Development of the Self Reference Effect and Source Memory in Childhood

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ABSTRACT

This research examined the development of episodic memory in 4- to 6-year-old children. A defining characteristic of episodic memory is that it involves memory for the source or context in which items occurred, as well as memory for the items themselves. The present work builds on research in two areas. First, it considers the development of source memory in childhood. Research in this area has shown that compared to older children and adults, young children often perform poorly on source memory tasks. A principal aim was to determine the basis of this difficulty for young children. Second, it focuses on the self-reference effect (SRE) in memory. The SRE in memory refers to the superior memory that occurs when information is encoded in relation to the self relative to other types of contextual encoding (e.g., other-referent, semantic). Recently, SREs have been observed in item memory, but not source memory in children younger than 6 years of age. The present research was interested in investigating the basis of this disparity, and the role of the self in the development of episodic memory.

A SRE paradigm in which source is operationalised as self versus other encoding-context has been used with young children (Sui & Zhu, 2005). This paradigm builds on research showing that self-recognition and the self-concept emerge early in development. Study items are pictures of common objects (e.g., chair, tree), and sources are photographs of the children themselves (self condition) or another child (other condition) pointing to the item. In the existing paradigm, the encoding phase is followed by a free recall test of items. Source memory is assessed for recalled items only. Whilst this paradigm has considerable potential for investigating the SRE and other types of source memory, there are some problems with the procedure.

In the present research, three experiments (Exps. 1, 2, and 3) employed modified versions of Sui and Zhu's (2005) paradigm. The effects of these methodological changes on children's performance on item and source memory tests were examined. Two experiments (Exps. 4 and 5) employed a binding recognition paradigm in which item-source bindings were assessed more directly. A feature of the binding recognition procedure is that it can distinguish between responding based on recognition of item-source bindings, and responding based on familiarity of the items and sources, independent of the bindings. In Experiment 4, encoding-context was operationalised as self versus other; in Experiment 5, it was operationalised in a different way (Bull mastiff versus German shepherd). The primary research questions of interest were: (a) the extent to which encoding in relation to the self facilitates recall and recognition of items and sources; and if so (b) the ages at which these effects are apparent; (c) whether the self-other contextual distinction has special significance in the development of source memory; and (d) the role of item-source binding in source memory.

Whereas Sui and Zhu (2005) observed SREs in item memory for 5-year-olds, results from Experiments 1, 2, and 3 showed self-referent encoding did not produce robust SREs in item memory for any age group. Self-referent encoding did, however, produce more accurate source recognition relative to other-referent encoding in each of the three experiments. This is a new finding as children in Sui and Zhu's study did not show a SRE in source recognition. The absence of a significant Encoding-context × Age interaction in Experiments 1, 2, and 3 also indicated the self-reference advantage in source recognition was present at 4 years and did not vary as a function of age. This finding extends previous research by showing that children younger than 6 years of age can benefit from self-referent encoding in source memory. Potential explanations for

the disparity in outcomes between the present research and Sui and Zhu's study are outlined and likely reflect the modified procedure.

In Experiment 4, self-referent encoding produced more accurate binding recognition than other-referent encoding, which is consistent with source recognition in Experiments 1, 2, and 3. In Experiment 5, there was no significant difference in binding recognition accuracy between the Bull mastiff and German shepherd encoding-context conditions. Binding recognition in Experiments 4 and 5 was also compared. Self-referent and other-referent encoding (Exp. 4) produced more accurate overall binding recognition than Bull mastiff-referent and German shepherd-referent encoding (Exp. 5) did. There was some evidence indicating developmental improvement in binding recognition between 4 and 6 years of age, but only for the self versus other contextual distinction (Exp. 4). In addition, children's binding recognition was more accurate when the retrieval-context matched the encoding-context for the self versus other and Bull mastiff versus German shepherd distinctions. However, children found it more difficult to reject new recombined item-source pairs when they did not involve self-referent and other-referent encoding (Exp. 5) relative to when they did (Exp. 4). This last outcome appeared to reflect responding that was based on a greater reliance of familiarity of the items and sources, rather than responding based on recognition of the item-source bindings, when the task did not involve self-referent and other-referent encoding (Exp. 5) relative to when it did (Exp. 4).

Together, the five experiments provide evidence for the role of binding processes in source memory, and support for the idea that the self-other contextual distinction has special status in the early development of episodic memory. The outcomes contribute to a better understanding of how episodic memory develops during

childhood, and have practical implications for the development of strategies to facilitate children's memory development.

STATEMENT OF ORIGINALITY

This work has not been previously submitted for a degree or diploma in any university. To the best of my knowledge and belief, the thesis contains no material previously published or written by another person except where due reference is made in the thesis itself.

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Michele D Dunbar

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CHAPTER 1. INTRODUCTION

In recent decades, researchers of cognitive psychology, neuropsychology, and neurobiology have attempted to better understand the nature and organisation of memory. This endeavour has produced a substantial literature which has led to the widely held view that memory is comprised of multiple systems (e.g., declarative and nondeclarative memory) and subsystems (e.g., episodic and semantic memory) that differ fundamentally from one another, and which might be subserved by distinct neural networks (Eichenbaum & Cohen, 2001; Schacter & Tulving, 1994; Squire, 2004).

One major goal of cognitive psychology is to understand the development of these different memory systems and subsystems. This was the focus of the current research, which investigated the development of source memory in children aged 4 to 6 years. Source memory is a form of episodic memory and involves discriminating between memories that originate from different informational sources (M. K. Johnson, Hashtroudi, & Lindsay, 1993). For example, take a memory you might have of turning off the stove. After leaving home you might think to yourself: "Did I really turn off the stove or did I just imagine turning it off?" In this instance, the judgement you make about whether you really did do something or just imagined doing that something will influence what action you take next (e.g., whether you will turn around and go back home or continue on your way).

The ability to accurately discriminate the source of our memories therefore plays an important role in everyday life. Equally for young children, source memory is involved in many aspects of daily functioning. Adequate source memory functioning is, for example, involved in memory for events and the acquisition of knowledge (Roberts, 2000). More broadly, source memory in young children has important implications for

areas such as eyewitness memory and suggestibility within forensic settings (Quas, Schaaf, Alexander, & Goodman, 2000).

The present study builds on research which has shown that compared to older children and adults, young children often perform poorly on source memory tasks (e.g., Cycowicz, Friedman, Snodgrass, & Duff, 2001; Foley & Johnson, 1985; Foley, Johnson, & Raye, 1983; Lindsay, Johnson, & Kwon, 1991). It also extends research which has shown that for children as young as 5 years of age, memory can be enhanced by relating information to the self. This is known as the self-reference effect (SRE) in memory (Symons & Johnson, 1997).

The present investigation therefore brings together literatures from the domains of source memory and the self-reference effect in memory. Additionally, in a bid to better understand the basis of young children's source memory difficulties, it draws on theory and empirical research about binding in memory. The present research employed two methodological paradigms to examine the development of source memory in childhood. In both of these paradigms, source was manipulated as self versus other.

The purpose of this introductory chapter is to provide an overview of the source memory and SRE in memory literatures and to elaborate the rationale for the present research. The chapter is partitioned into six main sections. In the first section, I provide a brief description of some different aspects of memory and their development. However, before doing so, it is worth noting that whilst the concept of multiple memory systems is now widely accepted (Eichenbaum & Cohen, 2001; Newcombe, Lloyd, & Ratliff, 2007; Schacter & Tulving, 1994; Schacter, Wagner, & Buckner, 2000; Squire, Stark, & Clark, 2004), some researchers maintain that memory comprises a unitary

memory system that retains all experiences and which is utilised in all tasks (e.g., Whittlesea & Price, 2001).

The core idea of this perspective, is that various processes operate on the unitary memory system, and that information within the system can be accessed via multiple methods. The aim here, however, is not to enter into a discussion about the details which characterise or differentiate the multiple memory systems versus unitary memory system approaches; nor is it to discuss the distinctions within these individual approaches. Rather, the aim here is simply to provide a framework within which to place the current research and its focus on the development of one kind of episodic memory—source memory.

In the second section, I describe the nature of source memory and its significance to episodic memory. Some theoretical background is also provided, along with an outline of standard assessment procedures, and a review of research on the development of source memory. In the third section, I introduce the SRE in memory paradigm which includes a brief history on the topic, standard methods of assessment, and empirical findings. In this section, I also review more recent work on the assessment of the SRE in memory with children and its development. Incorporated into the second and third sections are accounts of some perceived procedural and methodological limitations of contemporary research methods, and the strategies that were used in the present research to address these.

In the fifth section, I present a short overview of research that has contributed to our understanding of the neural mechanisms involved in source memory and self-referential processing. Whilst the present research does not examine the biological underpinnings of source memory and self-referential processing, it is important to consider the constraints that brain maturation (especially in prefrontal regions) might

place on children's memory. Finally, I provide an outline of the empirical framework for the present research which includes one pilot study and five experiments.

The Organisation of Memory

Squire and colleagues (Squire, 1992, 2004; Squire, Knowlton, & Musen, 1993; Squire & Zola, 1996) have proposed that memory[1] can be organised into two main systems: declarative memory and nondeclarative memory. These types of memory are largely distinguishable by the extent to which the information comprising them is consciously accessible. As shown in Figure 1.1, declarative and nondeclarative memory can be further subdivided.

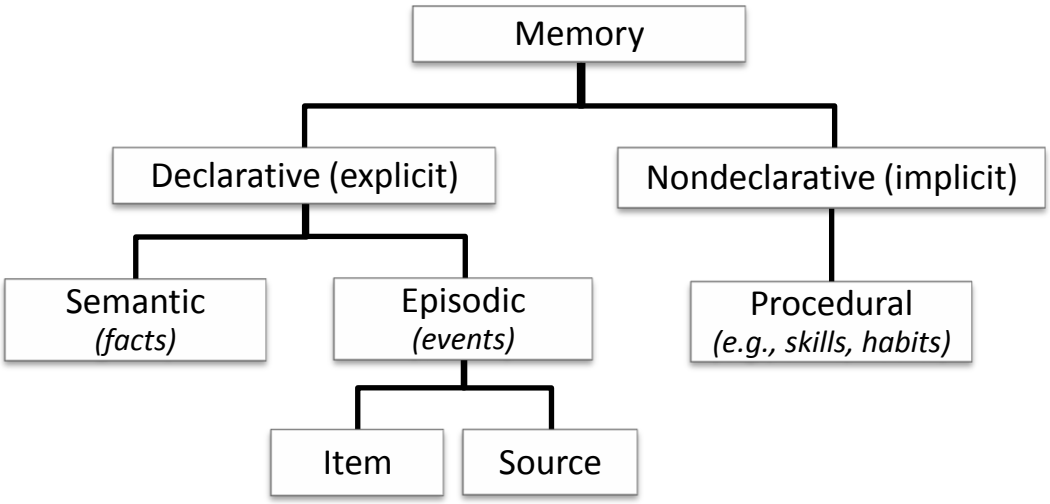

Figure 1.1. Organisation of memory (adapted from Squire & Zola, 1996).

Declarative and Nondeclarative Memory

[1] The term "memory" as it is used throughout, refers to long-term memory defined as "Memory for information that has been well processed and integrated into one's general knowledge store" (Reber & Reber, 2001, p. 424).

Declarative memory (also referred to as explicit memory) involves conscious recollection of events and facts, and encompasses memory for information that can be communicated to others (Reber & Reber, 2001; Squire, 2004). It is the type of memory that is generally associated with the everyday use of the term "memory".

Conversely, nondeclarative memory (also referred to as implicit memory) is unconscious and involves information of which we are unaware. Accordingly, it includes a varied collection of nonconscious learning capacities which are evidenced via performance rather than recollection (Squire & Zola, 1996; Tulving & Markowitsch, 1998). For example, procedural memory is a type of nondeclarative memory. As its name suggests, it involves memory for procedures or complex behaviours that have become highly automatised (Reber & Reber, 2001), such as driving a car or riding a bicycle. In some cases, these skills are developed without awareness of what has been learned, and are acquired independently of declarative memory for the specific learning episodes (Squire, 2004; Squire et al., 1993; Squire & Zola, 1996). Whilst nondeclarative memory appears to be fairly robust from an early age (Carroll, Byrne, & Kirsner, 1985; Graf, 1990; Greenbaum & Graf, 1989; Naito, 1990; Parkin & Streete, 1988), the development of declarative memory occurs more gradually over childhood, extending into adolescence (Kail, 1990).

Semantic and Episodic Memory

As Figure 1.1 shows, semantic memory and episodic memory are types of declarative memory. Semantic memory (e.g., remembering your name and date of birth) entails general factual knowledge about the world (i.e., knowing about the past), whilst episodic memory (e.g., remembering your first day at school) encompasses memory for events that have a specific spatial and temporal context (i.e., recollective experience of the past; Squire et al., 1993; Tulving, 1983). When personally relevant,

episodic memories of such events can also be autobiographical in nature. Both types of memory are considered declarative to the extent that the individual is aware they are accessing and retrieving stored information.

Tulving and colleagues (Tulving, 1983; Tulving & Markowitsch, 1998; Wheeler, Stuss, & Tulving, 1997) have made a further distinction between the types of conscious access or awareness associated with semantic and episodic retrieval. They have proposed that noetic (knowing) awareness is involved in semantic retrieval and that autonoetic (self-knowing) awareness is involved in episodic retrieval. The key distinction here reflects the involvement of the self, in that the *recollective* experience of episodic memory necessarily involves self as the rememberer, whereas the *knowing* experience of semantic memory does not.

Compared to episodic memories, semantic memories are more easily formed by young children. An example of this is evident in their rapid acquisition of vocabulary during the preschool years (Carey, 1978; Nelson, 1988). Conversely, young children have difficulty encoding and/or retrieving episodic memories. The childhood amnesia literature indicates that adults' memory for specific episodes that occurred prior to the age of 6 years is often sketchy and substantially poorer than their memory for episodes after this age (Perner & Ruffman, 1995). Nevertheless, episodic memory does undergo considerable improvement between the ages of 2 and 6, such that the likelihood of remembering an event that occurs during this period increases linearly as the age at which the event takes place increases (Howe & Courage, 1993, 1997).

Item and Source Memory

Finally, as shown in Figure 1.1, item memory and source memory are aspects of episodic memory. Whilst item memory involves memory for the content or facts of an event (e.g., memory for the topic of a news story), source memory entails memory for

the contextual aspects of an event (e.g., memory for where the news story was heard or read).

The Significance of Source Information in Episodic Memory

Remembering the source or contextual aspects of a memory is part of a broader phenomenon referred to as source monitoring. According to M. K. Johnson and her colleagues (M. K. Johnson, 2006; 1993; M. K. Johnson & Raye, 1981, 2000; Lindsay, 2008; Mitchell & Johnson, 2000), source monitoring involves the ability to specify contextual information, and results primarily from an amalgamation of feature[2] binding and judgement processes. In the context of memory research, binding refers to the conjoining of specific features of an event (Chalfonte & Johnson, 1996), or the encoding of the relations amongst stimuli that occur together (N. J. Cohen & Eichenbaum, 1993). It takes place at an early stage of consolidation (Moscovitch, 1994) and accounts for the phenomenal experience that certain features belong together (Chalfonte & Johnson, 1996; Chalfonte, Verfaellie, Johnson, & Reiss, 1996). From a source monitoring perspective, the capacity to bind particular combinations of event features such as perceptual (e.g., sound and colour), contextual (e.g., spatial and temporal), or affective (e.g., emotional reactions) information, semantic elements, or cognitive operations (e.g., records of organising, elaborating, retrieving, and identifying) established when the memory was generated, forms the basis of episodic memory (M. K. Johnson et al., 1993).

Memory for source information therefore represents an important facet of our everyday concept of memory. However, problems can arise because memories originate from numerous sources, and errors can occur when making judgements about

[2] The term "feature" refers to both item- and source-specifying information.

such sources. For example, source information can be externally derived, as in actions performed and words spoken by others, or information originating from external media (e.g., television, internet, radio, books, newspapers). Alternatively, source information can be internally generated, as in one's own actions, thoughts, dreams, or imaginations.

With this in mind, the source monitoring framework posits that memories originating from different sources are represented differently in memory (M. K. Johnson et al., 1993). For example, whereas real events are likely to contain more perceptual detail, such as spatial and temporal information, imagined events are likely to contain more information about the cognitive operations (e.g., thought processes) that were involved in generating the imagination. Discrimination of source is subsequently undertaken by engaging decision processes that utilise these qualitatively different characteristics as cues. To the extent that these cues lack distinctiveness, failures in source memory can occur (M. K. Johnson et al., 1993).

Assessment of Source Memory

The procedure usually used to examine source memory in the laboratory entails an encoding phase and two test phases. During the encoding phase, study items are encoded in relation to different sources. A recall or recognition test of items follows the encoding phase (i.e., test of item memory). Source memory is then tested for correctly retrieved items only. For example, during the encoding phase, participants listen to a series of sentences that are spoken by either a female voice or a male voice. In the item recognition test that follows, old and new sentences are presented and participants judge whether or not they heard each sentence during the encoding phase. Source memory is then tested for sentences correctly recognised as old. Participants report which voice (female or male) spoke the sentence during the encoding phase.

For adults, the general pattern of findings is such that, although memory for sources is quite good, it is usually worse than memory for items; and further, this discrepancy increases with aging (e.g., A. S. Brown, Jones, & Davis, 1995; Trott, Friedman, Ritter, & Fabiani, 1997; Trott, Friedman, Ritter, Fabiani, & Snodgrass, 1999). A meta-analysis of the adult literature underscores this distinction (Spencer & Raz, 1995). Spencer and Raz (1995) reported on 46 studies conducted in the two decades up to 1995. Participants in these studies were younger adults ($M_{age} \leq 35$ years) and older adults ($M_{age} \geq 65$ years). For item memory and source memory tasks, older adults' performance was poorer than younger adults'. However, the magnitude of the age effect was greater on measures of source memory than on measures of item memory. Whereas for item memory, the difference between younger and older adults reflected a moderate effect ($d = 0.58$), the difference between the two age groups for source memory reflected a large effect ($d = 0.87$). Based on these outcomes, Spencer and Raz (1995) concluded that source memory is more affected by aging than item memory.

Developmental Changes in Children's Source Memory

The developmental course and nature of children's source memory is by no means clear-cut. Whilst on some source memory tasks, young children's performance has been found to be on par with older children's and adults', on others, their performance has been substantially poorer than their older counterparts' (Foley, Aman, & Gutch, 1987; Foley, Durso, Wilder, & Freidman, 1991; M. K. Johnson, Raye, Hasher, & Chromiak, 1979). In general terms, research suggests when the sources to be discriminated are sufficiently dissimilar, young children's performance appears to be quite good, whereas when the sources are highly similar, young children seem to have considerable difficulty discriminating between them (Lindsay, 2008).

This point has been demonstrated by Foley and her colleagues (Foley & Johnson, 1985; Foley et al., 1983; Foley, Santini, & Sopasakis, 1989). In these studies, 6-year-old children were as good as older children and/or adults at discriminating between two actors who performed particular actions. However, they were less accurate when required to discriminate between memories of actions they had actually performed and memories of actions they had only imagined themselves performing.

For example, in Foley et al.'s (1983) study, although 6-year-olds' source memory was as accurate as 17-year-olds' when they discriminated between memories of what they had said and what another person had said, they were less accurate at discriminating between memories of words they had actually said and words they had only thought about saying. Similarly, in Foley and Johnson's (1985) study, children aged 6 and 9 years were as accurate as adults when required to discriminate between what they had done and what they had observed another person doing. However, compared to adults, the children had considerable difficulty discriminating between memories of actions they had actually performed and memories for actions they had only imagined performing. In another study, Foley et al. (1987) found that 7-year-olds were just as accurate as 10-year-olds at discriminating the sources of pictures they had traced using either a pencil and finger, stylus and finger, or stylus and pencil.

These studies suggest that from about 6 years of age, children can perform as well as older participants and adults on some types of source memory tasks. One question that arises then, involves the performance of children younger than 6 years of age on similar types of tasks. Studies that have investigated the development of source memory in even younger children suggest improvements on certain types of tasks are concentrated within the preschool period (e.g., Drummey & Newcombe, 2002; Foley,

Harris, & Hermann, 1994; Lindsay et al., 1991; Sluzenski, Newcombe, & Ottinger, 2004; Sussman, 2001; Welch-Ross, 1995).

Welch-Ross (1995) for example, had 3-, 4-, and 5-year-old children perform, pretend to perform, and imagine performing a series of actions (e.g., smelling a flower; Exp. 1). An old-new recognition task was used to assess item memory (e.g., "Did we talk about smelling a flower today?"; p. 429). In the event the child responded "yes", an additional source discrimination question was asked (e.g., "Did you imagine smelling a flower, pretend to smell a flower, or smell a flower for real?"; p. 429).

For item recognition, Welch-Ross's (1995) results showed performance was high for all age groups and there were no age-related differences. For source recognition, children were better at discriminating memories for performed actions than pretended actions, which in turn, were discriminated better than imagined actions. Children's level of performance was such that for performed actions, source recognition was above chance level for all age groups. For pretended actions, 4- and 5-year-olds' source recognition was above chance level, whereas 3-year-olds' performance was at chance level. For imagined actions, all age groups' source recognition was at chance level. Developmental improvement was also observed, such that 3-year-olds were less accurate than 4- and 5-year-olds at discriminating source, whilst the two older age groups' performance was comparable.

In a second experiment, Welch-Ross (1995) used a between-subjects design and had 3- and 4-year-olds either (a) perform and pretend, (b) pretend and imagine, or (c) perform and imagine the actions. Consistent with the first experiment, there was no difference between 3- and 4-year-olds' item recognition performance. Children's level of performance was such that for pretended actions, 4-year-olds' source recognition was above chance level in the pretend-perform condition, but at chance level in the pretend-

imagine condition. Three-year-olds' source recognition for pretended actions was at chance level in both the pretend-perform and pretend-imagine conditions. For imagined actions, 4-year-olds' source recognition was above chance level in the imagine-perform condition, but at chance level in the imagine-pretend condition. Once again, 3-year-olds' source recognition was at chance level in both conditions. Welch-Ross did not provide results for children's performance in relation to chance for performed actions. Based on the reported means, both age groups' source recognition appeared to be above chance level in both the perform-imagine condition (mean percentage correct scores were 76.86 and 89.33 for 3- and 4-year-olds, respectively) and pretend-perform condition (mean percentage correct scores were 72.06 and 95.13 for 3- and 4-year-olds, respectively). As in the first experiment, Welch-Ross observed an age effect, such that 3-year-olds' source recognition was less accurate than 4-year-olds', but only for pretended and performed actions. There was no difference between the age groups for imagined actions.

Sluzenski et al. (2004) also examined children's ability to distinguish between memories of performed and imagined actions. Four-, 6- and 8-year-olds (Exp. 1) performed and imagined performing scripted events (e.g., planting a seed, unpacking a picnic basket). After a 1-week delay, children were asked whether they had performed or imagined performing the given events (e.g., "Did you actually unpack a picnic basket or just imagine unpacking a picnic basket?"; p. 229). Whilst all age groups performed better than chance, 4-year-olds were less accurate than 6- and 8-year-olds at discriminating the source of their memories; the two older age groups performed comparably.

Sluzenski et al. (2004) reported similar outcomes for Experiment 2, in which source memory was tested within the same session and 4- and 6-year-olds only took

part. Although 4-year-olds made fewer errors than in the previous experiment, they were still less accurate at distinguishing between performed and imagined events than 6-year-olds, whose performance was at ceiling.

Sussman (2001) examined memory for performed and imagined actions within an interactive context. During the encoding phase, 4-, 8-, and 12-year-old children, and adults (a) performed and imagined performing actions; (b) observed another person performing actions; and (c) imagined observing another person performing actions (e.g., putting a Band Aid on a foot). A three-alternative forced-choice recognition/discrimination task was administered immediately and after a 1-week delay. The task assessed item and source memory simultaneously (e.g., "You showed me the bottom of your foot. Did you really do this, did you imagine doing this, or did this never happen?"; p. 125). For item recognition, 4-year-olds recognised fewer actions than 8-year-olds, 12-year-olds, and adults. Item recognition for the three older age groups was comparable. For source discrimination, with the exception of 4-year-olds, all age groups performed above chance level for imagined and performed actions in both the immediate and delayed test sessions. Four-year-olds performed above chance level for imagined and performed actions in the immediate test session, but at chance level for imagined actions in the delayed test session. Overall, children's source discrimination accuracy was higher for performed actions than for imagined actions, especially for 4- and 8-year-olds. There was also evidence of improvement with age, but only for imagined actions. Four-year-olds were less accurate than 12-year-olds and adults; 8-year-olds' accuracy did not differ significantly from any other age group.

In another study, Lindsay et al. (1991) had 4-year-old children and adults listen to tape-recorded words that were presented via two loud speakers: one situated on their left and one on their right. Fifty percent of the participants in each age group heard the

same voice coming from both loud speakers (same voice condition). The remaining participants heard a different voice (male versus female) coming from each loud speaker (different voice condition). An old-new recognition test of the words was used to assess item memory. Source memory (left loud speaker versus right loud speaker) was assessed for correctly recognised words. For item memory, performance was high for both age groups, with 4-year-olds recognising a comparable number of the words to adults. For source memory, children were less accurate than adults at determining the loud speaker from which a word had been projected, but only for the same voice condition. For the different voice condition, children were as accurate as adults at determining from which loud speaker they had heard a particular word.

Finally, Drummey and Newcombe (2002) adapted the fictitious fact paradigm (normally used with prefrontal patients; Schacter, Harbluk, & McLachlan, 1984) to investigate developmental changes in 4-, 6-, and 8-year-old children's source memory. This paradigm involves first teaching participants facts and then testing whether they can recall the source of remembered facts (where facts were learned). Children were presented with facts (e.g., "A giraffe cannot make any sounds"; p. 505) by either the experimenter or a puppet handled by the experimenter. After a 1-week delay, children were presented with old and new facts in a question format (e.g., "What animal cannot make any sounds?"; p. 505). After each correct response, children were then asked where they had learned the information (experimenter versus puppet). For fact recall, 4-year-olds remembered fewer facts than 6-year-olds, whilst these two age groups remembered fewer facts than 8-year-olds. For source memory, 4-year-olds were less accurate than 6- and 8-year-olds at distinguishing the source of remembered facts; 6- and 8-year-olds performed similarly.

Summary

Numerous studies have employed various procedures in an attempt to better understand the development of source memory in childhood. Whilst the nature and course of this development suggested by the findings is not always straightforward, it would appear that marked improvements occur between 4 and 6 years of age. For item memory, it would seem that development takes a somewhat different course, such that young children generally demonstrate good recognition memory of the items, whereas recall performance shows more gradual improvement with age.

Based on the findings discussed here, there are two main questions that arise: First, given that item and source memory are both aspects of episodic memory, why is it that children's memory for source information takes a different developmental course to that for item information; and second, why is it that young children often compare unfavourably to older children and adults when it comes to remembering the source of their memories? These questions represented the focus of the current research, for which the overall aim was to better understand the basis of young children's source memory difficulties.

Two main lines of enquiry were pursued. The first concerned methodological shortcomings in the procedures used to assess source memory in children. Based on a review of the literature, it is proposed that some procedures may impede the detection of source memory, and/or exacerbate the extent of the difficulties observed in young children. By addressing such issues, the present research aimed to develop a methodology that is more suited to examining source memory in young children.

The second area centred on identifying the cognitive operations that underlie source memory. According to Chalfonte and Johnson (1996), source memory involves the binding of features within a complex event. The core notion here is that intact

binding processes are essential for accurate source memory. Take the example of having a conversation. Memories for isolated features such as what was said and/or who was present might be formed. Alternatively, more complex representations of the relation between who said what might be constructed. The binding of features therefore enables the formation of more complex memories. Consequently, memory for isolated features does not produce complex memories; rather, the production of complex and coherent memories relies on the cognitive processes that bind particular features (Chalfonte & Johnson, 1996; Mitchell & Johnson, 2000; Newcombe et al., 2007).

Evidence from the adult literature provides some support for the involvement of binding processes in source memory. For example, studies with older adults have shown it is possible to reduce source memory deficits by facilitating binding processes at encoding (Glisky, Rubin, & Davidson, 2001; Hashtroudi, Johnson, Vnek, & Ferguson, 1994). To date, it appears no research has specifically examined the effects of binding at encoding on source memory performance with children. It might be that the binding processes involved in source memory develop slowly, thereby partly explaining why young children's memory for source information is poor. Thus, a further goal of the current research was to examine the role of binding in source memory in a younger population.

Factors that Potentially affect the Difficulty of Source Memory Tasks

Although improvements in children's performance on various source memory tasks is evident between the ages of 4 and 6 years, the finding that older children sometimes perform poorly (e.g., Foley & Johnson, 1985) suggests factors other than normal development contribute to this type of memory. As discussed, one factor that has been found to affect source memory is source similarity (M. K. Johnson et al., 1993).

When source features are similar, they are more difficult to distinguish (Ferguson, Hashtroudi, & Johnson, 1992; M. K. Johnson, Foley, & Leach, 1988; M. K. Johnson, Raye, Wang, & Taylor, 1979; Lindsay et al., 1991; Mitchell & Johnson, 2009). This is particularly so for memories that are self-generated (e.g., self-imagined versus self-performed). Under such circumstances, it is likely the cognitive operations involved in actually performing a given action versus imagining performing that action are very similar, thus making the events difficult to discriminate (M. K. Johnson, 2006). As several of the studies reviewed above operationalised source in this way (e.g., Foley et al., 1991; Foley & Johnson, 1985; M. K. Johnson & Raye, 1981; Lindsay et al., 1991), the younger children might have been particularly disadvantaged.

To overcome potential problems arising from similarity of source, the current research operationalised source as *self* and *other* encoding-context. Justification for operationalising source in this way comes from findings which suggest particular distinctions such as self versus other emerge as cues in memory earlier than other distinctions such as thoughts versus actions (Foley et al., 1983). Furthermore, the *self* is one factor known to facilitate memory in both children and adults (Symons & Johnson, 1997). Because the current research aimed to maximise children's performance on a source memory task, it included procedures that were likely to support the successful encoding and retrieval of the individual item and source features, as well as the item-source bindings. A SRE procedure was therefore incorporated to investigate source memory in young children.

Another potential source of difficulty, is the length of delay between study and test phases. In studies where a long delay (1 week) separated the study phase and the test phase (Drummey & Newcombe, 2002; Sluzenski et al., 2004 [Exp. 1]), the observed age effects might in part, have reflected young children's steeper general

forgetting rate, rather than their poorer memory for source per se. To eliminate the effects of extended study-test delays, the current research tested item and source memory within the same experimental session.

Methodological Issues with Measures of Source Memory

In most source memory experiments, source memory is tested for correctly remembered items only. The source memory test is therefore not independent of the item memory test. This procedure assumes there is no source memory for items that are not recalled or recognised. However, this might not be the case. The encoding of isolated item and source features is potentially a separate process from the encoding of these features combined (Sluzenski, Newcombe, & Kovacs, 2006). Memory for source might therefore be possible in the absence of demonstrated memory for the item.

Research with adults provides some support for this (Cook, Marsh, & Hicks, 2006; Kurilla & Westerman, 2010; Starns, Hicks, Brown, & Martin, 2008). These studies showed that in some instances, participants were able to accurately specify source even though they failed to recall or recognise the associated words. The current research investigated this possibility by comparing source memory for recalled items and for all items presented during the encoding phase. The purpose of this was to establish whether the current practice of testing source memory for correctly remembered items only is appropriate.

The above issue is further compounded in many experiments because different types of tests are used to assess item memory and source memory. For example, free recall might be used to assess item memory and a two-alternative forced-choice task might be used to assess source memory. These tests are not comparable in terms of their retrieval demands and the extent to which they rely on strategic processes (A. L. Brown, 1975; Craik & McDowd, 1987; Flavell, 1970; Whiting & Smith, 1997). One

consequence, is that any observed differences in item and source memory might reflect the relative difficulty of the type of test used, rather than differences in the type of memory.

When the test of source memory is based only on the items that were correctly reported, there is another likely consequence. Relative to a less demanding item memory test such as old-new recognition, a more demanding item memory test such as free recall, will result in fewer items being available for the assessment of source memory. In Experiments 1 and 3 of the current research, recall and recognition were used to assess item and source memory, respectively. The findings were compared to Experiment 2 in which a recognition test was used for both item and source memory. This enabled the impact of item memory task difficulty on source memory to be assessed.

The SRE in Memory

The SRE in memory refers to the superior memory that occurs when items are encoded in relation to the self. For example, the word "considerate" might be recalled better after responding to the question, "Does the word 'considerate' describe you?" than after the question, "Does the word 'considerate' describe your next-door neighbour?" Many studies have employed the SRE paradigm to examine the role of the self in memorial processes (Conway & Dewhurst, 1995) and to determine the brain regions associated with the effect (Craik et al., 1999; Kelley et al., 2002).

The SRE in memory is robust (Symons & Johnson, 1997) and has more recently been observed in item memory (i.e., memory for the content or facts of an event) with children as young as 4- and 5-years of age (Crawley, Newcombe, & Bingman, 2010; Kovacs & Newcombe, 2006; Sui & Zhu, 2005). Despite this, it has not always been clear why the effect occurs. A meta-analysis of the literature by Symons and Johnson

(1997) led them to conclude that the SRE exerts its advantage largely because the self represents a well developed and often used construct that facilitates more elaborate and organised processing in memory. This subsequently makes additional pathways and cues available at retrieval, thereby facilitating memory task performance.

SRE in Memory Paradigm

The SRE paradigm typically used in adult research was developed by Rogers, Kuiper, and Kirker (1977). Their original paradigm extended Craik and Tulving's (1975) depth-of-processing paradigm to include a self-referent condition. Depth-of-processing theory postulates that memory performance reflects the level at which information is processed, in that the amount of processing a stimulus receives at encoding will impact performance at retrieval. It proposes that the deeper the level-of-processing (i.e., the more processing the stimulus receives), the better memory will be.

In a typical depth-of-processing study, participants encode items (e.g., study list of common nouns) according to conditions that require different levels of processing (e.g., structural, phonemic, semantic). In the structural condition, items (e.g., CHAIR) might be judged on whether they are written in lower case or upper case letters. In the phonemic condition, items might be judged on whether they rhyme with another word (e.g., house—mouse). In the semantic condition, participants might be asked whether an item (e.g., tiger) is a member of a particular category (animal), or if it fits into a given sentence ("She saw a _____ at the zoo"). These orientating tasks vary qualitatively in encoding, and are structured in such a way that no memory test is expected. Memory for the study items is then tested using recall or recognition. The prediction is that relative to shallower level-of-processing questions (i.e., structural, phonemic), deeper level-of-processing questions (i.e., semantic) will take longer to

respond to, but will result in a more elaborate memory trace, which in turn will produce better memory (Craik & Tulving, 1975).

Rogers et al.'s (1977) adaptation of the depth-of-processing paradigm to incorporate a self-referent condition applies the level-of-processing principle to assess the impact of self-referent encoding on memory. Like the depth-of-processing paradigm, the SRE paradigm involves an encoding phase and a test phase. During the encoding phase, participants are typically presented with a study list of words (e.g., trait adjectives) and are asked to make judgements about each. For example, the trait adjective "honest" might be encoded in relation to the self ("Does this adjective describe you?"), other ("Does this adjective describe the current Australian prime minister, Julia Gillard?"), or a structural feature such as case ("Is this adjective written in lowercase letters?").

Memory for study list words (i.e., item memory) is then assessed during the test phase using recall or recognition. Because of the self's facilitative effect in memory, the prediction is that memory for study items will be best in the self-referent encoding condition, followed by the other-referent and case-referent encoding conditions, respectively. Overall, the level-of-processing procedure used in SRE studies has demonstrated the superiority of self-referent encoding for item memory over alternative encoding contexts including other-referent (i.e., encoding in relation to another person) and semantic encoding (Symons & Johnson, 1997).

