclusion-read $\underline{M} = .43$				.08
Exclusion-generate $\underline{M} = .35$				
Tukey's HSD = .14				

Appendix D

Stimulus materials for Experiment 2

Original story versions presented at Phase 1 *(Versions 1, 2, & 3)

Miss Peabody Becomes Famous

Let me tell you about the weirdest thing that happened in our town a few years ago. Now I'm just a normal kind of kid living in a normal house, in a normal street but what happened in the house down the road from mine was not exactly normal. What I'm going to tell you really did happen, honestly.

This is how it all started. Old Miss Peabody was just a normal old lady. However, one day as she was looking in her letterbox a peanut came out of nowhere and hit her on the back of the head (picture). She looked around to see where it came from, then picked it up, put it away, and forgot about it **(kitchen, bedroom, bathroom [*picture only*] target item 1).**

Time passed and word spread about some weird happenings in that house down the road. It all started when my friend Sally was sitting quietly on the bus stop outside Miss Peabody's house, and she heard some strange noises. She tiptoed up to the front window and peeped in. Guess what she saw! - she saw old Miss Peabody and her even older friend Miss Lilly, jumping on the table and being very silly (picture).

The next thing that happened was even stranger. Every week my friend Billy delivered Miss Peabody's groceries and then had breakfast with her. One day Billy was amazed to see that things were different. The old lady had a number of strange friends with very strange habits. Billy said he was quietly eating **(eggs, cereal, toast [*picture only*] target item 2)** when he saw a pink pig and an enormous squirrel having swimming races in Miss Peabody's swimming pool. And over by the garage there was a snowman doing tricks on the clothesline (picture). Billy took a closer look at Miss Peabody. She looked very different. Her nose had grown, she had warts on her face, and on the top of her head buried in her knotted hair sat a huge peacock. Boy did she look weird - kind of spooky - like a witch (picture)! Billy didn't know what to think so he gobbled his food and raced out the door and down the road to tell us kids. Poor Billy, he was never the same again and for many days he was sick **(headache, stomachache, sore throat [*picture only*] target item 3)** from eating too quickly.

My friends and I decided to keep watch for more signs of witchcraft. While we were keeping watch we noticed that every evening Miss Peabody strolled around her garden hand in hand with a shark (picture). But more amazing than this was the day we heard her pet kangaroo Zippy talking in a loud voice to the postman, and while they were talking, that walking shark jumped on his bike and rode off down the hill (picture). Can you believe it? Is it normal for these sorts of things to happen? Everyone including the postman, did his best to keep out of Miss Peabody's way after this happened.

A couple of weeks later we heard that witch Peabody had cooked up a batch of peanut butter that when eaten every day could make people smart - really smart - top of the class smart! You get the picture - super smart! Well, Miss Peabody knew she was on a winner with this. She set about making herself rich and famous. In her factory near her helicopter pad in the backyard (picture) she made lots

and lots of peanut butter. All day and all night she and her friends worked very very hard. She sold it to all sorts of people and animals and everyone gave her gifts because they all wanted to find out the recipe for the smart peanut butter (picture).

One day a phone call came from a man who wanted to make a movie about her life so Miss Peabody quickly got ready **(hat, coat, shoes [*picture only*] target item 4)** and flew to America in her helicopter. She soon got herself a movie star husband and the two of them went to live on a beautiful island where they *thought* they would live happily ever after (picture).

Meanwhile, back at the factory, Zippy was trying very hard to keep up the world demand for smart peanut butter. His helper, a bright young fox called Felix, served all the customers while Zippy made the peanut butter. Lots of people and animals tried to get hold of the recipe but Felix was built like Arnold Swarzenegger and had been able to keep all the baddies away (picture).

Looking back on it now what happened next was to be expected with all those millions of people and animals desperate to be smart. A couple of smooth looking gorillas wearing sunglasses pushed past Felix and searched the building until they found Zippy **(knife, fork, spoon [*picture only*] target item 5).** Quick as a flash one of the gorillas ripped off a gold chain, tied it to Zippy's collar and hauled him off down the road and up the hill and through the deep dark woods to where their plane was hidden (picture). What happened to Zippy next is not quite clear because he is not quite the kangaroo he used to be. But what we do know is that the kangaroo-napping was news all over the world (picture). Of course, Miss Peabody and her new super-smart husband, who could count backwards from 100 in 5 seconds (isn't that smart?), raced home **(dog, cat, rabbit [*picture only*] target item 6)** from America. But before they got there the supply of peanut butter ran out. Well, what a disaster! How could such smart people let something like this happen? Crowds built up everyday outside Miss Peabody's house. Kings, queens, princesses, and princes arrived in their coaches. As the days passed everyone became very impatient and late one afternoon the police had to be called when a mob of chickens wouldn't stop chanting "We want peanut butter!" (picture).

Meanwhile, there was no word about the whereabouts of Zippy. We heard later that the kangaroo-nappers took him away to a secret location at the North Pole. For the first few days they looked after him very well **(green, red, yellow [*picture only*] target item 7)** jellybeans. He was quite enjoying himself, but as the days passed he began to miss all his friends, so he tried to run away. But he didn't get far. The kangaroo-nappers caught him and tied him to an ironing board (picture) and asked him lots and lots of questions about the secret smart peanut butter recipe. But Zippy wouldn't tell them anything. He wasn't going to give away Miss Peabody's secret.

These cool smooth-looking hunks were not very smart. Remember I *didn't* say that they had taken some of the smart peanut butter with them, did I? Well they didn't. These were pretty dumb kangaroo-nappers. What they didn't realise was that everyday Zippy needed smart peanut butter and **(banana, apple, orange [*picture only*] target item 8)** so he could talk. If he missed out on this and couldn't talk, how could he tell them Miss Peabody's secret recipe?

But Zippy's luck was about to change. A huge brown bear found the secret hideaway up at the North Pole. When he saw what was going on he pulled out a toothbrush and frightened the kangaroo-

nappers who fell unconscious to the ground (picture). This smart bear, the last surviving smart bear in the world, then tied Zippy's tail to the end of a kite and set him free. He soared over the North Pole, down over the ocean (picture) and a few days later landed back in Miss Peabody's front yard. Everyone was so pleased to see him they forgot about the smart peanut butter. In fact, they couldn't even remember why he had been away! It was as if the whole thing had never happened. Perhaps it was because they were no longer super-smart. Anyway, Miss Peabody and her animal friends lived happily ever after in the old house down the road from mine and life returned to normal (picture).

The first target item alternative in brackets (e.g., kitchen) was presented in Version 1, the second in Version 2, and the third in Version 3

Example of Post-event Narratives presented at Phase 2

Original story version 1 post-event narrative version 1

A peanut hit Miss Peabody on the head while she was looking in her letterbox. She picked it up, put it **away (kitchen - control item 1)** and forgot about it. Billy was eating **(eggs - control item 2)** with Miss Peabody when he noticed she looked like a witch. He ate so quickly that he got a **stomachache (misled-generate item 1).** A movie producer rang and Miss Peabody put on her **coat (misled-generate item 2)** and flew to America and became rich and famous. The gorillas burst into the factory and found Zippy **(knife - control item 3)** and took him away. Miss Peabody raced home with her new **friends (dog - control item 4)**. But the supply of smart peanut butter had already run out. The kangaroo-nappers fed Zippy **red (misled-read item 1)** jellybeans so that he would tell them the secret smart peanut butter recipe. They didn't know he needed peanut butter and **apple (misled-read item 2)** so he could talk. A bear rescued Zippy and set him free. Everyone was so happy to see him they forgot about the smart peanut butter and lived happily ever after.

Appendix E

Statistical analyses for Experiment 2

Pilot Study: Mean Proportion Correct Acceptance of Items ("yes" response) (and standard deviations) as a Function of Experimental Condition

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Item type	Exclusion	Inclusion
Control	.69 (.19)	.65 (.20)
New	.38 (.13)	.35 (.17)
Misled-Read	.56 (.26)	.54 (.26)
Misled-Generate	.60 (.29)	.56 (.34)

N = 12, Mean age = 6 years, 8 months (Range: 6,3 – 7,0) (SD = 4 months)

Anova summary table: 3 (original story) x 4 (post-event narrative) x (4) (item type) (*p < .05)

Source	SS	DF	MS	F
Between				
Story version	0.08	2	0.04	1.00
Post-event narrative	0.06	3	0.02	0.48
Story x post-event	0.09	6	0.01	0.36
Error	6.95	167	0.04	
Within				
Item type	3.68	3	1.23	18.91*
Story version x item type	0.02	6	0.00	0.06
Post-event narr. x item type	0.09	9	0.01	0.15
Story x post-event x item	1.73	18	0.10	1.48
Error	32.50	501	0.06	

Anova summary table 2 (age) x (2) (test) x (3) (item type) (*p < .05)