Developmental Changes in the SRE in Memory

Up until recently, SREs in item memory had not been reported in children less than 7 years of age. Evidence concerning whether the effect improves developmentally has also been mixed. Pullyblank, Bisanz, Scott, and Champion (1985) for example, examined developmental changes in functional self-knowledge and how this

knowledge impacts information processing in 8-, 10-, and 11-year-old children, and adults. Participants encoded adjectives according to one of two conditions: (a) "Does this word (e.g., afraid) mean the same as (e.g., scared)?" (semantic); and (b) "Does this word (e.g., afraid) describe you today?" (self-referent; p. 1448). A free recall test of the adjectives followed. Results showed all age groups recalled more self-encoded than semantically-encoded words, but that the SRE did not improve with age.

In a second experiment, Pullyblank et al. (1985) tested 7-, 9-, 11-, and 19-year-olds. In the semantic condition, participants responded to questions such as: "How well does *nice* mean the same as *pleasant*?"; in the self-referent condition, they responded to the question: "How well does (target word) describe you today?" Results were consistent with Experiment 1 in that all age groups demonstrated a SRE in item recall. Similarly, the effect did not show developmental improvement.

In another study, Hammen and Zupan (1984) presented 7- to 12-year-olds with positive-valence (e.g., helpful, smart, brave) and negative-valence (e.g., scared, lonely, unhappy) adjectives. Children responded to each adjective under one of two encoding conditions. In the structural condition, children were asked: "Is this word long?"; in the self-referent condition they were asked: "Is this word like you?" (p. 601). An incidental free recall test of the adjectives was used to assess item memory. In their analysis of the data, Hammen and Zupan divided the sample into younger (M_{age} = 8 years, 6 months) and older (M_{age} = 10 years, 4 months) children. Results showed for adjectives that received a "yes" response at encoding, 8-year-olds recalled fewer words than 10-year-olds. Both age groups demonstrated a SRE in item recall, such that they recalled more self-referent words than structurally-encoded words.

Baker-Ward et al. (1990) examined the extent to which performing versus observing activities affected children's recall of the activities. In Experiment 1, 6- and

9-year-old children were grouped in same-age triads. During the encoding phase, each child took a turn at performing activities (e.g., arranging blocks in alphabetical order) while the other two children observed. Children were then interviewed individually and asked to recall "....all of the games that were played, and who played each one." (p. 58). Both age groups showed a SRE, such that they remembered more self-performed than other-performed activities. The magnitude of the SRE did not differ significantly between the two age groups.

In Experiment 2 of Baker-Ward et al.'s (1990) study, a slightly different pattern of outcomes was observed when children were grouped according to familiarity. Eight-year-olds who were more familiar with one another (in that they played together frequently) were grouped and compared to children who were less familiar with one another (in that they did not play together frequently). Children completed the same task as in Experiment 1. Overall, children recalled more self-performed than other-performed activities. However, children in the familiar group recalled more other-performed activities than children in the less familiar group, thereby eliminating the SRE for the familiar group. This last outcome indicates that the self has a facilitative impact, but only to the extent that the other is less well known to the individual.

Whilst the studies discussed thus far suggest the SRE is evident by 7 years of age, other findings have indicated the SRE in item memory does not emerge until late childhood. For example, Halpin, Puff, Mason, and Marston (1984) had 6-, 7-, and 10-year-old children encode trait adjectives (e.g., tall, quiet, happy) according to three conditions: (a) "Does this word have an 's' sound?" (structural); (b) "Is this a nice word?" (semantic), and; (c) "Does this word describe you?" (self-referent). A free recall test of the words was used to assess item memory. The 10-year-olds only showed a SRE. Seven-year-olds recalled more semantically encoded adjectives than structurally

encoded adjectives, whilst their recall of semantically encoded and self-referent adjectives was comparable. Six-year-olds' item recall did not vary as a function of encoding-context condition. Regarding this last finding, Halpin et al. noted that all three conditions appeared to be equally very difficult (in that recall was low for all encoding conditions) for this age group, and suggested the task might have been developmentally inappropriate.

Reasons for these inconsistent outcomes are not well understood. One potential explanation could be that the mnemonic strategies and/or self-knowledge necessary for the SRE are insufficiently developed in young children.

In a study that examined general memory, Justice, Baker-Ward, Gupta, and Jannings (1997) assessed children's use of mnemonic strategies during the encoding phase, and whether use of such strategies served to enhance memory at retrieval. Justice et al. presented children with sets of pictured objects (e.g., racecar, elephant, museum) and informed them they would be asked to remember the names of some of the objects. Children could use any method they wanted to help them remember the objects. If they chose to name the object in the picture to aid memory, then they were instructed to say these names aloud (i.e., verbal labelling). Outcomes suggested some 3-year-olds used basic mnemonic strategies like verbal labelling. However, these children did not perform better than the 3-year-olds who did not use such strategies.

Miller and colleagues (Miller & Harris, 1988; Miller & Seier, 1994; Miller, Woody-Ramsey, & Aloise, 1991) have termed the inability for young children to profit from mnemonic strategy use (i.e., in that it does not enhance memory performance) as *utilisation deficiency*. Justice et al.'s (1997) findings concur with earlier research, which has also reported utilisation deficiencies in young children. Baker-Ward, Ornstein, and Holden (1984) examined the effectiveness of mnemonic strategy use

(including verbal labelling) for 4-, 5-, and 6-year-old children. They found 6-year-olds who used verbal labelling demonstrated superior memory performance compared to 6-year-olds who did not. Similar to Justice et al. however, no enhanced memory was observed for 4- and 5-year-olds who used the identical strategy compared to children of the same age who did not.

Thus, although children of varying ages employ basic mnemonic strategies, their usage does not appear to produce better memory until about the age of 6 years. In relation to the absence of SREs in young children, self-referent encoding may facilitate the use of mnemonic strategies, but these children might simply not benefit from them.

The utilisation deficiency hypothesis potentially elucidates why young children (perhaps 6 years and less) do not demonstrate SREs. However, the distinction between the general memory studies discussed here and SRE in memory studies is noteworthy. The SRE exerts its advantage via elaborate and organised processing (Symons & Johnson, 1997). Compared to basic strategies like verbal labelling, these involve sophisticated processes. Accordingly, it might not be useful to compare outcomes of the general memory studies to those from SRE paradigms.

Another possible explanation, is that young children may lack the self-knowledge necessary to elicit SREs in memory. Although it is understood the self-concept undergoes gradual development, becoming more complex over childhood, some evidence indicates even young children have a fairly elaborate concept of self (Marsh, Ellis, & Craven, 2002).

Regarding this, Marsh et al. (2002) evaluated the appropriateness of their measure, *Self Description Questionnaire for Preschoolers*, for assessing multiple domains of self-concept in 4- and 5-year-old children. In order to maximise the sensitivity of the measure, they used the individual-interview style (Marsh, Craven, &

Debus, 1998) to administer the scale. Their results suggested that by 4 years of age, children are able to differentiate between multiple self-concept dimensions (academic [e.g., verbal, mathematics], nonacademic [e.g., physical, appearance]). In light of this, provided children are able to make use of their self-concept, it is conceivable that under suitable conditions, SREs in memory might be elicited in children as young as age 4.

The above idea links in with the view that children's source memory difficulties, in part, reflect methodological shortcomings. It might also be the case that SREs are not observed in young children because of problems with some of the experimental procedures used to assess it. SRE research with children has typically incorporated procedures similar to those used in adult research. For example, the use of trait adjectives which are encoded in relation to verbal statements that vary in levels of processing.

Potential problems exist with this practice because young children might not fully understand the meaning of the trait adjectives and/or the nature of the encoding statements. Consequently, it cannot be assumed children complete tasks according to the experimental requirements. The floor effects reported by Halpin et al. (1984) for their 6-year-olds offer some support for this idea. In that study, the three encoding-context conditions were all difficult for the youngest age group, an outcome which the authors themselves suggested was potentially due to the use of trait adjectives.

Symons and Johnson (1997) have also suggested that SREs in memory are not observed in young children because tasks are potentially developmentally inappropriate. In support of their claim, they reported on a study by Barnas and Symons (1995, as cited in Symons & Johnson, 1997) which compared the performance of 4-year-olds with 5- and 6-year-olds. During the encoding phase, stimulus words were presented with corresponding pictorial stimuli. A standard free recall test was used to assess item

memory. Results showed that even the youngest children demonstrated a SRE, and that there was no development of the effect with age. Because the study reported by Symons and Johnson is unpublished, it is not possible to evaluate specifics relating to the procedures used. However, it could be that the incorporation of pictures might have made the task more relevant to younger children, thereby enabling a SRE to be facilitated and detected.

Alternative SRE Paradigms

Some research provides support for the proposal that methodological problems contribute to SREs not being observed in young children. In particular, the outcomes of several more recent studies suggest that item memory can be facilitated through self-referent encoding in children as young as 4- and 5-years of age (Crawley et al., 2010; Kovacs & Newcombe, 2006; Sui & Zhu, 2005).

Kovacs and Newcombe (2006), for example, had 4- and 5-year-old children listen to statements that were spoken by either a female voice or a male voice (Exp. 1). Statements concerned child-relevant topics such as food and drink preferences, and activity likes and dislikes (e.g., "I like going to the circus to see the clowns."; p. 42). Children in the self-focus condition were asked whether they felt the same way (happy, scared, mad, yucky, sad, or surprised) as the speaker; children in the other-focus condition judged how the speaker felt about what she or he was saying. For the test of item memory, children were presented with old and new statements and judged whether they had heard each statement earlier. Results showed that 4-year-olds recognised fewer statements than 5-year-olds. A SRE in item memory was also observed, such that children in the self-focus condition recognised more statements than children in the other-focus condition.

These results were replicated when Kovacs and Newcombe (2006) presented 4- and 5-year-olds with video clips in which they saw a person (one of two female speakers) speak the statements (Exp. 2). Similarly, when they presented 4-year-olds with video clips in which a male and a female spoke the statements (Exp. 3), children in the self-focus condition recognised more statements than children in the other-focus condition.

Using a methodology similar to Kovacs and Newcombe (2006), Crawley et al. (2010) assigned 4- and 6-year-olds to one of five conditions (Exp. 1). Children viewed video clips depicting one of two women making statements that varied in emotional content (e.g., "My Dad gave me a present today."; "I had to eat broccoli today."; p. 284). After each statement, children responded to a given question: (a) "How does she feel about that?" (emotional other-focus condition); (b) "How do you feel about that?" (emotional self-focus condition); (c) "What colour is her hair?" (perceptual other-focus condition); (d) "What colour is your shirt?" (perceptual self-focus condition); and (e) "Is the sound loud enough for you to hear?" (control condition; p. 276). An old-new recognition test of the statements was used to assess item memory. A SRE in item memory was evident for emotional questions, such that children in the self-focus condition recognised more statements than children in the other-focus condition.

Sui and Zhu (2005) also proposed that SREs would be evident in children younger than 6 years provided the tasks are developmentally appropriate. Based on the limitations posed by the use of trait adjectives and level-of-processing encoding statements for children, these researchers developed an alternative SRE paradigm. In this paradigm, study items are pictures of common objects (e.g., chair, dog) and sources are photographs of the children themselves (self condition) or another child (other condition) pointing to the item. During the encoding phase, children are presented with

item-source stimulus displays and asked to report "who" (self or other) is pointing to the item (e.g., "I am pointing to the tree", or "Other is pointing to the tree", p. 383). The encoding phase is followed by a free recall test of items. Source memory is assessed for recalled items only. For this test, children report who (self or other) was pointing to each remembered item.

Sui and Zhu (2005) based their rationale for incorporating self images on the conjecture that recognition of one's own face is indicative of higher-order self-awareness, and that the ability to recognise one's own image facilitates the capacity for self-related tasks (Keenan, Wheeler, Gallup, & Pascual-Leone, 2000). A substantial body of research in the field of self-recognition indicates that human children recognise their own image at around 18-months, and can accurately label this image by 22-months (Amsterdam, 1972; Anderson, 1984; D. B. Johnson, 1983; Lewis & Brooks-Gunn, 1979; Marsh et al., 2002; Schulman & Kaplowitz, 1977). Thus, it is reasonable to conceive that the incorporation of object pictures as study items and face images as encoding references, might serve to overcome the limitations posed by methods used in earlier research.

In two experiments, Sui and Zhu (2005) examined the effects of self-referent and other-referent encoding on item and source memory in 4-, 5-, and 10-year-old children. For item memory in Experiment 1, recall improved with age such that 5-year-olds recalled more items than 4-year-olds; 10-year-olds recalled more items than both younger age groups. Only the 5-year-olds demonstrated a SRE in item memory. For source memory (self-referent and other-referent conditions combined), each age group performed above chance level, but there were no age-related differences. No SRE in source memory was observed at any age.

Sui and Zhu (2005) proposed that the absence of a SRE in item memory for the 10-year-olds in Experiment 1 was due to low task demands. They subsequently modified these in Experiment 2 by increasing the number of item-source stimulus displays (presented during the encoding phase) from 12 to 18, and by reducing the trial presentation time from 4 to 2 seconds. Five- and 10-year-olds only were tested. Consistent with Experiment 1, 5-year-olds recalled fewer items than 10-year-olds. However, in Experiment 2, the SRE was present in item memory for both age groups. For overall source memory, 5- and 10-year-olds' performance was above chance level. Consistent with Experiment 1, there was no age-related difference or evidence of a SRE in source memory for either age group.

Sui and Zhu's (2005) results offer preliminary support for the use of their paradigm with young children. Their finding that 5-year-olds' item memory was facilitated through self-referent encoding is important, as at the time of their study's publication, this was roughly 2 years younger than had previously been reported. However, that no age-related improvements were observed in source memory warrants attention. This finding is inconsistent with much research showing developmental improvements in source memory across the preschool period (e.g., Drummey & Newcombe, 2002; Foley et al., 1994; Lindsay et al., 1991; Sluzenski et al., 2004; Sussman, 2001). In addition, despite the use of object pictures and face images, no SRE was reported in item memory for the 4-year-olds. Furthermore, no SRE was observed in source memory for any age group. A number of methodological procedures might, in part, explain these outcomes.

Some research indicates that young children can encode and store a comparable amount of information to older children (A. L. Brown; Kee & Bell, 1981; Kobasigawa, 1974; Williams & Goulet, 1975). However, because free recall is generally more

demanding for younger children than it is for older children, much of the information can be rendered inaccessible when an effortful retrieval task such as this is required. If the SRE in item memory does emerge earlier, then the use of free recall for the test of item memory in Sui and Zhu's study (2005) might have impeded its detection in the youngest group.

Furthermore, Sui and Zhu's (2005) use of a difficult item memory test would almost certainly have meant that fewer items were remembered (than would have been if an old-new recognition test of items had been used) and therefore available for the assessment of source memory. This, combined with the fact that only 12 trials were administered (6 in the self and 6 in the other encoding condition) meant that overall source memory (self and other conditions combined) was tested on an average of 4.44 items for the 4-year-olds, 6.24 items for the 5-year-olds, and 7.44 for the 10-year-olds. The absence of age and encoding-context effects on source memory might therefore have resulted simply because there were too few items to discriminate between the conditions.

Summary of Procedural Problems and Modifications used in the Present Research

The present research investigated the development of children's source memory using modified versions of Sui and Zhu's (2005) SRE paradigm. As outlined, whilst this paradigm is potentially useful for examining the SRE in source memory with young children, there are some features which may detract from this. Furthermore, several other procedures used to assess source memory are potentially problematic for young children. Thus, in order to provide a valid test of the hypotheses using child appropriate procedures, several modifications were incorporated.

The power to detect age and encoding-context effects in item and source memory was increased by using a larger study item set. To ensure that item and source memory were assessed in a comparable way, recognition tests of item memory and source memory were used in one of the experiments (Exp. 2). In another experiment, a free recall test of items and a recognition test of sources were used (Exp. 1). This method allowed performance on both types of item memory tests to be compared between experiments. In order to avoid potential problems associated with general forgetting rates over time, item and source memory were assessed within the same experimental session.

To evaluate whether the current practice of using non-independent tests of item and source memory is appropriate, one experiment compared source memory for retrieved items only versus memory for source when all study items were presented (Exp. 3). Sui and Zhu's (2005) operationalisation of source as self versus other was retained as this was expected to overcome the problems associated with source similarity.

An issue related to source similarity, is the finding that self-referent encoding produces superior memory, but only to the extent that the other is less well known to the child (e.g., Baker-Ward et al., 1990). To avoid the effect of familiarity in the current research, care was taken to ensure that children whose face images were used to represent the other encoding-context were unknown to participant children. Finally, picture cards of the objects and face cards of the possible sources (self and other) were presented during the source memory test phase. The rationale for this last modification, is the idea that presenting pictures of items alongside the possible sources, might serve to reinstate the item-source bindings if these were established at encoding (M. K. Johnson & Chalfonte, 1994).

Neural Mechanisms involved in Source Memory and Self-referential Processing

Along with behavioural and neuropsychological methods, developments in neuroimaging techniques over the last two decades have contributed to a better understanding of the cognitive and neural mechanisms underlying source memory and self-referential processing. In particular, a substantial body of evidence from adult research implicates the role of prefrontal functioning in both source memory (Janowsky, Shimamura, & Squire, 1989; Knowlton & Squire, 1995; Schacter et al., 1984; Senkfor & Van Petten, 1998; Van Petten, Senkfor, & Newberg, 2000) and in self-referential processing (Northoff et al., 2006).

Evidence for the Role of Frontal Lobe Functioning in Source Memory

Evidence for the involvement of prefrontal functioning in source memory comes from research with prefrontal patients (Duarte, Ranganath, & Knight, 2005; M. K. Johnson, O'Connor, & Cantor, 1997; Ranganath & Blumenfeld, 2008; Schacter et al., 1984; Shimamura & Squire, 1987; Simons et al., 2002), brain imaging studies with healthy adults (Dobbins & Han, 2006; Mitchell, Raye, Johnson, & Greene, 2006; Mitchell et al., 2008; Nolde, Johnson, & D'Esposito, 1998; Simons, Gilbert, Owen, Fletcher, & Burgess, 2005), as well as correlational data linking performance on source memory tasks with behavioural measures thought to assess prefrontal lobe functioning (e.g., Wisconsin Card Sorting Test; Craik, Morris, Morris, & Loewen, 1990; Glisky, Polster, & Routhieaux, 1995; Schacter et al., 1984; Spencer & Raz, 1995).

For example, research involving patients with frontal lobe damage has shown that this population perform poorly on source memory tasks. Duarte et al. (2005) examined the effects of unilateral prefrontal cortex lesions on source memory. In this study, participants encoded object pictures (e.g., baseball, duck) in relation to their

animacy (living versus non-living) or manipulability (i.e., movable by hand: manipulable versus non-manipulable). An old-new recognition test of the objects followed.

For each object, Duarte et al. (2005) had participants select one of three response options: (a) "remember", indicating they were certain that the object had been studied and that they could recollect specific associations; (b) "know", indicating they were certain that the object had been studied, but that they could not recollect any specific associations; and (c) "new", indicating they were certain they had never studied the object. Participants made source judgements (object studied under the animacy condition versus manipulability condition) for objects to which they responded "remember" and "know". Results showed source accuracy was higher for "remember" than for "know" judgements for both frontal patients and matched controls, but that frontal patients' source accuracy for "remembered" objects was poorer than that of their matched counterparts.

Another line of evidence for the involvement of prefrontal functioning in source memory comes from studies in which participants carry out a source memory task whilst undergoing brain scanning. Such research with healthy adults has shown that source memory judgements are associated with activation in the left lateral prefrontal cortex (Dobbins, Foley, Schacter, & Wagner, 2002; Nolde et al., 1998; Ranganath, Johnson, & D'Esposito, 2000; Raye, Johnson, Mitchell, & Nolde, 2000; Rugg, Fletcher, Chua, & Dolan, 1999; Slotnick, Moo, Segal, & Hart, 2003).

For example, Slotnick et al. (2003) used fMRI to investigate whether performance on item memory and source memory tasks is associated with differential activity in right and left prefrontal cortex. Participants viewed abstract shapes which were presented on the left side or right side of the screen. Their task was to remember

the shapes and their spatial locations. An old-new recognition test of the shapes was used to assess item memory; source memory (left side versus right side) was assessed for all shapes presented during the encoding phase. Results of their event-related analysis of item and source memory indicated a distinction between the left and right prefrontal cortex. Whilst item memory was associated with greater right prefrontal activation, source memory was associated with greater left prefrontal activation.

Correlational data also indicate a link between performance on source memory tasks and behavioural measures thought to assess prefrontal lobe functioning (Craik et al., 1990; Glisky et al., 1995; Schacter et al., 1984; Spencer & Raz, 1995). Craik et al. (1990) for example, examined the relations between normal aging, source amnesia, and frontal lobe functioning. In this context, source amnesia refers to when a fact learned within the experimental session is correctly remembered, but incorrectly attributed to an alternative source (e.g., television, newspaper).

Craik et al. (1990) presented older adults with made-up facts about public personalities who were either well-known, somewhat known, or fictitious (e.g., "Ronald Reagan's favourite candies are jelly beans."; p. 149). After a 1-week retention period, participants were tested for their memory of the facts (e.g., "What are Ronald Reagan's favourite candies?"; p. 149), as well as their memory for the source of where they had learned the facts. Measures of frontal lobe functioning (Wisconsin Card Sorting Test, verbal fluency) were also administered. Results showed the degree of source amnesia was correlated with both measures of frontal lobe function. Specifically, source amnesia was positively correlated with age and the number of perseverative errors on the Wisconsin Card Sorting Test, and negatively correlated with verbal fluency.

If source memory is dependent on the integrity of prefrontal functioning, then young children's difficulties on source memory tasks potentially stem from the fact that

the frontal lobes are insufficiently mature to support the processes involved. In line with this idea, Schacter, Kagan, and Leichtman (1995) have proposed that source memory is slower to emerge in children than item memory because of its greater reliance on frontal lobe functioning, and the fact that maturation of this region continues throughout childhood (Huttenlocher, 1979, 1990; Huttenlocher & Dabholkar, 1997).

In addition, to the extent that source memory depends on executive functions (because it involves strategic processes that require self-reflection), Wheeler et al. (1997) have also argued for the involvement of the frontal lobes in source memory. Furthermore, studies of executive function in childhood support this conjecture, in that activities usually linked to prefrontal brain regions (e.g., planning, goal-directed behaviour, inhibition, flexibility) develop across the preschool years (for a review see Zelazo, Carter, Reznick, & Frye, 1997), the same period during which marked improvements in source memory are observed.

Evidence for the Role of Frontal Lobe Functioning in Self-Referential Processing

Comparable to the evidence for source memory, self-referential processing appears, to some extent, dependent on the integrity of prefrontal functioning. In particular, studies investigating the neural correlates of the SRE in memory have reported reliable activation of medial prefrontal cortex during self-referential processing (Craik et al., 1999; Fossati et al., 2003; Fossati et al., 2004; Heatherton et al., 2006; Lou et al., 2004; Macrae, Moran, Heatherton, Banfield, & Kelley, 2004; Schmitz, Kawahara-Baccus, & Johnson, 2004).

For example, using fMRI, Kelley et al. (2002) had participants make judgements about trait adjectives whilst undergoing imaging. Judgements were made according to three conditions: (a) self, “Does the adjective describe you?”; (b) other, “Does the adjective describe current US President George Bush?”; or (c) case, “Is the adjective

presented in uppercase letters?" (p. 786). An old-new recognition test of the trait adjectives was used to assess item memory.

Kelly et al. (2002) found that participants' recognition was highest for self-referenced adjectives, followed by other-referenced and case-referenced adjectives, respectively. Their imaging data showed that relative to case-referent judgements, during self-referent and other-referent judgements, left inferior frontal cortex and anterior cingulate were discriminately active. However, self-referent judgments were accompanied by selective engagement of a separate region of medial prefrontal cortex.

Macrae et al. (2004) also used fMRI to investigate whether the memorability of self-knowledge is supported by distinct neural regions. Participants were presented with trait adjectives (e.g., dependable, energetic, honest) and responded to the question: "Does this adjective describe you?" An old-new recognition test of the adjectives followed. Participants indicated whether they remembered the word with high confidence, low confidence, or whether they believed the word to be new. Compared to words that were not judged as self-descriptive, those that were judged to be self-descriptive were more likely to be remembered with high confidence.

For the imaging data, Macrae et al. (2004) grouped words according to remembered versus forgotten, and self-descriptive versus non self-descriptive. Relative to forgotten words, remembered words were accompanied by activation in dorsomedial prefrontal cortex, left lateral prefrontal cortex, and bilateral hippocampus/ parahippocampal gyrus. Compared to non self-descriptive words, self-descriptive words produced activation in medial prefrontal cortex.

In another imaging study, Fossati and colleagues (Fossati et al., 2003; Fossati et al., 2004) examined the neural correlates of the successful retrieval of positive-valence and negative-valence personality traits encoded in a self-referential mode. During fMRI

scanning, participants made yes/no judgements about trait adjectives under three conditions. In the self-referent condition, participants judged whether the trait described them; in the other-referent condition, they judged whether the trait was socially desirable. Finally, in the letter-recognition condition, participants judged whether the word contained a target letter ("e" or "a"). The encoding phase was followed by an old-new recognition test of the words.

Results from Fossati et al.'s (Fossati et al., 2003; Fossati et al., 2004) studies showed that participants recognised more negative-valence words than positive-valence words. A SRE was also evident as more self-referent words were recognised compared to other-referent words and words from the letter recognition condition. The imaging data showed that self-referential processing of both positive-valence and negative-valence words produced activation of right and left medial prefrontal cortex. Positive-valence words produced a more robust activation than negative-valence words did.

Taken together, the research indicates that prefrontal functioning supports the mechanisms involved in source memory and self-referential processing. In so much as the focus of the current research was to better understand the underlying cognitive operations involved in source memory (as opposed to its underlying biological basis), it was also necessary to acknowledge the limits that frontal lobe maturation may impose on young children's source memory. Accordingly, based on previous research, it was expected that developmental improvements in source memory would be observed across the preschool period. However, the extent to which procedural modifications and self-referential processing facilitate the detection of an earlier emergence of source memory was the main focus.

Empirical Framework

The present research further investigated the development of the SRE and source memory in children aged 4-, 5-, and 6-years. It extends research which has shown that compared to older children and adults, young children perform poorly on some source memory tasks (e.g., Cycowicz et al., 2001; Foley & Johnson, 1985; Foley et al., 1983; Lindsay et al., 1991). Furthermore, the current research aimed to determine the basis of young children's source memory difficulties. There were three main research questions: First, to what extent do methodological factors contribute to the observed findings? Second, do young children's source memory difficulties stem from a need to construct and retrieve item-source bindings? Third, does the self versus other contextual distinction have special status in the early development of episodic memory?

As outlined, a SRE paradigm in which source is operationalised as self versus other encoding-context has been used with young children (Sui & Zhu, 2005). This paradigm builds on research showing that self-recognition and the self-concept emerge early in development (Marsh et al., 1998; Marsh et al., 2002). Although Sui and Zhu's (2005) paradigm has considerable potential for investigating the SRE and other types of source memory, it has some features that might detract from its usefulness.

Modified versions of Sui and Zhu's (2005) procedure were used in Experiments 1, 2, and 3 to investigate 4-, 5-, and 6-year-old children's item and source memory. Questions of specific interest were: (a) the extent of age-related improvement in item and source memory during this period of childhood; (b) the extent to which self-referent encoding facilitates item and source memory in 4-, 5-, and 6-year-old children, and if so; (c) at what ages the facilitation is observed. If outcomes differ from Sui and Zhu's findings, then the methodological modifications might be responsible.

In Experiment 4, the encoding phase of Sui and Zhu's (2005) procedure was retained, but the tests of item and source memory were replaced by a recognition test of the item-source bindings. In Sui and Zhu's procedure, item and source memory are assessed in separate, successive tests, whereas the binding recognition procedure assesses item-source bindings more directly. This procedure is more comparable to that used to assess episodic memory (e.g., Sluzenski et al., 2006; Sluzenski et al., 2004). Questions of specific interest were: (a) the extent of age-related improvement in recognition of item-source bindings in the period from 4 to 6 years; (b) the extent to which self-referent encoding facilitates recognition of item-source bindings, and if so; (c) at what ages the facilitation is observed. The findings obtained with this binding recognition procedure were compared to the findings obtained with the modified Sui and Zhu procedure.

Experiment 5 was similar to Experiment 4 in that an item-source binding recognition procedure was employed. However, the nature of the source manipulation differed. Source was operationalised not as self versus other, but as two dog breeds: *Bull mastiff* versus *German shepherd*. The main question was the extent of age-related improvement in recognition of item-source bindings. Unlike Experiment 4, no significant difference between the two sources was expected in Experiment 5. If recognition of item-source bindings is more accurate in Experiment 4 than Experiment 5, this would be consistent with the interpretation that the self-concept is fundamental to the development of source processing and episodic memory more generally.

CHAPTER 2. PICTURE-NAMING TASK

The purpose of the picture-naming task was to select drawings that would be suitable to use as experimental stimuli for 4-, 5-, and 6-year-old children. It was important to ensure that children were familiar with the objects shown in the drawings, and that they had a suitable label for each. A suitable label included either the *dominant* object label or another *reasonable* alternative. Dominant object labels refer to those empirically derived as the target names produced by the largest number of participants in previous picture-naming studies (Boyce, 2005; Szekely et al., 2004). Examples of reasonable alternatives for the dominant label "tree" would be "bush", "plant", or "shrub". Only object drawings for which the majority (≥ 85%) of children had a suitable label were retained in the final set of 72 items. These object drawings were incorporated into Experiments 1 to 5.

Method

Participants

Fourteen (8 girls, 6 boys) 4-year-old (M = 53.93 months, SD = 3.58, range: 48 – 59) children participated in the picture-naming task. All attended a day-care centre located in a middle-class suburb of the Gold Coast, Queensland, Australia. All children had English as their first language. Participants were recruited through letters distributed to parents by day-care centre staff. Written consent was obtained from parents prior to testing. Children's verbal assent was also obtained prior to testing. Both recruitment and task procedures were conducted in accordance with specific guidelines established during ethics approval applications from Griffith University Human Research Ethics Committee (PSY/98/06/HREC). In this and subsequent experiments, children received stickers as a token of appreciation for their participation.

Stimuli

Stimuli were 138 pictures selected from *The International Picture-Naming Project's* (Szekely et al., 2004) pool of 520 object pictures. This pool comprises simple black-and-white line drawings of common objects. Figure 2.1 shows three examples.

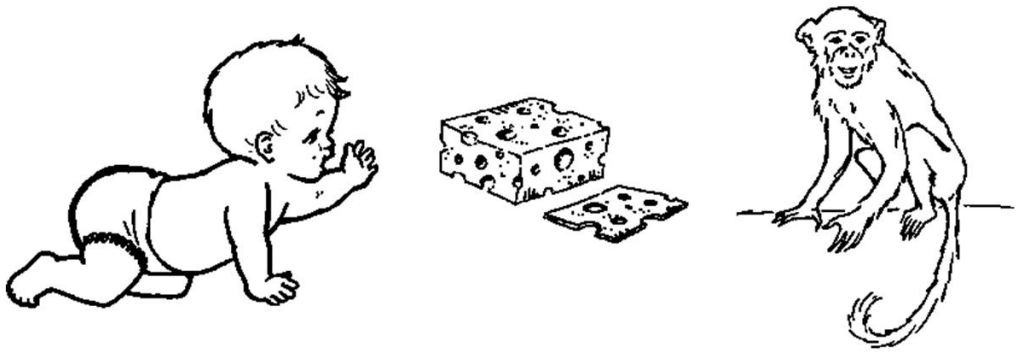

Figure 2.1. Object line drawings from The International Picture-Naming Project (Szekely et al., 2004) pool. From left to right, the dominant labels are *baby*, *cheese*, and *monkey*.

Selection criteria for the initial set of drawings included (a) age of acquisition for the label prior to 3 years, based on North American norms (Szekely et al., 2004); (b) no more than two syllables in the dominant label; (c) label accuracy rating of 95% or above, based on Australian norms (Boyce, 2005); and (d) relevance to an Australian population. For this last criterion, it was assumed that due to lack of exposure, Australian children would be less familiar with some objects (e.g., igloo, moose, squirrel), therefore such items were excluded. All drawings measured 7.50 cm (width) × 9.00 cm (height) and were presented centrally on a computer screen against a white background.

Drawings were randomly divided into two blocks (Block A and Block B) of 69 items. Three versions each of Block A and Block B were constructed. Within blocks, each version comprised a different randomised order of the drawings. Children received both Blocks A and B. Version presentation order was counterbalanced across participants.

Apparatus

Tasks for the picture-naming study and subsequent experiments were programmed using DMDX software (Forster & Forster, 2003), and were run using an HP Compaq nc6400 laptop computer (2.00 GHz, 1.99 RAM) set to 1024 × 768 bit depth resolution.

Procedure

Children were tested individually in a quiet room of the day-care centre, and were seated approximately 80 cm from the computer screen. The experimenter read task instructions aloud and checked that the child understood what was expected before proceeding. The participant's task was to name (e.g., "cat", "house") the target objects as they appeared one at a time on the screen. The experimenter initiated each trial by pressing the spacebar, after which a fixation cross (+) appeared centred on the screen for 200 ms. A 1,000 ms blank interval preceded the onset of each drawing which remained on the screen for a maximum of 10,000 ms. If the child provided a dominant label response or a reasonable alternative, the experimenter pressed the right shift key. The left shift key was pressed for other response types: (a) unsuitable label, and (b) "I don't know". A written account was taken of all labels other than the dominant one. The task took approximately 20 minutes to complete.

Results

Accuracy Rating

For each object, an accuracy rating was calculated that corresponded to the percentage of children who labelled the object correctly, using either the dominant label or a reasonable alternative. Drawings of objects with an accuracy rating of ≥ 85% were retained for further analysis. A total of 78 objects met this criterion.

Selection of Line Drawings

Seventy-two of the 78 black-and-white line drawings described above were randomly selected and divided into four picture sets (1, 2, 3, and 4) of 18 objects. Table 2.1 lists the dominant labels that correspond to the object line drawings comprising the four sets. Across sets, the line drawings were matched for age of acquisition (1, 2, and 3 years), number of syllables (one and two), frequency in the language, and visual complexity (Szekely et al., 2004).

Chi-square analyses indicated no significant association between set and age of acquisition, $\chi^2(6, N = 72) = 5.34$, $p = .501$, or set and number of syllables, $\chi^2(3, N = 72) = 0.18$, $p = .980$. Analyses of variance revealed no significant effect of set on either frequency in the language, $F(3, 68) = 0.09$, $p = .965$, $\eta^2 = .003$, or visual complexity, $F(3, 68) = 0.42$, $p = .738$, $\eta^2 = .018$. Finally, independent-samples *t*-tests showed no significant effect of sex on the total accuracy score for any object set, largest $t(12) = -1.34$, $p = .204$, $d = -0.77$.

The object line drawings from Picture Sets 1 and 2 were presented in the encoding phases of Experiments 1 to 5. Those from Picture Sets 3 and 4 were used as distracters in the old-new recognition test of item memory in Experiment 2, and the recognition test of item-source bindings in Experiments 4 and 5.

Table 2.1

Dominant Labels Corresponding to the Object Line Drawings Comprising the Picture Sets used in Experiments 1 through 5

Picture Set			
1	2	3	4
baby	balloon	apple	ball
bat	bowl	bell	book
bed	cake	bone	boot
chair	cat	bridge	bottle
clown	cheese	comb	box
dolphin	door	cow	car
ear	dress	crab	carrot
flower	eye	dog	clock
giraffe	foot	finger	dragon
hat	hand	fish	fork
horse	ladder	flag	house
key	monkey	glasses	knife
leaf	scissors	guitar	penguin
mirror	sock	hammer	robot
rabbit	spoon	road	snowman
shoe	toothbrush	pig	table
snake	whistle	snail	tent
sun	witch	window	tree

CHAPTER 3. EXPERIMENT 1

Earlier SRE in memory research with children involved methods similar to those used with adults. Most outcomes of such research indicated the effect does not emerge prior to age 7. However, more recent work has acknowledged the limitations of using stimuli such as trait adjectives with young children, and has attempted to modify the SRE methodology so as to make tasks more developmentally appropriate. In particular, based on the rationale that the ability to recognise one's own face image facilitates the capacity for self-related tasks (Keenan et al., 2000), along with research indicating the self-concept is relatively complex at an early age (Marsh et al., 1998; Marsh et al., 2002), Sui and Zhu (2005) developed an alternative paradigm.