Source	SS	DF	MS	F
Between				
Age	0.003	1	0.003	0.037
Error	13.988	177	0.079	
Within				
Test condition	1.222	1	1.222	25.862*
Age x test condition	0.006	1	0.006	0.123
Error	8.363	177	0.047	
Control x misled	3.052	1	3.052	41.032*
Age x control, misled	0.087	1	0.087	1.167
Error	13.167	177	0.074	
Misled-read x misled-generate	0.626	1	0.626	3.144
Age x misled-read, misled-generate	0.020	1	0.020	0.103
Error	35.114	177	0.198	
Test x control, misled	0.927	1	0.927	23.707*
Age, test x control, misled	0.008	1	0.008	0.214
Error	6.924	177	0.039	

Test x misled-read, misled-generate 3.947	1	3.947	44.238*
Age, test x misled-read, misled-gen 0.036	1	0.036	0.403
Error	15.791	177	0.089

Note. *Bonferroni adjustment to control family wise error of* ***a*** *= .05. Using this adjustment the critical* ***F*** *for the family of item effects and for interactions involving these effects was 5.02.*

T-tests to determine chance responding: New ("yes" response) items across age (*p < .05)

	Mean	StDev	SE Mean	T-value
Inclusion condition	.535	.123	.009	3.83*
Exclusion condition	.607	.124	.009	11.51*

Tukey's (HSD) post-hoc analyses
Interaction: Test condition (inclusion, exclusion) x control, misled (*p < .05)

	Inclusion-control M = .62	Inclusion-misled M = .57	Exclusion-control M = .61	Exclusion-misled M = .44
Inclusion-control M = .62		.05*	.01	.22*
Inclusion-misled M = .57			.04	.13*
Exclusion-control M = .61				.17*
Exclusion-misled M = .44				
Tukey's HSD = .05				

Interaction: Test condition (inclusion, exclusion) x misled-read, misled-generate (*p < .05)

	Inclusion-read M = .44	Inclusion-generate M = .67	Exclusion-read M = .48	Exclusion-generate M = .39
Inclusion-read M = .44		.23*	.04	.05
Inclusion-generate M = .67			.19*	.26*
Exclusion-read M = .48				.08*
Exclusion-generate M = .39				
Tukey's HSD = .08				

ANOVA summary table: 2 (age) x 2 test condition: New inclusion, New exclusion) (*p < .05)

Source	SS	DF	MS	F
Between				
Age	1.61	1	1.61	19.33*
Error	14.76	177	0.08	
Within				
Test condition	0.06	1	0.06	2.37
Age x test condition	0.08	1	0.08	2.91
Error	4.79	177	0.03	

Anova Summary Tables: 2 (age) x 2 (item type: misled-read, misled-generate) (cf. Jacoby, 1991) (*p < .05)

Recollection

Source	SS	DF	MS	F
Between				
Age	0.00	1	0.00	0.01
Error	10.81	177	0.06	
Within				
Read, generate	3.55	1	3.55	49.21*
Age x read, generate	0.01	1	0.01	0.08
Error	12.78	177	0.07	

Automaticity

Source	SS	DF	MS	F
Between				
Age	0.13	1	0.13	4.37*
Error	5.45	177	0.03	
Within				
Read, generate	0.21	1	0.21	3.99
Age x read, generate	0.01	1	0.01	0.11
Error	9.36	177	0.05	

Anova Summary Tables: 2 (age) x 2 (item type: misled-read, misled-generate) (cf. Yonelinas & Jacoby, 1996a) (*p < .05)

Recollection

Source	SS	DF	MS	F
Between				
Age	0.66	1	0.66	1.78
Error	65.65	177	0.37	
Within				
Read, generate	4.80	1	4.80	45.03*
Age x read, generate	0.07	1	0.07	0.61
Error	18.87	177	0.11	

Automaticity

Source	SS	DF	MS	F
Between				
Age	0.13	1	0.13	4.61*
Error	5.10	177	0.03	
Within				
Read, generate	0.10	1	0.10	1.74
Age x read, generate	0.02	1	0.02	0.30
Error	9.79	177	0.06	

Appendix F

<u>Stimulus materials for Experiment 3</u>

<u>Items employed in Experiment 3</u>

Item	Response alternatives

1.	kitchen / bedroom / bathroom
2.	biscuits / cakes / chocolate crackles
3.	eggs / cereal / toast
4.	headache / stomachache / "sore" throat
5.	doll / ball / truck
6.	hands / feet / legs
7.	hat / coat / shoes
8.	knife / fork / spoon
9.	dog / cat / rabbit
10.	chips / lollies / drinks
11.	green / red / yellow
12.	banana / apple / orange

<u>Original story versions presented at Phase 1 (Versions 1, 2, 3)</u>

Miss Peabody Becomes Famous

Let me tell you about the weirdest thing that happened in our town a few years ago. Now I'm just a normal kind of kid living in a normal house, in a normal street but what happened in the house (picture) down the road from mine was not exactly normal. What I'm going to tell you really did happen, honestly.

This is how it all started. Old Miss Peabody was just a normal old lady. One day as she was looking in her letterbox a peanut came out of nowhere and hit her on the back of the head (picture). She looked around to see where it came from then picked it up, went inside, put it in the **(kitchen, bedroom, bathroom [*picture only*] target item 1)** and forgot about it.

Time passed and word spread about some weird happenings in that house down the road. It all started when my friend Sally was sitting on the bus stop outside Miss Peabody's house. It was late in the afternoon and Sally was looking forward to getting home so that she could help her mother cook **(biscuits, cakes, chocolate crackles [*picture only*] target item 2)**. She was sitting quietly when she heard some strange noises coming from Miss Peabody's house. She tiptoed up to the front window and peeped in. Guess what she saw! - she saw old Miss Peabody and her even older friend Miss Lilly, jumping on the table and being very silly (picture). She got out of there like a flash and ran all the way home.

The next thing that happened was even stranger. Every week my friend Billy delivered Miss Peabody's groceries and then had breakfast with her. One day Billy was amazed to see that things were different. The old lady had a number of strange friends with very strange habits. Billy said he was quietly eating (**eggs, cereal, toast [*picture only*] target item 3**) when he saw a pink pig and an enormous squirrel having swimming races in Miss Peabody's pool. And over by the garage there was a snowman doing tricks on the clothesline (picture). Billy took a closer look at Miss Peabody. She looked very different. Her nose had grown, she had warts on her face, and on the top of her head half buried in her knotted hair sat a huge peacock. Boy did she look weird - kind of spooky - like a witch (picture)! Billy didn't know what to think so he gobbled his food and raced out the door and down the road to tell us kids. Poor Billy, he was never the same again and for many days he was sick (**headache, stomachache, sore throat [*picture only*] target item 4**) from eating too quickly.

My friends and I started looking for more signs of witchery. While we were keeping watch we noticed that every evening Miss Peabody strolled around her garden hand in hand with a shark (picture). But more amazing than this was the day we spied her pet kangaroo Zippy talking in a very loud voice to the postman (**doll, ball, truck [*picture only*] target item 5**). And, to our great surprise, while they were talking that walking shark jumped on the postman's bike and rode off down the hill (picture). Can you believe it? Is it normal for these sorts of things to happen? Everyone including the postman did their best to keep out of Miss Peabody's way after this happened.

Sometime later we heard that old witch Peabody had cooked up a batch of peanut butter that when eaten daily could make people smart - really smart - top of the class smart! You get the picture - super smart! Well, Miss Peabody knew she was on a winner with this. She set about making herself rich and famous. In her factory down by the helicopter pad in the backyard (picture) she made lots and lots of peanut butter. All day and all night she and her friends worked very very hard (**hands, feet, legs [*picture only*] target item 6**). She sold peanut butter to all sorts of people and animals and everyone gave her gifts because they all wanted to find out the recipe for the smart peanut butter (picture). One day a phone call came from a man who wanted to make a movie about her life so Miss Peabody quickly got ready (**hat, coat, shoes [*picture only*] target item 7**) and flew to America in her helicopter. She soon got herself a movie star husband and the two of them went to live on a beautiful island where they *thought* they would live happily ever after (picture).

Meanwhile, back at the factory Zippy was trying very hard to keep up the world demand for smart peanut butter. His helper, a bright young fox called Felix, served all the customers while Zippy made the peanut butter. Lots of people and animals tried to get hold of the recipe but Felix was built like Arnold Swarzenegger and had been able to keep all the baddies away (picture). Looking back on it now what happened next was to be expected with all those millions of people and animals desperate to be smart. A couple of smooth looking gorillas wearing sunglasses pushed past Felix and searched the building until they found Zippy (**knife, fork, spoon [*picture only*] target item 8**). Quick as a flash one of them ripped off his gold chain, tied it to poor Zippy's collar and hauled him off down the road and up the hill and through the deep dark woods to where their plane was hidden (picture).