Sui and Zhu (2005) proposed that the face photographs (of self and other) and common object pictures used in their paradigm would be more suitable for examining and detecting SREs in young children. Outcomes of their study provided preliminary support for the efficacy of the paradigm, as results showed 5-year-olds benefited from self-referent encoding in item memory.

Prior to the publication of Sui and Zhu's (2005) study, no research had reported SREs in item memory for children younger than age 7. Since then, Kovacs and Newcombe (2006), and Crawley et al. (2010) have reported SREs in item memory with children aged 4 and 5 years. Although these studies differed to the current experiment, in that encoding-context involved the manipulation of emotional focus, they provide additional support for the proposal that the SRE in item memory emerges earlier in development than previously supposed.

To date, no study using a SRE paradigm has reported self-reference advantages in source memory with children younger than 6 years. This represented a key area of interest in the current experiment, the main purpose of which was to determine whether

Sui and Zhu's (2005) results would be replicated when their procedure was modified by (a) increasing the number of trials in the encoding phase, and (b) presenting picture cards of the objects and face cards of the possible sources during the source memory test phase. For item memory, Sui and Zhu reported developmental improvements during the periods between 4 and 5 years of age, 4 and 10 years of age, and 5 and 10 years of age (Exp. 1). Five-year-olds (Exps. 1 and 2) and 10-year-olds (Exp. 2), but not 4-year-olds (Exp. 1) showed SREs.

For source memory, the 4-, 5-, and 10-year-olds in Sui and Zhu's (2005) study performed better than chance, but there was no evidence of developmental improvement or a SRE. Much developmental research indicates significant improvements in source memory across the preschool period (Drummey & Newcombe, 2002; Foley et al., 1994; Lindsay et al., 1991; Sluzenski et al., 2004; Sussman, 2001; Welch-Ross, 1995). Thus, Sui and Zhu's finding that 4-year-olds' source memory was as developed as 5-year-olds' required further investigation.

As noted earlier, source recognition in Sui and Zhu's (2005) study was based on very few items. The larger study item pool used in the present experiment was intended to increase the reliability of both the item and source memory tests. Furthermore, if item-source bindings are established at encoding, then presenting object picture cards depicting the recalled objects, as well as face cards depicting photographs of both self and other (during the source memory test phase), might facilitate source memory by reinstating the item-source bindings (Glisky et al., 2001; Hashtroudi et al., 1994; M. K. Johnson & Chalfonte, 1994).

With these modifications in place, the research questions were: (a) the extent of age-related improvement in item and source memory between the ages of 4 and 6; (b)

the extent to which self-referent encoding facilitates item and source memory in 4-, 5-, and 6-year-old children, and if so; (c) the ages at which the facilitation is observed.

Method

Participants

Seventy-two children from two day-care centres and one Catholic Education primary school located in middle-class suburbs of the Gold Coast region, Queensland, Australia participated in this experiment. Children from three age groups were recruited with equal numbers of girls and boys in each age group: twenty-four 4-year-olds (*M* = 53.58 months, *SD* = 3.92, range: 48 – 59), twenty-four 5-year-olds (*M* = 65.79 months, *SD* = 3.32, range: 60 – 70), and twenty-four 6-year-olds (*M* = 76.38 months, *SD* = 3.45, range: 72 – 83). In addition to the 72 children described, there were five 5-year-olds whose data were not included as they did not complete the task. Three boys commenced the task, but indicated they did not wish to continue. One boy did not have English as his first language and appeared to not understand the task instructions. One girl (after repeated instruction) provided the identical response ("I'm pointing to the _____") to each trial during the encoding phase. The experimenter terminated the session for these five children either during or at the end of the encoding phase.

Participants were recruited through letters distributed to parents by day-care centre and school staff. Written consent was obtained from parents prior to testing. Both recruitment and task procedures were conducted in accordance with specific guidelines established during ethics approval applications from Griffith University Human Research Ethics Committee (PSY/H1/07/HREC).

Independent of the participants described above, an additional 12 children from three age groups were recruited with equal numbers of girls and boys in each age group: four 4-year-olds, four 5-year-olds, and four 6-year-olds. Participants in this second

group were either children of undergraduate psychology students from Griffith University who received course credit for their child's participation, or children of colleagues known to the author. These children were recruited to represent the *other* encoding-context condition[3]. Because of this, care was taken to ensure they did not know the participant children in the first group[4].

Socioeconomic status (SES). For this and subsequent experiments, SES was assessed using Hollingshead's (1975) *Four-Factor Index of Socioeconomic Status*. A score was calculated for each participant based on the self-reported educational attainment and occupational status of the child's parents: SES = (education level × 3) + (occupation × 5). Where educational and occupational details for both parents were provided, an average score was calculated. Scores could range from 8 to 61 with higher scores indicating higher SES. In Experiment 1, mean SES scores according to age group were: 4-year-olds (M = 42.39, SD = 9.99, range: 17.00 – 56.00), 5-year-olds (M = 43.15, SD = 8.67, range: 24.50 – 58.00), and 6-year-olds (M = 44.59, SD = 8.86, range: 25.50 – 56.00). SES scores were subject to a one-way ANOVA which showed there were no significant differences between the age groups, $F(2, 66) = 0.34$, $p = .714$, $\eta_p^2 = .010$.

Stimuli

Face photographs. Prior to testing, a black-and-white digital photograph was taken of each participant child's face. The procedure for taking photographs was standardised, such that children stood or sat in front of a plain coloured wall.

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[3] Face images of these children were also used in the binding recognition test in Experiment 4 to represent the novel source component.

[4] Children recruited to represent the other encoding-context condition attended different day-care centres and schools to those of participant children.

Photographs were taken with a Canon Power Shot S5IS, 12 × optical zoom, 8.00 megapixels digital camera that was fixed to a tripod, positioned approximately 1.50 m from the child. All photographs were taken at the participant's day-care centre or school during regular attendance hours. For children who represented the other encoding-context, photographs were taken in a laboratory at Griffith University. A copy of the image of each child's face was printed and laminated, and used in the source memory test. The dimensions of these face cards were 9.00 cm (width) × 9.00 cm (height). Digital copies of the images of children's faces were also incorporated into the encoding stimulus displays, as described further below.

Body representation. A black-and-white line drawing of an androgynous body representation similar to that used by Sui and Zhu (2005) was used in all stimulus displays in the self and other encoding-context conditions, as described further below.

Encoding item-source stimulus displays. Digital images of the faces and body representation described above, and the line drawings described in the picture-naming study were used to construct item-source stimulus displays which were presented during the encoding phase. Each item-source stimulus display comprised a face photograph linked to the body representation paired with a line drawing, an example of which is shown in Figure 3.1.

For the self encoding-context condition, a photograph of the participating child's own face was linked to the body representation (self face-body image). For the other encoding-context condition, the photograph of a matched[5] child's face was linked to the body representation (other face-body image). The pairing of face-body images with object line drawings was counterbalanced, such that 50% of the children in each age

[5] Children representing the other encoding-context condition were matched to participant children according to sex, age and hair colour (fair, dark).

group received drawings from Picture Set 1 paired with their own face-body image, and drawings from Picture Set 2 paired with the other face-body image (Presentation A). The remaining children received the opposite assignment of drawings to self and other encoding-context conditions (Presentation B). Thus, for Presentation B, drawings from Picture Set 2 were paired with the children's own face-body image, and drawings from Picture Set 1 were paired with the other face-body image.

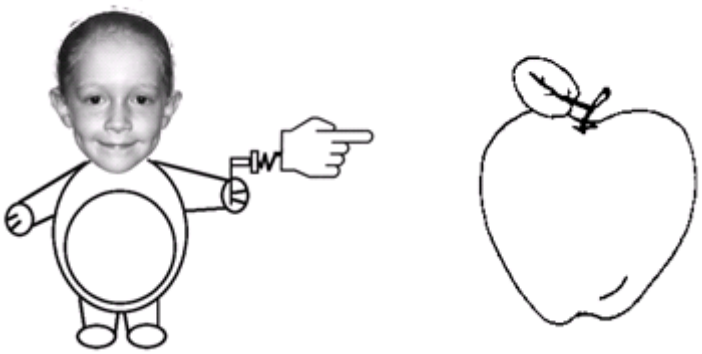

Figure 3.1. An example item-source stimulus display used during the encoding phase. For the self and other encoding-context conditions, the face photograph was of the participant child and matched child, respectively.

The dimensions of the face-body images and object line drawings were each 9.00 × 7.50 cm. A copy of each drawing from Picture Sets 1 and 2 was printed and laminated, and used in the source memory test phase. The dimensions of these object picture cards were 9.00 × 9.00 cm.

Procedure

The experiment comprised three phases: encoding, item memory test, and source memory test.

Encoding phase. The experimenter first read aloud the task instructions: "For this task, I'm going to show you pictures of different things. Pointing to each thing will be a picture of either you or a picture of another girl (boy). What I'd like you to do, is to say the name of the thing when it appears on the screen, and to also say who is pointing to the thing. So for example, if the thing is a picture of a bird and you're pointing to it, then you would say 'I'm pointing to the bird'. But if the other girl (boy) is pointing to it, then you would say 'The other girl (boy) is pointing to the bird'. Shall we have a practice so you understand what I mean?"

Children were presented with two practice item-source stimulus displays (one each of self- and other-condition) followed by 36 (18 self-condition, 18 other-condition) test item-source stimulus displays presented in random order. The experimenter initiated each trial by pressing the spacebar. A 1000 ms blank screen preceded the presentation of the item-source stimulus display which remained on the screen. While the item-source stimulus display was on the screen the experimenter asked: "Who is pointing to the _____?" Children were encouraged to indicate who (self or other) was pointing to the object and to include the name of the object in their response. The experimenter pressed the right shift key once the correct response was given. To ensure accurate encoding, in the event children responded incorrectly, the experimenter pointed out the error and asked them to state the correct response. The experimenter initiated subsequent trials by pressing the space bar.

Item memory test. The encoding phase was followed immediately by an incidental free recall test of the objects presented during the encoding phase. Children were asked to report as many of the objects shown at encoding as possible. No time limit was imposed. The experimenter marked off all correctly recalled items on a checklist in preparation for the source memory test that followed. The maximum score

was 18 in each of the self and other encoding-context conditions. After the item memory test, children completed a filler task that involved drawing a picture of themselves. The task took approximately 2 minutes and was followed immediately by the source memory test.

Source memory test. Cards corresponding to the correctly recalled items were presented one at a time in a different order than during the encoding phase. Children were asked: "When you saw this _____ before during the game, who was pointing to it, was it you or was it the other girl (boy)?" The two face cards (self and other) were presented and children had the option of responding verbally (saying "me" or "other girl [boy]") and/or by pointing to one of the face cards. The task took approximately 20 minutes to complete.

Design and Analyses

A mixed factorial design was used to examine the effects of sex (girl, boy), age (4-, 5-, and 6-years), and encoding-context (self, other) on item and source memory. Sex and age were between-subjects variables; encoding-context was a within-subjects variable. Item memory was measured as the mean proportion of correctly recalled items. Source memory was measured as the mean proportion of correct source judgements made for correctly recalled items.

A mixed factorial analysis of variance (ANOVA) was used to assess the main and interaction effects of sex, age, and encoding-context on item and source memory. Effect sizes are reported as partial eta squared (η_p^2). When appropriate, Scheffe post-hoc tests were conducted.

Paired-samples *t*-tests were also conducted to further evaluate the effect of encoding-context on item and source memory. These were run separately for girls and

boys at each age level. They assessed whether the SRE was present for any subgroup. Effect sizes are reported as Cohen's *d*.

Follow-up sign tests corresponding to the ANOVA and paired-samples *t*-tests were used to evaluate the robustness of encoding-context effects on item and source memory. It is possible that a significant overall SRE in item memory could occur as the result of a minority of children showing a substantially large SRE for either item or source memory. The sign tests compared the percentages of children who did and did not demonstrate a SRE for item and source memory to demonstrate that results were not an artefact of a few participants with abnormally large SREs.

Correlation analyses were also conducted to rule out an alternative explanation for a significant SRE in source memory. The alternative explanation is that when in doubt, children are biased to select the photograph of themselves rather than the other child. If this bias is common among children, then a high number of self responses and a low number of other responses would be expected. This would be revealed as a negative correlation between source recognition scores for self-encoded and other-encoded items. Consistent with the analyses described above, Pearson's correlations between the two scores were conducted for the entire sample, as well as separately for girls and boys at each age level.

Finally, single-sample *t*-tests were used to compare children's source memory performance in the self and other encoding-context conditions to chance level. That is, the level at which children could be expected to perform if they simply guessed. The test of source memory was a two-alternative forced-choice task, therefore chance level was .50. Comparisons were made separately for girls and boys at each age level.

The assumptions of the individual analyses described above were met. An alpha level of .05 was applied to all analyses. Unless otherwise specified, reported *p* values

are two-tailed. Because there is evidence that young children can show SREs in memory and this was the direction of interest, *p* values are one-tailed for analyses that examined the effect of encoding-context, as well as for the single sample *t*-tests.

Results

Preliminary Analyses

Preliminary analyses conducted for Experiments 1 through 5 indicated that the presentation (A or B) children received during the encoding phase had no significant main or interaction effect on any dependent measure, largest $F(1, 60) = 1.71$, $p = .197$, $\eta_p^2 = .028$. Data were therefore collapsed across this variable in subsequent analyses for Experiments 1 through 5.

Item Recall

Mean proportions of correctly recalled items were analysed with a 2 (sex: girl, boy) × 3 (age: 4-, 5-, and 6-years) × 2 (encoding-context: self, other) mixed factorial ANOVA. Descriptive statistics are presented in the second and third columns of Table 3.1. The analysis indicated a significant main effect of age, $F(2, 66) = 4.92$, $p = .01$, $\eta_p^2 = .13$. A Scheffe test showed 6-year-olds ($M = .26$, $SE = .02$) recalled significantly more items than 4-year-olds ($M = .18$, $SE = .02$; $p = .017$), and marginally more items than 5-year-olds ($M = .20$, $SE = .02$; $p = .073$). The difference in item recall between 4- and 5-year-olds was not significant ($p = .832$). For the main effect of sex, there was a trend towards significance, $F(1, 66) = 3.33$, $p = .073$, $\eta_p^2 = .048$, such that girls ($M = .23$, $SE = .02$) recalled marginally more items than boys ($M = .19$, $SE = .02$). The main effect of encoding-context was not significant, $F(1, 66) = 0.90$, $p = .383$ (one-tailed), $\eta_p^2 = .001$. All two- and three-way interactions were not significant, largest $F(1, 66) = 1.31$, $p = .256$, $\eta_p^2 = .02$.

Table 3.1

Effect of Encoding-Context on Mean Proportions of Correctly Recalled Items for Girls and Boys within each Age Group in Experiment 1 (N = 72)

	Encoding-Context				
Subgroup	Self	Other	*t*	*d*[a]	*p* (one-tailed)
Girls					
4-years	.21 (.04)	.18 (.04)	0.53	0.24	.305
5-years	.19 (.03)	.22 (.02)	-1.05	-0.32	.160
6-years	.32 (.04)	.26 (.04)	1.80	0.47	.050
Boys					
4-years	.17 (.04)	.17 (.03)	0.12	0.04	.454
5-years	.17 (.02)	.20 (.02)	-0.94	-0.36	.183
6-years	.21 (.02)	.23 (.04)	-0.47	-0.19	.324

Note. Standard errors are in parentheses. [a]Effect size estimate is Cohen's *d*.

The Sign test assessing the encoding-context effect showed that of the 72 children, 38.89% demonstrated a SRE compared to 46.83% who did not demonstrate a SRE. The difference between these percentages was not significant, $Z = -0.51$, $p = .305$ (one-tailed). Results of the paired-samples *t*-tests examining the SRE in item memory for girls and boys at each age are presented in the last three columns of Table 3.1. These showed that the effect of encoding-context on item memory was marginally significant only for 6-year-old girls. Results of the Sign tests for each sex and age group are presented in Table 3.2. These showed no significant difference between the percentages of children who did and did not demonstrate a SRE for any subgroup, thereby suggesting that the marginally significant SRE in item memory for 6-year-old

girls might have been due a minority of children in this subgroup showing an extreme SRE. Thus, outcomes of both the parametric and nonparametric tests indicate that self-referent encoding did not facilitate children's item recall performance.

Table 3.2

Sign Tests Comparing the Percentages of Children by Sex and Age Group who did and did not show a SRE on Item Recall in Experiment 1 (N = 72)

	SRE		
Subgroup	Yes	No	*p* (one-tailed)
Girls			
4-years	50.00	41.67	.500
5-years	25.00	50.00	.254
6-years	58.33	33.33	.275
Boys			
4-years	41.67	50.00	.500
5-years	16.67	50.00	.145
6-years	41.67	50.00	.500

Source Recognition

Results of the single-sample *t*-tests comparing mean source recognition scores for each encoding-context condition to chance level (.50) are presented in the second and third columns of Table 3.3. For self-encoded items, source recognition for each subgroup was higher than chance. For other-encoded items, source recognition was significantly higher than chance for boys in each age group and for 5-year-old girls, whilst for 4- and 6-year-old girls it did not differ significantly from chance.

Table 3.3

Effect of Encoding-Context on Mean Proportions of Correct Source Judgements for Girls and Boys within each Age Group in Experiment 1 (N = 72)

	Encoding-Context				
Subgroup	Self	Other	*t*	*d*[a]	*p* (one-tailed)
Girls					
4-years	.78 (.08)*	.59 (.11)	1.34	0.58	.103
5-years	.78 (.10)*	.78 (.06)*	-0.12	-0.03	.455
6-years	.80 (.07)*	.67 (.10)	1.17	0.43	.133
Boys					
4-years	.74 (.12)*	.70 (.08)*	0.24	0.11	.408
5-years	.87 (.06)*	.65 (.06)*	3.51	1.03	.003
6-years	.79 (.07)*	.67 (.08)*	1.18	0.45	.132

Note. Standard errors are in parentheses. [a]Effect size estimate is Cohen's *d*. *Subgroup's mean source recognition score was significantly higher than chance level (.50) as assessed by a one-tailed single-sample *t*-test with an alpha level of .05.

Mean proportions of correct source judgements were analysed with a 2 (sex: girl, boy) × 3 (age: 4-, 5-, and 6-years) × 2 (encoding-context: self, other) mixed factorial ANOVA. Descriptive statistics are presented in the second and third columns of Table 3.3. The analysis indicated a significant main effect of encoding-context, $F(1, 66) = 6.13$, $p = .008$ (one-tailed), $\eta_p^2 = .085$. An overall SRE was evident as children's source recognition was more accurate for self-encoded items ($M = .79$, $SE = .03$) than for other-encoded items ($M = .68$, $SE = .03$). The main effects of sex, $F(1, 66) = 0.00$, $p = .952$, $\eta_p^2 = .000$, and age, $F(2, 66) = 0.58$, $p = .565$, $\eta_p^2 = .017$, were not significant.

Likewise, all two- and three-way interactions were not significant, largest $F(2, 66) = 1.40$, $p = .255$, $\eta_p^2 = .041$.

The Sign test assessing the robustness of the overall significant SRE in source memory showed that of the 72 children, the percentage who demonstrated a SRE (54.17%) was significantly greater than the percentage who did not demonstrate a SRE (22.22%), $Z = -2.97$, $p = .002$ (one-tailed). Results of the paired-samples *t*-tests examining whether the SRE in source memory was present for girls or boys at any age are presented in last three columns of Table 3.3. These showed the SRE was significant only for 5-year-old boys. Results of the Sign tests for each sex and age group are presented in Table 3.4 and closely reflected those of the *t*-tests, in that the percentage of children who showed a SRE was significantly greater only for 5-year-old boys.

Table 3.4

Sign Tests Comparing the Percentages of Children by Sex and Age Group who did and did not show a SRE on Source Recognition in Experiment 1 (N = 72)

	SRE		
Subgroup	Yes	No	*p* (one-tailed)
Girls			
4-years	66.67	25.00	.114
5-years	33.33	25.00	.500
6-years	58.33	25.00	.172
Boys			
4-years	50.00	25.00	.254
5-years	66.67	8.33	.020
6-years	50.00	25.00	.254

Detecting response bias. The correlation analyses assessing the presence of a self response bias in source recognition showed that scores for self-encoded and other-encoded items were not significantly negatively correlated, $r = .09$, $p = .46$. For each subgroup, the only significant finding was a positive correlation between the two scores for 5-year-old girls, thereby indicating that for this subgroup, as source recognition for self-encoded items increased, so too did source recognition for other-encoded items, $r = .68$, $p = .014$. There were no other significant correlations, largest $r = .48$, $p = .112$ (5-year-old boys). These results support the validity of the SRE in source recognition as no self response bias was evident.

Discussion

In Experiment 1, the effect of self-referent versus other-referent encoding was examined on two memory tasks: item recall and source recognition for correctly recalled items. It was of interest whether Sui and Zhu's (2005) findings would be replicated using the modified procedure. Two main modifications were incorporated: First, the number of trials in the encoding phase was increased; second, picture cards of the recalled items and face cards of the possible sources (self and other) were presented during the source memory test phase. Results of the item memory test are discussed first, followed by those of the source memory test.

Item Memory

Results of the item memory test showed that girls' recall was marginally higher than boys'. Because Sui and Zhu (2005) did not assess differences between girls and boys in item recall, no direct comparison with their study can be made. However, others who have tested for sex effects on item recall have not observed any (Hammen & Zupan, 1984; Pullyblank et al., 1985). Having said this, differences between the study samples as well as dissimilar procedures make such comparisons difficult. The children

in Hammen and Zupan's (1984), and Pullyblank et al.'s (1985) studies for example, were older (7 years and older) than the children in the present experiment. Moreover, both studies used trait adjectives as experimental stimuli. It is therefore not clear whether sex differences in item memory are to be expected in young children using the current paradigm. This was investigated further in Experiments 2 and 3.

Developmental improvement in item recall was observed between 4 and 6 years of age. This finding is in line with Sui and Zhu (2005) who reported similar development between 4 and 5 years of age. The result is also consistent with others such as Baker-Ward et al. (1990) who examined the extent to which performing versus observing activities affected children's recollection of those activities. Such age-related increases are expected in item recall and are generally interpreted as evidence for the development of strategic retrieval processes in memory (Bjorklund & Douglas, 1997; Howe, Brainerd, & Kingma, 1985).

The SRE in item recall was not significant in any age group or by any statistical test. This contrasts with Sui and Zhu (2005) who reported a significant SRE for their 5-year-olds in both their experiments. Increasing the number of trials during the encoding phase in Experiment 1 was intended to increase the reliability of the item memory test. It is therefore unclear why Sui and Zhu's findings were not replicated here.

Self-referent encoding enhances memory because it engages elaborative and organisational processes at encoding, which as a consequence, provide multiple cues and routes for retrieval (Klein & Loftus, 1988; Symons & Johnson, 1997). Recent findings have shown that SREs in item memory can be elicited in young children (Crawley et al., 2010; Kovacs & Newcombe, 2006). This indicates that under certain conditions, the processes that benefit older children and adults appear also to enhance younger children's item memory performance.

The absence of a SRE in item memory, might suggest the nature of the task was such that self-referencing and other-referencing produced equivalent levels of processing of the items at encoding—although the SRE observed in source memory discussed further below would indicate otherwise. Alternatively, it might be that the effortful nature of the free recall test of item memory, combined with the increased memory load requirements of the larger encoding item pool, meant children could not benefit from any additional processing that self-referenced items might have received. Kobasigawa (1974) has suggested that a problem with young children, is that they can fail to see the value of internal memory cues for assisting memory. Thus, even if self-referenced items received greater processing than other-referenced items at encoding and this produced more internal cues, children might not have been able to profit from these at retrieval.

That both Kovacs and Newcombe (2006), and Crawley et al. (2010) observed SREs in item recognition provides some support for this idea. Whereas free recall involves complex processing at retrieval, recognition relies on the presence of the original stimulus to prompt memory (Bjorklund & Douglas, 1997). In Experiment 2, the free recall test of item memory was replaced with an old-new recognition test of the items. This enabled the SRE in item memory to be investigated using a technique that does not require the demands of strategic retrieval, and which might better differentiate between self-referent and other-referent encoding in item memory for young children.

Source Memory

Results of the source memory test showed that children's accuracy of source judgements did not vary as a function of age. This finding replicates that of Sui and Zhu (2005), and provides preliminary support for their conclusion that children's source memory is well developed at 4 years of age. The result is, however, inconsistent with

much of the developmental research which documents significant improvements in source memory across the preschool period (Drummey & Newcombe, 2002; Foley et al., 1994; Lindsay et al., 1991; Sluzenski et al., 2004; Sussman, 2001; Welch-Ross, 1995). Procedural differences between the current paradigm and others might account for this disparity. However, because so few studies have used the current methodology, further research is required before conclusions about the age invariance in children's source recognition can be made. Experiments 2 and 3 provided additional opportunities to examine the effect of age on source recognition during the 4 to 6 age period using the current paradigm.

A significant SRE in source recognition was observed in the present experiment. This appears to be a new finding, in that no previous studies have reported SREs in source memory for children younger than 6 years. The effect seems to be due mainly to the 5-year-old boys for whom the SRE was evident on both the parametric and nonparametric tests. Although the SRE was not significant in other subgroups, the means in Table 3.3 (p. 58) and the percentages in Table 3.4 (p. 59) suggest that at least for some children, self-referent encoding facilitated source recognition. The single-sample *t*-tests comparing mean levels of performance to chance also support this. Source recognition for self-encoded items was above chance level for all subgroups. This was less frequently the case for source recognition of other-encoded items. Given what appears to be a trend towards a SRE for source memory, even for the 4-year-olds, the use of old-new recognition for the test of item memory in Experiment 2 should ensure that more items are available for the source memory test. This will provide greater power to investigate the differential effects of self-referent and other-referent encoding on source recognition.

CHAPTER 4. EXPERIMENT 2

Experiment 2 addressed two procedural issues identified within the source memory literature: The suitability of free recall tests for use with young children, and the comparability of the tests used to assess item and source memory.

Regarding the first issue, because recall involves more strategic processing than recognition (A. L. Brown, 1975; Craik & McDowd, 1987; Flavell, 1970; Whiting & Smith, 1997; Yonelinas, 2002), and these processes develop with age (Bjorklund & Douglas, 1997; Murphy, McKone, & Slee, 2003), younger children are likely to be disadvantaged relative to older children when free recall is required than when recognition is required. Furthermore, because greater retrieval demands are imposed by recall relative to recognition, it is likely that young children have additional information available, but that this information is inaccessible via methods such as free recall (A. L. Brown; Kee & Bell, 1981; Kobasigawa, 1974; Williams & Goulet, 1975). Consequently, if the SRE does emerge earlier in development, then its detection might be impeded by using a free recall task.

With these points in mind, the free recall test of item memory used in Experiment 1 was replaced by an old-new recognition test of the items in Experiment 2. Because the presence of the original study items cues memory (Bjorklund & Douglas, 1997), memory performance is usually superior under recognition than under free recall (Haist, Shimamura, & Squire, 1992). Based on this, children were expected to show better item memory in Experiment 2 than in Experiment 1.

Crawley et al. (2010) and Kovacs and Newcombe (2006) observed a SRE in item memory for their 4- to 6-year-old participants. In these studies, an old-new recognition test was used to assess item memory. It was therefore of interest whether a

SRE in item memory would be observed in the present experiment when old-new recognition was used to assess item memory.

Regarding the second procedural issue, in many experiments the tests of item and source memory are not equated (Glisky et al., 1995). For example, recall might be used to assess item memory, whilst recognition is used to assess source memory. Because recall is usually more difficult than recognition (Botwinick, 1978; Salthouse, 1982), any differences observed in item and source memory, might in part reflect differences in retrieval demands, rather than differences in item and source memory per se. In Experiment 2, both item and source memory were assessed using a recognition task, thereby addressing this problem and allowing for a more equivalent comparison between the two memory types to be made.

The old-new recognition test of item memory was also intended to provide a larger set of items for the test of source memory. It has been suggested that source memory depends on the retrieval of item-source bindings, and that items often serve as strong retrieval cues for the bindings (Glisky et al., 2001; Hashtroudi et al., 1994). Consequently, if more items are available for the source memory test, then the total number of correct source judgements should be higher in Experiment 2 than in Experiment 1, as more items are available to cue the item-source bindings. Based on this, source recognition was expected to be more accurate in Experiment 2 than in Experiment 1.

Considering the outcomes of Experiment 1, along with the task modification employed in the present experiment (i.e., old-new recognition test of item memory), the research questions of interest were: (a) the extent of age-related improvements in item and source memory between 4 and 6 years; (b) the extent to which self-referent encoding facilitates item and source memory in 4-, 5-, and 6-year-old children, and if

so; (c) the ages at which the facilitation is observed. Results of Experiment 1 indicated a trend towards girls showing higher item recall than boys, therefore sex differences in both item and source memory were examined further.

Method

Participants

Seventy-two children from three day-care centres and two Catholic Education primary schools located in middle-class suburbs of the Gold Coast region, Queensland, Australia participated in this experiment. Children from three age groups were recruited with equal numbers of girls and boys in each age group: twenty-four 4-year-olds (*M* = 55.38 months, *SD* = 3.20, range: 48 – 59), twenty-four 5-year-olds (*M* = 65.79 months, *SD* = 3.22, range: 60 – 71), and twenty-four 6-year-olds (*M* = 78.08 months, *SD* = 2.92, range: 73 – 83).

In addition to the 72 children described above, there were two 6-year-olds whose data were not included. One boy commenced the task, but indicated he did not wish to continue part way through. One girl (despite repeated instruction) responded "yes" to all trials on the old-new item recognition test described further below. Participants were recruited through the same procedures described in Experiment 1. Both recruitment and task procedures were conducted in accordance with specific guidelines established during the ethics approval application from Griffith University Human Research Ethics Committee (PSY/92/08/HREC).

SES was calculated as described in Experiment 1. Mean SES scores according to age group were: 4-year-olds (*M* = 41.00, *SD* = 9.42, range: 22.00 – 58.00), 5-year-olds (*M* = 43.25, *SD* = 8.46, range: 24.50 – 56.00), and 6-year-olds (*M* = 42.73, *SD* = 8.71, range: 22.00 – 58.00). A one-way ANOVA showed there were no significant differences in SES between the age groups, $F(2, 67) = 0.40$, $p = .671$, $\eta_p^2 = .012$.

Procedure

The experiment comprised the same three phases as in Experiment 1: encoding, item memory test, and source memory test.

Encoding phase. This was identical to Experiment 1.

Item memory test. Item memory was assessed using an old-new recognition test. The 36 objects presented during the encoding phase, along with 36 novel distracter objects (18 each from Picture Sets 3 and 4; see p. 45) were displayed on the computer screen in two randomised blocks of 36 trials each. Each block contained 18 old and 18 novel object drawings. Objects were displayed one at a time and remained on the screen for a maximum of 4,000 ms. The experimenter asked children: "Did you see this _____ before during the game?" The experimenter pressed either the right or the left shift key for a "yes" or "no" response, respectively. The experimenter then marked off all correctly recognised objects on a checklist in preparation for the source memory test that followed. After the item memory test, children completed the same filler drawing task as in Experiment 1. This was followed immediately by the source memory test.

Source memory test. Memory for source (self versus other) was assessed for correctly recognised items using the same procedure as in Experiment 1.

Design and Analyses

A mixed factorial design was used to examine the effects of sex (girl, boy), age (4-, 5-, and 6-years), and encoding-context (self, other) on item and source memory. Sex and age were between-subjects variables; encoding-context was a within-subjects variable.

When an old-new recognition test is used to assess item memory, it is common practice to calculate a corrected recognition score or sensitivity score such as *d'*, both of

which take into account participants' false alarm rates. However, neither measure was calculated in this experiment because encoding-context was manipulated within-subjects and this meant that false alarm rates could not be computed separately for each condition. Item memory was therefore measured as the mean proportion of correctly recognised items—that is, the mean proportion of hits. However, in order to further assess the development of children's item memory, separate analysis of overall false alarm rates was also conducted. Children made a false alarm during the item memory test phase when they incorrectly identified a new item that had not been presented during the encoding phase as old. The false alarm rate was measured as the mean proportion of new items incorrectly recognised as old. Source memory was measured as the mean proportion of correct source judgements made for correctly recognised items.

Except where indicated, data were analysed using the same methods as in Experiment 1. The assumptions of all analyses were met. An alpha level of .05 was applied to all analyses. Unless otherwise specified, reported *p* values are two-tailed.

Results

Item Recognition

Single-sample *t*-tests compared the mean item recognition score for each encoding-context condition to chance level. The item recognition test was a two-alternative forced-choice task, therefore chance level was .50. Comparisons were conducted for each subgroup. Results are presented in the second and third columns of Table 4.1. For self and other encoding-context conditions, the mean score for each subgroup was significantly better than chance.

Mean proportions of correctly recognised items were analysed with a 2 (sex: girl, boy) × 3 (age: 4-, 5-, and 6-years) × 2 (encoding-context: self, other) mixed

factorial ANOVA. Descriptive statistics are presented in the second and third columns of Table 4.1. The analysis revealed a significant main effect of sex, $F(1, 66) = 9.82$, $p = .003$, $\eta_p^2 = .130$, such that girls ($M = .90$, $SE = .02$) recognised more items than boys ($M = .80$, $SE = .02$). The main effect of encoding-context was also significant, $F(1, 66) = 3.95$, $p = .023$ (one-tailed), $\eta_p^2 = .056$, such that children recognised more self-encoded items ($M = .86$, $SE = .02$) than other-encoded items ($M = .83$, $SE = .02$). The main effect of age was not significant, $F(2, 66) = 0.71$, $p = .493$, $\eta_p^2 = .021$. Likewise, all two- and three-way interactions were not significant, largest $F(2, 66) = 1.45$, $p = .241$, $\eta_p^2 = .042$.

Table 4.1

Effect of Encoding-Context on Mean Proportions of Correctly Recognised Items for Girls and Boys within each Age Group in Experiment 2 (N = 72)

	Encoding-Context				
Subgroup	Self	Other	*t*	*d*[a]	*p* (one-tailed)
Girls					
4-years	.89 (.03)*	.90 (.03)*	-0.17	-0.05	.346
5-years	.92 (.03)*	.84 (.04)*	2.20	0.70	.025
6-years	.93 (.03)*	.92 (.03)*	0.36	0.10	.362
Boys					
4-years	.87 (.03)*	.84 (.03)*	0.61	0.09	.276
5-years	.80 (.05)*	.76 (.06)*	0.62	0.18	.275
6-years	.78 (.06)*	.71 (.09)*	1.08	0.27	.151

Note. Standard errors are in parentheses. [a]Effect size estimate is Cohen's *d*. *Subgroup's mean item recognition score was significantly higher than chance level (.50) as assessed by a one-tailed single-sample *t*-test with an alpha level of .05.

A sign test assessed whether the significant SRE in item recognition was due to most children showing a self-reference advantage. Of the 72 participants, 43.06% demonstrated a SRE compared to 34.72% who did not. The difference between these percentages was not significant, thereby suggesting the SRE in item memory might have resulted from a minority of children showing a large self-reference advantage, $Z = -0.67$, $p = .252$ (one-tailed). Results of the paired-samples *t*-tests examining whether the SRE was present for any subgroup are presented in the last three columns of Table 4.1. The SRE was significant only for 5-year-old girls. Results of the Sign tests for each sex and age group are presented in Table 4.2 and closely reflected those of the *t*-tests. For 5-year-old girls, the percentage of children who showed a SRE was greater than the percentage who did not, although the difference only showed a marginal trend towards significance. For other subgroups, the percentage of children who demonstrated a SRE was not significantly different to the percentage who did not demonstrate a SRE.

False alarms. Mean proportion false alarm rates were analysed with a 2 (sex: girl, boy) × 3 (age: 4-, 5-, and 6-years) factorial ANOVA. Descriptive statistics are presented in Table 4.3. The main effect of age was significant, $F(2, 66) = 4.39$, $p = .016$, $\eta^2 = .117$. A Scheffe test showed 6-year-olds ($M = .03$, $SE = .05$) made significantly fewer false alarms than 5-year-olds ($M = .23$, $SE = .05$; $p = .016$), but not 4-year-olds ($M = .14$, $SE = .05$; $p = .292$). The difference in false alarm rates between 4- and 5-year-olds was not significant ($p = .394$). The main effect of sex was marginally significant, $F(2, 66) = 3.82$, $p = .055$, $\eta^2 = .055$, such that girls ($M = .08$, $SE = .04$) made fewer false alarms than boys ($M = .19$, $SE = .04$). The Sex × Age interaction was not significant, $F(2, 66) = 1.33$, $p = .27$, $\eta^2 = .039$. These results suggest that the higher hit rate observed for girls (see Table 4.1) did not come at the expense of a higher false alarm rate compared to boys.

Table 4.2

Sign Tests Comparing the Percentages of Children by Sex and Age Group who did and did not show a SRE on Item Recognition in Experiment 2 (N = 72)

	SRE		
Subgroup	Yes	No	*p* (one-tailed)
Girls			
4-years	25.00	41.67	.364
5-years	58.33	16.67	.090
6-years	33.33	25.00	.500
Boys			
4-years	41.67	50.00	.500
5-years	50.00	33.33	.377
6-years	50.00	41.67	.500

Table 4.3

Mean Proportions of False Alarms for Item Recognition for Girls and Boys within each Age Group in Experiment 2 (N = 72)

	Sex	
Age group	Girls	Boys
4-years	.10 (.07)	.17 (.07)
5-years	.12 (.07)	.34 (.07)
6-years	.02 (.07)	.04 (.07)

Note. Standard errors are in parentheses.

Source Recognition

Results of the single-sample *t*-tests comparing mean source recognition scores for each encoding-context condition to chance level (.50) are presented in the second and third columns of Table 4.4. For self-encoded items, source recognition was significantly higher than chance level for all subgroups. For other-encoded items, source recognition for girls in each age group was significantly higher than chance level, whilst it did not differ significantly from chance level for 4-, 5-, and 6-year-old boys.

Table 4.4

Effect of Encoding-Context on Mean Proportions of Correct Source Judgements for Girls and Boys within each Age Group in Experiment 2 (N = 72)

	Encoding-Context				
Subgroup	Self	Other	*t*	*d*[a]	*p* (one-tailed)
Girls					
4-years	.84 (.03)*	.61 (.06)*	3.65	1.35	.002
5-years	.83 (.04)*	.71 (.05)*	2.67	0.78	.011
6-years	.82 (.07)*	.69 (.05)*	3.12	0.58	.005
Boys					
4-years	.83 (.04)*	.54 (.05)	4.50	1.84	< .001
5-years	.76 (.05)*	.51 (.06)	3.64	1.29	.002
6-years	.74 (.07)*	.54 (.07)	3.28	0.80	.004

Note. Standard errors are in parentheses. [a]Effect size estimate is Cohen's *d*. *Subgroup's mean source recognition score was significantly higher than chance level (.50) as assessed by a one-tailed single-sample *t*-test with an alpha level of .05.

Mean proportions of correct source judgements were analysed with a 2 (sex: girl, boy) × 3 (age: 4-, 5-, and 6-years) × 2 (encoding-context: self, other) mixed factorial ANOVA. Descriptive statistics are presented in the second and third columns of Table 4.4. The analysis revealed a significant main effect of sex, $F(1, 66) = 6.54$, $p = .013$, $\eta_p^2 = .090$, such that girls' ($M = .75$, $SE = .03$) source recognition was more accurate than boys' ($M = .65$, $SE = .03$). The main effect of encoding-context indicated a significant overall SRE, $F(1, 66) = 76.26$, $p < .001$, $\eta_p^2 = .536$, as children's source recognition was more accurate for self-encoded items ($M = .80$, $SE = .02$) than for other-encoded items ($M = .60$, $SE = .02$).

The Sign test evaluating the overall SRE in source recognition showed that of the 72 children, the percentage who demonstrated a SRE (83.33%) was significantly greater than the percentage who did not (11.11%), $Z = -6.19$, $p < .001$. Results of the paired-samples *t*-tests examining whether the SRE in source memory was present for any subgroup are presented in the last three columns of Table 4.4. These showed the SRE was significant for girls and boys at each age level. Results of the Sign tests for each sex and age group are presented in Table 4.5. These were consistent with the *t*-tests in that for all subgroups, the percentage of children who showed a SRE was significantly greater than the percentage who did not.

Table 4.5

Sign Tests Comparing the Percentages of Children by Sex and Age Group who did and did not show a SRE on Source Recognition in Experiment 2 (N = 72)

	SRE		
Subgroup	Yes	No	*p* (one-tailed)
Girls			
4-years	75.00	16.67	.033
5-years	75.00	16.67	.033
6-years	75.00	16.67	.033
Boys			
4-years	100.00	0.00	< .001
5-years	91.67	8.33	.003
6-years	83.33	8.33	.006

Interpretation of the main effects of sex and encoding-context were modified by a significant Sex × Encoding-context interaction, $F(1, 66) = 4.02$, $p = .049$, $\eta_p^2 = .057$. Descriptive statistics for this interaction are presented in Figure 4.1. Analysis of the simple effects revealed the effect of sex was significant for other-encoded items, such that source recognition was more accurate for girls than for boys, $t(70) = 3.16$, $p = .002$, $d = 0.75$. The simple effect of sex was not significant for self-encoded items, $t(70) = 1.25$, $p = .215$, $d = 0.29$. The simple effect of encoding-context was significant for girls, $t(35) = 5.41$, $p < .001$, $d = 0.97$, and for boys, $t(35) = 6.91$, $p < .001$, $d = 1.23$. Source recognition was more accurate for self-encoded items than for other-encoded items for girls and boys, although the SRE was larger for boys than girls. The main effect of age was not significant, $F(2, 66) = 0.03$, $p = .975$, $\eta_p^2 = .001$. Likewise, the Age ×

Encoding-context, $F(2, 66) = 1.52$, $p = .227$, $\eta_p^2 = .044$, and Sex × Age × Encoding-context, $F(2, 66) = 0.13$, $p = .882$, $\eta_p^2 = .004$, interactions were not significant.

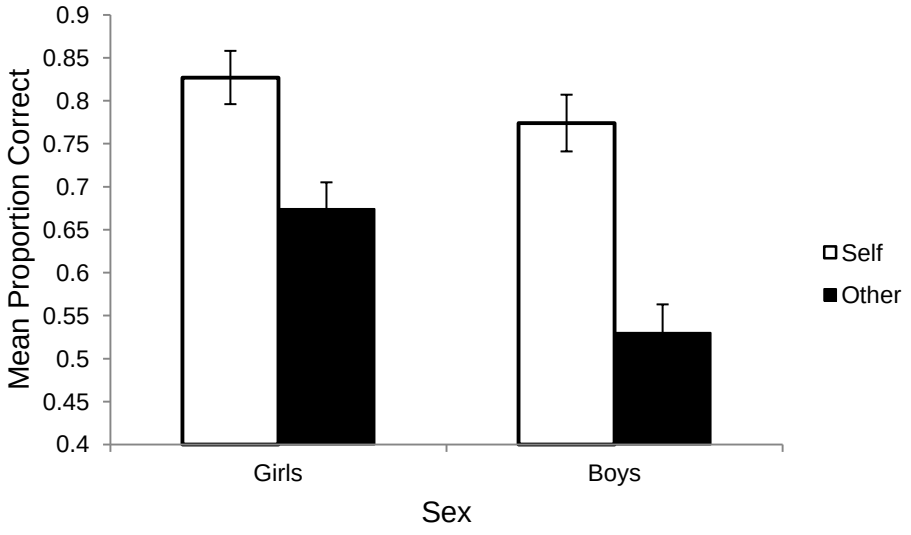

Figure 4.1. Mean proportions of correct source judgments according to sex and encoding-context in Experiment 2 ($N = 72$). Error bars denote standard errors.

Detecting response bias. Correlation analyses evaluated whether children were prone to a self response bias. As noted previously, such a bias would be revealed as a significant negative correlation between the mean source recognition scores for self-encoded and other-encoded items. This is because children exhibiting a self response bias would perform at a high level in the self-referent condition and a low level in the other-referent condition. As in Experiment 1, these were conducted for the entire sample and for the individual subgroups. In addition, given the significant Sex × Encoding-context interaction which showed boys' source recognition was poorer for other-encoded items than it was for girls, a separate correlation was conducted for each sex group.

For the entire sample, the scores for self-encoded and other-encoded items were not significantly negatively correlated, thereby suggesting that overall, children did not show a response bias towards the self. Rather, the two scores were significantly positively correlated, indicating that as source recognition for self-encoded items increased, so too did source recognition for other-encoded items, $r = .49$, $p < .001$.

Similarly, there was no indication of a bias towards self responses for any subgroup as scores for self-encoded and other-encoded items were not significantly negatively correlated. There were, however, significant positive correlations between the two scores for 6-year-old girls, $r = .84$, $p = .001$, and 6-year-old boys, $r = .64$, $p = .024$. There was also a trend towards a significant positive correlation for 5-year-old girls, $r = .52$, $p = .081$. Thus, for these three subgroups, as source recognition for self-encoded items increased, so too did source recognition for other-encoded items. There were no other significant correlations, largest $r = .25$, $p = .431$ (5-year-old boys).

Finally, the two scores were significantly positively correlated for girls, $r = .50$, $p = .001$, and for boys, $r = .43$, $p = .009$, thereby indicating that for both groups, as source recognition for self-encoded items increased, so too did source recognition for other-encoded items. Taken as a whole, results of the correlation analyses suggest children were not prone towards a self response bias, thereby supporting the validity of the SRE in source recognition.

Discussion

In Experiment 2, the effect of self-referent versus other-referent encoding was examined on item recognition and source recognition for correctly recognised items. A primary purpose of replacing the free recall test of items in Experiment 1 with the old-new recognition test of the items, was to investigate whether the SRE in item memory would be apparent when demands of the item memory test were reduced. Also of

interest was whether the larger pool of items, made available for the source memory test through the use of item recognition, would see the outcomes of Experiment 1 replicated in terms of the level of source accuracy, the SRE, as well as sex and age effects.

Item Memory

Results of the item memory test showed that children's item recognition was sound, in that performance for each age group was above chance level in the self and other encoding-context conditions. As expected, old-new recognition led to children remembering a larger proportion of the items than was observed in Experiment 1. On average, item recognition in this experiment was around four times greater than item recall was in Experiment 1.

Girls recognised significantly more items than boys. This is roughly consistent with Experiment 1, in which there was a trend towards higher item recall for girls compared to boys. However, the magnitude of the effect was considerably larger for item recognition (Exp. 2) than it was for item recall (Exp. 1). The analysis of false alarm rates further suggests that boys' poorer performance might have been due to their incorrectly judging new items as old more frequently than girls. These data also showed that girls' more accurate item recognition performance did not come at the cost of a higher false alarm rate relative to boys.

Similar to item recall, sex differences in item recognition using a SRE paradigm have not been frequently reported in the literature. Crawley et al. (2010) tested for, but did not observe an effect of sex on item recognition for their 4- to 6-year-olds. In their study, however, encoding-context (self versus other) was manipulated between groups, whereas in the current research it was a within-subjects variable. Consequently, power to detect sex differences might have been lower in Crawley et al.'s study. Thus, whilst the preliminary evidence from Experiments 1 and 2 suggests boys' item memory might

be poorer than girls', more data are needed. The effect of sex on item memory was evaluated further in Experiment 3.

Children's hit rate for the items did not vary as a function of age. This is in contrast to the developmental improvements observed in item recall in Experiment 1, and in Sui and Zhu's (2005) two experiments. The reduced retrieval demands of the item recognition test relative to the free recall test used in the previous experiments likely contributed to this difference.

In free recall, strategic processing must be engaged to retrieve information from memory, whereas in recognition, the items themselves can serve as prompts for remembering (Bjorklund & Douglas, 1997). In this way, recognition is easier than free recall. This is particularly so for younger children who are less inclined to utilise internal cues to retrieve stored information (Kobasigawa, 1974). Furthermore, research has shown that younger children tend to benefit more from explicit retrieval cues than older children, who are more likely to spontaneously engage active retrieval strategies (Hasselhorn, 1990). Thus, it is perhaps not surprising that the 4-year-olds in this experiment were able to recognise as many items as their older counterparts.

Despite the age invariance in the hit rate described above, children differed in their ability to correctly reject new items. That is, there were differences between the age groups in their tendency to make false alarms. To some extent, this outcome likely accounts for the null effect of age on hits. Six-year-olds made fewer false alarms than both of the younger age groups, with the difference between 5- and 6-year-olds reaching significance. It is possible that the two youngest age groups were prone to a "yes" response bias, thereby inflating their item recognition performance.

The present findings concur with Crawley et al. (2010) who also found no age differences in item recognition (non-corrected) for their 4- and 6-year-olds, but

observed that 6-year-olds made fewer false alarms than 4-year-olds (Exps. 1 and 2). In their study, self versus other encoding was manipulated between-subjects which also enabled a false alarm rate to be calculated separately for each condition. Crawley et al. found that children in the other encoding condition made more false alarms than children in the self encoding condition in Experiment 2, but not in Experiment 1. However, due to the within-subjects manipulation of encoding-context in the current experiment, it is not possible to assign "new" items to self or other conditions, therefore no such distinction could be made. Thus, although younger children's ability to recognise old items appears to be well developed by 4 years of age, this might be due to their tendency to respond "yes".

Regarding this, if it is the case that younger children are prone to a "yes" response bias, then hit and false alarm rates would be expected to be significantly positively correlated. This was checked for the entire sample as well as for each subgroup. However, the hypothesis was not supported as the only significant finding was a negative correlation between the two scores for 5-year-old girls (r = -.66, p = .020), indicating that as the hit rate for this subgroup increased, the false alarm rate decreased.

In Experiment 2, a significant overall SRE in hits, which appeared to be due mainly to the 5-year-old girls, was observed. This contrasts with Experiment 1 in which no SRE was evident for either sex at any age. Although the result is similar to that observed by Sui and Zhu (2005), it should be interpreted in light of the fact that only 31 of the 72 children demonstrated a SRE in item memory. Furthermore, examination of the means in Table 4.1 (p. 69) and the percentages in Table 4.2 (p. 71) indicates that for most subgroups, children's hit rate was not facilitated by self-referent encoding. It is

therefore possible that the overall SRE in hits was due to a small number of children showing a large self-reference advantage.

In summary, despite the reduced demands of the item memory test, it appears that self-referent encoding did not produce more accurate item recognition than other-referent encoding. Rather, it seems that children had equivalent access to self-encoded and other-encoded item information. Reasons as to why robust SREs in item memory in the current research have not been found might relate to some procedural variations relative to Sui and Zhu's (2005) study. These are considered further in Experiment 3.

Source Memory

There was no evidence of developmental improvement in source recognition in Experiment 2. This result concurs with Experiment 1 as well as with Sui and Zhu (2005). Conversely, it is at odds with other research that has shown improvements in children's ability to discriminate source information between 4 and 6 years of age (Drummey & Newcombe, 2002; Foley et al., 1994; Lindsay et al., 1991; Sluzenski et al., 2004; Sussman, 2001; Welch-Ross, 1995). It is likely that differences between the current paradigm and others, for which age improvements have been observed, can account for this disparity.

For example, the manipulation of source as self versus other was intended to avoid problems that young children have with distinguishing between similar sources (Ferguson et al., 1992; M. K. Johnson et al., 1988; M. K. Johnson, Raye, Wang, et al., 1979; Lindsay et al., 1991). Additionally, the incorporation of face images and common object pictures was expected to make the task more developmentally appropriate for children as young as 4 years (Sui and Zhu, 2005). Furthermore, the task instructions and procedure were such that they emphasised the need for children to focus on who was pointing to each of the object pictures during the encoding phase.

Regarding this last point, Roberts (2000) has suggested that very young children may perform poorly on source memory tasks relative to older children, in part, because they do not see the need to distinguish between sources. During the encoding phase, children could not proceed to the next trial unless they correctly stated the source and the name of the item. This might have highlighted the importance of noting who was pointing at what. Taken together, these differences likely resulted in the task being easier as well as relevant to children, thereby bringing the younger children's performance on par with their older counterparts'.

Consistent with Experiment 1, a significant SRE in source recognition was observed. However, unlike Experiment 1, in which the effect was mostly due to the 5-year-old boys, in Experiment 2 the SRE was significant for girls and boys at all ages. The robustness of the SRE was supported by the sign tests which showed most children (60 out of the 72) benefited from self-referent encoding. Comparatively, fewer children (39 out of 72) showed a self-reference advantage for source memory in Experiment 1. The advantage produced through self-referent encoding was apparently amplified when more items were available for the source memory test. The validity of the SRE on source judgements was also supported by the correlation analyses which ruled out the possibility of the effect being an artefact of a self response bias.

In Experiment 1, there was no main or interaction effect involving sex for source memory. In contrast, the breakdown of the Encoding-context × Sex interaction in the present experiment showed that the SRE was larger for boys due to their poorer source memory for other-encoded items. This outcome was highlighted by the single-sample *t*-tests, in that girls performed above chance in both encoding-context conditions, whereas boys' performance was above chance only in the self encoding-context condition. The

correlation analyses further indicated this outcome was not due to a response bias on the part of the boys.

Because very little research using the SRE paradigm employed here has been conducted, reasons as to why boys' source memory for other-encoded items would be poorer than girls' are unclear. It might be that the processes involved in source memory for other information develop more slowly for boys than for girls, or that the finding reflects certain characteristics of the sample. Differences between girls' and boys' source memory performance for self- and other-encoded items were investigated further in the subsequent analysis as well as in Experiment 3.

Comparison of Source Recognition in Experiments 1 and 2

A primary purpose of using old-new recognition for the test of item memory in Experiment 2 was to increase the set of items available for the source memory test. It was assumed more items would be remembered under old-new recognition (Exp. 2) than under free recall (Exp. 1). For illustrative purposes, the mean item memory scores in Experiments 1 and 2 are re-presented in Table 4.6 according to encoding-context, sex, and age. For each subgroup, it can be seen that the proportion of items remembered was greater in Experiment 2 (M = .87, SE = .01) than in Experiment 1 (M = .20, SE = 01).

In Experiments 1 and 2, different procedures were used to assess item memory (i.e., fee recall versus old-new recognition), whereas the same procedure was used in both experiments to assess source memory (i.e., source memory was measured as the mean proportion of correct source judgements made for correctly remembered items). To allow a more direct comparison between source memory outcomes and determine whether source recognition varied as a function of the number of items upon which it was based, data from Experiments 1 and 2 were examined in the same analysis.

Table 4.6

Mean Proportions of Correctly Recalled Items in Experiment 1 and Correctly Recognised Items in Experiment 2 for Girls and Boys within each Age Group (N = 144)

	Encoding-Context	
Subgroup	Self	Other
	Experiment 1	
Girls		
4-years	.21 (.04)	.18 (.04)
5-years	.19 (.03)	.22 (.02)
6-years	.32 (.04)	.26 (.04)
Boys		
4-years	.17 (.04)	.17 (.03)
5-years	.17 (.02)	.20 (.02)
6-years	.21 (.02)	.23 (.04)
	Experiment 2	
Girls		
4-years	.89 (.03)	.90 (.03)
5-years	.92 (.03)	.84 (.04)
6-years	.93 (.03)	.92 (.03)
Boys		
4-years	.87 (.03)	.84 (.03)
5-years	.80 (.05)	.76 (.06)
6-years	.78 (.06)	.71 (.09)

Note. Item memory was measured as the mean proportion of correctly recalled items in Experiment 1 and the mean proportion of correctly recognised items in Experiment 2. Standard errors are in parentheses.

The mean proportions of correct source judgements were analysed with a 2 (sex: girl, boy) × 2 (experiment: 1, 2) × 3 (age: 4-, 5-, and 6-years) × 2 (encoding-context: self, other) mixed factorial ANOVA. Sex, experiment, and age were between-subjects variables; encoding-context was a within-subjects variable. For ease of comparison, descriptive statistics for source recognition in Experiments 1 and 2 are re-presented in Table 4.7. The only significant finding was the main effect of encoding-context, $F(1, 132) = 37.19$, $p < .001$, $\eta_p^2 = .220$. As in previous analyses, an overall SRE was evident as children's source recognition was more accurate for self-encoded items ($M = .80$, $SE = .02$) than for other-encoded items ($M = .64$, $SE = .02$). The main effects of sex, $F(1, 132) = 2.26$, $p = .135$, $\eta_p^2 = .017$, and age, $F(2, 132) = 0.36$, $p = .695$, $\eta_p^2 = .005$, were not significant. More importantly, the main effect of experiment was also not significant, $F(1, 132) = 1.06$, $p = .304$, $\eta_p^2 = .008$. Similarly, all two-, three-, and four-way interactions were not significant, largest $F(1, 132) = 2.76$, $p = .099$, $\eta_p^2 = .020$.

Consistent with previous analyses, results of the analysis of data from Experiments 1 and 2 showed an overall SRE in source recognition, thereby indicating the advantage produced through self-referent encoding is robust in source memory. In contrast to the analysis of Experiment 2 data only, which showed that boys' source recognition for other-encoded items was poorer than girls', analysis of the combined experimental data showed no evidence of such a difference. Both the main effect of sex and the Sex × Encoding-context interaction were nonsignificant, thereby suggesting the finding might have been sample specific. Additionally, consistent with the individual analyses from Experiments 1 and 2, the combined data analysis showed source recognition did not vary significantly with age, further indicating that 4-year-olds' source recognition is as developed as 5- and 6-year-olds'.

Table 4.7

Mean Proportions of Correct Source Judgements for Girls and Boys within each Age Group in Experiments 1 and 2 (N = 144)

	Encoding-Context	
Subgroup	Self	Other
	Experiment 1	
Girls		
4-years	.78 (.08)	.59 (.11)
5-years	.78 (.10)	.78 (.06)
6-years	.80 (.07)	.67 (.10)
Boys		
4-years	.74 (.12)	.70 (.08)
5-years	.87 (.06)	.65 (.06)
6-years	.79 (.07)	.67 (.08)
	Experiment 2	
Girls		
4-years	.84 (.03)	.61 (.06)
5-years	.83 (.04)	.71 (.05)
6-years	.82 (.07)	.69 (.05)
Boys		
4-years	.83 (.04)	.54 (.05)
5-years	.76 (.05)	.51 (.06)
6-years	.74 (.07)	.54 (.07)

Note. Source memory was measured as the mean proportion of correct source judgments made for correctly recalled (Exp. 1) and recognised (Exp. 2) items. Standard errors are in parentheses.

It was predicted that children's source recognition would be more accurate in Experiment 2 (when more items were available for the source memory test) than in Experiment 1 (when fewer items were available for the source memory test). Results did not support this as the main effect of experiment was not significant. Performance on a source recognition task therefore appears to not be affected by how many items are available. This finding was unexpected. If items serve as retrieval cues to source information (Glisky et al., 2001; Hashtroudi et al., 1994), then accuracy of source judgments should have been higher in Experiment 2 than in Experiment 1 because of the larger item pool.

Some procedural differences between the two experiments might, in part, account for this surprising outcome. Most notably, the nature of the task in each experiment was such that the delay between the commencement of the item memory test and completion of the source memory test was longer in Experiment 2 than in Experiment 1. This was so because in the item memory test phase, the time it took children to make old-new recognition judgements for 72 items (Exp. 2) was considerably longer than the time it took children to recall as many items as possible (Exp. 1). Furthermore, the source memory test phase was longer in Experiment 2 than in Experiment 1, simply because many more items were recognised than were recalled. This meant that more source judgements had to be made in the second experiment compared to the first. Consequently, greater decay of the memory trace for source information might have occurred in Experiment 2 relative to Experiment 1, and this might have diminished any difference in source accuracy between the two experiments.

In the subsequent experiment, item memory was again assessed with free recall, whilst source memory was assessed for all items. This meant that the item memory test phase was short, as in Experiment 1, but that the source memory test phase was

relatively longer (similar to Exp. 2) as it was based on all items. This provided further opportunity to consider the possibility that decay of source over time might be partly responsible for not observing more accurate source recognition in Experiment 2 than in Experiment 1. More importantly, testing source recognition for all items in Experiment 3 enabled the methodological issue of assessing source memory for correctly remembered items only to be addressed. Thus, the independence or otherwise of the tests of item and source memory was investigated.

CHAPTER 5. EXPERIMENT 3

In most studies, source memory is assessed only for those items that are correctly remembered and reported. However, some research with adults suggests that source memory in the absence of item recall or recognition is possible (Cook et al., 2006; Kurilla & Westerman, 2010; Starns et al., 2008). A primary goal of Experiment 3 was to determine the appropriateness of the current practice by assessing source memory for all items presented at encoding.

As in Experiment 1, item memory was assessed using free recall. This enabled the differential effects of self-referent and other-referent encoding on item memory to be further investigated using the procedure by which Sui and Zhu (2005) observed a SRE in 5-year-olds. However, assessing source recognition for all items ensured there were enough items available for the test of source memory so as to evaluate the effects of sex, age, and encoding-context.

Results from Experiments 1 and 2 showed that girls remembered more items than boys, but that this sex difference was larger for item recognition (Exp. 2) than it was for item recall (Exp. 1). In addition, children's item recall showed developmental improvement between 4 and 6 years of age (Exp. 1), a result which is in line with Sui and Zhu's (2005) study. Of interest, was whether these outcomes would be replicated in the present experiment when free recall was again used to assess item memory.

Regarding whether children's item memory benefits from self-referent encoding using the current paradigm, evidence thus far is mixed. On one hand, Sui and Zhu (2005) observed a SRE in item recall for 5-year-olds (Exps. 1 and 2). Conversely, in Experiment 1, no SRE in item recall was evident. Similarly in Experiment 2, although the SRE in item recognition was significant for 5-year-old girls, evidence for a robust self-reference advantage was weak. Given these inconsistent findings, Experiment 3

provided an additional test of the impact of self-referent versus other-referent encoding on item memory in children aged 4 to 6 years.

In Experiment 1, source memory was assessed for items that were correctly recalled. The two main findings were that children's overall accuracy of source judgements was comparable across age groups, and that an overall SRE in source memory was observed. Thus, when source memory is based on correctly recalled items only in Experiment 3, it was of interest whether outcomes would replicate those of Experiment 1, in terms of the level of accuracy, the absence of an age effect, and the occurrence and magnitude of the SRE.

Comparison of Experiments 1 and 2 revealed that accuracy of source judgements did not vary as a function of the number of items upon which it was assessed. As is standard practice, the source memory test in the previous two experiments was based on items that were either correctly recalled (Exp. 1) or correctly recognised (Exp. 2). To date, it would appear that no child research has examined source memory for items that have not been correctly remembered and reported. Therefore, an additional research question for Experiment 3 was the extent to which 4-, 5-, and 6-year-old children can access source information in the absence of item recall.

If the current practice of assessing source memory for correctly remembered items only is appropriate, then when the accuracy of children's source judgements for correctly recalled items only and for all items within Experiment 3 are compared, the analyses should yield similar patterns of results. However, if children can access additional source information in the absence of demonstrated item memory, then accuracy of source judgements should be higher when it is based on all items compared to when it is based on correctly remembered items only. In order to further evaluate the

appropriateness of assessing source memory for correctly remembered items only, source recognition accuracy in Experiments 1, 2, and 3 was compared.

Method

Participants

Seventy-two children from four day-care centres and two Catholic Education primary schools located in middle-class suburbs of the Gold Coast region, Queensland, Australia participated in this experiment. Children from three age groups were recruited with equal numbers of girls and boys in each age group: twenty-four 4-year-olds (M = 55.29 months, SD = 3.39, range: 48 – 59), twenty-four 5-year-olds (M = 64.58 months, SD = 3.79, range: 56 – 71), and twenty-four 6-year-olds (M = 77.33 months, SD = 3.71, range: 72 – 83). All children who commenced the task completed it. Participants were recruited through the same procedures described in Experiment 1. Both recruitment and task procedures were conducted in accordance with specific guidelines established during the ethics approval application from Griffith University Human Research Ethics Committee (PSY/B0/08/HREC).

SES was calculated as described in Experiment 1. Mean SES scores according to age group were: 4-year-olds (M = 43.19, SD = 9.96, range: 21.00 – 56.00), 5-year-olds (M = 40.95, SD = 5.98, range: 30.00 – 53.00), and 6-year-olds (M = 40.91, SD = 9.16, range: 22.00 – 56.00). A one-way ANOVA showed there were no significant differences in SES between the age groups, $F(2, 61) = 0.49$, $p = .613$, $\eta_p^2 = .016$.

Procedure

The experiment comprised the same three phases as in Experiment 1: encoding, item memory test, and source memory test.

Encoding phase. This was identical to Experiment 1.

Item memory test. Item memory was assessed using the same incidental free recall procedure as in Experiment 1. Children then completed the filler drawing task also as in Experiment 1.

Source memory test. Memory for source (self versus other) was assessed using the same procedure as in Experiment 1, with one exception. In Experiment 3, source memory was assessed for all items, irrespective of whether they were correctly recalled. Thus, children were presented with picture cards corresponding to all items shown during the encoding phase.

Design and Analyses

A mixed factorial design was used to examine the effects of sex (girl, boy), age (4-, 5-, and 6-years), and encoding-context (self, other) on item and source memory. Sex and age were between-subjects variables; encoding-context was a within-subjects variable. Item memory was measured as the mean proportion of correctly recalled items. The source memory test was scored in two ways. The first method was based only on items for which item memory was demonstrated, as in Experiments 1 and 2 (i.e., mean proportion of correct source judgements made for correctly recalled items). The second method was based on all items. In this case, source memory was measured as the mean proportion of correct source judgements made for all items presented at encoding. Except where indicated, data were analysed using the same methods as in Experiment 1. The assumptions of all analyses were met. An alpha level of .05 was applied to all analyses. Unless otherwise specified, reported *p* values are two-tailed.

Results

Item Recall

Mean proportions of correctly recalled items were analysed with a 2 (sex: girl, boy) × 3 (age: 4-, 5-, and 6-years) × 2 (encoding-context: self, other) mixed factorial

ANOVA. Descriptive statistics are presented in the second and third columns of Table 5.1. The analysis indicated a significant main effect of age, $F(2, 66) = 4.81$, $p = .011$, $\eta_p^2 = .127$. A Scheffe test showed that 6-year-olds ($M = .22$, $SE = .02$) recalled significantly more items than 4-year-olds ($M = .15$, $SE = .02$; $p = .016$), but not 5-year-olds ($M = .20$, $SE = .02$; $p = .774$). Five-year-olds recalled marginally more items than 4-year-olds ($p = .087$). The main effects of sex, $F(1, 66) = 0.17$, $p = .685$, $\eta_p^2 = .003$, and encoding-context, $F(1, 66) = 1.39$, $p = .122$ (one-tailed), $\eta_p^2 = .021$, were not significant. All two- and three-way interactions were not significant, largest $F(2, 66) = 1.50$, $p = .23$, $\eta_p^2 = .044$.

Table 5.1

Effect of Encoding-Context on Mean Proportions of Correctly Recalled Items for Girls and Boys within each Age Group in Experiment 3 (N = 72)

	Encoding-Context				
Subgroup	Self	Other	*t*	*d*[a]	*p* (one-tailed)
Girls					
4-years	.14 (.03)	.12 (.02)	0.67	0.23	.259
5-years	.25 (.05)	.19 (.02)	1.09	0.46	.149
6-years	.21 (.04)	.23 (.05)	-0.27	0.46	.400
Boys					
4-years	.18 (.03)	.14 (.02)	1.21	0.36	.127
5-years	.20 (.03)	.15 (.02)	1.97	0.60	.038
6-years	.20 (.03)	.22 (.03)	-0.44	-0.20	.335

Note. Standard errors are in parentheses. [a]Effect size estimate is Cohen's *d*.

The Sign test assessing the encoding-context finding showed that of the 72 children, the percentage who demonstrated a SRE (51.39%) was significantly greater than the percentage who did not demonstrate a SRE (31.94%), $Z = -1.68$, $p = .047$ (one-tailed). Results of the paired-samples *t*-tests examining whether the SRE was present for any subgroup are presented in the last three columns of Table 5.1. These showed the SRE was significant only for 5-year-old boys. Results of the Sign tests for each sex and age group are presented in Table 5.2, and were mostly consistent with the *t*-tests. These showed that for the 5-year-old boys, a greater percentage demonstrated a SRE, although the difference did not reach statistical significance. The difference was not significant for any other subgroup.

Table 5.2

Sign Tests Comparing the Percentages of Children by Sex and Age Group who did and did not show a SRE on Item Recall in Experiment 3 (N = 72)

	SRE		
Subgroup	Yes	No	*p* (one-tailed)
Girls			
4-years	41.67	41.67	.500
5-years	58.33	25.00	.172
6-years	58.33	33.33	.275
Boys			
4-years	41.67	25.00	.364
5-years	58.33	16.67	.090
6-years	50.00	50.00	.500

Analysis of item recall data from Experiments 1 and 3. In order to further evaluate the effects of sex, age, and encoding-context on item recall, data from Experiments 1 and 3 were examined in the same analysis. Results of the item memory test in Experiment 1 indicated that girls recalled marginally more items than boys, whereas in this experiment there was no evidence of a difference between the groups. It was therefore of particular interest whether a sex difference would be evident with the combined data set. Cross-experiment comparisons were also made, whereby experiment (1 and 3) was a between-subjects variable.

Mean proportions of correctly recalled items were analysed with a 2 (sex: girl, boy) × 2 (experiment: 1 and 3) × 3 (age: 4-, 5-, and 6-years) × 2 (encoding-context: self, other) mixed factorial ANOVA. Descriptive statistics are presented in the second and third columns of Table 5.3. The main effect of age was significant, $F(2, 132) = 8.82$, $p < .001$, $\eta_p^2 = .118$. A Scheffe test indicated that 6-year-olds ($M = .24$, $SE = .01$) recalled significantly more items than 4-year-olds ($M = .16$, $SE = .01$; $p < .001$), and marginally more items than 5-year-olds ($M = .20$, $SE = .01$; $p = .089$). The difference in recall between 4- and 5-year-olds was not significant ($p = .145$). There was a trend towards a significant main effect of experiment, $F(1, 132) = 3.12$, $p = .080$, $\eta_p^2 = .023$, such that children recalled marginally more items in Experiment 1 ($M = .21$, $SE = .01$) than in Experiment 3 ($M = .19$, $SE = .01$). More importantly, the main effect of sex was not significant, thereby indicating girls' and boys' item recall was comparable, $F(1, 132) = 2.61$, $p = .108$, $\eta_p^2 = .019$. The main effect of encoding-context was also not significant, $F(1, 132) = 1.12$, $p = .146$ (one-tailed), $\eta_p^2 = .008$. All two-, three-, and four-way interactions were not significant, largest $F(2, 132) = 2.25$, $p = .110$, $\eta_p^2 = .033$.

Paired-samples *t*-tests also assessed whether a SRE was present for any subgroup when data from Experiments 1 and 3 were examined in the same analysis.

Results are presented in the last three columns of Table 5.3 and showed the SRE was not significant for any subgroup.

Table 5.3

Effect of Encoding-Context on Mean Proportions of Correctly Recalled Items for Girls and Boys within each Age Group for Experiments 1 and 3 combined (N = 144)

	Encoding-Context				
Subgroup	Self	Other	*t*	*d*[a]	*p* (one-tailed)
Girls					
4-years	.17 (.03)	.15 (.02)	0.77	0.22	.225
5-years	.22 (.03)	.21 (.02)	0.56	0.15	.290
6-years	.27 (.03)	.24 (.03)	0.80	0.18	.217
Boys					
4-years	.17 (.03)	.16 (.02)	0.79	0.17	.218
5-years	.19 (.02)	.18 (.02)	0.46	0.12	.324
6-years	.21 (.02)	.23 (.03)	-0.65	-0.97	.262

Note. Standard errors are in parentheses. [a]Effect size estimate is Cohen's *d*.

Source Recognition

Source recognition based on correctly recalled items. Results of the single-sample *t*-tests comparing mean source recognition scores for each encoding-context condition to chance level (.50) are presented in the second and third columns of Table 5.4. For self-encoded items, source recognition in each subgroup was significantly higher than chance. For other-encoded items, source recognition was significantly higher than chance for 5-year-old girls, whilst for other subgroups it did not differ significantly from chance.