What happened to Zippy next is not quite clear because he is not quite the kangaroo he used to be. But what we do know is that the kangaroo-napping was headline news all over the world (picture). Of course Miss Peabody was very upset and as soon as possible she and her new supersmart husband who could count backwards from 100 in 5 seconds (isn't that smart?) raced home **(dog, cat, rabbit [*picture only*]) (target item 9)**. But before they got there the supply of peanut butter ran out. Well, what a disaster! How could such smart people let something like that happen? Crowds built up everyday outside Miss Peabody's house. Kings, queens, princesses, and princes arrived in their coaches. Us kids decided to set up a shop **(chips, lollies, drinks [*picture only*] target item 10)** and we were kept very busy. As the days passed everyone became very impatient and late one afternoon the police had to be called when a mob of angry chickens wouldn't stop chanting "We want peanut butter!" (picture)

Meanwhile, no word about the whereabouts of Zippy. We heard later that the kangaroo-nappers took him away to a secret location at the North Pole. For the first few days they looked after him very well **(green, red, yellow [*picture only*] target item 11)** jellybeans. He was quite enjoying himself, but as the days passed he began to miss all his friends so he tried to run away. But he didn't get far. The kangaroo-nappers caught him and tied him to an ironing board (picture) and asked him lots and lots of questions about the secret smart peanut butter recipe. But Zippy wouldn't tell them anything. He wasn't going to give away Miss Peabody's secret.

These cool smooth-looking hunks were not very smart. Remember I *didn't* say that they had taken some of the smart peanut butter with them, did I? Well they didn't. These were pretty silly kangaroo-nappers. What they didn't realise was that everyday Zippy needed special food and smart peanut butter **(banana, apple, orange [*picture only*] target item 12)** so he could talk. If he missed out on this and couldn't talk, how could he tell them Miss Peabody's secret recipe?

But Zippy's luck was about to change. A huge brown bear found the secret hideaway up at the North Pole. When he saw what was going on he pulled out a toothbrush and scared the life out of the kangaroo-nappers who fell unconscious to the ground (picture). This smart bear, the last surviving smart bear in the world then tied Zippy's tail to the end of a kite and set him free. He soared over the North Pole, down over the ocean, (picture) and a few days later landed back in Miss Peabody's front yard. Everyone was so pleased to see him they forgot about the smart peanut butter. In fact, they couldn't even remember why he had been away. It was as if the whole thing had never happened. Perhaps it was because they were no longer super-smart. Anyway, Miss Peabody and her animal friends lived happily ever after in the old house down the road from mine and life returned to normal (picture).

The first target item alternative in brackets (e.g., kitchen) was presented in Version 1, the second in Version 2, and the third in Version 3.

Example of Post-event Narratives presented at Phase 2

Original story version 1 post-event narrative version 1

A peanut hit Miss Peabody on the head while she was looking in her letterbox. She picked it up, put it away **(kitchen - control item 1 ST)** and forgot about it. Sally was thinking about helping her mother **cook (biscuits - control item 2 ST)** while waiting for the bus. She got scared when she saw the two old ladies jumping on the table. Billy was eating **cereal (misled-read item 1ST)** with Miss Peabody when he noticed she looked like a witch. He ate so quickly that he got a **stomachache (misled-read item 2 ST).** The kids saw Zippy with his **ball (misled-generate item 1 ST)** talking to the postman while the shark stole the bicycle. Miss Peabody and her friends made smart peanut butter in the factory and they worked very hard and got sore **feet (misled-generate item 2 ST).** She became rich and famous. When a movie producer rang she got **ready (hat - control item 1 MT)** and flew to America. The gorillas burst into the factory and found Zippy **(knife - control item 2 MT)** and took him away. Miss Peabody raced home with her new pet **cat (misled-read item 1 MT).** But the supply of smart peanut butter had already run out. The kids set up a shop and sold **lollies (misled-read item 2 MT)** to the crowd. The kangaroo-nappers fed Zippy **red jellybeans (misled-generate item 1 MT)** so that he would tell them the secret smart peanut butter recipe. They didn't know he needed peanut butter and **apple (misled-generate item 2 MT)** so he could talk. A bear rescued Zippy and set him free. Everyone was so happy to see him they forgot about the smart peanut butter and lived happily ever after.

Allocation of items to the standard and modified test conditions

Original story version 1 post-event narrative version 2

Standard Test

Original (e.g., doll) vs. control (e.g., ball)

Original (e.g., hands) vs. control (e.g., feet)

Original (e.g., kitchen) vs. misled-read (e.g., bedroom)

Original (e.g., biscuits) vs. misled-read (e.g., cakes)

Original (e.g., eggs) vs. misled-generate (e.g., cereal)

Original (e.g., headache) vs. misled-generate (e.g., stomachache)

Modified Test

Original (e.g., green jellybeans) vs. novel control (e.g., yellow jellybeans)

Original (e.g., banana) vs. novel control (e.g., orange)

Original (e.g., hat) vs. novel misled-read (e.g., shoes)

Original (e.g., knife) vs. novel misled-read (e.g., spoon)

Original (e.g., dog) vs. novel-misled-generate (e.g., rabbit)

Original (e.g., chips) vs. novel misled-generate (e.g., drinks)

Original story version 1 post-event narrative version 3

Standard Test

Original (e.g., eggs) vs. control (e.g., cereal)

Original (e.g., headache) vs. control (e.g., stomachache)

Original (e.g., doll) vs. misled-read (e.g., ball)

Original (e.g., hands) vs. misled-read (e.g., feet)

Original (e.g., kitchen) vs. misled-generate (e.g., bedroom)

Original (e.g., biscuits) vs. misled-generate (e.g., cakes)

Modified Test

Original (e.g., dog) vs. novel control (e.g., rabbit)

Original (e.g., chips) vs. novel control (e.g., drinks)

Original (e.g., green jellybeans) vs. novel misled-read (e.g., yellow jellybeans)

Original (e.g., banana) vs. novel misled-read (e.g., orange)

Original (e.g., hat) vs. novel-misled-generate (e.g., shoes)

Original (e.g., knife) vs. novel misled-generate (e.g., spoon)

Original story version 1 post-event narrative version 4

Standard Test

Original (e.g., hat) vs. control (e.g., coat)

Original (e.g., knife) vs. control (e.g., fork)

Original (e.g., dog) vs. misled-read (e.g., cat)

Original (e.g., chips) vs. misled-read (e.g., lollies)

Original (e.g., green jellybeans) vs. misled-generate (e.g., red jellybeans)

Original (e.g., banana) vs. misled-generate (e.g., apple)

Modified Test

Original (e.g., kitchen) vs. novel control (e.g., bathroom)

Original (e.g., biscuits) vs. novel control (e.g., chocolate crackles)

Original (e.g., eggs) vs. novel misled-read (e.g., toast)

Original (e.g., headache) vs. novel misled-read (e.g., sore throat)

Original (e.g., doll) vs. novel-misled-generate (e.g., truck)

Original (e.g., hands) vs. novel misled-generate (e.g., legs)

Original story version 1 post-event narrative version 5

Standard Test

Original (e.g., green jellybeans) vs. control (e.g., red jellybeans)

Original (e.g., banana) vs. control (e.g., apple)

Original (e.g., hat) vs. misled-read (e.g., coat)

Original (e.g., knife) vs. misled-read (e.g., fork)

Original (e.g., dog) vs. misled-generate (e.g., cat)

Original (e.g., chips) vs. misled-generate (e.g., lollies)

Modified Test

Original (e.g., doll) vs. novel control (e.g., truck)

Original (e.g., hands) vs. novel control (e.g., legs)

Original (e.g., kitchen) vs. novel misled-read (e.g., bathroom)

Original (e.g., biscuits) vs. novel misled-read (e.g., chocolate crackles)

Original (e.g., eggs) vs. novel-misled-generate (e.g., toast)

Original (e.g., headache) vs. novel misled-generate (e.g., sore throat)

Original story version 1 post-event narrative version 6

Standard Test

Original (e.g., dog) vs. control (e.g., cat)

Original (e.g., chips) vs. control (e.g., lollies)

Original (e.g., green jellybeans) vs. misled-read (e.g., red jellybeans)

Original (e.g., banana) vs. misled-read (e.g., apple)

Original (e.g., hat) vs. misled-generate (e.g., coat)

Original (e.g., knife) vs. misled-generate (e.g., fork)

Modified Test

Original (e.g., eggs) vs. novel control (e.g., toast)

Original (e.g., headache) vs. novel control (e.g., sore throat)

Original (e.g., doll) vs. novel misled-read (e.g., truck)

Original (e.g., hands) vs. novel misled-read (e.g., legs)

Original (e.g., kitchen) vs. novel-misled-generate (e.g., bathroom)

Original (e.g., biscuits) vs. novel misled-generate (e.g., chocolate crackles)

Original story version 2 post-event narrative version 1

Standard Test

Original (e.g., bedroom) vs. control (e.g., bathroom)

Original (e.g., cakes) vs. control (e.g., chocolate crackles)

Original (e.g., cereal) vs. misled-read (e.g., toast)

Original (e.g., stomachache) vs. misled-read (e.g., sore throat)

Original (e.g., ball) vs. misled-generate (e.g., truck)

Original (e.g., feet) vs. misled-generate (e.g., legs)

Modified Test

Original (e.g., coat) vs. novel control (e.g., hat)

Original (e.g., fork) vs. novel control (e.g., knife)

Original (e.g., cat) vs. novel misled-read (e.g., dog)

Original (e.g., lollies) vs. novel misled-read (e.g., chips)

Original (e.g., red jellybeans) vs. novel-misled-generate (e.g., green jellybeans)

Original (e.g., apple) vs. novel misled-generate (e.g., banana)

Original story version 2 post-event narrative version 2

Standard Test

Original (e.g., ball) vs. control (e.g., truck)

Original (e.g., feet) vs. control (e.g., legs)

Original (e.g., bedroom) vs. misled-read (e.g., bathroom)

Original (e.g., cakes) vs. misled-read (e.g., chocolate crackles)

Original (e.g., cereal) vs. misled-generate (e.g., toast)

Original (e.g., stomachache) vs. misled-generate (e.g., sore throat)

Modified Test

Original (e.g., red jellybeans) vs. novel control (e.g., green jellybeans)

Original (e.g., apple) vs. novel control (e.g., banana)

Original (e.g., coat) vs. novel misled-read (e.g., hat)

Original (e.g., fork) vs. novel misled-read (e.g., knife)

Original (e.g., cat) vs. novel-misled-generate (e.g., dog)

Original (e.g., lollies) vs. novel misled-generate (e.g., chips)

Original story version 2 post-event narrative version 3

Standard Test

Original (e.g., cereal) vs. control (e.g., toast)

Original (e.g., headache) vs. control (e.g., sore throat)

Original (e.g., ball) vs. misled-read (e.g., truck)

Original (e.g., hands) vs. misled-read (e.g., legs)

Original (e.g., bedroom) vs. misled-generate (e.g., bathroom)

Original (e.g., cakes) vs. misled-generate (e.g., chocolate crackles)

Modified Test

Original (e.g., cat) vs. novel control (e.g., dog)

Original (e.g., lollies) vs. novel control (e.g., chips)

Original (e.g., red jellybeans) vs. novel misled-read (e.g., green jellybeans)

Original (e.g., apple) vs. novel misled-read (e.g., banana)

Original (e.g., coat) vs. novel-misled-generate (e.g., hat)

Original (e.g., fork) vs. novel misled-generate (e.g., knife)

Original story version 2 post-event narrative version 4

Standard Test

Original (e.g., coat) vs. control (e.g., shoes)

Original (e.g., fork) vs. control (e.g., spoon)

Original (e.g., cat) vs. misled-read (e.g., rabbit)

Original (e.g., lollies) vs. misled-read (e.g., drinks)

Original (e.g., red jellybeans) vs. misled-generate (e.g., yellow jellybeans)

Original (e.g., apple) vs. misled-generate (e.g., orange)

Modified Test

Original (e.g., bedroom) vs. novel control (e.g., kitchen)

Original (e.g., cakes) vs. novel control (e.g., biscuits)

Original (e.g., cereal) vs. novel misled-read (e.g., eggs)

Original (e.g., stomachache) vs. novel misled-read (e.g., headache)

Original (e.g., ball) vs. novel-misled-generate (e.g., doll)

Original (e.g., feet) vs. novel misled-generate (e.g., hands)

Original story version 2 post-event narrative version 5

Standard Test

Original (e.g., red jellybeans) vs. control (e.g., yellow jellybeans)

Original (e.g., apple) vs. control (e.g., orange)

Original (e.g., coat) vs. misled-read (e.g., shoes)

Original (e.g., fork) vs. misled-read (e.g., spoon)

Original (e.g., cat) vs. misled-generate (e.g., rabbit)

Original (e.g., lollies) vs. misled-generate (e.g., drinks)

Modified Test

Original (e.g., ball) vs. novel control (e.g., doll)

Original (e.g., feet) vs. novel control (e.g., hands)

Original (e.g., bedroom) vs. novel misled-read (e.g., kitchen)

Original (e.g., cakes) vs. novel misled-read (e.g., biscuits)

Original (e.g., cereal) vs. novel-misled-generate (e.g., eggs)

Original (e.g., stomachache) vs. novel misled-generate (e.g., headache)

Original story version 2 post-event narrative version 6

Standard Test

Original (e.g., cat) vs. control (e.g., rabbit)

Original (e.g., lollies) vs. control (e.g., drinks)

Original (e.g., red jellybeans) vs. misled-read (e.g., yellow jellybeans)

Original (e.g., apple) vs. misled-read (e.g., orange)

Original (e.g., coat) vs. misled-generate (e.g., shoes)

Original (e.g., fork) vs. misled-generate (e.g., spoon)

Modified Test

Original (e.g., cereal) vs. novel control (e.g., eggs)

Original (e.g., stomachache) vs. novel control (e.g., headache)

Original (e.g., ball) vs. novel misled-read (e.g., doll)

Original (e.g., feet) vs. novel misled-read (e.g., hands)

Original (e.g., coat) vs. novel-misled-generate (e.g., hat)

Original (e.g., fork) vs. novel misled-generate (e.g., knife)

Original story version 3 post-event narrative version 1

Standard Test

Original (e.g., bathroom) vs. control (e.g., kitchen)

Original (e.g., chocolate crackles) vs. control (e.g., biscuits)

Original (e.g., toast) vs. misled-read (e.g., eggs)

Original (e.g., sore throat) vs. misled-read (e.g., headache)

Original (e.g., ball) vs. misled-generate (e.g., doll)

Original (e.g., legs) vs. misled-generate (e.g., hands)

Modified Test

Original (e.g., shoes) vs. novel control (e.g., coat)

Original (e.g., spoon) vs. novel control (e.g., fork)

Original (e.g., rabbit) vs. novel misled-read (e.g., cat)

Original (e.g., drinks) vs. novel misled-read (e.g., lollies)

Original (e.g., yellow jellybeans) vs. novel-misled-generate (e.g., red jellybeans)

Original (e.g., orange) vs. novel misled-generate (e.g., apple)

Original story version 3 post-event narrative version 2

Standard Test

Original (e.g., truck) vs. control (e.g., doll)

Original (e.g., legs) vs. control (e.g., hands)

Original (e.g., bathroom) vs. misled-read (e.g., kitchen)

Original (e.g., chocolate crackles) vs. misled-read (e.g., biscuits)

Original (e.g., toast) vs. misled-generate (e.g., eggs)

Original (e.g., sore throat) vs. misled-generate (e.g., headache)

Modified Test

Original (e.g., yellow jellybeans) vs. novel control (e.g., red jellybeans)

Original (e.g., orange) vs. novel control (e .g., apple)

Original (e.g., shoes) vs. novel misled-read (e.g., coat)

Original (e.g., spoon) vs. novel misled-read (e.g., fork)

Original (e.g., rabbit) vs. novel-misled-generate (e.g., cat)

Original (e.g., drinks) vs. novel misled-generate (e.g., lollies)

Original story version 3 post-event narrative version 3

Standard Test

Original (e.g., toast) vs. control (e.g., eggs)

Original (e.g., sore throat) vs. control (e.g., headache)

Original (e.g., truck) vs. misled-read (e.g., doll)

Original (e.g., legs) vs. misled-read (e.g., hands)

Original (e.g., bathroom) vs. misled-generate (e.g., kitchen)

Original (e.g., chocolate crackles) vs. misled-generate (e.g., biscuits)

Modified Test

Original (e.g., rabbit) vs. novel control (e.g., cat)

Original (e.g., drinks) vs. novel control (e.g., lollies)

Original (e.g., yellow jellybeans) vs. novel misled-read (e.g., red jellybeans)

Original (e.g., orange) vs. novel misled-read (e.g., apple)

Original (e.g., shoes) vs. novel-misled-generate (e.g., coat)

Original (e.g., spoon) vs. novel misled-generate (e.g., fork)

Original story version 3 post-event narrative version 4

Standard Test

Original (e.g., shoes) vs. control (e.g., hat)

Original (e.g., spoon) vs. control (e.g., knife)

Original (e.g., rabbit) vs. misled-read (e.g., dog)

Original (e.g., drinks) vs. misled-read (e.g., chips)

Original (e.g., yellow jellybeans) vs. misled-generate (e.g., green jellybeans)

Original (e.g., orange) vs. misled-generate (e.g., banana)

Modified Test

Original (e.g., bathroom) vs. novel control (e.g., bedroom)

Original (e.g., chocolate crackles) vs. novel control (e.g., cakes)

Original (e.g., toast) vs. novel misled-read (e.g., cereal)

Original (e.g., sore throat) vs. novel misled-read (e.g., stomachache)

Original (e.g., truck) vs. novel-misled-generate (e.g., ball)

Original (e.g., legs) vs. novel misled-generate (e.g., feet)

Original story version 3 post-event narrative version 5

Standard Test

Original (e.g., yellow jellybeans) vs. control (e.g., green jellybeans)

Original (e.g., orange) vs. control (e.g., banana)

Original (e.g., shoes) vs. misled-read (e.g., hat)

Original (e.g., spoon) vs. misled-read (e.g., knife)