Table 5.4

Effect of Encoding-Context on Mean Proportions of Correct Source Judgements for Recalled Items for Girls and Boys within each Age Group in Experiment 3 (N = 72)

	Encoding-Context				
Subgroup	Self	Other	*t*	*d*[a]	*p* (one-tailed)
Girls					
4-years	.90 (.08)*	.61 (.14)	1.63	0.75	.066
5-years	.83 (.08)*	.68 (.10)*	1.36	0.45	.101
6-years	.87 (.05)*	.66 (.10)	1.65	0.78	.064
Boys					
4-years	.90 (.08)*	.63 (.10)	2.77	0.83	.009
5-years	.85 (.06)*	.69 (.12)	1.12	0.53	.143
6-years	.79 (.09)*	.57 (.09)	1.66	0.67	.063

Note. Standard errors are in parentheses. [a]Effect size estimate is Cohen's *d*. *Subgroup's mean source recognition score for recalled items was significantly higher than chance level (.50) as assessed by a one-tailed single-sample *t*-test with an alpha level of .05.

Mean proportions of correct source judgements for correctly recalled items were analysed with a 2 (sex: girl, boy) × 3 (age: 4-, 5-, and 6-years) × 2 (encoding-context: self, other) mixed factorial ANOVA. Descriptive statistics are presented in the second and third columns of Table 5.4. The main effect of encoding-context was significant, $F(1, 66) = 15.60$, $p < .001$, $\eta_p^2 = .191$, such that children's source recognition was more accurate for self-encoded items ($M = .86$, $SE = .03$) than for other-encoded items ($M = .64$, $SE = .04$). The main effects of sex, $F(1, 66) = 0.18$, $p = .672$, $\eta_p^2 = .003$, and age, $F(2, 66) = 0.24$, $p = .79$, $\eta_p^2 = .007$, were not significant. Likewise, all two- and three-way interactions were not significant, largest $F(2, 66) = 0.44$, $p = .649$, $\eta_p^2 = .013$.

The Sign test assessing the encoding-context finding showed that of the 72 children, the percentage who demonstrated a SRE (58.33%) was significantly greater than the percentage who did not (20.83%), thereby supporting the robustness of the SRE in source memory, $Z = -3.24$, $p = .001$. Results of the paired-samples *t*-tests examining whether the SRE was present for any subgroup are presented in the last three columns of Table 5.4. These showed the SRE was significant only for 4-year-old boys, although there was a trend towards a significant SRE for 4- and 6-year-old girls, and 6-year-old boys. Results of the Sign tests for each sex and age group are presented in Table 5.5. Consistent with the *t*-tests, these showed that for 4-year-old boys, the percentage of children who showed a SRE was significantly greater than the percentage who did not.

Table 5.5

Sign Tests Comparing the Percentages of Children by Sex and Age Group who did and did not show a SRE on Source Recognition for Recalled Items in Experiment 3 (N = 72)

	SRE		
Subgroup	Yes	No	*p* (one-tailed)
Girls			
4-years	50.00	16.67	.145
5-years	50.00	16.67	.145
6-years	66.67	25.00	.114
Boys			
4-years	58.33	8.33	.035
5-years	50.00	33.33	.377
6-years	58.33	25.00	.172

Detecting response bias in source recognition based on recalled items. In order to evaluate whether children were prone to a self response bias, correlation analyses were conducted between scores for self-encoded and other-encoded items. As in Experiments 1 and 2, these were conducted for the entire sample and for the individual subgroups. There was no evidence of a self response bias, as the two scores were not significantly negatively correlated either for the entire sample, r = -.02, p = .852, or for any subgroup, largest r = .47, p = .134 (4-year-old boys).

Source recognition based on all items presented at encoding. Results of the single-sample *t*-tests comparing mean source recognition scores for each encoding-context condition to chance level (.50) are presented in the second and third columns of Table 5.6. For self-encoded and other-encoded items, source recognition was significantly higher than chance level for each subgroup.

Mean proportions of correct source judgements for all items were analysed with a 2 (sex: girl, boy) × 3 (age: 4-, 5-, and 6-years) × 2 (encoding-context: self, other) mixed factorial ANOVA. Descriptive statistics are presented in the second and third columns of Table 5.6. The main effect of sex was significant, $F(1, 66) = 5.56$, p = .021, η_p^2 = .078, such that girls' (M = .81, SE = .02) source recognition was more accurate than boys' (M = .76, SE = .02). The main effect of encoding-context was also significant, $F(1, 66) = 15.49$, $p < .001$, η_p^2 = .190. An overall SRE was evident as children's source recognition was more accurate for self-encoded items (M = .82, SE = .02) than for other-encoded items (M = .75, SE = .02).

Table 5.6

Effect of Encoding-Context on Mean Proportions of Correct Source Judgements for all Items for Girls and Boys within each Age Group in Experiment 3 (N = 72)

	Encoding-Context				
Subgroup	Self	Other	*t*	*d*[a]	*p* (one-tailed)
Girls					
4-years	.82 (.03)*	.78 (.03)*	1.18	0.42	.132
5-years	.84 (.04)*	.79 (.04)*	1.33	0.36	.106
6-years	.82 (.03)*	.82 (.02)*	0.24	0.10	.408
Boys					
4-years	.78 (.04)*	.63 (.04)*	3.77	1.02	.002
5-years	.82 (.04)*	.74 (.04)*	1.81	0.68	.049
6-years	.83 (.04)*	.73 (.04)*	1.53	0.75	.075

Note. Standard errors are in parentheses. [a]Effect size estimate is Cohen's *d*. *Subgroup's mean source recognition score based on all items was significantly higher than chance level (.50) as assessed by a one-tailed single-sample *t*-test with an alpha level of .05.

The significant overall SRE was further evaluated. The Sign test showed that of the 72 children, the percentage who showed a SRE (59.72%) was significantly greater than the percentage who did not (29.17%), thereby supporting the robustness of the SRE in source memory, $Z = -2.63$, $p = .005$ (one-tailed). Results of the paired-samples *t*-tests examining whether the SRE was present for any subgroup are presented in the last three columns of Table 5.6. These showed the SRE was significant only for 4- and 5-year-old boys. There was also a trend towards a significant SRE for 6-year-old boys. Results of the Sign tests for each sex and age group are presented in Table 5.7 and were consistent

with the *t*-tests. For 4- and 5-year-old boys, the percentage who showed a SRE was significantly greater than the percentage who did not.

Table 5.7

Sign Tests Comparing the Percentages of Children by Sex and Age Group who did and did not show a SRE on Binding Recognition in Experiment 3 (N = 72)

	SRE		
Subgroup	Yes	No	*p* (one-tailed)
Girls			
4-years	41.67	33.33	.500
5-years	50.00	41.67	.500
6-years	33.33	41.67	.500
Boys			
4-years	91.67	8.33	.003
5-years	75.00	16.67	.033
6-years	66.67	33.33	.194

Interpretation of the main effects of sex and encoding-context were modified by a significant Sex × Encoding-context interaction, $F(1, 66) = 4.36$, $p = .041$, $\eta_p^2 = .062$. Descriptive statistics for this interaction are presented in Figure 5.1. Analysis of the simple effects revealed the effect of sex was significant for other-encoded items, such that girls' source recognition was more accurate than boys', $t(70) = 3.11$, $p = .003$, $d = 0.73$. The simple effect of sex was not significant for self-encoded items, $t(70) = 0.52$, $p = .606$, $d = 0.12$. The simple effect of encoding-context was significant for boys, $t(35) = 3.77$, $p < .001$ (one-tailed), $d = 0.82$, and marginally significant for girls, $t(35) = 1.62$,

p = .058 (one-tailed), d = 0.31. A SRE was evident for boys and there was a trend towards one for girls, such that source recognition was more accurate for self-encoded items than for other-encoded items. The larger SRE for boys appeared to be due to their poorer source recognition for other-encoded items compared to girls. No main or interaction effect involving age was observed, largest $F(2, 66) = 0.71$, $p = .498$, $\eta_p^2 = .021$.

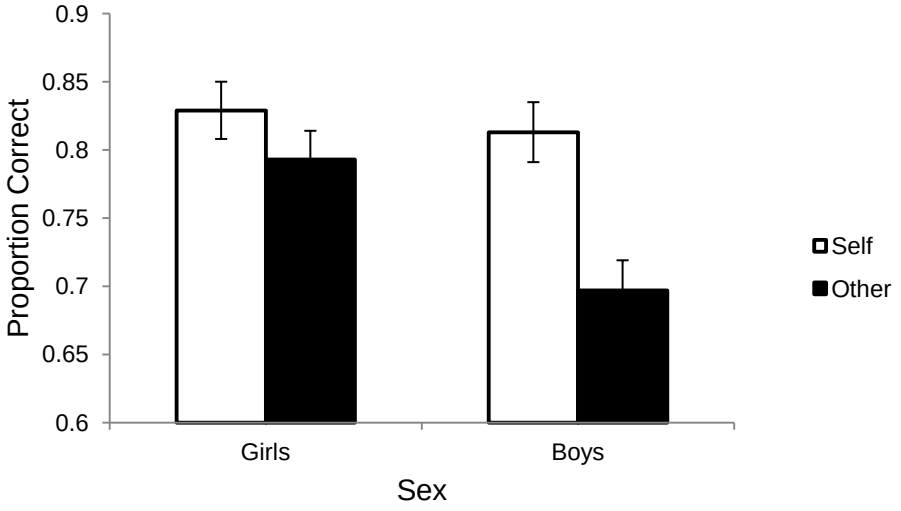

Figure 5.1. Mean proportions of correct source judgements for all items according to sex and encoding-context in Experiment 3 (N = 72). Error bars denote standard errors.

In order to further evaluate the Sex × Encoding-context interaction, an additional Sign test was conducted separately for girls and boys. Results are presented in Table 5.8 and reflected findings of the simple effects analysis. For boys, the percentage who showed a SRE was significantly greater than the percentage who did not. For girls, there was no significant difference between the percentage who showed a SRE and the percentage who did not.

Table 5.8

Sign Tests Comparing the Percentages of Children by Sex who did and did not show a SRE on Binding Recognition in Experiment 3 (N = 72)

	SRE		
Sex	Yes	No	*p* (one-tailed)
Girls	41.67	38.89	.500
Boys	77.78	19.44	< .001

Detecting response bias in source recognition based on all items. Correlation analyses were conducted between scores for self-encoded and other-encoded items for the entire sample and for the individual subgroups. In addition, given the significant Sex × Encoding-context interaction which showed boys' source recognition was poorer for other-encoded items than it was for girls, a separate correlation was conducted for each group.

For the entire sample, the scores for self-encoded and other-encoded items were not significantly negatively correlated, thereby suggesting that overall, children did not show a response bias towards the self, $r = .23$, $p = .052$. Rather, the marginally significant positive correlation indicated that as children's source recognition for self-encoded items increased, so too did their source recognition for other-encoded items. Similarly, the two scores were not significantly negatively correlated for any subgroup. There were, however, marginally significant positive correlations for 4-year-old boys, $r = 57$, $p = .055$, and 5-year-old girls, $r = .56$, $p = .057$, indicating that for these subgroups, as source recognition for self-encoded items increased, so too did source recognition for other-encoded items. There were no other significant correlations, largest $r = -.44$, $p = .151$ (6-year-old boys).

Finally, the scores for self-encoded and other-encoded items were not significantly negatively correlated for girls, $r = .34$, $p = .051$, or for boys, $r = .16$, $p = .366$. The marginally significant positive correlation for girls indicates that as their source recognition for self-encoded items increased, so too did their source recognition for other-encoded items. The absence of a negative correlation for boys suggests their poorer performance for other-encoded items was not due to a self response bias. Taken together, the correlation analyses indicate children were not prone to a self response bias, thereby supporting the validity of the SRE in source recognition.

Discussion of Experiment 3 Findings

Experiment 3 further investigated the SRE in item memory in children aged 4 to 6 years. It aimed to clarify conflicting findings between Sui and Zhu's (2005) study and the present research. Whereas Sui and Zhu observed a SRE in item recall for their 5-year-old children, no robust SREs were observed in either item recall (Exp. 1) or item recognition (Exp. 2) in the present research. Experiment 3 also assessed the appropriateness of the practice of assessing source memory only for those items that are correctly remembered and reported. Results of the item memory test are discussed first, followed by those of the source memory test.

Item Memory

Results of the item memory test showed that girls and boys recalled a comparable proportion of items. Although in Experiment 1, there was a trend towards girls recalling more items than boys, when data from Experiments 1 and 3 were examined together, there was no evidence of a difference between the two groups. However, a sex effect was evident in Experiment 2, such that girls recognised significantly more items than boys. It is therefore unclear whether girls and boys perform differently on the different types of tests (i.e., item recall versus item

recognition), or whether free recall is insufficiently sensitive to detect sex differences. Additional data are needed to provide a clearer picture about whether differences exist between girls and boys in their development of item memory during the 4 to 6 year age period.

Children's item recall showed developmental improvements between 4 and 6 years of age. This replicates children's recall performance in both Experiment 1 and in Sui and Zhu's (2005) study. More generally, this particular finding supports the notion that developments in strategic processing occur during the preschool years (Bjorklund & Douglas, 1997; Murphy et al., 2003).

Sui and Zhu (2005) observed a SRE in item recall for their 5-year-olds in both of their experiments. This outcome was not replicated in Experiment 3, and on the whole, evidence for SREs in item memory across Experiments 1, 2, and 3 was weak. For example, although self-referent encoding appeared to facilitate item recall for the 5-year-old boys in Experiment 3, the result was not supported by the sign test which showed just 7 of the 12 boys demonstrated a SRE. In Experiment 1, the SRE in item recall was not significant in any age group or by any statistical test. Moreover, when item recall data from Experiments 1 and 3 were examined together, there was no evidence of an overall SRE or a SRE for any subgroup. In Experiment 2, although there was some indication of an overall SRE in item recognition, the result was not robust as less than half of the children benefited from self-referent encoding. Taken together, the results of Experiments 1, 2, and 3 are not consistent with Sui and Zhu's finding that self-referent encoding facilitates item memory in children aged between 4 and 6.

According to Symons and Johnson (1997), self-referent encoding facilitates memory because it promotes elaboration and/or organisation of the items at encoding. Both types of processing enhance memory by subsequently generating multiple routes

to retrieval. Accumulating evidence supporting the earlier emergence of the SRE in item memory (Baker-Ward et al., 1990; Crawley et al., 2010; Kovacs & Newcombe, 2006) suggests these processes can also be engendered in young children to promote remembering.

The question that arises then, is why did self-referent encoding produce superior item memory compared to other-referent encoding in Sui and Zhu's (2005) study, but not in the present research? The most likely explanation is that the modifications employed, in some way, impacted children's performance. One particular alteration, meant that the stimulus presentation time for each trial in the current procedure was longer than it was in Sui and Zhu's study. This was because during the encoding phase, each stimulus display was left on the screen for children to view whilst they reported who was pointing to the item. Furthermore, children could not proceed to the next trial until they had correctly identified who was pointing to what. This was intended to ensure adequate encoding of the item and its source. In contrast, Sui and Zhu's participants made their reports after the stimulus display had been removed from the screen. The extended exposure time that children received, might have enabled them to better encode the other-referent items, thereby diminishing any advantage that might otherwise have occurred through self-referent encoding.

Some support for this idea is evident, in that item recall (when measured as the mean number of items correctly recalled) for other-referent items in the present research was higher than it was in Sui and Zhu's (2005) study. Whereas children in the present research recalled an average of 2.72 and 3.43 items (4- and 5-year-olds, respectively; Exps. 1 and 3 combined) from the other-referent condition, same-aged children in Sui and Zhu's study recalled an average of 2.29 and 2.60 items (4- and 5-year-olds, respectively; Exp. 1) from the other-referent condition.

Further support for the idea that additional stimulus exposure time might have enabled children to better encode other-referent items comes from Symons and Johnson's (1997) meta-analysis. These authors reported a significant negative relation between stimulus presentation length and the SRE in item memory. Thus, the magnitude of the SRE was greater when the stimulus presentation time was shorter compared to when it was longer. Symons and Johnson suggested this finding might reflect the more spontaneous or automatic processes involved in self-referencing in facilitating memory compared to other-referencing, which might rely on strategies such as rehearsal.

Moreover, results from Sui and Zhu's (2005) study provide evidence for this line of thinking. In their second experiment, when the item presentation time was reduced (and the number of items presented increased), the 10-year-olds also showed a self-reference advantage. This was not the case in their first experiment when a longer item presentation time was used. For other-encoded items, whereas in Experiment 1, children recalled an average of 2.60 and 3.71 items (5- and 10-year-olds, respectively), in Experiment 2, this dropped to an average of 2.00 and 3.20 items (5- and 10-year-olds, respectively). Additional research which explicitly manipulates the duration of item presentation is required to better understand the parameters of this factor and its effect on the SRE in item memory.

Source Memory

Results of the source memory tests for correctly recalled items and for all items indicated no developmental improvement in children's accuracy of source judgements. This replicates outcomes from Experiments 1 and 2, as well as findings from Sui and Zhu's (2005) study. Thus, the absence of an age effect appears to be due to the procedure used in Sui and Zhu's study and the present experiments versus procedures

used in other studies which have observed developmental improvements in source memory (Drummey & Newcombe, 2002; Foley et al., 1994; Lindsay et al., 1991; Sluzenski et al., 2004; Sussman, 2001; Welch-Ross, 1995).

Central to Sui and Zhu's (2005) rationale for developing the current paradigm and incorporating self and other images, was the idea that the ability to recognise one's own face is indicative of higher-order self-awareness, and that this can facilitate performance on self-related tasks (Keenan et al., 2000). Given that children can recognise and correctly label their own image by around 22 months (Courage, Edison, & Howe, 2004), it is reasonable to expect that 4-year-olds might be able to utilise the self versus other distinction when discriminating source information. The overall sound performance by the 4-year-olds in both Sui and Zhu's study and the three current experiments, provides support for this reasoning, and the utility of using self and other images for investigating source memory in young children.

The current findings also lend themselves to Foley et al.'s (1983) suggestion that the self versus other distinction is relatively well developed in school-aged children, and further, that children are able to use the cues generated for differentiating the self from others to aid source discrimination. However, the current findings extend Foley et al.'s work, in that it appears the self versus other distinction is reasonably developed even earlier than they suggested. Based on the outcomes thus far, it would appear that children from as young as age 4 can utilise the self versus other distinction when determining the source of their memories.

Results of the source memory tests for both correctly recalled items and for all items also showed that children's accuracy of source judgments was facilitated by self-referent encoding. This is consistent with outcomes from Experiments 1 and 2. In each of the three experiments, children demonstrated an overall SRE in source recognition.

Furthermore, encoding-context and age did not interact, indicating that 4-year-olds experienced equivalent memorial benefits from self-referent encoding as did 5- and 6-year-olds. This is a new finding using the current paradigm as Sui and Zhu (2005) did not observe a SRE in source memory. It also extends previous research by showing that children younger than 6 years of age can benefit from self-referent encoding in source memory.

Previously, Roberts (2000, 2002) suggested SREs in source memory had not been elicited in younger children because identification of source for self-referenced items requires a sound sense of self, and that this sense of self undergoes considerable development during the preschool period. However, the outcomes of Experiments 1, 2, and 3 would suggest that under appropriate conditions, even 4-year-olds' sense of self is sufficiently developed, so as to engage the mnemonic processes necessary for producing SREs in source memory.

In Experiment 3, whilst encoding-context did not interact with age, it did interact with sex, but only when source recognition was based on all items. This represented the main difference between the analyses of source judgements based on correctly recalled items only versus all items in this experiment. Comparison of the means in Tables 5.4 (p. 96) and 5.6 (p. 99) shows that the principal variation between the two source recognition data sets, is that performance for other-encoded items increased from chance level, when based on correctly recalled items only (see Table 5.4, p. 96), to above chance level when based on all items (see Table 5.6, p. 99). Consequently, although both girls and boys still demonstrated higher source accuracy for self-encoded items than for other-encoded items, the size of the self-reference advantage for girls was reduced to the extent the SRE was no longer significant, whereas it remained significant for the boys (see Figure 5.1, p. 101). Perhaps more

importantly, the finding suggests children might have encoded additional source information for other-encoded items, but were able to access it only when provided with the external cues (i.e., pictures of objects and possible sources). Interestingly, this occurrence did not generalise to self-encoded items as source recognition for these remained constant—although given that performance was already high in the self-referent condition, there was less room for improvement.

The interaction pattern between encoding-context and sex just described, closely reflects that seen in Experiment 2, when source recognition was assessed for correctly recognised items. Inspection of Figures 4.1 (p. 76) and 5.1 (p. 102) shows the magnitude of the SRE in source memory was larger for boys than it was for girls. It is also evident that this effect size difference was due to boys' poorer accuracy of source judgements for other-encoded items compared to girls.

That boys would have poorer source memory for other-referent items compared to girls is a somewhat unexpected finding. Sui and Zhu (2005) did not report testing for main or interaction effects of sex—presumably there were none. Other studies have either not reported including sex as a factor of interest (e.g., Baker-Ward et al., 1990; Kovacs & Newcombe, 2006), or that there were no main or interaction effects involving sex (e.g., Crawley et al., 2010). As noted earlier, it might be that the processes involved in source memory for other-encoded information are slower to develop in boys than in girls, or that the outcome is due to particular sample characteristics. In any case, further research is required to clarify of the nature of the interaction effect found here.

That there was no significant interaction between sex and encoding-context when source recognition was based on correctly recalled items only is consistent with Experiment 1, in which source recognition was also assessed for correctly recalled items. Thus, the discrepancy between source recognition outcomes, when based on all

items (Exp. 3) and correctly recognised items (Exp. 2) versus correctly recalled items only (Exps. 1 and 3), highlights a potential issue for studies investigating sex differences in children's source memory. As indicated by the present findings, if the source memory test is based on recalled items only, sex differences might be obscured.

Comparison of Source Recognition between Experiments 1, 2, and, 3

In order to further evaluate the differential effects of the procedures used in Experiments 1, 2, and 3 on children's source recognition, data from the three experiments were examined in the same analysis. Source recognition was based on correctly recalled items in Experiment 1, correctly recognised items in Experiment 2, and correctly recalled or all items in Experiment 3. Mean proportions of correct source judgements were analysed with two 2 (sex: girls, boys) × 3 (experiment: 1, 2, and 3) × 3 (age: 4-, 5-, and 6-years) × 2 (encoding-context: self, other) mixed factorial ANOVAs. Source recognition scores for Experiment 3 were based on correctly recalled items only in the first analysis and on all items in the second analysis. Sex, experiment, and age were between-subjects variables; encoding-context was a within-subjects variable.

The first ANOVA revealed a significant main effect of encoding-context, $F(1, 198) = 49.71$, $p < .001$, $\eta_p^2 = .201$. Children's source recognition was more accurate for self-encoded items ($M = .82$, $SE = .02$) than for other-encoded items ($M = .64$, $SE = .02$). The main effects of sex, $F(1, 198) = 2.03$, $p = .156$, $\eta_p^2 = .010$, experiment, $F(2, 198) = 1.00$, $p = .369$, $\eta_p^2 = .010$, and age, $F(2, 198) = 0.41$, $p = .662$, $\eta_p^2 = .004$, were not significant. Likewise, all two-, three, and four-way interactions were not significant, largest $F(2, 198) = 1.61$, $p = .203$, $\eta_p^2 = .016$.

The second ANOVA revealed a significant main effect of sex, $F(1, 198) = 4.96$, $p = .027$, $\eta_p^2 = .024$, such that girls' ($M = .77$, $SE = .02$) source recognition was more accurate than boys' ($M = .71$, $SE = .02$). The main effect of encoding-context was also

significant, $F(1, 198) = 50.29$, $p < .001$, $\eta_p^2 = .203$, such that children's source recognition was more accurate for self-encoded items ($M = .80$, $SE = .01$) than for other-encoded items ($M = .68$, $SE = .02$). More importantly, the main effect of experiment was significant, $F(2, 198) = 4.40$, $p = .013$, $\eta_p^2 = .043$. A Scheffe test revealed children's source recognition was significantly more accurate in Experiment 3 ($M = .78$, $SE = .02$) than in Experiment 2 ($M = .70$, $SE = .02$, $p = .014$). There was no significant difference in children's source recognition accuracy between Experiment 1 ($M = .73$, $SE = .02$) and Experiment 2 ($p = .488$), or Experiments 1 and 3 ($p = .215$).

Interpretation of the main effects of sex, experiment, and encoding-context were modified by a significant Experiment × Encoding-context interaction, $F(2, 198) = 3.99$, $p = .020$, $\eta_p^2 = .039$, and a Sex × Encoding-context interaction for which there was a trend towards significance, $F(1, 198) = 3.22$, $p = .074$, $\eta_p^2 = .016$. Because the primary focus of this analysis was to identify differences between the experiments, only the Experiment × Encoding-context interaction is considered further.

Descriptive statistics for the Experiment × Encoding-context interaction are presented in Figure 5.2. Analysis of the simple effects indicated the effect of experiment was significant for other-encoded items, $F(2, 213) = 7.82$, $p = .001$. A Scheffe test revealed children's source recognition for other-encoded items in Experiment 3 was more accurate than in Experiment 2 ($p = .001$), but not Experiment 1 ($p = .689$). Children's source recognition for other-encoded items was not significantly different between Experiments 1 and 2 ($p = .962$). The simple effect of experiment was not significant for self-encoded items, $F(2, 213) = 0.39$, $p = .679$. The simple effect of encoding-context was significant for Experiment 1, $t(71) = 2.51$, $p = .014$, $d = 0.40$, Experiment 2, $t(71) = 8.59$, $p < .001$, $d = 1.03$, and Experiment 3, $t(71) = 3.91$, $p < .001$, $d = 0.57$. An overall SRE was evident in each experiment as children's source

recognition was more accurate for self-encoded items than for other-encoded items. Inspection of Figure 5.2 shows that the SRE was largest in Experiment 2, followed by Experiments 1 and 3, respectively.

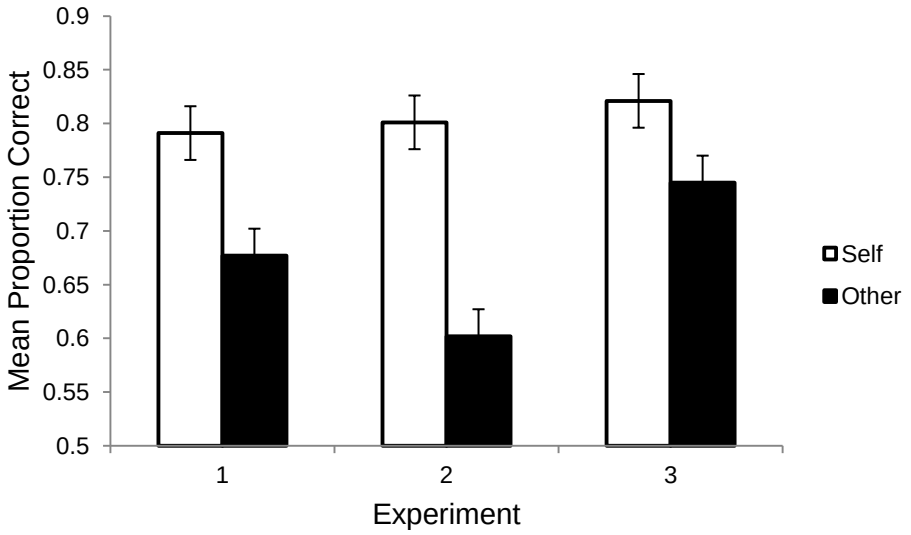

Figure 5.2. Mean proportions of correct source judgements according to experiment and encoding-context for combined data of Experiments 1, 2, and 3 (N = 216). In Experiments 1, 2, and 3, source recognition was based on recalled items, recognised items, and all items, respectively. Error bars denote standard errors.

Comparison of SES between Experiments 1, 2, and 3

In order to assess whether SES varied across the three experiments and/or age groups, mean SES scores were subject to a 3 (experiment: 1, 2, and 3) × 3 (age: 4-, 5-, and 6-years) factorial ANOVA. The main effects of experiment, $F(2, 194) = 0.62$, $p = .539$, $\eta_p^2 = .006$, and age, $F(2, 194) = 0.06$, $p = .938$, $\eta_p^2 = .001$, were not significant. Likewise, the Age × Experiment interaction was not significant, $F(4, 194) = 0.57$, $p = .684$, $\eta_p^2 = .012$.

Discussion of Comparison of Source Recognition between Experiments 1, 2, and, 3

A principal aim of Experiment 3 was to evaluate the appropriateness of testing source memory only for those items that children demonstrate recall or recognition. In two separate analyses, combined source recognition data from Experiments 1, 2, and 3 were examined. Results of these analyses suggest that some outcomes are constant, irrespective of whether source recognition is based on remembered items only or on all items. Other outcomes, however, indicate that the current convention might not be entirely justified.

More specifically, across Experiments 1, 2, and 3, three constant outcomes were apparent. First, irrespective of whether the test of source memory was based on correctly remembered items only (recalled or recognised) or on all items, children's source recognition did not vary significantly with age. That SES was comparable across age groups and experiments, further indicates that the absence of an age effect was not due to variations in this variable. Second, source recognition was facilitated by self-referent encoding; and third, this facilitative effect was invariant between the ages of 4 and 6.

The robustness and validity of the SRE in source recognition were further supported by both the sign tests and the correlation analyses. In each experiment, the sign test showed that of the children who did and did not demonstrate a SRE, the majority of these children showed a SRE. Moreover, the results of the correlation analyses indicated the SRE in source memory did not result from a response bias towards the self. In saying this, it is important to acknowledge that the correlations conducted in each experiment were based on a small number of observations. Accordingly, results of the analyses should be interpreted with this in mind. Nevertheless, there was no indication that children were biased in their responses.

Other outcomes of the analysis of combined experimental data suggest that some effects might be obscured. In particular, results indicated that when source memory is based on correctly recognised items only, the full extent to which children encode source information for other-referent items might not be demonstrated. Some support for this idea was evident, in that children's source recognition for other-encoded items was significantly higher when it was based on all items relative to correctly recognised items only.

Thus, the presentation of all items for the test of source memory benefited source accuracy for other-referent items selectively, whilst providing no increase in source accuracy for self-referent items. One interpretation of this outcome is that because self-referent encoding automatically engages more processing, which leads to more retrieval cues, no further advantage is gained. In contrast, memory for information encoded in relation to other is less automatic. Re-presentation of the original item therefore benefits source retrieval to a greater extent for other-encoded items than for self-encoded items. The nature of the item-source representations for self-encoded items compared to those for other-encoded items, therefore appears to be such, that they are more elaborated and more robust. However, there is another possible explanation.

It might be that when children are required to make source judgements for all items, they engage a form of decision process which results in source being attributed to the other child when in doubt. This decision process can be explained as follows. The nature of the two-alternative forced-choice source memory task is such that for any given item, either *self* or *other* must be selected as source. In instances when the item-source representation is weak and children are uncertain about an item's source, they might reason that if they had pointed to the item, then they would remember it more

clearly, therefore the other child must have pointed to it. The consequence of this form of reasoning would be to increase the accuracy of source judgements for other-encoded items, but not for self-encoded items when certainty is low. Such a decision process could be automatic or more deliberate in nature. In either case, the interpretation of the higher accuracy of source judgments for other-referent items, when based on all items compared to correctly recognised items, remains unclear.

The difficulty in isolating the basis of children's more accurate source recognition for all items compared to recognised items only, further highlights the potential problem with assessing item and source memory separately. This also links in with the unexpected finding that children's source recognition for correctly recognised items was equivalent to that for correctly recalled items.

In Experiment 2, it was discussed that the time delay between the commencement of the item memory test and completion of the source memory test varied, depending on whether free recall or old-new recognition was used to assess item memory. Further to this in Experiment 3, was that the duration of the source memory test was longer compared to Experiments 1 and 2, because children were required to make source judgements for all 36 items. Thus, across the three experiments, the duration of the experimental session was longest in Experiment 2, which required children to make old-new judgements for a total of 72 items before making self-other source judgements for correctly recognised items, and shortest in Experiment 1, whereby the time it took children to recall as many items as possible and to judge source for correctly recalled items was relatively brief.

Accordingly, these durational differences between the experiments likely meant that source degradation would have been least in Experiment 1 and greatest in Experiment 2. This possibly explains why source recognition was not more accurate in

the latter two experiments compared to the first. This underscores a potential problem with evaluating item and source memory with separate, successive tests, and is addressed more directly in Experiments 4 and 5.

General Discussion

In three experiments, the effect of self-referent versus other-referent encoding was examined on two types of item memory tasks: item recall and item recognition. The encoding-context effect was also examined on source recognition for correctly recalled items (Exps. 1 and 3), correctly recognised items (Exp. 2), and for all items presented during the encoding phase (Exp. 3).

By and large, results of the item memory tests showed that self-referent encoding did not produce higher recall or more accurate recognition of items than other-referent encoding did. These findings are inconsistent with Sui and Zhu (2005) who observed SREs on item recall for 5-year-olds in two experiments. Whilst it is understood that self-referent encoding exerts its advantage by facilitating elaboration and organisation in memory, several factors have been found to moderate the magnitude of the SRE in memory (Symons & Johnson, 1997). In their meta-analysis, Symons and Johnson (1997) reported on two such factors in particular (duration of item presentation, duration between encoding and test), which might help explain the discrepancy between the present research and Sui and Zhu's study.

Specifically, Symons and Johnson (1997) described a negative relation between item presentation duration and the SRE. This relation indicates that the magnitude of the SRE in memory increases as the duration of item presentation decreases. Symons and Johnson's interpretation of this relation was that self-referent encoding produces good retention in memory faster than other-referent encoding, which likely relies on strategies such as rehearsal. The flip side of this relation, is that as the duration of item

presentation increases, the magnitude of the SRE decreases. As discussed previously, a consequence of the modifications employed, was that stimulus exposure during the encoding phase was longer in the present research than it was in Sui and Zhu's (2005) study. Children might therefore have had the opportunity to better encode other-referent items, which could have diminished or masked the SRE in item memory in the shorter-term.

Whilst SREs in item memory were not evident, results of the source memory tests showed that self-referent encoding produced more accurate source recognition than other-referent encoding did. Furthermore, the SRE in source recognition did not show developmental improvements between 4 and 6 years of age, thereby indicating that the 4-year-olds benefited as much from self-referent encoding as did their older counterparts. These findings extend those of Sui and Zhu (2005), as children in that study did not show a SRE in source recognition. Moreover, this finding is new to the field, in that the SRE in source memory has not been reported in children younger than 6 years of age. It would therefore seem that even by 4-years of age, the self represents a cognitive structure around which information can be organised to enhance episodic memory.

The presence of a SRE in source memory in the present research likely reflects the modified procedure. In particular, it might be the result of durational differences between the encoding and test phases compared to Sui and Zhu (2005). In their meta-analysis, Symons and Johnson's (1997) found that the duration between encoding and retrieval moderated the SRE in memory, such that the magnitude of the SRE increased as the duration between encoding and retrieval increased. This positive relation suggests that the longer the time between the encoding phase and the test phase is, the

more likely it is that memory will be facilitated by self-referent encoding compared to other-referent encoding.

As discussed above, the stimulus presentation time during the encoding phase was longer in the current research than it was in Sui and Zhu's (2005) study. Consequently, this also meant that children had to retain information longer than Sui and Zhu's participants had to. Thus, whilst additional processing of other-referent items might have benefited children's item memory in the shorter-term—in that item memory was tested immediately after the encoding phase—given that source memory was tested after item memory (and after a filler task), the mnemonic strategies engaged through self-referent encoding presumably promoted better source memory longer-term.

Thus, findings from Symons and Johnson's (1997) meta-analysis potentially explain the two main differences in outcomes between the current research and Sui and Zhu's (2005) study—these being, that self-referent encoding did not produce better item memory than other-referent encoding, whereas in Sui and Zhu's study it did; and second, that self-referent encoding did facilitate more accurate source recognition than other-referent encoding in the present research, whereas in Sui and Zhu's study it did not. These differences emphasise the role of other factors in moderating the SRE, and the conditions under which self-referent encoding is most likely to produce superior performance on an episodic memory task.