Original (e.g., rabbit) vs. misled-generate (e.g., dog)

Original (e.g., drinks) vs. misled-generate (e.g., chips)

Modified Test

Original (e.g., truck) vs. novel control (e.g., ball)

Original (e.g., legs) vs. novel control (e.g., feet)

Original (e.g., bathroom) vs. novel misled-read (e.g., bedroom)

Original (e.g., chocolate crackles) vs. novel misled-read (e.g., cakes)

Original (e.g., toast) vs. novel-misled-generate (e.g., cereal)

Original (e.g., sore throat) vs. novel misled-generate (e.g., stomachache)

Original story version 3 post-event narrative version 6

Standard Test

Original (e.g., rabbit) vs. control (e.g., dog)

Original (e.g., drinks) vs. control (e.g., chips)

Original (e.g., yellow jellybeans) vs. misled-read (e.g., green jellybeans)

Original (e.g., orange) vs. misled-read (e.g., banana)

Original (e.g., shoes) vs. misled-generate (e.g., hat)

Original (e.g., spoon) vs. misled-generate (e.g., knife)

Modified Test

Original (e.g., toast) vs. novel control (e.g., cereal)

Original (e.g., sore throat) vs. novel control (e.g., stomachache)

Original (e.g., truck) vs. novel misled-read (e.g., ball)

Original (e.g., legs) vs. novel misled-read (e.g., feet)

Original (e.g., bathroom) vs. novel-misled-generate (e.g., bedroom)

Original (e.g., chocolate crackles) vs. novel misled-generate (e.g., cakes)

Appendix G

Statistical analyses for Experiment 3

Standard test: Anova summary table 3 (original story) x 6 (post-event narrative) x (6) (item type) (*p < .05)

Source	SS	DF	MS	F
Between				
Story version	0.77	2	0.39	2.23
Post-event narrative	0.78	5	0.16	0.89
Story x post-event narr.	2.39	10	0.24	1.38
Error	25.02	144	0.17	
Within				
Item type	11.38	5	2.28	24.61*
Story version x item type	1.22	10	0.12	1.32
Post-event narr. x item type	1.28	25	0.05	0.55
Story x post-event x item	6.20	50	0.12	1.34
Error	66.59	720	0.09	

Standard Test: Anova summary table 2 (age) x 2 (test) x (3) (item type) (*p < .05)

Source	SS	DF	MS	F
Between				
Age	0.30	1	0.302	1.681
Error	28.710	160	0.179	
Within				
Test condition	2.947	1	2.947	39.805*
Age x test condition	0.002	1	0.002	0.031
Error	11.845	160	0.074	
Control x misled-read	1.881	1	1.881	13.539*
Age x control, misled-read	0.004	1	0.004	0.032
Error	22.230	160	0.141	
Control x misled-generate	5.757	1	5.757	40.729*
Age x control, misled-generate	0.016	1	0.016	0.116
Error	22.616	160	0.141	
Misled-read x Misled-generate	1.057	1	1.057	10.219*
Age x misled-read, misled-generate	0.038	1	0.038	0.368
Error	21/9	160	0.103	
Test x control, misled-read	0.126	1	0.126	1.795
Age, test x control, misled-read	0.003	1	0.003	0.039
Error	11.247	160	0.070	
Test x control, misled-generate	2.813	1	2.813	39.356*
Age, test x control, misled-generate	0.085	1	0.085	1.186
Error	11.437	160	0.071	
Test x misled-read, misled-generate	1.748	1	1.748	26.078*

Age, test x read, generate	0.118	1	0.118	1.762
Error	10.723	160	0.067	

Note. Bonferroni adjustment = 5.02 for contrasts involving control items vs. read items, and control items vs. generate items.

Standard test: T-tests to determine chance responding (*p < .05)
Correct responses by test condition across age and item type

	Mean	StDev	SE Mean	T value
Inclusion condition	.539	.203	.016	2.46*
Exclusion condition	.649	.208	.016	9.13*

Tukey's (HSD) post-hoc analyses
Standard Test: Interaction: Test condition (inclusion, exclusion) x control, misled-generate (*p < .05)

	Inclus-control $M = .69$	Inclus-generate $M = .37$	Exclus-control $M = .69$	Exclus-generate $M = .64$
Inclusion-control $M = .69$		.32*	.00	.05
Inclusion-generate $M = .37$			.32*	.27*
Exclusion-control $M = .69$				.05
Exclusion-generate $M = .64$				
Tukey's HSD = .08				

Standard Test: Anova Summary Tables 2 (age) x (2) (item type: misled-read, misled-generate) (*p < .05) (cf. Jacoby, 1991)
Recollection

Source	SS	DF	MS	F
Between				
Age	0.00	1	0.00	0.02
Error	14.33	160	0.09	
Within				
Misled-read, misled-generate	1.54	1	1.54	26.08*
Age x read, generate	0.10	1	0.10	1.75
Error	9.42	160	0.06	
Automaticity				
Between				
Age	0.07	1	0.07	1.44
Error	7.58	160	0.05	
Within				
Misled-read, misled-generate	0.21	1	0.21	7.01*
Age x read, generate	0.02	1	0.02	0.76
Error	4.83	160	0.03	

Standard test: ANOVA table 2 (age) x (2) (test condition: novel inclusion, novel exclusion) (*p < .05)

Source	SS	DF	MS	F

Between

Age	0.04	1	0.04	0.55
Error	10.94	160	0.07	

Within

Test condition	0.00	1	0.00	0.03
Age x test condition	0.01	1	0.01	0.44
Error	3.11	160	0.02	

Modified test: Anova summary table 3 (original story) x 6 (post-event narrative) x (6) (item type) (*p < .05)

Source	SS	DF	MS	F

Between

Story version	0.61	2	0.30	1.85
Post-event narrative	0.42	5	0.08	0.52
Story x post-event narrative	1.40	10	0.14	0.86
Error	23.53	144	0.16	

Within

Item type	1.36	5	0.27	3.28*
Story version x item type	0.92	10	0.09	1.11
Post-event narr. x item type	1.93	25	0.08	0.93
Story x post-event x item	5.30	50	0.11	1.28
Error	59.69	720	0.08	

Modified Test: Anova summary table 2 (age) x (2) (test) x (3) (item type) (*p < .05)

Source	SS	DF	MS	F

Between

Age	0.862	1	0.862	5.487*
Error	25.133	160	0.157	

Within

Test condition	0.031	1	0.031	0.540
Age x test condition	0.168	1	0.168	2.896
Error	9.295	160	0.058	
Control x misled-read	0.474	1	0.476	3.515
Age x control, misled-read	0.198	1	0.198	1.465
Error	21.677	160	0.135	
Control x misled-generate	0.995	1	0.995	7.512*
Age x control, misled-generate	0.397	1	0.397	3.002
Error	21.184	160	0.132	
Misled-read x misled-generate	0.094	1	0.094	0.755
Age, misled-read, misled-generate	0.034	1	0.034	0.274
Error	19.992	1	0.125	

Test x control, misled-read	0.290	1	0.290	6.002*
Age, test x control, misled-read	0.086	1	0.086	1.789
Error	7.736	160	0.048	
Test x control, misled-generate	0.020	1	0.020	0.445
Age, test x control, misled-generate	0.182	1	0.182	4.062*
Error	7.168	160	0.045	
Test, misled-read, misled-generate	0.158	1	0.158	2.904
Age, test, read, generate	0.018	1	0.018	0.323
Error	8.703	160	0.054	

Note. Bonferroni adjustment = 5.02 for contrasts involving control items vs. read items, and control items vs. generate items.

Tukey's (HSD) post-hoc analyses

Modified Test: Interaction: Test condition (inclusion, exclusion) x control, misled-read (*p < .05)

	Inclusion-control $M = .72$	Inclusion-read $M = .62$	Exclusion-control $M = .70$	Exclusion-read $M = .69$
Inclusion-control $M = .72$		.10*	.02	.03
Inclusion-read $M = .62$			.08*	.07*
Exclusion-control $M = .70$				.01
Exclusion-read $M = .69$				
Tukey's HSD = .06				

Modified Test: Interaction Test condition (inclusion, exclusion) x control, misled-generate x age (*p < .05)

	Inclusion-control $M = .73$	Inclusion-generate $M = .55$	Exclusion-control $M = .69$	Exclusion-generate $M = .61$
5-year-olds				
Inclusion-control $M = .73$		.18*	.04	.12*
Inclusion-generate $M = .55$			.14*	.06
Exclusion-control $M = .69$				.08
Exclusion-generate $M = .61$				

	Inclusion-control $M = .72$	Inclusion-generate $M = .71$	Exclusion-control $M = .71$	Exclusion-generate $M = .65$
9-year-olds				
Inclusion-control $M = .72$		.01	.01	.07
Inclusion-generate $M = .71$			.00	.06
Exclusion-control $M = .71$				.06
Exclusion-generate $M = .65$				
Tukey's HSD = .10				

Modified Test: Anova Summary Tables 2 (age) x (2) (item type: misled-read, misled-generate) (cf. Jacoby, 1991) (*p < .05)

Source	SS	DF	MS	F
Between				
Age	0.29	1	0.29	5.60*
Error	8.24	160	0.05	
Within				
Read, generate	0.14	1	0.14	2.92
Age x read, generate	0.02	1	0.02	0.33
Error	7.63	160	0.05	

Automaticity

Source	SS	DF	MS	F
Between				
Age	0.17	1	0.17	4.94*
Error	5.41	160	0.03	
Within				
Read, generate	0.02	1	0.02	0.66
Age x read, generate	0.02	1	0.02	0.59
Error	4.99	160	0.03	

Modified test: ANOVA table 2 (age) x (2) (test: novel inclusion, novel exclusion) (p < .05)

Source	SS	DF	MS	F
Between				
Age	.00	1	.00	0.01
Error	10.83	160	.07	
Within				
Test condition	.02	1	.02	1.11
Age x test condition	.00	1	.00	0.25
Error	3.04	160	.02	

Appendix H

Stimulus materials for Experiment 4

Miss Peabody Becomes Famous

Let me tell you about the weirdest thing that happened in our town a few years ago. Now I'm just a normal kind of kid living in a normal house, in a normal street but what happened in the house (picture) down the road from mine was not exactly normal. What I'm going to tell you really did happen, honestly.