A principal question of the present research relates to the appropriateness of testing source memory for remembered items only. Relative to source recognition based on correctly recognised items only, source recognition based on all items (presented during the encoding phase) selectively benefited source accuracy for other-referent items. Thus, to some degree, this outcome supports adult research which has shown memory for source information is possible in the absence of item recall or

recognition (Cook et al., 2006; Kurilla & Westerman, 2010; Starns et al., 2008), and calls the current convention into question. Two possible explanations for the selective enhancement of source memory for other-referent items in the present research were suggested.

First, no additional advantage is obtained through self-referent encoding (when source memory is based on all items relative to recognised only items) because it automatically engages strategic processing which provides more retrieval cues; other-referent encoding is less automatic, therefore re-presentation of the original item serves as a cue to memory for source. Alternatively, children might engage a decision process which results in source being attributed to the other child when the item-source representation is weak. Of course, whether young children are able to utilise metamemory rules such as this, is in itself open to question (Foley et al., 1983; Roberts, 2000). Further clarification on the issue is required.

Another finding which requires further clarification, is that which indicated accuracy of source judgements is not necessarily higher when more items are available for the source memory test. This outcome was unexpected. Rather, it was predicted that source memory performance would be better when it was based on more items than less items because the items were expected to cue the item-source bindings. Indeed, the higher source accuracy for other-encoded items in Experiment 3 relative to other-referent items in Experiment 2 would lend some support for this notion. However, the finding that source accuracy was not significantly higher in either Experiment 2 or 3 relative to Experiment 1 suggests other factors were at play.

Earlier, it was suggested that because the duration between the encoding phase and source memory test phase varied between the experiments, then source degradation might also have varied accordingly. In particular, given the duration was longest in

Experiment 2, followed by Experiments 3 and 1, respectively, it is reasonable to suppose that source degradation would have also followed this pattern and been greatest in Experiment 2 and least in Experiment 1. The outcomes obtained would fit reasonably well with this supposition. Unfortunately, this highlights a potential limitation of the current paradigm and its use of separate, successive tests of item and source memory. Thus, due to the possibility that differential source degradation occurred between the experiments, the extent to which source memory is enhanced by the availability of more items for the source memory test is not clear. This issue was addressed in Experiments 4 and 5 for which a binding recognition test assessed children's item and source memory simultaneously.

CHAPTER 6. BINDING PROCESSES IN SOURCE MEMORY

Source monitoring theory holds that source memory necessarily involves intact binding processes (M. K. Johnson et al., 1993). M. K. Johnson et al. (1993) have proposed that this is because binding processes facilitate the relations that correctly link the source-specifying features within an event. Chalfonte and Johnson (1996) have expressed a similar view and postulated that source monitoring probably requires memory for the bound features as well as memory for the isolated features.

From this perspective, isolated feature information specifies source, therefore when feature information is available, judgements about the source of memories are likely to be more accurate. For example, knowing that the type of paper on which an article was printed, was smooth and glossy, might assist in remembering that the source of the written piece was a magazine and not the daily newspaper. Alternatively, knowing that the time of day you had a conversation with your spouse was early morning, might serve as cue for you to remember that this conversation took place in-person at home, and not via telephone while you were at work.

Evidence for the Role of Binding Processes in Source Memory

Empirically, the proposal that binding facilitates source memory is based on evidence which shows that some populations demonstrate poor performance on both binding in memory and on source memory tasks. For example, research conducted with young children (Drummey & Newcombe, 2002; Foley et al., 1994; Lindsay et al., 1991; Sluzenski et al., 2004; Sussman, 2001; Welch-Ross, 1995) and older adults (Chalfonte & Johnson, 1996; Light & Zelinski, 1983; Mitchell, Johnson, Raye, Mather, & D' Esposito, 2000; Naveh-Benjamin, 2000; Park, Puglisi, & Sovacool, 1983; Pezdek, 1983; Spencer & Raz, 1995), has shown that these two populations have particular difficulty

on memory tasks that require the binding of isolated features, as well as on tasks that involve discriminating the source of their memories.

The developmental literature also provides a link between binding processes and source memory, in that children demonstrate discernible improvements in their performance on both types of tasks over the same developmental period (Drummey & Newcombe, 2002; Foley et al., 1994; Lindsay et al., 1991; Sluzenski et al., 2004; Sussman, 2001; Welch-Ross, 1995). Evidence from the aging literature has also shown that when encoding questions are orientated in a way that facilitates consideration of the relation between the item and its source, significant improvements in performance on a source memory task can be achieved (Glisky, Rubin, & Davidson, 2001; Hashtroudi, Johnson, Vnek, & Ferguson, 1994). The purpose of this chapter is to provide an overview of some of the empirical research which corresponds to each of these lines of evidence.

In Chapter 1, research pertaining to the difficulties preschool-age children have with tasks that require them to discriminate the source of their memories was discussed (e.g., Drummey & Newcombe, 2002; Foley et al., 1994; Lindsay et al., 1991; Sluzenski et al., 2004; Sussman, 2001; Welch-Ross, 1995), and therefore will not be reviewed again here. However, it is worth noting again that these difficulties have been observed using various manipulations of source within different source memory paradigms.

Similarly, the source memory deficits demonstrated by older adults were briefly discussed earlier and will not be reviewed at length in this chapter. However, such deficits are well documented, and consistent with young children, have been observed using various manipulations of source within different source memory paradigms (Spencer & Raz, 1995). For example, compared to their younger counterparts, older adults have difficulty remembering the modality (e.g., visual or auditory) in which

information was presented (Lehman, Bovasso, Grout, & Happ, 1991; Lehman & Mellinger, 1984, 1986; Light, La Voie, Valencia-Laver, Albertson-Owens, & Mead, 1992), or indeed the presenter (e.g., male or female) of such information (e.g., words and facts; Schacter, Kaszniak, Kihlstrom, & Valdiserri, 1991; Schwartz, Hashtroudi, Herting, & Deutsch, 1992). Older adults also have difficulty remembering the spatial locations of stimulus items such as words, pictures, and objects (Mäntylä & Bäckman, 1992; Moore, Richards, & Hood, 1984; Park, Puglisi, & Lutz, 1982; Park et al., 1983; Pezdek, 1983; Puglisi, Park, Anderson, & Hill, 1985), and whether events were perceived or imagined (G. Cohen & Faulkner, 1989). Similarly, older adults' ability to remember whether words were thought or said (Hashtroudi, Johnson, & Chrosniak, 1989), or read or generated (Rabinowitz, 1989) is poorer than younger adults'.

The remainder of this chapter is partitioned into three sections. In the first section, I review the few studies that have examined binding processes in young children. Although data are limited, preliminary findings suggest that consistent with source memory, improvements in performance on binding in memory tasks occur between 4 and 6 years of age. In the second section, I review several studies conducted with older adults that clearly demonstrate the difficulties this population also has on binding in memory tasks. Finally, in the third section I review two studies that provide stronger evidence for the idea that binding processes impact performance on source memory tasks.

Development of Binding in Memory Processes in Children

In a study involving 4- and 6-year-olds, Kovacs, Hansell, and Newcombe (2005) investigated children's memory for individual features and their memory for bound features. Children examined pictures for which they were to remember either one of two features (objects or colours), or the objects together with their colours. Kovacs et

al. found that 4-year-olds were just as good as 6-year-olds at remembering the objects and colours in isolation, but that 4-year-olds were worse than 6-year-olds at remembering the objects and their colours in combination.

In another study, Sluzenski et al. (2006) presented 4- and 6-year-old children (Exp. 2) with picture sets, each comprising a picture of an (a) animal (e.g., panda bear); (b) arbitrary background (e.g., desert); and (c) animal in the background (e.g., panda bear in a desert). An old-new recognition test was used to assess children's memory for the isolated features and combined features (i.e., the animals, the backgrounds, and the animal-background combinations). During the test phase, children saw pictures of old and new animals, and old and new backgrounds. They also saw old animal-background combinations as well as new re-pairings of previously seen animal-background combinations. Thus, the isolated features that comprised the new animal-background recombinations were all old. For example, if during the encoding phase children saw a panda bear in a desert and a hyena in a street, then during the test phase, they might have seen a picture of a bear in a street or a hyena in a desert. This meant that children could not make a correct response based solely on familiarity of the individual animals or backgrounds.

Sluzenski et al.'s (2006) results concurred with those of Kovacs et al. (2005). In the animal only and background only conditions, there was no age difference in feature memory. Four-year-olds recognised as many features as 6-year-olds. However, in the animal-background condition, 4-year-olds remembered fewer combinations than 6-year-olds.

Sluzenski et al. (2006) were also interested in the developmental relation between children's performance on the binding task and their recall of a naturalistic event. Their rationale for this, is the idea that memory for bound information

contributes to episodic memory development in childhood. In addition to completing the binding task described, 4-, 5-, and 6-year-old children listened to an audio-taped story about a girl who baked a cake on a rainy day. After a 1-hour delay, children undertook a free recall test of the story details (people, objects, locations, and actions). For the 6-year-olds, there was no significant correlation between the two tasks. For the 4-year-olds, there was a positive association that approached significance. Finally, for the 5-year-olds, there was a significant positive correlation between children's performance on the binding task and recall task.

Sluzenski et al. (2006) took the stronger correlation between the binding and episodic memory tasks for the 5-year-olds as support for the involvement of binding processes in source memory—an interpretation consistent with the developmental literature which shows that marked improvements in source memory (and memory for other complex events) occur between 4- and 6-years of age, with gradual improvement thereafter.

Building on Sluzenski et al.'s (2006) work, Lloyd, Doydum, and Newcombe (2009) were interested in determining the nature of young children's binding in memory difficulties—more specifically, whether it represents an encoding or retrieval deficit. They did this by manipulating the amount of time (short versus long) between the study and test phases. Four- and 6-year-old children were assigned to either a short study-test interval group (short-term memory condition) or a long study-test interval group (long-term memory condition). Lloyd et al. reasoned that if children's problem lies at encoding, then tasks requiring binding in memory should show age-related differences, irrespective of the time between study and test. However, if the problem occurs at retrieval, then performance on tasks involving binding in memory should improve when the time between study and test is shorter relative to when it is longer.

Lloyd et al. (2009) presented children with a series of study-test sequences. In the study phase of each sequence, children saw an assortment of pictures of (a) individual objects (e.g., ant, cat); (b) individual patterned backgrounds; and (c) object + background combinations (e.g., balloon on a blue patterned background). In the recognition test phase of the sequence, children saw an assortment of old and new items which could include individual objects, individual patterned backgrounds, and object + background combinations. As in Sluzenski et al.'s (2006) study, the object + background combinations were comprised of re-pairings of previously seen object + background combinations. The children's task was to judge (yes or no) whether they had seen the items during the preceding study phase. In the short-term memory condition, each study-test sequence consisted of four study items followed by two test items. In the long-term memory condition, there were 12 study items followed by four test items. In both conditions, children studied a total of 48 items and responded to 24 test questions (8 object, 8 background, and 8 object + background).

Rather than examining corrected recognition scores (i.e., hit rate – false alarm rate), Lloyd et al. (2009) analysed hit and false alarm rates separately. They suggested that if young children have a specific memory binding deficit, then the false alarm rate of 4-year-olds should be greater than that of 6-year-olds, however, if children's responses are based on familiarity of the test stimuli (i.e., respond "yes" to trials containing old features), then the hit rate for each age group might be comparable.

For objects, Lloyd et al. (2009) reported that there was no significant difference between 4- and 6-year-olds' hit and false alarm rates in the short-term memory condition. For objects in the long-term memory condition, although 6-year-olds had a higher hit rate than 4-year-olds, both age groups recorded comparable false alarm rates.

For backgrounds, hit and false alarm rates were equivalent between age groups in the short-term and long-term memory conditions.

More importantly, Lloyd et al. (2009) found support for a specific binding deficit. For the object + background combinations, there was no significant difference between the age groups' hit rates in either the short-term or long-term memory condition. However, for false alarm rates, whilst there was no age difference in the short-term memory condition, in the long-term memory condition, 4-year-olds made significantly more false alarms than 6-year-olds. Based on these outcomes, Lloyd et al. concluded that young children's binding difficulties, in part, reflect a retrieval deficit, rather than an encoding deficit. Furthermore, the reduction in false alarm rates between 4 and 6 years provides additional evidence for the developmental improvement in retrieval of bindings during this period.

In summary, research examining the development of binding in memory processes in young children is limited. What evidence there is, suggests that improvements in binding processes over the preschool years (Kovacs et al., 2005; Lloyd et al., 2009; Sluzenski et al., 2006) coincide with those seen in source memory for the same period (e.g., Drummey & Newcombe, 2002; Foley et al., 1994; Lindsay et al., 1991; Sluzenski et al., 2004; Sussman, 2001). Sluzenski et al.'s (2006) finding that performance on a binding task correlated positively with performance on an episodic memory task for 5-year-olds also provides support for the involvement of binding processes in source memory. Furthermore, Lloyd et al.'s (2009) findings indicate that young children's difficulty on a binding task likely reflects a retrieval problem rather than an encoding one. This suggests that young children are able to encode the relational links, but have trouble retrieving them.

Binding in Memory Processes in Older Adults

Whilst very few studies have examined binding processes in young children, many have done so with adults. The general finding is that older adults demonstrate performance decrements relative to younger adults. Similar to young children, older adults often show good performance on tasks requiring memory for isolated features, but impaired performance on binding in memory tasks (e.g., Chalfonte & Johnson, 1996; Light & Zelinski, 1983; Mitchell et al., 2000; Naveh-Benjamin, 2000; Park et al., 1983; Pezdek, 1983).

Chalfonte and Johnson (1996) for example, were interested in whether age-related declines in complex-event memory are due to deficits in the cognitive processes that bind individual features of an event together. They assessed whether memory for source features (location, colour) was disproportionately impaired compared to memory for item features (objects). They also assessed participants' ability to bind item and source features together. Younger and older adults saw an array comprising coloured line drawings of objects in different locations. Their task was to remember either (a) one of three features (objects, colours, or locations); (b) the objects together with their colours (object + colour); or (c) the objects together with their locations (object + location).

Chalfonte and Johnson's (1996) results showed that younger and older adults remembered a similar number of the individual objects and individual colours, but that older adults remembered fewer individual locations than younger adults. More importantly, compared to younger adults, older adults were worse at remembering the object + colour and object + location combinations, despite exhibiting no such impairment for remembering objects and colours in isolation. Based on these outcomes, Chalfonte and Johnson concluded that impaired memory for certain types of source-

specifying features (i.e., feature deficit) such as location, as well as impaired memory for bound features (i.e., binding deficit) contribute to the deficits observed in older adults' source memory.

In another study that involved memory for spatial information, Light and Zelinski (1983) had younger and older adults study a map comprising line drawings of structures (e.g., church, fountain) situated within a street network. Participants in the incidental learning condition were told they would be tested on memory for the structures only; those in the intentional learning condition were instructed to remember the structures as well as their locations. Memory for the structures and locations, and which structures occupied which locations was subsequently assessed. Results showed that overall performance was better in the intentional learning condition. However, older adults performed more poorly than younger adults in remembering both the individual structures and the individual locations, and more importantly, the locations of remembered structures.

In line with Chalfonte and Johnson (1996), Naveh-Benjamin and his colleagues have suggested that older adults' poorer episodic memory, is in part, due to a deficiency in establishing and retrieving the links between individual pieces or units of information (Naveh-Benjamin, 2000; Naveh-Benjamin, Guez, & Shulman, 2004; Naveh-Benjamin, Hussain, Gues, & Bar-On, 2003). In one study, Naveh-Benjamin (2000) had younger and older adults view word-nonword pairs (Exp. 1). Participants were instructed to study these in preparation for recognition tests of the words, nonwords, and the word-nonword pairs that were to follow. For each test, participants were given a written list of old and new items and asked to circle those items that had been presented during the encoding phase. For the recognition test of word-nonword pairs, 50% of the items were intact pairs from the encoding phase; the remaining items were recombined pairs from

the encoding phase. Naveh-Benjamin's (2000) results showed that younger adults' overall recognition was better than older adults'. More importantly, whilst performance between the age groups was comparable for word recognition, older adults performed worse than younger adults on recognition of both the nonwords and word-nonword pairs.

Naveh-Benjamin (2000) wanted to determine whether older adults' poorer memory for word-nonword pairs was due simply to their poorer memory for nonwords (as opposed to a binding deficit per se). In Experiment 2, unrelated word pairs only were used. Fifty percent of the participants in each age group were instructed to study the individual words in preparation for an item recognition test. The remaining participants in each age group were instructed to study the word pairs in preparation for a pair recognition test. This time, older adults performed worse than their younger counterparts on both the word and word-pair recognition tests. Furthermore, older adults demonstrated a larger memory deficit for the word-pairs than for the words in isolation. Moreover, relative to younger adults, the deficit for word pairs was particularly large for those older adults who were instructed to study the word pairs specifically.

Naveh-Benjamin reported similar outcomes in subsequent studies that used word pairs (Naveh-Benjamin et al., 2004) and picture pairs (Naveh-Benjamin et al., 2003). In each case, compared to younger adults, older adults demonstrated a disproportionate impairment in their memory for the word or picture pairs than for the words or pictures in isolation.

Facilitating Binding at Encoding Reduces Source Memory Deficits

Some additional findings from the aging literature provide a more direct link between binding processes and source memory. These studies involved healthy older

adults and showed that when feature binding was facilitated during the encoding phase, source memory deficits were either reduced (Hashtroudi et al., 1994) or eliminated (Glisky et al., 2001) at test.

In Hashtroudi et al.'s (1994) study, younger and older adults took part as actors in a brief play. They then reviewed the events under one of three focus conditions: factual, affective, and no focus. In the factual condition, participants talked and thought about what was said by themselves and the other actor in each scene. In the affective condition, they talked or thought about how they felt during each scene. In the no focus condition, participants discussed or thought about anything regarding the play they could remember.

The source memory task required participants to discriminate between scripts they had said and scripts the other actor had said. Hashtroudi et al.'s (1994) results showed that older participants' ability to discriminate between self and other scripts was worse than younger adults' in both the affective and no focus conditions. However, when participants were instructed to focus on what they had said, as well as what the other actor said (i.e., link item to source), the age-related source memory deficit seen in the other two conditions was significantly reduced.

Hashtroudi et al. (1994) speculated about how factual focus might have exerted an advantage for the older adults. Their reasoning went something like this: During the review phase, aspects of the event were reactivated. This assisted participants to decipher who said what, which subsequently facilitated the binding of perceptual and contextual features to the semantic content of the scripted event. Re-presenting the script during the source memory test phase then served as a cue to source.

In another study, Glisky et al. (2001) were interested in why source memory is usually more affected by aging than item memory is, and whether the frontal lobe

deterioration associated with aging contributes to this phenomenon. Younger and older adults listened to voices, and judged how likely it was that each voice would be heard on the radio (Exp. 1). Older adults were further grouped according to frontal lobe-functioning (low and high). A two-alternative forced-choice recognition test of the target voices (item) and sentences (source) followed. Each target voice heard at encoding was re-presented at test, speaking either the same sentence or an alternative sentence.

For the test of item memory, Glisky et al.'s (2001) results showed that compared to younger adults who identified 83% of the voices, older adults identified only 70%. There was however, no difference between the high frontal lobe-functioning and low frontal lobe-functioning older adults on the number of voices recognised. For the test of source memory, older adults recognised fewer target sentences than younger adults. In addition, older adults with low frontal lobe-functioning demonstrated poorer source memory, recognising fewer target sentences, than older adults with high frontal lobe-functioning.

Glisky et al. (2001) wanted to determine whether the source deficits observed in older adults reflected an encoding or retrieval problem. They did this by manipulating the encoding instructions in subsequent experiments. For example, participants made judgements about how likely it was that each voice (item) presented would have spoken the given sentence (source; Exp. 4). As in Hashtroudi et al.'s (1994) study, the instructions were designed to facilitate consideration of the relation between the item and its source. In Experiment 4, younger and older adults performed similarly on the source memory task and identified a comparable number of sentences. Moreover, there was no difference between the low and high frontal lobe-functioning older adults at recognising the sentences. In this experiment, encoding instructions effectively

eliminated the source memory deficits previously seen for both the older adults in general, and specifically for the low frontal lobe group.

Glisky et al. (2001) conducted two additional experiments that involved visuo-spatial stimuli (multiple chairs in one of two rooms) rather than the auditory-verbal (multiple voices speaking one of two sentences) stimuli described above. The pattern of results replicated those of their previous two experiments. Source memory deficits were eliminated when the orientating question facilitated the encoding of the item-source relation. Based on these outcomes, Glisky et al. made two main conclusions: First, the frontal lobes are involved in the encoding of source information; and second, older adults' source memory impairments arise in part, from a failure to activate the binding processes necessary for encoding the item-source relation.

In light of both Hashtroudi et al.'s (1994) and Glisky et al.'s (2001) findings, two additional conclusions can be tentatively made. First, although older adults do not spontaneously make the item-source links, they are able to do so under certain conditions. Second, provided the item-source relation is established at encoding, re-presentation of the item at test potentially serves to cue the original binding, thereby facilitating memory for source.

Because so little research has been conducted with young children, it is not known whether young children's source memory difficulties stem from a basis similar to that of the older adults in the studies described. It might be that young children's binding processes are simply not sufficiently developed to encode the item-source relations. Alternatively, like Hashtroudi et al.'s (1994) and Glisky et al.'s (2001) older participants, it could be that young children are capable of making the bindings, but do not do so spontaneously. Indeed, Lloyd et al.'s (2009) findings would suggest that

under certain conditions, young children can successfully encode the item-source relations, but that they have difficulty retrieving these.

The present research further investigated children's binding processes using an episodic memory task. In Experiments 4 and 5, a binding recognition task assessed 4-, 5-, and 6-year-old children's ability to encode and retrieve item-source bindings. This task specifically examined the extent to which self-referent encoding facilitates the recognition of old item-source bindings, and the rejection of new items and sources. Because responses can be based on familiarity, the task was also designed to distinguish between responding based on intact item-source bindings and responding based on familiarity of the items and sources, independent of the bindings.

CHAPTER 7. EXPERIMENT 4

In Experiments 1, 2, and 3, modified versions of Sui and Zhu's (2005) SRE procedure were used to examine the effect of self-referent versus other-referent encoding on 4-, 5-, and 6-year-old children's item memory and source memory task performance. Results suggested that even by 4 years of age, children are well able to utilise the contextual cues present at encoding to aid their memory for source. Furthermore, relative to other-referent encoding, self-referent encoding appears to facilitate children's source recognition between 4 and 6 years of age.

One potential limitation highlighted by the results of Experiments 1, 2, and 3 involves the assessment of item memory and source memory in separate and successive tests. The binding recognition procedure used in the present experiment should address this issue because children's memory for the item and its source is assessed simultaneously. However, the main focus of Experiment 4 was to examine whether children's source memory difficulties stem from the need to construct and retrieve item-source bindings.

Although research examining the development of binding processes in young children is limited, evidence suggests that improvements (Kovacs et al., 2005; Lloyd et al., 2009; Sluzenski et al., 2006) coincide with those seen in source memory (e.g., Drummey & Newcombe, 2002; Foley et al., 1994; Lindsay et al., 1991; Sluzenski et al., 2004; Sussman, 2001) between 4 and 6 years of age. Thus, a possible explanation for young children's difficulty on source memory tasks, is that the encoding of isolated components is a separate process from the binding of multiple components (Sluzenski et al., 2006). Young children might perform poorly because they encode and/or retrieve the item and source separately, but fail to encode and/or retrieve the item-source bindings.

Findings reported by Lloyd et al. (2009) suggest that children can encode the item-source bindings but that they have trouble retrieving these. Experiment 4 investigated this further by using a binding recognition test that assessed the extent to which self-referent encoding facilitates the recognition of original item-source bindings, and the rejection of new combinations of items and sources. Its purpose was to also distinguish between responding based on intact item-source bindings and responding based on familiarity of the items and sources, independent of the bindings.

These outcomes were inferred from children's pattern of responses to eight item-source combinations developed for the binding recognition test. In Experiment 4, the encoding phase was identical to that used in the previous three experiments, whilst the binding recognition test replaced tests of item and source memory. Children judged (yes or no) whether they had seen a particular item-source combination previously during the encoding phase of the experiment.

A description and explanation of each item-source combination developed for the binding recognition test is presented in Table 7.1. The label and description for each combination can be seen in the first column (e.g., old-self, old-other). Four combination types were designed to examine the SRE in binding recognition and were therefore of theoretical interest. The remaining four combination types served as procedural controls and were incorporated to evaluate both children's understanding of the task requirements and the presence of response bias.

The first four item-source combinations listed in Table 7.1 were included to examine the SRE in binding recognition. All items and sources used in the construction of these combinations were old, in that they were presented during the encoding phase. More specifically, the items used in the *old-self* and *old-self→other* combinations were originally self-encoded. At test, the *old-self* combinations were presented intact,

Table 7.1

Description and Explanation of the Item-Source Combinations Presented during the Binding Recognition Test Phase of Experiment 4

Label and Description	Item at test	Source at test	Number of novel components	Combination	Correct response
Old-self: combination presented previously at encoding—object paired with photograph of participant child's own face (i.e., self encoding-context)	old	old (self)	0	intact	yes
Old-other: combination presented previously at encoding—object paired with photograph of other child's face (i.e., other encoding-context)	old	old (other)	0	intact	yes
Old-self→other: old object previously paired with photograph of participant child's own face at encoding subsequently paired with photograph of other child's face at test	old	new (other)	0	recombination	no
Old-other→self: old object previously paired with photograph of other child's face at encoding subsequently paired with photograph of participant child's own face at test	old	new (self)	0	recombination	no
Old-novel: old object presented at encoding subsequently paired with photograph of a novel child's face at test	old	novel	1	new	no
Novel-self: novel object paired with photograph of participant child's own face at test	novel	self	1	new	no
Novel-other: novel object paired with photograph of other child's face at test	novel	other	1	new	no
Novel-novel: novel object paired with photograph of a novel child's face at test	novel	novel	2	new	no

but the source changed from self to other for the *old-self→other* recombinations. Similarly, the items in the *old-other* and *old-other→self* combinations were originally other-encoded. At test, the *old-other* combinations were presented intact, but the source changed from other to self for the *old-other→self* recombinations. The effects of encoding-context (self versus other) and retrieval-context (self versus other) on binding recognition were assessed using these four combination types.

Children's binding recognition was also evaluated in terms of their ability to recognise old intact item-source pairs (*old-self* and *old-other*) versus their capacity to reject new recombined item-source pairs (*old-self→other* and *old-other→self*). Regarding this, Glisky et al. (2001) observed that younger and older adult participants' recognition of voices (item memory) was more accurate when the voice spoke the same sentence (source) at test as it did at study compared to when it spoke a different sentence at test than it did at study (Exps. 1 and 4). Thus, item recognition was more accurate when the retrieval-context matched the encoding-context. This finding suggests that participants encoded the binding between the item and source, and that retrieval of the item at test was aided by the presence of the original source.

Based on this, it was of interest whether children's binding recognition might also be enhanced when the retrieval-context matched the encoding-context. If children are able to construct bindings between the items and sources at encoding, then re-presentation of these same components might serve as strong retrieval cues for the bindings at test (M. K. Johnson & Chalfonte, 1994). If Glisky et al.'s (2001) findings generalise to children's binding recognition, then accuracy might be expected to be higher for old intact item-source pairs (*old-self* and *old-other*) than for new recombined item-source pairs (*old-self→other* and *old-other→self*) because the retrieval-context for the intact combinations is identical to the encoding-context.

The *old-novel*, *novel-self*, *novel-other*, and *novel-novel* combinations described in Table 7.1 were included as procedural controls. All contain at least one novel component, therefore the correct response to these combinations is "no". If children have a tendency to respond on the basis of familiarity (of either the item or the source), rather than on episodic memory for the specific item-source binding, then it might be expected that a "yes" response bias would be observed on trials involving *old-novel*, *novel-self*, and *novel-other* combinations. This is because at least one component is old, and therefore familiar. Similarly, if children are reluctant to respond "no", then it might also be expected that a "yes" response bias would be observed on these item-source combinations. Alternatively, if children do not understand the task requirements, then binding recognition performance is likely to be random. In any case, such problems would be revealed as poor binding recognition performance which would be expected to not exceed chance level.

Children's performance on trials involving *old-novel*, *novel-self*, *novel-other*, and *novel-novel* combinations was therefore interpreted in terms of their understanding of the stipulations of the task and their tendency towards responding in a biased manner. If performance is above chance level on these item-source combinations, this would reflect a sound understanding of the task and the absence of a response bias. This in turn would enable children's performance on trials involving the *old-self* and *old-other* combinations, and *old-self→other* and *old-other→self* recombinations to be reliably interpreted. Conversely, if performance is at chance level or below on trials involving a novel component, this would impact the manner in which outcomes on the *old-self* and *old-other* combinations, and *old-self→other* and *old-other→self* recombinations could be interpreted.

Questions of specific interest in this experiment were: (a) the extent of age-related improvement in binding recognition during the period from 4 to 6 years; (b) the extent to which self-referent encoding facilitates recognition of intact item-source bindings and rejection of recombined items and sources, and if so; (c) at what ages the facilitation is observed. The extent to which retrieval-context interacts with encoding-context was also of interest.

Method

Participants

Seventy-two children from two day-care centres and one Catholic Education primary school located in middle-class suburbs of the Gold Coast region, Queensland, Australia participated in this experiment. Children from three age groups were recruited with equal numbers of girls and boys in each age group: twenty-four 4-year-olds (*M* = 54.33 months, *SD* = 3.21, range: 48 – 59), twenty-four 5-year-olds (*M* = 65.50 months, *SD* = 3.21, range: 58 – 70), and twenty-four 6-year-olds (*M* = 77.17 months, *SD* = 3.24, range: 72 – 82). All children who commenced the task completed it. Participants were recruited through the same procedures described in Experiment 1. Both recruitment and task procedures were conducted in accordance with specific guidelines established during the ethics approval application from Griffith University Human Research Ethics Committee (PSY/09/09/HREC).

SES was calculated as described in Experiment 1. Mean SES scores according to age group were: 4-year-olds (*M* = 40.93, *SD* = 8.06, range: 29.00 – 58.50), 5-year-olds (*M* = 45.71, *SD* = 7.24, range: 29.50 – 56.00), and 6-year-olds (*M* = 40.77, *SD* = 7.24, range: 31.50 – 56.00). A one-way ANOVA showed the effect of age on SES was significant, $F(2, 65) = 3.25$, $p = .045$, $\eta_p^2 = .091$. A Scheffe test revealed there was a trend towards 5-year-olds having significantly higher SES than 6-year-olds ($p = .092$).

There was no significant difference in SES between 4- and 5-year-olds (p = .106), or 4- and 6-year-olds (p = .998). That SES was slightly higher for 5-year-olds than it was for 6-year-olds needs to be taken into consideration when evaluating outcomes involving the presence or absence of age effects.

Stimuli

Stimuli for the encoding phase were as described in Experiment 1. For the binding recognition test, a total of 48 stimulus displays (six each for the eight item-source combination types outlined in Table 7.1) were constructed. For the two intact combination types (*old-self* and *old-other*), the stimulus displays were identical to ones presented during the encoding phase. Twelve original stimulus displays (six from each of the self and other encoding-context conditions) were randomly selected for the *old-self* and *old-other* combinations.

For the recombination types (*old-self→other* and *old-other→self*), the item component of the original encoding stimulus display was retained, whilst the source component was substituted for the alternative (i.e., self→other and other→self). An additional 12 original stimulus displays (6 from each of the self and other encoding-context conditions) were randomly selected. For the self encoding-context stimulus displays, the source component (participant child's own face) was replaced with other (matched child's face). Conversely, for the other encoding-context stimulus displays, the source component (matched child's face) was replaced with self (participant child's own face).

For the *old-novel* combination type, the item component of the original encoding stimulus display was retained whilst the source component was novel. An additional six original stimulus displays (three from each of the self and other encoding-context conditions) were randomly selected. The source component of these displays was

replaced with the image of a novel child's face, as described in Experiment 1. For this combination and the *novel-novel* combination described below, the face image was matched to the participant child according to sex, age, and hair colour.

The *novel-self*, *novel-other*, and *novel-novel* combination types all included a new item. To create these combinations, 18 new items were randomly selected from Picture Sets 3 and 4 (9 from each; see Table 2.1, p. 45). These items were randomly allocated to the *novel-self*, *novel-other*, and *novel-novel* combination types (six to each). For the *novel-self* combination, the source component was represented by the participant child's own face image. For the *novel-other* combination, the source component was represented by the matched child's face image. Finally, for the *novel-novel* combination, the source component was represented by the matched novel child's face.

The 48 stimulus displays were presented in six blocks of eight trials. Each block comprised one each of the item-source combinations described in Table 7.1. The trials within each block and the blocks themselves were ordered in a random sequence that was different for each participant.

Procedure

The experiment comprised two phases: encoding and binding recognition test.

Encoding. This was identical to Experiment 1.

Binding recognition test. After the encoding phase, children completed the same filler drawing task as in Experiment 1. This was followed immediately by a recognition test of the item-source bindings. Children were presented with the 48 stimulus displays described above, one at a time. They were asked to judge (yes or no) whether they had seen the particular item-source combination previously during the encoding phase: "For this task, I'm going to show you pictures of different things. Some of the things you will have seen before in the last part of the game, while other

things are new, so you won't have seen them before. Like in the last part of the game, someone will be pointing to each of the things. The 'someone' might be you—just like before—or it might be the other girl (boy)—just like before. But different to before, there will be a new girl (boy) who you haven't seen, and she (he) will be pointing to some of the things as well. Now, what I'd like you to do this time, is to tell me whether you remember seeing the particular girl (boy) pointing to the particular thing (in the last part of the game). Shall we have a practice so you understand what I mean?"

Children were presented with two practice trials. These were identical to the two practice trials used during the encoding phase. Children who received Presentation A were asked: "Were you pointing to a boat before?" and "Was she (he) pointing to an egg before?" Children who received Presentation B were asked: "Were you pointing to an egg before?" and "Was she (he) pointing to a boat before?" After children correctly responded "yes" to both trials, the experimenter provided feedback. For example, "That's right, you were pointing to the boat" or "That's right, she (he) was pointing to the egg". "So that's all you need to do for this part of game. If you've seen the particular girl (boy) pointing to the particular thing, you say 'yes', but if you haven't seen the particular girl (boy) pointing to the particular thing, then you say 'no'. Let's get started."

All children correctly responded "yes" to the two practice trials. Children's understanding of the task requirements was also monitored during the first block of trials and feedback provided where appropriate. If a "yes" response bias was suspected, the experimenter reminded the child that some things were new and that there was also a new girl (boy), and that in such cases it would be correct to say "no". Similarly, the child was reminded that it would be correct to say "no" when they thought that a different girl (boy) had been pointing to a given object. The experimenter reiterated:

"Remember, you have to tell me whether you remember seeing the particular girl (boy) pointing to the particular thing." Conversely, other children demonstrated their understanding of the task and made comments such as: "She wasn't pointing to the dolphin, I was" or "She wasn't pointing to the scissors—she wasn't even in it." The task took approximately 20 minutes to complete.

Design and Analyses

A full factorial design was used to examine the effects of sex (girl, boy), age (4-, 5-, and 6-years), encoding-context (self, other), and retrieval-context (self, other) on binding recognition for the *old-self* and *old-other* intact combination types, and the *old-self→other* and *old-other→self* recombination types described in Table 7.1. Sex and age were between-subjects variables; encoding-context and retrieval-context were within-subjects variables. Binding recognition was measured as the mean proportion of correctly recognised item-source bindings. Except where indicated, data were analysed using the same methods as in Experiment 1. The assumptions of all analyses were met. An alpha level of .05 was applied to all analyses. Unless otherwise specified, reported *p* values are two-tailed. The purpose of including the last four item-source combination conditions described in Table 7.1 (*old-novel*, *novel-self*, *novel-other*, and *novel-novel*) was to assess children's understanding of the task procedures, and to detect the presence of any response biases. With the exception of single sample *t*-tests examining children's performance in relation to chance, no tests of significance were conducted on these data.

Results

Performance in Comparison to Chance

Single-sample *t*-tests conducted separately for girls and boys at each age level compared mean binding recognition accuracy scores in each item-source combination

condition to chance level. The binding recognition task was a two-alternative forced-choice test, therefore chance level was .50. Descriptive statistics and results of the *t*-tests are presented in Table 7.2. In the *old-self* and *old-other* intact combination conditions (columns 2 and 3) and in combination conditions involving a novel item (columns 7, 8, and 9), binding recognition for all subgroups was significantly higher than chance level. In the *old-novel* combination condition (column 6), binding recognition for most subgroups was significantly better than chance level. In this condition, 4-year-old boys' binding recognition did not differ significantly from chance. In the *old-self→other* recombination condition (column 4), binding recognition for 5-year-olds (girls and boys) and 6-year-old boys was above chance level, whilst other subgroups' binding recognition did not differ significantly from chance. In the *old-other→self* recombination condition (column 5), binding recognition was above chance level only for 6-year-olds (girls and boys), whilst it did not differ significantly from chance for 4- and 5-year-olds (girls and boys).

Detection of Response Bias

Inspection of the binding recognition means in Table 7.2 for combinations involving a novel component (*old-novel*, *novel-self*, *novel-other*, and *novel-novel*) shows generally high levels of accuracy. With the exception of 4-year-old boys in the *old-novel* combination condition, all other subgroups' binding recognition neared ceiling or was at ceiling for each of the four conditions. This level of performance indicates children understood the requirements of the task, thereby enabling performance in the remaining item-source combination conditions to be interpreted without concern for response bias. The poorer level of accuracy shown by the 4-year-old boys in the *old-novel* condition, potentially reflects a difficulty for this subgroup to distinguish novel sources and/or a tendency to respond based on familiarity of the item.

Table 7.2

Mean Binding Recognition Accuracy for each Subgroup and Item-Source Combination Condition in Experiment 4 (N = 72)

	Item-Source Combination							
	Intact item-source pairs		Recombined item-source pairs		Novel item and/or source pairs			
Subgroup	Old-self	Old-other	Old-self→other	Old-other→self	Old-novel	Novel-self	Novel-other	Novel-novel
Girls								
4-years	.94 (.03)*	.76 (.08)*	.60 (.13)	.50 (.09)	.83 (.09)*	.92 (.03)*	.89 (.04)*	.97 (.02)*
5-years	.86 (.03)*	.82 (.06)*	.67 (.07)*	.53 (.08)	.97 (.02)*	1.00 (.00)*	1.00 (.00)*	1.00 (.00)*
6-years	.99 (.02)*	.86 (.05)*	.60 (.09)	.71 (.09)*	.79 (.11)*	.90 (.08)*	.90 (.08)*	.90 (.08)*
Boys								
4-years	.88 (.08)*	.82 (.07)*	.58 (.11)	.63 (.11)	.60 (.11)	.89 (.08)*	.82 (.08)*	.93 (.06)*
5-years	.88 (.04)*	.67 (.07) *	.83 (.05)*	.57 (.07)	.97 (.03)*	.96 (.03)*	.96 (.03)*	.96 (.03)*
6-years	.81 (.07)*	.64 (.07)*	.79 (.07)*	.65 (.07)*	.94 (.04)*	.97 (.02)*	.96 (.02)*	1.00 (.00)*

Note. Standard errors are in parentheses. *Mean score significantly above chance level (.50) as assessed by a one-tailed single-sample *t*-test with an alpha level of .05.

Main and Interaction Effects

Mean binding recognition accuracy scores for the *old-self*, *old-other*, *old-self→other*, and *old-other→self* combination conditions were analysed with a 2 (sex: girl, boy) × 3 (age: 4-, 5-, and 6-years) × 2 (encoding-context: self, other) × 2 (retrieval-context: self, other) mixed factorial ANOVA. Results indicated a significant main effect of encoding-context, $F(1, 66) = 14.14$, $p < .001$, $\eta_p^2 = .176$. A SRE was evident as children's binding recognition was more accurate in the self-referent condition ($M = .79$, $SE = .02$) than in the other-referent condition ($M = .68$, $SE = .02$). A Sign test showed that of the 72 children, the percentage who demonstrated a SRE (61.11%) was significantly greater than the percentage who did not (30.56%), thereby supporting the robustness of the main effect finding, $Z = -2.59$, $p = .010$.

The Encoding-context × Retrieval-context interaction was significant, indicating accuracy was higher when the retrieval-context matched the encoding-context, $F(1, 66) = 20.02$, $p < .001$, $\eta_p^2 = .233$. This effect was modified by a significant Encoding-context × Retrieval-context × Sex interaction, $F(2, 66) = 4.02$, $p = .049$, $\eta_p^2 = .057$. Descriptive statistics for the three-way interaction are presented in Table 7.3. Partitioned by sex, the Encoding-context × Retrieval-context interaction was significant for girls, $F(1, 33) = 24.55$, $p < .001$, $\eta_p^2 = .427$, but not for boys, $F(1, 33) = 2.67$, $p = .112$, $\eta_p^2 = .075$.

For girls, the simple effect of retrieval-context was significant in the self-referent encoding condition ($p < .001$) and in the other-referent encoding condition ($p = .001$). For self-encoded items, binding recognition was more accurate in the self-retrieval condition than in the other-retrieval condition. For other-encoded items, binding recognition was more accurate in the other-retrieval condition than in the self-retrieval condition. The simple effect of encoding-context was significant in the self-retrieval

condition ($p < .001$) and in the other-retrieval condition ($p = .022$). In the self-retrieval condition, binding recognition was more accurate for self-encoded items than for other-encoded items. In the other-retrieval condition, binding recognition was more accurate for other-encoded items than for self-encoded items. Thus, binding recognition for girls was more accurate for old intact item-source pairs than for new recombined item-source pairs.

Table 7.3

Mean Binding Recognition Accuracy for Girls and Boys at each level of Encoding-Context and Retrieval-Context in Experiment 4 (N = 72)

	Encoding-Context	
Retrieval-Context	Self	Other
	Girls	
Self	.93 (.03)	58 (.05)
Other	.62 (.05)	.82 (.04)
	Boys	
Self	.85 (.03)	.62 (.05)
Other	.74 (.05)	.71 (.04)

Note. Standard errors are in parentheses.

The simple effects of retrieval-context and encoding-context were also examined for boys. There was a trend towards a significant simple effect of retrieval-context in the self-referent encoding condition ($p = .077$), but not in the other-referent encoding condition ($p = .205$). For self-encoded items, binding recognition was more accurate in the self-retrieval condition than in the other-retrieval condition. The simple effect of encoding-context was significant in the self-retrieval condition ($p = .004$), but not in the

other-retrieval condition (p = .701). In the self-retrieval condition, binding recognition was more accurate for self-encoded items than for other-encoded items. Thus, boys' binding recognition was more accurate for old intact item-source pairs than for new recombined item-source pairs for self-encoded items only.

The Encoding-context × Sex × Age interaction showed a trend towards significance, $F(2, 66) = 2.73$, $p = .072$, $\eta_p^2 = .076$. In line with Experiments 1, 2, and 3, paired-samples *t*-tests and corresponding Sign tests were used to assess whether self-referent encoding facilitated binding recognition for any subgroup. Descriptive statistics and results of the *t*-tests are presented in Table 7.4. These showed the SRE was significant for 4-year-old girls, as well as 5- and 6-year-old boys.

Table 7.4

Effect of Encoding-Context on Mean Binding Recognition Accuracy for Girls and Boys within each Age Group in Experiment 4 (N = 72)

	Encoding-Context				
Subgroup	Self	Other	*t*	*d*[a]	*p* (one-tailed)
Girls					
4-years	.77 (.05)	.63 (.05)	1.82	0.76	.048
5-years	.76 (.05)	.67 (.05)	1.23	0.55	.123
6-years	.79 (.05)	.79 (.05)	0.10	0.04	.461
Boys					
4-years	.73 (.05)	.72 (.05)	0.16	0.04	.437
5-years	.85 (.05)	.62 (.05)	3.00	1.38	.006
6-years	.80 (.05)	.65 (.05)	2.33	0.94	.020

Note. Standard errors are in parentheses. [a]Effect size estimate is Cohen's *d*.

Results of the Sign tests for each sex and age group are presented in Table 7.5. For 6-year-old boys, the percentage who showed a SRE was significantly greater than the percentage who did not. There was also a trend towards a significant difference for 5-year-old boys, in that the percentage who demonstrated a SRE was greater than the percentage who did not. The difference was not significant in any other subgroup.

Table 7.5

Encoding-Context Sign Tests Comparing the Percentages of Children by Sex and Age Group who did and did not show a SRE on Binding Recognition in Experiment 4 (N = 72)

	SRE		
Subgroup	Yes	No	*p* (one-tailed)
Girls			
4-years	66.67	33.33	.194
5-years	50.00	25.00	.254
6-years	41.67	50.00	.500
Boys			
4-years	50.00	33.33	.377
5-years	75.00	25.00	.073
6-years	83.33	16.67	.020

The Retrieval-context × Age interaction was also marginally significant, $F(2, 66) = 3.04$, $p = .055$, $\eta_p^2 = .084$. Descriptive statistics are presented in Table 7.6. Simple effects analysis revealed that the retrieval-context effect was significant for 6-year-olds ($p = .041$), such that binding recognition was more accurate in the self-

referent retrieval condition than in the other-referent retrieval condition. The simple effect of retrieval-context was not significant for 4-year-olds (p = .158) and 5-year-olds (p = .231). The simple effect of age was not significant in the self-referent retrieval condition, $F(2, 69) = 1.74$, p = .183, η_p^2 = .048, or in the other-referent retrieval condition, $F(2, 69) = 0.81$, p = .450, η_p^2 = .023.

Table 7.6

Mean Binding Recognition Accuracy according to Retrieval-Context and Age Group in Experiment 4 (N = 72)

	Retrieval-Context	
Age group	Self	Other
4-years	.74 (.03)	.69 (.03)
5-years	.71 (.03)	.75 (.03)
6-years	.79 (.03)	.72 (.03)

Note. Standard errors are in parentheses.

The main effects of retrieval-context, $F(1, 66) = 1.77$, p = .188, η_p^2 = .026, sex $F(1, 66) = 0.07$, p = .794, η_p^2 = .001, and age, $F(2, 66) = 0.63$, p = .536, η_p^2 = .019, were not significant. Likewise, all other two-, three-, and four-way interactions were not significant, largest $F(2, 66) = 1.17$, p = .316, η_p^2 = .034. Earlier, it was reported that SES was higher for 5-year-olds than it was for 6-year-olds. To examine whether the absence of a significant age effect was due to differences in SES, the 2 (sex: girl, boy) × 3 (age: 4-, 5-, and 6-years) × 2 (encoding-context: self, other) × 2 (retrieval-context: self, other) mixed factorial ANOVA was re-run including SES as a covariate. After controlling for SES, the main effect of age remained nonsignificant, $F(2, 61) = 0.41$, p = .668, η_p^2 = .013.

Supplementary Analyses

Supplementary *t*-tests and Sign tests were conducted to further evaluate the effect of encoding-context on binding recognition. In Experiments 1, 2, and 3, the SRE corresponded to the main effect of encoding-context. Retrieval-context did not vary in Experiments 1, 2, and 3, but it was manipulated in Experiment 4. The main effect of encoding-context in Experiment 4 collapses over variations in retrieval-context. Although the four-way interaction was not significant, the effect of encoding-context (self versus other) in each retrieval-context condition (self and other) was examined separately for each subgroup. This was to enable cross-experiment comparisons.

Effect of encoding-context in the self and other retrieval conditions. Descriptive statistics for each sex and age group were presented in Table 7.2, but are re-presented in the second and third columns of Table 7.7 to correspond with the relevant comparisons. Results of the *t*-tests are presented in the last three columns of Table 7.7. In the self-referent retrieval condition, the SRE was significant for 4-, 5-, and 6-year-old girls, and 5-year-old boys. There was a trend towards a significant SRE for 4-year-old boys. Results of the Sign tests are presented in Table 7.8. These showed that for 4-, 5-, and 6-year-old girls, and 4-, and 5-year-old boys, the percentage of children who showed a SRE was significantly greater than the percentage who did not. For 6-year-old boys, the difference showed a trend towards significance, in that the percentage of children who showed a SRE was greater than the percentage who did not.

In the other-referent retrieval condition, there was a trend towards a significant SRE for 5-year-old boys only. The Sign test supported this, such that the percentage of 5-year-old boys who showed a SRE was significantly greater than the percentage who did not. There was a significant reverse pattern for 6-year-old girls. The Sign test reflected this finding, in that the percentage of 6-year-old girls who showed a SRE was

significantly less than the percentage who did not. Finally, although there was a trend towards a significant reverse pattern for 4-year-old boys, this was not supported by the Sign test which showed no significant difference between the percentages of 4-year-old boys who did and did not show a SRE.

Effect of encoding-context in the same and different retrieval conditions. Taken together, the outcomes described in the previous section indicate the significant SRE observed in the self retrieval-context condition for 4-, 5-, and 6-year-old girls, and 5-year-old boys, was magnified because of the match between the encoding-context and retrieval-context. In light of this, the SRE for the subgroups was examined at each level of retrieval-context, whereby retrieval-context was defined in a different way: same as encoding versus different from encoding.

Descriptive statistics corresponding to the comparisons are re-presented in the second and third columns of Table 7.9. Results of the *t*-tests are presented in the last three columns of Table 7.9. These showed that when the retrieval-context was the same as the encoding-context, the SRE was significant for 4- and 6-year-old girls, and 5- and 6-year-old boys. Results of the Sign tests for each sex and age group are presented in Table 7.10. For 4- and 6-year-old girls, and 6-year-old boys, the percentage of children who showed a SRE was significantly greater than the percentage who did not. There was also a trend towards a significant difference for 5-year-old boys, such that the percentage who demonstrated a SRE was greater than the percentage who did not.

When the retrieval-context was different from the encoding-context, the SRE was significant for 5- and 6-year-old boys. There was also a trend towards a significant SRE for 5-year-old girls. The Sign tests were mostly consistent with these outcomes, in that the percentage of children who showed a SRE was significantly greater than the percentage who did not for 5- and 6-year-old boys.

Table 7.7

Effect of Encoding-Context on Mean Binding Recognition Accuracy for each Subgroup according to Retrieval-Context in Experiment 4 (N = 72)

	Encoding-Context				
Retrieval-Context	Self	Other	*t*	*d*[a]	*p* (one-tailed)
		Girls			
4-years					
Self	.94 (.03)	.50 (.09)	3.93	1.92	.001
Other	.60 (.13)	.76 (.08)	-0.96	-0.46	.180
5-years					
Self	.86 (.04)	.53 (.08)	4.51	1.58	<.001
Other	.67 (.07)	.82 (.06)	-1.31	-0.67	.109
6-years					
Self	.99 (.01)	.71 (.09)	2.93	1.22	.007
Other	.60 (.09)	.86 (.05)	-2.13	-1.02	.029
		Boys			
4-years					
Self	.88 (.09)	.63 (.11)	1.55	0.72	.074
Other	.58 (.11)	.82 (.07)	-1.56	-0.73	.074
5-years					
Self	.88 (.04)	.57 (.07)	3.19	1.54	.005
Other	.83 (.05)	.67 (.07)	1.66	0.78	.063
6-years					
Self	.81 (.07)	.65 (.07)	1.19	0.63	.131
Other	.79 (.07)	.64 (.07)	1.33	0.60	.106

Note. Standard errors are in parentheses. [a]Effect size estimate is Cohen's *d*.

Table 7.8

Encoding-Context Sign Tests Comparing the Percentages of Children by Sex and Age Group who did and did not show a SRE on Binding Recognition in each Retrieval-Context Condition in Experiment 4 (N = 72)

	SRE		
Retrieval-Context	Yes	No	*p* (one-tailed)
	Girls		
4-years			
Self	75.00	16.67	.033
Other	33.33	50.00	.377
5-years			
Self	83.33	8.33	.006
Other	25.00	58.33	.172
6-years			
Self	66.67	00.00	.004
Other	16.67	66.67	.055
	Boys		
4-years			
Self	75.00	8.33	.011
Other	25.00	58.33	.275
5-years			
Self	75.00	16.67	.033
Other	75.00	25.00	.073
6-years			
Self	75.00	25.00	.073
Other	58.33	25.00	.172

Table 7.9

Effect of Encoding-Context on Mean Binding Recognition Accuracy for each Subgroup according to Retrieval-Context in Experiment 4 (N = 72)

	Encoding-Context				
Retrieval-Context	Self	Other	*t*	*d*[c]	*p* (one-tailed)
		Girls			
Same as encoding[a]					
4-years	.94 (.03)	.76 (.07)	2.86	0.90	.008
5-years	.86 (.03)	.82 (.06)	0.51	0.24	.312
6-years	.99 (.01)	.86 (.05)	2.28	0.92	.022
Different from encoding[b]					
4-years	.60 (.13)	.50 (.09)	0.81	0.28	.219
5-years	.67 (.07)	.53 (.08)	1.42	0.54	.092
6-years	.60 (.09)	.71 (.09)	-1.17	-0.35	.133
		Boys			
Same as encoding[a]					
4-years	.88 (.08)	.82 (.07)	0.94	0.21	.184
5-years	.88 (.04)	.67 (.07)	2.26	1.06	.023
6-years	.81 (.07)	.64 (.07)	2.17	0.66	.027
Different from encoding[b]					
4-years	.58 (.11)	.63 (.11)	-0.61	-0.11	.278
5-years	.83 (.05)	.57 (.07)	3.51	1.22	.003
6-years	.79 (.07)	.65 (.07)	1.89	0.57	.043

Note. Standard errors are in parentheses. [a]Intact item-source combination types (*old-self* versus *old-other*). [b]Recombined item-source combination types (*old-self→other* versus *old-other→self*). [c]Effect size estimate is Cohen's *d*.

Table 7.10

Encoding-Context Sign Tests Comparing the Percentages of Children by Sex and Age Group who did and did not show a SRE on Binding Recognition in each Retrieval-Context Condition in Experiment 4 (N = 72)

	SRE		
Retrieval-Context	Yes	No	*p* (one-tailed)
	Girls		
Same as encoding[a]			
4-years	58.33	00.00	.011
5-years	25.00	33.33	.500
6-years	41.67	00.00	.031
Different from encoding[b]			
4-years	50.00	41.67	.500
5-years	58.33	25.00	.172
6-years	16.67	50.00	.145
	Boys		
Same as encoding[a]			
4-years	50.00	25.00	.254
5-years	58.33	16.67	.090
6-years	58.33	8.33	.035
Different from encoding[b]			
4-years	33.33	33.33	.500
5-years	75.00	16.67	.033
6-years	75.00	16.67	.033

Note. [a]Intact item-source combination types (*old-self* versus *old-other*). [b]Recombined item-source combination types (*old-self→other* versus *old-other→self*).

Discussion

Experiment 4 examined the effect of self-referent versus other-referent encoding on binding recognition in 4-, 5-, and 6-year-old children. In Experiments 1, 2, and 3, SREs were observed in source recognition. Given the proposal that intact binding processes are involved in accurate source discrimination (Chalfonte & Johnson, 1996; M. K. Johnson et al., 1993), it was of interest whether a similar self-reference advantage would be observed in binding recognition.

Children's performance on the procedural control trials indicated they understood the requirements of the task. Furthermore, it appeared children were not prone to a response bias, in that they were willing to give "no" responses. This allowed for their performance on the item-source combinations designed to evaluate the SRE in binding recognition to be interpreted in a straight forward manner.

Regarding developmental improvements in binding recognition, results of the ANOVA indicated there were none. Based on this analysis, 4-year-olds' accuracy was equivalent to that of 5- and 6-year-olds'. Furthermore, despite the finding that 5-year-olds had higher SES than 6-year-olds, the analysis of covariance indicated the absence of an age effect could not be accounted for by differences in SES

Although results of the ANOVA indicated that 4-year-olds' binding recognition accuracy was equivalent to that of the two older age groups, children's performance in relation to chance provides some evidence that 4-year-olds had difficulty rejecting the new item-source recombinations (see Table 7.2; p. 146). In contrast, 6-year-olds' performance on the recombined items was above chance[6]. For 4-year-old boys, the

[6] For 6-year-olds, performance on recombined item-source pairs (collapsed across self-other) was above chance for girls, $t(11) = 1.96$, $p = .038$ (one-tailed) and for boys, $t(11) = 3.30$, $p = .002$ (one-tailed).

basis of this difficulty does not appear to be due to a general reluctance to respond "no", as their performance on the *novel-self*, *novel-other*, and *novel-novel* items, which require "no" responses, was high. Rather, given their performance on the *old-novel* items was at chance level, the difficulty might reflect a reliance on familiarity of the items. This does not appear to be the case for 4-year-old girls who performed well above chance on the *old-novel* items, but at chance on *old-self→other*, and *old-other→self*. For girls, these outcomes might reflect a more general difficulty in retrieving the item-source bindings.

Taken as a whole, the higher accuracy observed for 6-year-olds relative to 4-year-olds on the recombined item-source pairs, could be seen to reflect development in binding recognition. That SES was comparable between 4- and 6-year-olds, indicates that the increase in accuracy on the recombined items-source pairs between 4 and 6 years of age, was not due to a difference in SES between the two age groups. This interpretation of development in binding recognition, is consistent with previous research showing improvements in binding in memory task performance between 4 and 6 years of age (Kovacs et al., 2005; Lloyd et al., 2009; Sluzenski et al., 2006). In particular, the present finding is consistent with Lloyd et al. (2009). These authors proposed that if young children have a specific memory binding deficit, then a particular pattern of findings should be evident. Lloyd et al. (2009) suggested that in the event young children base their responses on familiarity of the test stimuli (i.e., respond "yes" to trials containing old features), then binding recognition (i.e., hit rate) between 4- and 6-year-olds might be comparable, but that the false alarm rate of 4-year-olds should be greater than that of 6-year-olds. Consistent with this idea, Lloyd et al. (2009) found that 4- and 6-year-olds did not differ in their hit rate of old object-background combinations, but that 4-year-olds made more false alarms than 6-year-olds (long-term memory

condition). Thus, as in the present experiment, the 4-year-olds in Lloyd et al.'s (2009) study had greater difficulty rejecting the new recombined object-background pairs than the 6-year-olds did.

In the present experiment, the main effect of encoding-context showed that self-referent encoding produced superior overall binding recognition than other-referent encoding did. The robustness of this self-reference advantage was further supported by the Sign test which showed the majority of children demonstrated a SRE in binding recognition. The Encoding-context × Sex × Age interaction indicated the SRE in binding recognition was especially evident for 4-year-old girls, and 5- and 6-year-old boys. There was also some suggestion that the effect emerges slightly earlier for girls (by age 4) than it does for boys (by age 5). It then appears to level out by around 6-years of age for girls, whereas for boys it is still evident at age 6. Separate analysis of the intact item-source combinations also showed that self-referent encoding produced higher accuracy than other-referent encoding did for several of the subgroups (see Tables 7.9 and 7.10). Although to a slightly lesser extent, this was also the case for the recombined item-source combinations. Thus, the SRE in binding recognition appears to be evident when the retrieval-context matches the encoding-context as well as when it does not.

The finding of a SRE in binding recognition appears to be new, as no previous research has reported SREs in binding recognition with young children. It is consistent with the claim that binding processes are involved in source memory, as it corresponds to findings from Experiments 1, 2, and 3 which showed that self-referent encoding produced more accurate source recognition than other-referent encoding did. The finding also provides some support for the idea that the self has special significance in the early development of episodic memory. It might be, that when information is

encoded in relation to self, this facilitates the formation and retrieval of more robust bindings between items and sources relative to when information is encoded in relation to other. In turn, these more robust bindings perhaps serve to facilitate memory for source information. This is further investigated in Experiment 5 for which an alternative encoding-context is employed.

Finally, children's binding recognition was more accurate when the retrieval-context matched the encoding-context, particularly for girls. Children therefore found it easier to recognise old intact item-source pairs than to reject new recombined item-source pairs. This outcome is consistent with Glisky et al. (2001). These authors found that younger and older adults' recognition of items (voices) was more accurate when they were re-presented at test paired with the same source (sentence) as at study, compared to when items were re-presented at test with a different source than at study (Exps. 1 and 4). If the bindings between particular items and sources are established at encoding, then re-presentation of the same item-source pairs at test, likely serves to reinstate these bindings (M. K. Johnson & Chalfonte, 1994). Presumably, more effortful processing must be engaged when item-source pairs are presented in a new recombined way at test, making retrieval of the bindings more difficult for children and adults alike.

CHAPTER 8. EXPERIMENT 5

The primary purpose of Experiment 5 was to assess the special significance of self-referent encoding in binding recognition. Experiment 5 was similar to Experiment 4 in that an item-source binding recognition procedure was used. However, the operationalisation of source was modified, so as to determine whether self-referent encoding produces superior binding recognition compared to an alternative form of contextual encoding. The self versus other distinction used in Experiment 4 was changed to the distinction between two dog breeds: Bull mastiff versus German shepherd. A description and explanation of the eight item-source combinations used in the binding recognition test is presented in Table 8.1. The label and description for each combination can be seen in the first column (e.g., *old-Bull mastiff*, *old-German shepherd*).

Results of Experiment 4 indicated children understood the requirements of the binding recognition task, and further, that they were not biased towards responding in a particular way (i.e., "yes" or "no"). This was demonstrated in that they correctly rejected item-source combinations involving a novel component (i.e., *old-novel*, *novel-self*, *novel-other*, and *novel-novel* conditions) at a high level. Based on this, children's binding recognition in this experiment was expected to exceed chance level in the corresponding item-source combination conditions (i.e., *old-novel*, *novel-Bull mastiff*, *novel-German shepherd*, and *novel-novel*).

Consistent with Experiment 4, the effects of encoding-context (Bull mastiff versus German shepherd) and retrieval-context (Bull mastiff versus German shepherd) were evaluated. However, no significant difference between the two encoding-context conditions was expected in Experiment 5. As in Experiment 4, it was expected that binding recognition would be more accurate when the retrieval-context matched the

Table 8.1

Description and Explanation of the Item-Source Combinations Presented during the Binding Recognition Test Phase of Experiment 5

Label and Description	Item at test	Source at test	Number of Novel Components	Combination	Correct Response
Old-Bull mastiff: combination presented previously at encoding—object paired with photograph of a Bull mastiff (i.e., Bull mastiff encoding-context)	old	Bull mastiff	0	intact	yes
Old-German shepherd: combination presented previously at encoding—object paired with photograph of a German shepherd (i.e., German shepherd encoding-context)	old	German shepherd	0	intact	yes
Old-Bull mastiff→German shepherd: old object previously paired with photograph of Bull mastiff at encoding subsequently paired with photograph German shepherd at test	old	German shepherd	0	recombination	no
Old-German shepherd→Bull mastiff: old object previously paired with photograph of German shepherd at encoding subsequently paired with photograph of Bull mastiff at test	old	Bull mastiff	0	recombination	no
Old-novel: old object presented at encoding subsequently paired with photograph of a novel dog (Dalmatian) at test	old	Novel	1	new	no
Novel-Bull mastiff: novel object paired with photograph of Bull mastiff at test	novel	Bull mastiff	1	new	no
Novel-German shepherd: novel object paired with photograph of German shepherd at test	novel	German shepherd	1	new	no
Novel-novel: Novel object paired with photograph of a novel dog (Dalmatian)	novel	novel	2	new	no

encoding-context (i.e., intact item-source combinations: *old-Bull mastiff* and *old-German shepherd*) compared to when the retrieval-context differed from the encoding-context (i.e., recombined item-source combinations: *old-Bull mastiff→German shepherd* and *old-German shepherd→Bull mastiff*). This is because re-presentation of the same item-source pairs at test should serve as strong retrieval cues for the bindings (Glisky et al., 2001; Hashtroudi et al., 1994).

Previous research examining the development of binding processes, has demonstrated that young children show marked improvement between 4- and 6-years of age (Kovacs et al., 2005; Lloyd et al., 2009; Sluzenski et al., 2006). In Experiment 4, there was some evidence of such improvement, in that performance on the new recombined item-source pairs was more accurate for 6-year-olds than it was for 4-year-olds. Given the modified operationalisation of source in the current experiment, the extent of age-related improvements in binding recognition was of continued interest.

Finally, given that self-referent encoding had a facilitative effect in binding recognition in Experiment 4, it was expected that performance on the binding recognition task would be more accurate in Experiment 4 than in Experiment 5. Such an outcome would be consistent with the interpretation that the self-concept is fundamental to the development of source memory specifically, and episodic memory more generally.

Method

Participants

Seventy-two children from one Catholic Education primary school located in a middle-class suburb of the Gold Coast region, Queensland, Australia participated in this experiment. Children from three age groups were recruited with equal numbers of girls and boys in each age group: twenty-four 4-year-olds (M = 57.50 months, SD = 1.06, range: 56 –

59), twenty-four 5-year-olds (*M* = 67.17 months, *SD* = 3.43, range: 60 – 71), and twenty-four 6-year-olds (*M* = 75.17 months, *SD* = 2.76, range: 72 – 83). All children who commenced the task completed it. Participants were recruited through the same procedures described in Experiment 1. Both recruitment and task procedures were conducted in accordance with specific guidelines established during the ethics approval application from Griffith University Human Research Ethics Committee (PSY/D1/09/HREC).

SES was calculated as described in Experiment 1. Mean SES scores according to age group were: 4-year-olds (*M* = 41.89, *SD* = 7.85, range: 22.00 – 56.00), 5-year-olds (*M* = 44.11, *SD* = 9.96, range: 16.00 – 56.00), and 6-year-olds (*M* = 43.57, *SD* = 10.01, range: 21.00 – 58.50). A one-way ANOVA showed there were no significant differences in SES between the age groups, $F(2, 62) = 0.34$, $p = .712$, $\eta_p^2 = .011$.

Stimuli

The stimuli used in Experiment 5 were identical to those described in Experiment 4, except for the operationalisation of source. The self and other images used in the encoding and test phase tasks in Experiment 4, were arbitrarily replaced with the large dog breed images: Bull mastiff and German shepherd, respectively. The novel face image used in the test phase task in Experiment 4 was replaced with the image of a Dalmatian in Experiment 5. Each source was assigned a one-syllable name: Max, Zac, and Sam for the Bull mastiff, German shepherd, and Dalmatian, respectively. A description and explanation of the stimulus displays used in the binding recognition test are presented in Table 8.1. An example item-source stimulus display with “Max” as source is presented in Figure 8.1.

Figure 8.1. An example item-source stimulus display used in Experiment 5. During the encoding phase children were asked "Who's looking at the flower?" During the test phase they were asked "Was Max looking at a flower?"

Procedure

Encoding phase. The format for the encoding phase was identical to that used in Experiment 1, with one exception. The self and other source components used in previous experiments were replaced with the Bull mastiff and German shepherd components, respectively. Children were familiarised with the two sources prior to commencing the encoding task: "Before we get started, I want to introduce you to two of the characters that you're going to be seeing during this game. They're both big dogs." Children were shown a picture card of each dog: "This is one of the dogs (Bull mastiff) that you'll be seeing; his name is Max. You can see that Max is a big dog and he's light in colour. This is the other dog (German shepherd) that you'll be seeing; his name is Zac. You can see that Zac is also a big dog, but he's dark in colour. Do you think that you will be able to remember which dog is Max and which dog is Zac?" Children were asked to identify each dog: "Can you point to Max for me? Good. Now can you point to Zac for me?" The experimenter then

removed the picture cards momentarily, before returning them (one at a time) and asking the child to identify each dog by name: "Who's this?" When it was clear the child was familiar with each dog and its name, the experimenter commenced the encoding task: "Great, let's get started."

Binding recognition test. After the encoding phase, children completed the filler drawing task as described in Experiment 1. This was followed immediately by a recognition test of the item-source bindings, the format for which was identical to that used in Experiment 4. Children were presented with 48 stimulus displays (6 from each of the eight item-source combinations outlined in Table 8.1), one at a time, and asked to judge (yes or no) whether they had seen the particular item-source combination previously during the encoding phase: "For this task, I'm going to show you pictures of different things. Some of the things you will have seen before in the last part of the game, while other things are new, so you won't have seen them before. Like in the last part of the game, a dog will be looking at each of the things. The dog might be Max—just like before, or it might be Zac—just like before. But different to before, there will be a new dog that you haven't seen. His name is Sam, and he's going to be looking at some of the things as well. What I'd like you to do this time, is to tell me whether you remember seeing the particular dog looking at the particular thing in the last part of the game. Shall we have a practice so you understand what I mean?"

Design and Analyses

A full factorial design was used to examine the effects of sex (girl, boy), age (4-, 5-, and 6-years), encoding-context (Bull mastiff, German shepherd), and retrieval-context (Bull mastiff, German shepherd) on binding recognition for the *old-Bull mastiff, old-German shepherd, old-Bull mastiff→German shepherd*, and *old-German shepherd→Bull mastiff*

combination conditions described in Table 8.1. Sex and age were between-subjects variables; encoding-context and retrieval-context were within-subjects variables. When appropriate, pairwise comparisons (with Bonferroni correction) were conducted. Binding recognition was measured as the mean proportion of correctly recognised item-source bindings. Except where indicated, data were analysed using the same methods as in Experiment 4. The assumptions of all analyses were met. An alpha level of .05 was applied to all analyses. Reported *p* values are two-tailed. As in Experiment 4, the *old-novel*, *novel-Bull mastiff*, *novel-German shepherd*, and *novel-novel* combination conditions were used to assess children's understanding of the task procedures, and to detect response biases. The only tests of significance conducted on these data were single sample *t*-tests which compared children's performance to chance level (.50).

Results

Performance in Comparison to Chance

Single-sample *t*-tests conducted separately for each subgroup compared mean binding recognition accuracy scores in each item-source combination condition to chance (.50). Descriptive statistics and results are presented in Table 8.2. In the *old-Bull mastiff* and *old-German shepherd* intact combination conditions (columns 2 and 3), and in each condition involving a novel component (columns 6, 7, 8, and 9), binding recognition for all subgroups was significantly higher than chance. In the recombination conditions (columns 4 and 5), binding recognition was not significantly better than chance for any subgroup. In the *old-German shepherd→Bull mastiff* recombination condition (column 4), 4-year-old boys' and 5-year-olds' (girls and boys) binding recognition was significantly below chance. Likewise, 5-year-old girls' binding recognition was significantly below chance level in the *old-Bull mastiff→German shepherd* recombination condition (column 5).

Table 8.2

Mean Binding Recognition Accuracy for each Subgroup and Item-Source Combination Condition in Experiment 5 (N = 72)

	Item-Source Combination Type							
	Intact item-source pairs		Recombined item-source pairs		Novel item and/or source pairs			
Subgroup	Old-BM	Old-GS	Old-BM→GS	Old-GS→BM	Old-novel	Novel-BM	Novel-GS	Novel-novel
				Girls				
4-years	.78 (.05)*	.76 (.05)*	.54 (.08)	.58 (.07)	.88 (.08)*	1.00 (.00)*	1.00 (.00)*	.96 (.04)*
5-years	.89 (.05)*	.88 (.03)*	.26 (.10)‡	.21 (.09)‡	.81 (.09)*	.96 (.02)*	.96 (.02)*	.93 (.07)*
6-years	.88 (.05)*	.86 (.04)*	.35 (.12)	.33 (.08)	.99 (.01)*	.99 (.01)*	.97 (.02)*	.99 (.01)*
				Boys				
4-years	.78 (.05)*	.71 (.08)*	.36 (.10)	.32 (.09)‡	.72 (.11)*	.99 (.01)*	.94 (.04)*	.88 (.08)*
5-years	.79 (.07)*	.71 (.09)*	.42 (.12)	.39 (.10)‡	.82 (.10)*	1.00 (.00)*	.97 (.02)*	.88 (.08)*
6-years	.86 (.04)*	.83 (.05)*	.44 (.09)	.36 (.10)	.92 (.05)*	1.00 (.00)*	1.00 (.00)*	1.00 (.00)*

Note. Standard errors are in parentheses. BM = Bull mastiff; GS = German shepherd. *Mean score significantly above chance level (.05) as assessed by a one-tailed single-sample *t*-test with an alpha level of .05. ‡Mean score significantly below chance level (.05) as assessed by a one-tailed single-sample *t*-test with an alpha level of .05.