This is how it all started. Old Miss Peabody was just a normal old lady. One day as she was looking in her letterbox a peanut came out of nowhere and hit her on the back of the head (picture). She looked around to see where it came from then picked it up, went inside, put it in the **(kitchen, bedroom, bathroom [*picture only*] target item 1)** and forgot about it.

Time passed and word spread about some weird happenings in that house down the road. It all started when my friend Sally was sitting on the bus stop outside Miss Peabody's house. It was late in the afternoon and Sally was looking forward to getting home so that she could help her mother cook **(biscuits, cakes, chocolate crackles [*picture only*] (target item 2)**. She was sitting quietly when she heard some strange noises coming from Miss Peabody's house. She tiptoed up to the front window and peeped in. Guess what she saw! - she saw old Miss Peabody and her even older friend Miss Lilly, jumping on the table and being very silly (picture). She got out of there like a flash and ran all the way home.

The next thing that happened was even stranger. Every week my friend Billy delivered Miss Peabody's groceries and then had breakfast with her. One day Billy was amazed to see that things were different. The old lady had a number of strange friends with very strange habits. Billy said he was quietly eating **(eggs, cereal, toast [*picture only*] target item 3)** when he saw a pink pig and an enormous squirrel having swimming races in Miss Peabody's pool. And over by the garage there was a snowman doing tricks on the clothesline (picture). Billy took a closer look at Miss Peabody. She looked very different. Her nose had grown, she had warts on her face, and on the top of her head half buried in her knotted hair sat a huge peacock. Boy did she look weird - kind of spooky - like a witch (picture)! Billy didn't know what to think so he gobbled his food and raced out the door and down the road to tell us kids. Poor Billy, he was never the same again and for many days he was sick **(headache, stomachache, sore throat [*picture only*] target item 4)** from eating too quickly.

My friends and I started looking for more signs of witchery. While we were keeping watch we noticed that every evening Miss Peabody strolled around her garden hand in hand with a shark (picture). But more amazing than this was the day we spied her pet kangaroo Zippy talking in a very loud voice to the postman **(doll, ball, truck [*picture only*] target item 5)**. And, to our great surprise, while they were talking that walking shark jumped on the postman's bike and rode off down the hill (picture). Can you believe it? Is it normal for these sorts of things to happen? Everyone including the postman did their best to keep out of Miss Peabody's way after this happened.

Sometime later we heard that old witch Peabody had cooked up a batch of peanut butter that when eaten daily could make people smart - really smart - top of the class smart! You get the picture - super smart! Well, Miss Peabody knew she was on a winner with this. She set about making herself rich and famous. In her factory down by the helicopter pad in the backyard (picture) she made lots and lots of peanut butter. All day and all night she and her friends worked very very hard **(hands, feet, legs [*picture only*] (target item 6).** She sold peanut butter to all sorts of people and animals and everyone gave her gifts because they all wanted to find out the recipe for the smart peanut butter (picture).

One day a phone call came from a man who wanted to make a movie about her life so Miss Peabody quickly got ready **(coat, hat, shoes [*picture only*] target item 7)** and flew to America in her helicopter. She soon got herself a movie star husband and the two of them went to live on a beautiful island where they thought they would live happily ever after (picture).

Meanwhile, back at the factory Zippy was trying very hard to keep up the world demand for smart peanut butter. His helper, a bright young fox called Felix, served all the customers while Zippy made the peanut butter. Lots of people and animals tried to get hold of the recipe but Felix was built like Arnold Swarzenegger and had been able to keep all the baddies away (picture). Looking back on it now what happened next was to be expected with all those millions of people and animals desperate to be smart. A couple of smooth looking gorillas wearing sunglasses pushed past Felix and searched the building until they found Zippy **(knife, fork, spoon [*picture only*] target item 8)**. Quick as a flash one of them ripped off his gold chain, tied it to poor Zippy's collar and hauled him off down the road and up the hill and through the deep dark woods to where their plane was hidden (picture).

What happened to Zippy next is not quite clear because he is not quite the kangaroo he used to be. But what we do know is that the kangaroo-napping was headline news all over the world (picture). Of course Miss Peabody was very upset and as soon as possible she and her new super-smart husband who could count backwards from 100 in 5 seconds (isn't that smart?) raced home **(dog, cat, rabbit [*picture only*] target item 9)**. But before they got there the supply of peanut butter ran out. Well, what a disaster! How could such smart people let something like this happen? Crowds built up everyday outside Miss Peabody's house. Kings, queens, princesses, and princes arrived in their coaches. Us kids decided to set up a shop **(chips, lollies, drinks [*picture only*] (target item 10)** and we were kept very busy. As the days passed everyone became very impatient and late one afternoon the police had to be called when a mob of anry chickens wouldn't stop chanting "We want peanut butter!" (picture)

Meanwhile no word about the whereabouts of Zippy. We heard later that the kangaroo-nappers took him away to a secret location at the North Pole. For the first few days they looked after him very well **(green, red, yellow jellybeans [*picture only*] target item 11)**. He was quite enjoying himself, but as the days passed he began to miss all his friends so he tried to run away. But he didn't get far. The kangaroo-nappers caught him and tied him to an ironing board (picture) and asked him lots and lots of questions about the secret smart peanut butter recipe. But Zippy wouldn't tell them anything. He wasn't going to give away Miss Peabody's secret.

These cool smooth-looking hunks were not very smart. Remember I *didn't* say that they had taken some of the smart peanut butter with them, did I? Well they didn't. These were pretty silly kangaroo-

nappers. What they didn't realise was that everyday Zippy needed special food and smart peanut butter **(banana, apple, orange [*picture only*] target item 12)** so he could talk. If he missed out on this and couldn't talk, how could he tell them Miss Peabody's secret recipe?

But Zippy's luck was about to change. A huge brown bear found the secret hideaway up at the North Pole. When he saw what was going on he pulled out a toothbrush and scared the life out of the kangaroo-nappers who fell unconscious to the ground (picture). This smart bear, the last surviving smart bear in the world then tied Zippy's tail to the end of a kite and set him free. He soared over the North Pole, down over the ocean (picture) and a few days later landed back in Miss Peabody's front yard. Everyone was so pleased to see him they forgot about the smart peanut butter. In fact, they couldn't even remember why he had been away. It was as if the whole thing had never happened. Perhaps it was because they were no longer super-smart. Anyway, Miss Peabody and her animal friends lived happily ever after in the old house down the road from mine and life returned to normal (picture).

* The first target item alternative in brackets (e.g., kitchen) was presented in Version 1, the second in Version 2, and the third in Version 3.

Example of Post-event Narratives presented at Phase 2

Original story version 1 post-event narrative version 1

A peanut hit Miss Peabody on the head while she was looking in her letterbox. She picked it up, put it away **(kitchen - control-event item 1)** and forgot about it. Sally was thinking about helping her mother cook **(biscuits - control-event item 2)** while waiting for the bus. She got scared when she saw the two old ladies jumping on the table. Billy was eating toast **(misled-read-event item 1)** with Miss Peabody when he noticed she looked like a witch. He ate so quickly that he got a **stomachache (misled-read-event item 2)**. The kids saw Zippy with his **ball (misled-generate-event item 1)** and talking to the postman while the shark stole the bicycle. Miss Peabody and her friends made smart peanut butter in the factory and they worked very hard and got sore **feet (misled-generate-event 2).** She became rich and famous. When a movie producer rang she got ready **(coat - control-novel item 1)** and flew to America. The gorillas burst into the factory and found Zippy **(knife - control-novel item 2)** and took him away. Miss Peabody raced home with her new pet **rabbit (misled-read-novel item 1)**. But the supply of smart peanut butter had already run out. The kids set up a shop and sold **lollies (misled-read-novel item 2)** to the crowd. The kangaroo-nappers fed Zippy **red** jelly beans **(misled-generate-novel item 1)** so that he would tell them the secret smart peanut butter recipe. They didn't know he needed peanut butter and **apple (misled-generate -novel item 2)** so he could talk. A bear rescued Zippy and set him free. Everyone was so happy to see him they forgot about the smart peanut butter and lived happily ever after.

Appendix I

Statistical Analyses for Experiment 4

Original story and post-event narrative versions: ANOVA summary table 3 (original story) x 6 (post-event narrative) x (12) (item type) (*p < .05)

Source	SS	DF	MS	F
Between				
Story version	0.06	2	0.03	0.19
Post-event narrative	0.59	5	0.12	0.80
Story x post-event	0.63	10	0.06	0.43
Error	25.62	174	0.15	
Within				
Item type	38.53	11	3.50	35.89*
Story version x item type	3.22	22	0.15	1.50
Post-event narr. x item type	5.27	55	0.10	0.98
Story x post-event x item	7.18	110	0.07	0.67
Error	186.82	1914	0.10	

ANOVA Summary Table (inclusion condition) 2 (age) x (2) (information type) x (3) (item type) (*p < .05)

Source	SS	DF	MS	F
Between				
Age	0.015	1	0.015	0.143
Error	19.479	190	0.103	
Within				
Information	0.372	1	0.372	3.287
Age x information	0.086	1	0.086	0.756
Error	21.508	190		
Control x misled	0.999	1	0.999	11.383*
Age x control, misled	0.240	1	0.240	2.730
Error	16.777	190	0.088	
Read x generate	1.527	1	1.527	16.622*
Age x read, generate	0.181	1	0.181	1.968
Error	17.457	190	0.092	
Inform x control, misled	32.870	1	32.870	242.759*
Age x inform x control, misled	0.060	1	0.060	0.444
Error	25.726	190	0.135	
Read, generate x information	0.267	1	0.267	2.627
Age x read, generate x inform	0.088	1	0.088	0.861
Error	19.326	190	0.102	

Tukey's (HSD) post-hoc analyses

Inclusion condition: Control vs. misled-read, misled-generate items across event and novel information by age (*p < .05)

		Control $\underline{M}$ = .55	Misled-Read $\underline{M}$ = .45	Misled-Generate $\underline{M}$ = .57
5-year-olds				
Control	$\underline{M}$ = .55		.10*	.02
Misled-Read	$\underline{M}$ = .45			.12*
Misled-Generate	$\underline{M}$ = .57			
Tukey's HSD = .10				
		Control $\underline{M}$ = .58	Misled-Read $\underline{M}$ = .46	Misled-Generate $\underline{M}$ = .51
8-year-olds				
Control	$\underline{M}$ = .58		.12*	.07
Misled-Read	$\underline{M}$ = .46			.05
Misled-Generate	$\underline{M}$ = .51			
Tukey's HSD = .10				

Anova Summary Tables for Novel Information: 2 (age) x (2) (item type: read, generate) (cf. Jacoby, 1991) (*p < .05)

Source	SS	DF	MS	F
Recollection				
Between				
Age	0.02	1	0.02	0.33
Error	11.16	190	0.06	
Within				
Read, generate	0.19	1	0.19	3.93
Age x read, generate	0.02	1	0.02	0.33
Error	9.23	190	0.05	
Automaticity				
Between				
Age	0.06	1	0.06	1.57
Error	7.74	190	0.04	
Within				
Read, generate	0.04	1	0.04	1.19
Age x read, generate	0.00	1	0.00	0.04
Error	5.62	190	0.03	

Anova summary table: False alarms to novel items (*p < .05)

Source	SS	DF	MS	F
Between				
Age	.03	1	.03	0.43

Error	14.43	190	.08	
Within				
Test condition	.06	1	.06	2.61
Test condition x age	.08	1	.08	3.44
Error	4.42	190	.02	

Appendix J

Stimulus materials for Experiment 5

Example of pre-event narratives presented at Phase 1

Original story version 1 pre-event narrative version 1

A peanut hit Miss Peabody on the head while she was looking in her letterbox. She picked it up, put it away **(kitchen - control item 1 ST)** and forgot about it. Sally was thinking about helping her mother **cook (biscuits - control item 2 ST)** while waiting for the bus. She got scared when she saw the two old ladies jumping on the table. Billy was eating **cereal (misled-read item 1ST)** with Miss Peabody when he noticed she looked like a witch. He ate so quickly that he got a **stomachache (misled-read item 2 ST).** The kids saw Zippy with his **ball (misled-generate item 1 ST)** talking to the postman while the shark stole the bicycle. Miss Peabody and her friends made smart peanut butter in the factory and they worked very hard and got sore **feet (misled-generate item 2 ST).** She became rich and famous. When a movie producer rang she got **ready (hat - control item 1 MT)** and flew to America. The gorillas burst into the factory and found Zippy **(knife - control item 2 MT)** and took him away. Miss Peabody raced home with her new pet **cat (misled-read item 1 MT)**. But the supply of smart peanut butter had already run out. The kids set up a shop and sold **lollies (misled-read item 2 MT)** to the crowd. The kangaroo-nappers fed Zippy **red jellybeans (misled-generate item 1 MT)** so that he would tell them the secret smart peanut butter recipe. They didn't know he needed peanut butter and **apple (misled-generate item 2 MT)** so he could talk. A bear rescued Zippy and set him free. Everyone was so happy to see him they forgot about the smart peanut butter and lived happily ever after.

Original story versions presented at Phase 2 (Versions 1, 2, 3)

Miss Peabody Becomes Famous

Let me tell you about the weirdest thing that happened in our town a few years ago. Now I'm just a normal kind of kid living in a normal house, in a normal street but what happened in the house (picture) down the road from mine was not exactly normal. What I'm going to tell you really did happen, honestly.

This is how it all started. Old Miss Peabody was just a normal old lady. One day as she was looking in her letterbox a peanut came out of nowhere and hit her on the back of the head (picture). She looked around to see where it came from then picked it up, went inside, put it in the **(kitchen, bedroom, bathroom [*picture only*] target item 1)** and forgot about it.

Time passed and word spread about some weird happenings in that house down the road. It all started when my friend Sally was sitting on the bus stop outside Miss Peabody's house. It was late in the afternoon and Sally was looking forward to getting home so that she could help her mother cook **(biscuits, cakes, chocolate crackles [*picture only*] target item 2)**. She was sitting quietly when she heard some strange noises coming from Miss Peabody's house. She tiptoed up to the front window and peeped in. Guess what she saw! - she saw old Miss Peabody and her even older friend Miss Lilly, jumping on the table and being very silly (picture). She got out of there like a flash and ran all the way home.

The next thing that happened was even stranger. Every week my friend Billy delivered Miss Peabody's groceries and then had breakfast with her. One day Billy was amazed to see that things were different. The old lady had a number of strange friends with very strange habits. Billy said he was quietly eating **(eggs, cereal, toast [*picture only*] target item 3)** when he saw a pink pig and an enormous squirrel having swimming races in Miss Peabody's pool. And over by the garage there was a snowman doing tricks on the clothesline (picture). Billy took a closer look at Miss Peabody. She looked very different. Her nose had grown, she had warts on her face, and on the top of her head half buried in her knotted hair sat a huge peacock. Boy did she look weird - kind of spooky - like a witch (picture)! Billy didn't know what to think so he gobbled his food and raced out the door and down the road to tell us kids. Poor Billy, he was never the same again and for many days he was sick **(headache, stomachache, sore throat [*picture only*] target item 4)** from eating too quickly.

My friends and I started looking for more signs of witchery. While we were keeping watch we noticed that every evening Miss Peabody strolled around her garden hand in hand with a shark (picture). But more amazing than this was the day we spied her pet kangaroo Zippy talking in a very loud voice to the postman **(doll, ball, truck [*picture only*] target item 5)**. And, to our great surprise, while they were talking that walking shark jumped on the postman's bike and rode off down the hill (picture). Can you believe it? Is it normal for these sorts of things to happen? Everyone including the postman did their best to keep out of Miss Peabody's way after this happened.

Sometime later we heard that old witch Peabody had cooked up a batch of peanut butter that when eaten daily could make people smart - really smart - top of the class smart! You get the picture - super smart! Well, Miss Peabody knew she was on a winner with this. She set about making herself rich and famous. In her factory down by the helicopter pad in the backyard (picture) she made lots and lots of peanut butter. All day and all night she and her friends worked very very hard **(hands, feet, legs [*picture only*] target item 6).** She sold peanut butter to all sorts of people and animals and everyone gave her gifts because they all wanted to find out the recipe for the smart peanut butter (picture). One day a phone call came from a man who wanted to make a movie about her life so Miss Peabody quickly got ready **(hat, coat, shoes [*picture only*] target item 7)** and flew to America in her helicopter. She soon got herself a movie star husband and the two of them went to live on a beautiful island where they *thought* they would live happily ever after (picture).

Meanwhile, back at the factory Zippy was trying very hard to keep up the world demand for smart peanut butter. His helper, a bright young fox called Felix, served all the customers while Zippy made the peanut butter. Lots of people and animals tried to get hold of the recipe but Felix was built like Arnold Swarzenegger and had been able to keep all the baddies away (picture). Looking back on it now what happened next was to be expected with all those millions of people and animals desperate to be smart. A couple of smooth looking gorillas wearing sunglasses pushed past Felix and searched the building until they found Zippy **(knife, fork, spoon [*picture only*] target item 8)**. Quick as a flash one of them ripped off his gold chain, tied it to poor Zippy's collar and hauled him off down the road and up the hill and through the deep dark woods to where their plane was hidden (picture).

What happened to Zippy next is not quite clear because he is not quite the kangaroo he used to be. But what we do know is that the kangaroo-napping was headline news all over the world (picture). Of course Miss Peabody was very upset and as soon as possible she and her new supersmart husband who could count backwards from 100 in 5 seconds (isn't that smart?) raced home **(dog, cat, rabbit [*picture only*]) (target item 9)**. But before they got there the supply of peanut butter ran out. Well, what a disaster! How could such smart people let something like that happen? Crowds built up everyday outside Miss Peabody's house. Kings, queens, princesses, and princes arrived in their coaches. Us kids decided to set up a shop **(chips, lollies, drinks [*picture only*] target item 10)** and we were kept very busy. As the days passed everyone became very impatient and late one afternoon the police had to be called when a mob of angry chickens wouldn't stop chanting "We want peanut butter!" (picture)

Meanwhile, no word about the whereabouts of Zippy. We heard later that the kangaroo-nappers took him away to a secret location at the North Pole. For the first few days they looked after him very well **(green, red, yellow [*picture only*] target item 11)** jellybeans. He was quite enjoying himself, but as the days passed he began to miss all his friends so he tried to run away. But he didn't get far. The kangaroo-nappers caught him and tied him to an ironing board (picture) and asked him lots and lots of questions about the secret smart peanut butter recipe. But Zippy wouldn't tell them anything. He wasn't going to give away Miss Peabody's secret.

These cool smooth-looking hunks were not very smart. Remember I *didn't* say that they had taken some of the smart peanut butter with them, did I? Well they didn't. These were pretty silly kangaroo-nappers. What they didn't realise was that everyday Zippy needed special food and smart peanut butter **(banana, apple, orange [*picture only*] target item 12)** so he could talk. If he missed out on this and couldn't talk, how could he tell them Miss Peabody's secret recipe?

But Zippy's luck was about to change. A huge brown bear found the secret hideaway up at the North Pole. When he saw what was going on he pulled out a toothbrush and scared the life out of the kangaroo-nappers who fell unconscious to the ground (picture). This smart bear, the last surviving smart bear in the world then tied Zippy's tail to the end of a kite and set him free. He soared over the North Pole, down over the ocean (picture) and a few days later landed back in Miss Peabody's front yard. Everyone was so pleased to see him they forgot about the smart peanut butter. In fact, they couldn't even remember why he had been away. It was as if the whole thing had never happened. Perhaps it was because they were no longer super-smart. Anyway, Miss Peabody and her animal friends lived happily ever after in the old house down the road from mine and life returned to normal (picture).

The first target item alternative in brackets (e.g., kitchen) was presented in Version 1, the second in Version 2, and the third in Version 3.

Example of allocation of items to the standard and modified test conditions (Original story version 1 pre-event narrative version 1)

Standard Test

Original (e.g., kitchen) vs. control (e.g., bedroom)

Original (e.g., biscuits) vs. control (e.g., cakes)

Original (e.g., eggs) vs. misled-read (e.g., cereal)

Original (e.g., headache) vs. misled-read (e.g., stomachache)

Original (e.g., doll) vs. misled-generate (e.g., ball)

Original (e.g., hands) vs. misled-generate (e.g., feet)

Modified Test

Original (e.g., hat) vs. novel control (e.g., shoes)

Original (e.g., knife) vs. novel control (e.g., spoon)

Original (e.g., dog) vs. novel misled-read (e.g., cat)

Original (e.g., chips) vs. novel misled-read (e.g., lollies)

Original (e.g., green jellybeans) vs. novel-misled-generate (e.g., yellow jellybeans)

Original (e.g., banana) vs. novel misled-generate (e.g., orange)

Appendix K

Statistical Analyses for Experiment 5

Standard Test: Anova summary table 3 (original story) x 6 (post-event narrative) x (12) (item type) (*p < .05)

Source	SS	DF	MS	F
Between				
Story version	0.01	2	0.00	0.03
Post-event narrative	1.18	5	0.24	1.44
Story x post-event narrative	2.64	10	0.26	1.60
Error	6.76	41	0.16	
Within				
Item type	1.61	5	0.32	3.62
Story version x item type	1.05	10	0.11	1.18
Post-event narr. x item type	2.65	25	0.11	1.19
Story x post-event x item	4.80	50	0.10	1.08
Error	18.21	205	0.09	

Standard Test: Anova summary table: (2) (test) x (3) (item type) (*p < .05)

Source	SS	DF	MS	F
Within				
Test condition	0.342	1	0.342	7.231*
Error	2.742	58	0.047	
Control x misled-read	1.298	1	1.298	6.756*
Error	11.140	58	0.192	
Control x misled-generate	0.953	1	0.953	5.792*
Error	9.547	58	0.165	
Test x control, misled-read	0.001	1	0.001	0.036
Error	1.686	58	0.192	
Test x control, misled-generate	0.424	1	0.424	7.989*
Error	3.076	58	0.053	

Note. Bonferroni adjustment = 5.02 for contrasts involving control items vs. read items, and control items vs. generate items

Tukey's (HSD) post-hoc analyses
Standard Test: Interaction Test condition (inclusion, exclusion) x control, misled-generate (*p < .05)

	Inclusion-control	Inclusion-generate	Exclusion-control	Exclusion-generate
	$\underline{M}$ = .79	$\underline{M}$ = .58	$\underline{M}$ = .80	$\underline{M}$ = .75

Inclusion-control $\underline{M}$ = .79   .21*   .01   .04
Inclusion-generate $\underline{M}$ = .58   .22*   .17*
Exclusion-control $\underline{M}$ = .80   .05
Exclusion-generate $\underline{M}$ = .75
Tukey's HSD = .11

Standard Test: Anova Summary Tables: (2) (item type: misled-read, misled-generate) (cf. Jacoby, 1991) (*p <.05)

Source	SS	DF	MS	F

Recollection

Within

| Read, generate | 0.37 | 1 | 0.37 | 11.84* |
| Error | 1.82 | 58 | 0.03 | |

Automaticity

Within

| Read, generate | 0.01 | 1 | 0.01 | 0.25 |
| Error | 2.20 | 58 | 0.04 | |

Standard test: ANOVA Summary table: (2) (test: novel inclusion, novel exclusion) (*p < .05)

Source	SS	DF	MS	F

Within

| Test condition | 0.00 | 1 | 0.00 | 0.05 |
| Error | 1.15 | 58 | 0.02 | |

Modified Test: Anova summary table 3 (original story) x 6 (post-event narrative) x (12) (item type) (*p < .05)

Source	SS	DF	MS	F

Between

Story version	0.03	2	0.02	0.07
Post-event narrative	0.71	5	0.14	0.62
Story x post-event narrative	3.06	10	0.31	1.34
Error	9.36	41	0.23	

Within

Item type	0.23	5	0.05	0.59
Story version x item type	0.45	10	0.05	0.58
Post-event narrative x item type	2.57	25	0.10	1.33

Source	SS	DF	MS	F
Story x post-event x item	4.94	50	0.10	1.28
Error	15.87	205	0.08	

Modified Test: Anova summary table (2) (test) x (3) (item type) (*p < .05)

Source	SS	DF	MS	F
Within				
Test condition	0.057	1	0.057	2.518
Error	1.318	58	0.023	
Control x misled-read	0.306	1	0.306	1.820
Error	9.756	58	0.168	
Control x misled-generate	0.106	1	0.106	0.584
Error	10.519	58	0.181	
Test x control, misled-read	0.001	1	0.001	0.039
Error	1.561	58	0.027	
Test x ctl misled-generate	0.017	1	0.017	0.529
Error	1.858	58	0.032	

Note. Bonferroni *adjustment = 5.02 for contrasts involving control items vs. read items, and control items vs. generate items.*

Modified Test: Anova Summary Tables (2) (item type: misled-read, misled-generate) (cf. Jacoby, 1991)

Source	SS	DF	MS	F
Recollection				
Within				
Read, generate	0.03	1	0.03	2.04
Error	0.95	58	0.02	
Automaticity				
Within				
Read, generate	0.01	1	0.01	0.21
Error	2.39	58	0.04	

Modified test: ANOVA Summary table (2) (test: novel inclusion, novel exclusion) (*p < .05)

Source	SS	DF	MS	F
Within				
Test condition	0.02	1	.02	0.91
Error	0.97	58	.02	