Detection of Response Bias

The generally high level of performance demonstrated in each condition involving a novel component (*old-novel*, *novel-Bull mastiff*, *novel-German shepherd*, and *novel-novel*) indicates children understood the requirements of the task, and were not prone to a response bias, in that they were willing to give "no" responses.

Main and Interaction Effects

Mean binding recognition accuracy scores for the *old-Bull mastiff*, *old-German shepherd*, *old-Bull mastiff→German shepherd*, and *old-German shepherd→Bull mastiff* conditions were analysed with a 2 (sex: girl, boy) × 3 (age: 4-, 5-, and 6-years) × 2 (encoding-context: Bull mastiff, German shepherd) × 2 (retrieval-context: Bull mastiff, German shepherd) mixed factorial ANOVA. Results indicated a significant Encoding-context × Retrieval-context interaction, $F(2, 66) = 73.62$, $p < .001$, $\eta_p^2 = .527$. The Sex × Age interaction also showed a trend towards significance, $F(2, 66) = 2.56$, $p = .085$, $\eta_p^2 = .072$.

Descriptive statistics for the Encoding-context × Retrieval-context interaction are presented in Table 8.3. Analysis of the simple effects revealed the retrieval-context effect was significant in the Bull mastiff-referent encoding condition ($p < .001$) and in the German shepherd-referent encoding condition ($p < .001$). For Bull mastiff-encoded items, binding recognition was more accurate in the Bull mastiff-referent retrieval condition than in the German shepherd-referent retrieval condition. Likewise, for German shepherd-encoded items, binding recognition was more accurate in the German shepherd-referent retrieval condition than in the Bull mastiff-referent retrieval condition.

The simple effect of encoding-context was significant in the Bull mastiff-referent retrieval condition ($p < .001$) and in the German shepherd-referent retrieval

condition ($p < .001$). In the Bull mastiff-referent retrieval condition, binding recognition was more accurate for Bull mastiff-encoded items than for German shepherd-encoded items. Similarly, in the German shepherd-referent retrieval condition, binding recognition was more accurate for German shepherd-encoded items than for Bull mastiff-encoded items. Thus, binding recognition was more accurate when the retrieval-context matched the encoding-context.

Table 8.3

Mean Binding Recognition Accuracy according to Encoding-Context and Retrieval-Context in Experiment 5 (N = 72)

	Encoding-Context	
Retrieval-Context	Bull mastiff	German shepherd
Bull mastiff	.83 (.02)	.37 (.04)
German shepherd	.40 (.04)	.79 (.03)

Note. Standard errors are in parentheses.

Descriptive statistics for the Sex × Age interaction are presented in Table 8.4. Analysis of the simple effects revealed the effect of sex was significant for 4-year-olds ($p = .019$), but not 5-year-olds ($p = .740$) or 6-year-olds ($p = .690$). For the 4-year-olds, girls' binding recognition was more accurate than boys'. The simple effect of age was not significant for girls, $F(2, 66) = 2.16$, $p = .124$, $\eta_p^2 = .061$, or for boys, $F(2, 66) = 1.29$, $p = .281$, $\eta_p^2 = .038$.

As expected, the main effect of encoding-context was not significant, $F(1, 66) = 2.06$, $p = .156$, $\eta_p^2 = .030$. The Sign test supported this finding in that of the 72 children, the percentage who demonstrated higher accuracy for Bull mastiff-encoded items (45.83%) was not significantly different to the percentage who demonstrated higher

accuracy for German shepherd-encoded items (38.89%), $Z = -0.51$, $p = .609$. The main effects of sex, $F(1, 66) = 0.93$, $p = .339$, $\eta_p^2 = .014$, age, $F(2, 66) = 0.90$, $p = .413$, $\eta_p^2 = .026$, and retrieval-context, $F(1, 66) = 0.05$, $p = .827$, $\eta_p^2 = .001$, were not significant. Likewise, all other two-, three-, and four-way interactions were not significant, largest $F(2, 66) = 2.03$, $p = .139$, $\eta_p^2 = .058$.

Table 8.4

Mean Binding Recognition Accuracy according to Sex and Age Group in Experiment 5 (N = 72)

	Sex	
Age group	Girls	Boys
4-years	.67 (.04)	.54 (.04)
5-years	.56 (.04)	.58 (.04)
6-years	.60 (.04)	.63 (.04)

Note. Standard errors are in parentheses.

Supplementary Analyses

As in Experiment 4, supplementary *t*-tests and Sign tests were conducted to examine the effect of encoding-context on binding recognition for girls and boys at each age. Consistent with Experiment 4, retrieval-context was defined in two ways: (a) Bull mastiff versus German shepherd, and (b) same as encoding versus different from encoding.

Effect of encoding-context in the Bull mastiff and German shepherd retrieval conditions. Results of the *t*-tests and corresponding descriptive statistics are presented in Table 8.5. In the Bull mastiff-retrieval condition, the encoding-context effect was significant for 5- and 6-year-old girls, and boys (4-, 5-, and 6-years), such

that binding recognition was more accurate for Bull mastiff-encoded items than German shepherd-encoded items. Results of the Sign tests for each subgroup are presented in Table 8.6, and were mostly consistent, in that the percentage of children who showed higher accuracy for Bull mastiff-encoded items than German shepherd-encoded items was significantly greater for 5- and 6-year-old girls, and 4- and 6-year-old boys. In the German shepherd-retrieval condition, the encoding-context effect was significant for 5-, and 6-year-old girls, and 6-year-old boys, such that binding recognition was more accurate for German shepherd-encoded items than Bull mastiff-encoded items. There was a trend towards a significant effect for 4-year-old girls and boys, whereby accuracy was higher for German shepherd-encoded items than Bull mastiff-encoded items. The Sign tests showed the difference was significant for 5-year-old girls only, in that the percentage of children who showed higher accuracy for German shepherd-encoded items was greater than the percentage who showed higher accuracy for Bull mastiff-encoded items. Thus, for most subgroups in the Bull mastiff- retrieval condition, and several subgroups in the German shepherd-retrieval condition, binding recognition was more accurate when the retrieval-context matched the encoding-context.

Effect of encoding-context in the same and different retrieval conditions. Results of the *t*-tests and corresponding descriptive statistics are presented in Table 8.7. The encoding-context effect was not significant in either retrieval condition for any subgroup. Results of the Sign tests for each sex and age group are presented in Table 8.8, and also showed that the difference between the percentages of children who showed higher accuracy in either encoding-context condition was not significantly different in either retrieval condition for any subgroup. Thus, irrespective of whether retrieval-context was the same as or different from encoding, binding recognition did vary as a function of encoding-context.

Table 8.5

Effect of Encoding-Context on Mean Binding Recognition Accuracy for each Subgroup according to Retrieval-Context in Experiment 5 (N = 72)

	Encoding-Context				
Retrieval-Context	Bull mastiff	German shepherd	*t*	*d*[a]	*p*
		Girls			
4-years					
Bull mastiff	.78 (.05)	.58 (.07)	1.80	0.89	.100
German shepherd	.54 (.08)	.76 (.05)	-2.00	-0.95	.071
5-years					
Bull mastiff	.89 (.05)	.21 (.09)	5.09	2.74	<.001
German shepherd	.26 (.10)	.88 (.03)	-5.50	-2.40	<.001
6-years					
Bull mastiff	.88 (.06)	.33 (.09)	4.39	2.19	.001
German shepherd	.35 (.12)	.86 (.04)	-3.53	-1.65	.005
		Boys			
4-years					
Bull mastiff	.78 (.05)	.32 (.09)	3.94	1.87	.002
German shepherd	.36 (.10)	.71 (.09)	-1.99	-1.09	.072
5-years					
Bull mastiff	.79 (.07)	.39 (.10)	2.79	1.35	.018
German shepherd	.42 (.12)	.71 (.09)	-1.48	-0.78	.167
6-years					
Bull mastiff	.86 (.04)	.36 (.10)	4.78	1.93	.001
German shepherd	.44 (.09)	.83 (.05)	-3.24	-1.54	.008

Note. Standard errors are in parentheses. [a]Effect size estimate is Cohen's *d*.

Table 8.6

Encoding-Context Sign Tests Comparing the Percentages of Children by Sex and Age Group who had Higher Accuracy for either Encoding-Context Condition in each Retrieval-Context Condition in Experiment 5 (N = 72)

	Higher accuracy		
Retrieval-Context	Bull mastiff	German shepherd	*p*
	Girls		
4-years			
Bull mastiff	66.67	25.00	.227
German shepherd	16.67	58.33	.180
5-years			
Bull mastiff	83.33	8.33	.012
German shepherd	8.33	83.33	.012
6-years			
Bull mastiff	91.67	8.33	.006
German shepherd	25.00	75.00	.146
	Boys		
4-years			
Bull mastiff	83.33	16.67	.039
German shepherd	25.00	75.00	.146
5-years			
Bull mastiff	66.67	16.67	.109
German shepherd	41.67	58.33	.774
6-years			
Bull mastiff	83.33	8.33	.012
German shepherd	16.67	66.67	.109

Table 8.7

Effect of Encoding-Context on Mean Binding Recognition Accuracy for each Subgroup according to Retrieval-Context in Experiment 5 (N = 72)

	Encoding-Context				
Retrieval-Context	Bull mastiff	German shepherd	*t*	*d*[c]	*p*
		Girls			
Same as encoding[a]					
4-years	.78 (.05)	.76 (.05)	0.29	0.08	.777
5-years	.89 (.05)	.88 (.03)	0.32	0.10	.754
6-years	.88 (.05)	.86 (.04)	0.22	0.08	.830
Different from encoding[b]					
4-years	.54 (.08)	.58 (.07)	-0.46	-0.15	.651
5-years	.26 (.10)	.21 (.09)	1.08	0.17	.305
6-years	.35 (.12)	.33 (.08)	0.13	0.04	.900
		Boys			
Same as encoding[a]					
4-years	.78 (.05)	.71 (.08)	1.05	0.29	.318
5-years	.79 (.07)	.71 (.09)	1.39	0.30	.754
6-years	.86 (.04)	.83 (.05)	0.69	0.19	.830
Different from encoding[b]					
4-years	.36 (.10)	.32 (.09)	0.41	0.13	.687
5-years	.42 (.12)	.39 (.10)	0.46	0.07	.305
6-years	.44 (.09)	.36 (.10)	1.39	0.25	.900

Note. Standard errors are in parentheses. [a]Intact item-source combinations (*old-Bull mastiff* versus *old-German shepherd*). [b]Recombined item-source combinations (*old-Bull mastiff→ German shepherd* versus *old- German shepherd→ Bull mastiff*). [c]Effect size estimate is Cohen's *d*.

Table 8.8

Encoding-Context Sign Tests Comparing the Percentages of Children by Sex and Age Group who had Higher Accuracy for either Encoding-Context Condition in each Retrieval-Context Condition in Experiment 5 (N = 72)

	Higher Accuracy		
Retrieval-Context	Bull mastiff	German shepherd	*p*
	Girls		
Same as encoding[a]			
4-years	33.33	33.33	1.000
5-years	33.33	25.00	.688
6-years	41.67	41.67	1.000
Different from encoding[b]			
4-years	33.33	50.00	.754
5-years	41.67	25.00	.727
6-years	50.00	25.00	.508
	Boys		
Same as encoding[a]			
4-years	50.00	25.00	.508
5-years	50.00	25.00	.508
6-years	25.00	16.67	1.000
Different from encoding[b]			
4-years	33.33	25.00	1.000
5-years	33.33	16.67	.688
6-years	50.00	25.00	.508

Note. [a]Intact item-source combinations (*old-Bull mastiff* versus *old-German shepherd*). [b]Recombined item-source combinations (*old-Bull mastiff→ German shepherd* versus *old-German shepherd→ Bull mastiff*).

Discussion of Experiment 5 Findings

Experiment 5 examined the impact of an encoding-context (Bull mastiff versus German shepherd), on 4-, 5-, and 6-year-old children's binding recognition, that was different to Experiment 4 (self versus other). The primary purpose of this was to evaluate whether the self has special significance in the development of binding recognition.

As in Experiment 4, children's performance on the procedural control trials indicated they understood the requirements of the task, and that they did not have a general reluctance to give "no" responses. Accordingly, this allowed for their performance on the item-source combinations designed to evaluate the impact of encoding-context on binding recognition to be interpreted in a straight forward manner.

There was some indication of a sex difference, such that girls' binding recognition was more accurate than boys', but only for the 4-year-olds. This suggests that girls' capacity to make the necessary links between isolated features might develop a little earlier than boys', prior to levelling out by around age 5.

Children's binding recognition did not show developmental improvement. Four-year-olds' performance was comparable to that of both 5-year-olds' and 6-year-olds'. This finding is inconsistent with Experiment 4, in which there was some evidence that children's ability to reject the new recombined item-source pairs improved between 4 and 6 years of age. In the present experiment, no such improvement was evident. Rather, it was apparent that all age groups had difficultly rejecting the recombined item-source pairs. The present finding is also inconsistent with Lloyd et al. (2009) who reported outcomes similar to Experiment 4, in that whilst 4- and 6-year-olds' recognition of old object-background combinations was comparable, 6-year-olds were better than 4-year-olds at rejecting recombinations of old objects and

backgrounds. The absence of developmental improvement in Experiment 5, is likely due to the procedure employed (i.e., use of two arbitrary dog breeds) versus other procedures. In particular, it might have been that the contextual cues present at encoding were insufficiently meaningful or distinctive to aid children's retrieval of the item-source bindings.

The stimuli used to operationalise encoding-context (Bull mastiff versus German shepherd) in this experiment were arbitrarily selected, and were therefore not expected to have a differential effect on binding recognition. Results supported this as children's performance did not vary as a function of encoding-context, either for the entire sample or for any subgroup. The small overall encoding-context effect size ($\eta_p^2 = .030$) also suggests this was a genuine null effect, rather than the result of insufficient power. The Sign tests further supported the null effect, in that the difference between the percentages of children who demonstrated higher accuracy in either encoding-context condition was not significant for the entire sample or for any subgroup.

The absence of an effect of encoding-context in the present experiment contrasts with Experiment 4, in which self-referent encoding produced superior binding recognition compared to other-referent encoding. This is important as it provides support for the idea that self-referential processing produces more robust item-source bindings, which in turn likely aid source memory. More generally, it fits well with the idea that the self-concept is fundamental in the early development of episodic memory.

Finally, as in Experiment 4, children's binding recognition was more accurate when the retrieval-context matched the encoding-context (although in Exp. 4 the advantage was mostly due to girls). Overall, children found it easier to recognise old intact item-source pairs than to reject new recombined item-source pairs. Glisky et al. (2001) reported a similar outcome in younger and older adults, whereby item

recognition was more accurate when items were re-presented at test paired with the same source as at encoding compared to when items were paired with a different source at test than at encoding (Exps. 1 and 4). The present finding therefore extends the age boundaries to which this interaction effect applies, to include young children. One interpretation of this effect, is that in those instances the binding between item and source is encoded, re-presentation of the same item-source pair at test serves to reinstate these bindings (M. K. Johnson & Chalfonte, 1994), thereby facilitating recognition performance. In contrast, when item-source pairs are presented in a new recombined way at test, more effortful processing is necessary, thereby making rejection of the recombinations more difficult.

The findings from Experiment 5 can also be interpreted in terms of children's tendency to base their decisions on familiarity of the individual components (i.e., items and sources), as opposed to familiarity of the item-source bindings. In this experiment, four item-source combination types involved at least one novel component. Results showed that all subgroups' performance on these types was above chance level. This suggests that the presence of a novel component leads children to easily reject these combinations because something is unfamiliar. As previously noted, children's success on these item-source combination types also indicates they are willing to give "no" responses.

The remaining four item-source combination types involved no novel components. If children respond mainly on the basis of familiarity of the individual components (i.e., respond "yes" when the item-source combination comprises old components), as opposed to recognition of the item-source bindings, then a distinct pattern of findings would be expected on these types. For the old intact item-source pairs, the individual item and source components, as well as the bindings are familiar.

A "yes" response to these item-source combination types is correct, therefore children's performance would be expected to be above chance. For the new recombined item-source pairs, the individual items and sources are familiar, however, the item-source bindings are novel. A "yes" response to these types is incorrect, thus children's performance would be expected to not exceed chance level. At the group level, results reflected this pattern. Children's binding recognition accuracy was above chance for the old intact item-source pairs, but was at chance level or below chance level for the new recombined item-source pairs. These outcomes therefore appear to reflect a general reliance on familiarity of the items and sources, rather than recognition of the item-source bindings.

If it is the case that young children have a binding deficit and base their responses primarily on familiarity of the isolated components, then this should also be revealed as a significant negative correlation between binding recognition accuracy scores for intact item-source pairs and recombined item-source pairs. This idea was subsequently examined. There was a significant negative correlation between the two scores for the entire sample (r = -.54, p < .001), as well as for 5-year-old girls (r = -.76, p = .004), and 4- (r = -.72, p = .009) and 5-year-old (r = -.62, p = .031) boys. The correlations were also examined for Experiment 4 data. Binding accuracy scores for intact and recombined item-source pairs were significantly negatively correlated for the entire sample (r = -.36, p = .002) and for 4-year-old girls (r = -.59, p = .046). Although these outcomes are suggestive of an overall binding deficit in Experiments 4 and 5, it can be seen that the overall effect size was smaller in Experiment 4 than Experiment 5. In addition, whereas in Experiment 4 the relation was significant for one subgroup only, it was significant for three subgroups in Experiment 5. A possible interpretation of these differences, is that when binding recognition involves self-referent and other-

referent encoding (as in Exp. 4), children's responses are less dependent on familiarity of the individual components and more dependent on recognition of the item-source bindings relative to when binding recognition involves an alternative encoding-context such as that used in Experiment 5.

Binding Recognition Accuracy between Experiments 4 and 5

In order to determine whether binding recognition varied depending on the manner in which source was operationalised, overall performance in the intact and recombination item-source conditions was compared between Experiments 4 and 5. Mean binding recognition accuracy scores were analysed with a 2 (experiment: 4, 5) × 2 (sex: girl, boy) × 3 (age: 4-, 5-, and 6-years) × 2 (encoding-context: 1 [self/ Bull mastiff], 2 [other/ German shepherd]) × 2 (retrieval-context: 1 [self/ Bull mastiff], 2 [other/ German shepherd]) mixed factorial ANOVA. Experiment, sex, and age were between-subjects variables; encoding-context and retrieval-context were within-subjects variables. Based on the results of Experiments 4 and 5, a significant main effect of experiment was expected, along with a significant Encoding-context × Retrieval-context interaction. It was also of interest whether the three-way Experiment × Encoding-context × Retrieval-context interaction would be significant; and further, whether sex and/or age would interact with any of the described effects.

As expected, the main effect of experiment was significant, $F(1, 132) = 40.18$, $p < .001$, $\eta_p^2 = .223$, such that binding recognition was more accurate in Experiment 4 ($M = .73$, $SE = .02$) than in Experiment 5 ($M = .60$, $SE = .02$). The Encoding-context × Retrieval-context interaction was also significant, indicating higher accuracy when the retrieval-context matched the encoding-context, $F(1, 132) = 89.20$, $p < .001$, $\eta_p^2 = .403$.

The above effects were modified by three- and four-way interactions. The Experiment × Encoding-context × Retrieval-context interaction was significant, $F(1,$

132) = 13.53, $p < .001$, $\eta_p^2 = .093$. In addition, the Sex × Encoding-context × Retrieval-context interaction, $F(1, 132) = 3.13$, $p = .079$, $\eta_p^2 = .023$, and the Experiment × Age × Encoding-context × Retrieval-context interaction, $F(1, 132) = 2.56$, $p = .081$, $\eta_p^2 = .037$, both showed a trend towards significance.

Experiment × Age × Encoding-Context × Retrieval-Context Interaction

The four-way interaction was partitioned by experiment and age. Descriptive statistics are presented in Table 8.7, whereby the self versus other encoding and retrieval contexts relate to Experiment 4, and the Bull mastiff versus German shepherd encoding and retrieval contexts relate to Experiment 5.

In Experiment 4, the Encoding-context × Retrieval-context interaction was significant for 4-year-olds, $F(1, 22) = 7.86$, $p = .010$, $\eta_p^2 = .263$, and 5-year-olds, $F(1, 22) = 12.84$, $p = .002$, $\eta_p^2 = .369$. It was only marginally significant for 6-year-olds, $F(1, 22) = 4.05$, $p = .057$, $\eta_p^2 = .155$. In Experiment 5, the Encoding-context × Retrieval-context interaction was significant for 4-year-olds, $F(1, 22) = 14.89$, $p = .001$, $\eta_p^2 = .404$, 5-year-olds, $F(1, 22) = 23.85$, $p < .001$, $\eta_p^2 = .520$, and 6-year-olds, $F(1, 22) = 39.81$, $p < .001$, $\eta_p^2 = .644$. With the exception of 6-year-olds in Experiment 4, the general pattern was such that for all age groups across Experiments 4 and 5, binding recognition was more accurate for old intact item-source pairs than for new recombined item-source pairs.

Table 8.9

Mean Binding Recognition Accuracy according Encoding-Context, Retrieval-Context, and Age Group in Experiments 4 and 5 (N = 144)

	Encoding-Context[a]	
Retrieval-Context[b]	Self	Other
Self		
4-years	.91 (.05)	.56 (.07)
5-years	.87 (.03)	.55 (.05)
6-years	.90 (.04)	.68 (.06)
Other		
4-years	.59 (.08)	.79 (.05)
5-years	.75 (.04)	.74 (.05)
6-years	.69 (.06)	.75 (.05)
	Bull mastiff	German shepherd
Bull mastiff		
4-years	.78 (.04)	.45 (.06)
5-years	.84 (.04)	.30 (.07)
6-years	.87 (.03)	.35 (.07)
German shepherd		
4-years	.45 (.06)	.74 (.05)
5-years	.34 (.08)	.79 (.05)
6-years	.40 (.08)	.85 (.03)

Note. Standard errors are in parentheses. [a]The encoding-contexts in Experiments 4 and 5 were self versus other and Bull mastiff versus German shepherd, respectively. [b]The retrieval-contexts in Experiments 4 and 5 were self versus other and Bull mastiff versus German shepherd, respectively.

Sex × Encoding-Context × Retrieval-Context Interaction

Descriptive statistics for the three-way interaction are presented in Table 8.8. Partitioned by sex, the Encoding-context (1 [self/ Bull mastiff], 2 [other/ German shepherd]) × Retrieval-context (1 [self/ Bull mastiff], 2 [other/ German shepherd]) interaction was significant for girls, $F(1, 66) = 77.82$, $p < .001$, $\eta_p^2 = .541$, and for boys, $F(1, 66) = 24.71$, $p < .001$, $\eta_p^2 = .272$. Results showed binding recognition was more accurate when the retrieval-context matched the encoding-context. However, this general pattern was stronger for girls than it was for boys across Experiments 4 and 5, thereby indicating this was the source of the three-way interaction.

Table 8.10

Mean Binding Recognition Accuracy according to Encoding-Context, Retrieval-Context, and Sex in Experiments 4 and 5 (N = 144)

	Encoding-Context	
Retrieval-Context	1	2
Girls		
1	.89 (.02)	.48 (.04)
2	.50 (.04)	.82 (.02)
Boys		
1	.83 (.03)	.49 (.04)
2	.57 (.04)	.73 (.03)

Note. Standard errors are in parentheses. 1 = self (Exp. 4)/ Bull mastiff (Exp. 5). 2 = other (Exp. 4)/ German shepherd (Exp. 5).

Children's Performance in Relation to Chance

Examination of children's performance in relation to chance further highlights the differential impact of the encoding-context manipulation between Experiments 4 (see Table 7.2, p. 146) and 5 (see Table 8.2, p. 169). In the old intact item-source combination conditions, binding recognition was above chance level for all subgroups in both experiments. In contrast, for the new item-source recombination conditions, whilst several of the subgroups performed above chance level in Experiment 4, none of the subgroups performed above chance level in the corresponding conditions in Experiment 5. Specifically, performance was significantly below chance for some subgroups in Experiment 5 (5-year-old girls, 4- and 5-year-old boys), thereby indicating that rejection of the new recombined item-source pairs was particularly difficult when the context did not involve self-referent and other-referent encoding.

Comparison of SES between Experiments 4 and 5

In order to assess whether SES varied between Experiments 4 and 5 and/or across age groups, mean SES scores were subject to a 2 (experiment: 4, 5) × 3 (age: 4-, 5-, and 6-years) factorial ANOVA. The main effects of age, $F(2, 127) = 1.67$, $p = .192$, $\eta_p^2 = .026$, and experiment, $F(1, 127) = 0.23$, $p = .634$, $\eta_p^2 = .002$, were not significant. Likewise, the Age × Experiment interaction was not significant, $F(2, 127) = 1.39$, $p = .254$, $\eta_p^2 = .021$.

Discussion of Binding Recognition Accuracy between Experiments 4 and 5

A principal aim of Experiment 5 was to evaluate children's binding recognition using a task that does not involve self-referent encoding. As expected, binding recognition was more accurate in Experiment 4 than in Experiment 5. This provides further evidence that the cues generated from self-referent and other-referent encoding can be better used to retrieve the bound information. It would seem that when

information is encoded in relation to self and other, it is processed in such a way that produces more robust representations of the bound information compared to when information is encoded in relation to an alternative context.

Analysis of the combined experimental data also confirmed that children's binding recognition was more accurate when the retrieval-context matched the encoding-context. This pattern was generally consistent for girls and boys at each age level under both types of encoding context manipulation (i.e., self versus other and Bull mastiff versus German shepherd). However, based on children's performance in relation to chance, it is apparent that children found it considerably more difficult to reject the new recombined item-source pairs when they did not involve self-referent and other-referent encoding. These outcomes suggest two things. First, children clearly found it easier to recognise old intact item-source pairs than to reject new recombined item-source pairs. Second, children found it easier to correctly reject new item-source combinations when those combinations involved self-referent and other-referent encoding, as opposed to when they involved an alternative encoding-context such as two dog breeds. Although there was a trend towards 5-year-olds having significantly higher SES than 6-year-olds in Experiment 4, when SES data from Experiments 4 and 5 were combined in the same analysis, SES was comparable between the age groups and experiments. Thus, it is unlikely that the differences between the experiments were due to variations in SES.

General Discussion

Experiments 4 and 5 examined the impact of two different types of encoding-context on binding recognition in 4-, 5-, and 6-year-old children. In Experiment 4, encoding-context was operationalised as self versus other, whereas in Experiment 5, it was operationalised as Bull mastiff versus German shepherd. The purpose of this was

to evaluate the extent to which self-referent encoding facilitates the recognition of old item-source bindings, and the rejection of new item-source combinations.

In both experiments, children demonstrated a sound understanding of what was required, and there was no evidence they were biased in their responding. This meant their performance on the item-source combinations designed to evaluate the impact of encoding-context on binding recognition could be interpreted in a straight forward manner.

In Experiments 1, 2, and 3, SREs in source memory were observed. If the proposal that intact binding processes are involved in accurate source discrimination (Chalfonte & Johnson, 1996; M. K. Johnson et al., 1993) is correct, then self-reference advantages should also be observed in binding recognition. Results supported this, as self-referent encoding produced superior binding recognition than other-referent encoding did (Exp. 4). Consistent with the source memory experiments, the self-reference advantage observed in binding recognition was evident at 4 years of age.

That self-referent and other-referent encoding (Exp. 4) produced more accurate binding recognition than Bull mastiff-referent and German shepherd-referent encoding (Exp. 5) further supports the validity of SRE observed in Experiment 4. It also supports the idea that the self versus other distinction emerges earlier in development than alternative distinctions such as that used in Experiment 5. Based on the current outcomes, it appears that bindings for the item-source representations produced from self-referent and other-referent encoding are more elaborated and more robust than those produced from the alternative encoding context.

This conclusion is further supported by the analysis of children's performance in relation to chance. Whilst in both Experiments 4 and 5, it was evident that children found it more difficult to reject the new recombined item-source pairs than to recognise

the old intact item-source pairs, this difficulty was clearly greater when the item-source combinations did not involve self-referent and other-referent encoding (Exp. 5) than when they did (Exp. 4). Furthermore, whilst there was evidence that children's ability to reject the new item-source combinations improved between 4 and 6 years of age for the self versus other distinction, there was no such evidence of improvement for the Bull mastiff versus German shepherd distinction. Previously, Foley et al. (1983) suggested that the self versus other distinction is reasonably well developed in school-aged children. However, the present results suggest that development of this distinction is such, that by around age 4 it can be utilised to create and retrieve the bindings between item and source information.

The developmental improvement in children's ability to reject new recombined item-source pairs for self versus other encoding-context described above is consistent with Lloyd et al. (2009). These authors also found that 6-year-olds were better than 4-year-olds at rejecting recombined object-background pairs. More generally, the present finding is also consistent with Sluzenski et al. (2006) who reported improvement in children's rejection of recombined animal-background pairs between 4 and 6 years of age. That no such improvement was observed for the Bull mastiff versus German shepherd distinction (Exp. 5) probably reflects the manner in which context was operationalised. Although children were able to distinguish between the dogs when they were presented alone, the cues present at encoding might have been insufficiently distinct to promote the construction of robust bindings between the items and sources.

In Experiments 4 and 5, children's binding recognition was more accurate when the retrieval-context matched the encoding-context. This is consistent with Glisky et al. (2001) who found that adults' item recognition was more accurate when the items were re-presented at test paired with the same source as at study relative to when items were

re-presented at test with a different source than at study (Exps. 1 and 4). Presumably, if the item-source bindings are established at encoding, then re-presentation of the same item-source pairs at test serves to reinstate these bindings (M. K. Johnson & Chalfonte, 1994). However, when item-source pairs are presented in a recombined way, it is likely that more effortful processing is involved, thereby making it more difficult to successfully reject these. Alternatively, if item-source bindings are not encoded in a robust manner, children might default to responding based on familiarity of the individual item and/or source components.

CHAPTER 9. CONCLUSIONS

The present research examined the development of the SRE in item and source memory during the period from 4 to 6 years. The principal aim was to better understand the basis of young children's source memory difficulties. Three broad research questions were considered. First, to what extent do methodological factors contribute to Sui and Zhu's (2005) observed findings? Second, do young children's source memory difficulties stem from a need to construct and retrieve item-source bindings? Third, does the self versus other distinction have special status in the development of episodic memory?

Two methodologies were employed in an attempt to answer these questions. In Experiments 1, 2, and 3, modified versions of Sui and Zhu's (2005) SRE procedure were used to assess children's item and source memory in separate and successive tests. In Experiments 4 and 5, a binding recognition procedure was used to assess children's item and source memory simultaneously. Both procedures incorporated a self versus other manipulation of source and were intended to ensure valid tests of the hypotheses using child appropriate procedures. Each research question is discussed in turn, before considering some implications of the present findings.

Do Children's Source Memory Difficulties Reflect Methodological Factors?

Evaluation of Modified Source Memory Procedure

Compared to Sui and Zhu's (2005) procedure, the present research incorporated three main modifications: First, more items were presented during the encoding phase (Exps. 1, 2, and 3); second, an old-new recognition test (as opposed to free recall) of the items was used in Experiment 2; and third, source recognition was based on all items (as opposed to correctly recalled or recognised items only) in Experiment 3.

There were two main differences in outcomes between the current research and Sui and Zhu's study (2005). First, self-referent encoding did not produce better item memory than other-referent encoding in the present research, whereas in Sui and Zhu's study it did. Second, self-referent encoding produced more accurate source recognition than other-referent encoding in the present research, whereas in Sui and Zhu's study it did not. An apparent difference of the current procedure therefore, is that it enables the detection of SREs in source memory in young children. However, the absence of SREs in item memory suggests some modifications impacted item memory in inadvertent ways.

Based on Symons and Johnson's (1997) meta-analysis, it was suggested earlier that the longer stimulus presentation time at encoding might have enabled children to better encode items in the other-referent condition, which in the shorter-term, could have reduced the magnitude of the SRE on item memory. Conversely, the longer duration between the encoding phase and source memory test phase might have enabled the SRE in source memory to be observed. In both instances, it appears that self-referent encoding is more likely to produce superior item and source memory when the task demands are greater. This highlights the role of other factors in moderating the SRE, and the conditions under which self-referent encoding is most likely to enhance performance on an episodic memory task. Future research might benefit from taking such factors into consideration. For example, manipulation of duration of stimulus presentation at encoding, as well as the interval between the encoding and test phases, would assist in better understanding the extent to which these factors impact the SRE in both item and source memory.

Testing source memory for retrieved items only versus all items. The present research assessed the appropriateness of testing source memory for correctly

remembered and reported items only. Results provided some evidence that the current convention might not be justified. Relative to source recognition based on correctly recognised items only, source recognition based on all items (presented at encoding) selectively benefited source accuracy for other-referent items. This outcome is to some extent, consistent with adult research which has shown that memory for source information is possible in the absence of item recall or recognition (Cook et al., 2006; Kurilla & Westerman, 2010; Starns et al., 2008). Two interpretations were put forward for the present outcome.

The first interpretation suggests that self-referent encoding automatically engages more processing which leads to more retrieval cues, therefore no further advantage is gained when non-retrieved items are re-presented at test. In contrast, memory for information encoded in relation to other is less automatic, therefore re-presentation of the original item benefits source retrieval to a greater extent for other-encoded items than for self-encoded items.

The second interpretation suggests that children engage a decision process, whereby they select *other* whenever the item-source representation is weak. Children reason that if they had pointed to the item, then their memory of it would be stronger. Such reasoning would increase the accuracy of source judgements for other-encoded items, but not self-encoded items when non-retrieved items are re-presented at test. However, based on previous analyses of children's source errors (Foley et al., 1983; Roberts, 2000), it is questionable whether young children can engage a metamemory rule such as this. In either case, a problem with assessing source memory for all items relative to recognised items, using the procedure in its current form, is that the basis for higher accuracy of source judgments for other-referent items is unclear. Clarification of this matter is therefore still required.

On a related issue, it was expected that children's source recognition accuracy would be higher when more items were available (Exps. 2 and 3) relative to when fewer items were available (Exp. 1) for the source memory test. More items were available in Experiments 2 and 3 because source recognition was based on correctly recognised items and all items presented at encoding, respectively, whereas in Experiment 1, source recognition was based on correctly recalled items only. If the item-source bindings are established at encoding, then re-presentation of the items at test should serve to re-instate the bindings (M. K. Johnson & Chalfonte, 1994). However, the present findings did not entirely support this as source recognition was equivalent for correctly recognised items (Exp. 2) versus correctly recalled items (Exp. 1), and for all items (Exp. 3) versus correctly recalled items (Exp. 1). It was suggested that durational differences between the experimental sessions potentially led to source degradation (which was probably least in Exp. 1 and greatest in Exp. 2); thereby counteracting any benefits that additional items might have had on source recognition.

The difficulty in determining whether source degradation was the basis for the null effect of number of items on source recognition highlights the potential problem of assessing item and source memory in separate and successive tests. To some extent, the binding procedure used in Experiments 4 and 5 controls for this, as item memory and source memory are assessed simultaneously.

Evaluation of Binding Recognition Procedure

The binding procedure used in Experiment 4 is new as no previous research has examined the SRE in binding recognition. A particular strength of the procedure is that different item-source combination types can be incorporated into the task. This enables the assessment of children's understanding of the task requirements as well as the detection of response bias. Importantly, because responses to item-source combination

types involving an old component can be made based on familiarity, the task can distinguish between responding based on binding recognition and responding based on familiarity of the items and sources, independent of the bindings. As noted above, an additional strength of the procedure is that item memory and source memory are tested simultaneously. This has the potential to counteract the impact that source degradation might have on source recognition when it is tested after memory for the items. The findings obtained through the binding recognition task provide additional information about the development of binding processes and their role in source memory in young children.

For example, in Experiment 4, a reduction in false alarms for new recombined item-source pairs from 4 to 6 years was observed. This is consistent with previous research (Lloyd et al., 2009) and indicates that developmental improvement in binding processes occurs during this period. However, given the present binding recognition procedure, it is not possible to determine whether this development was due to improvements in encoding and/or retrieval processes. In contrast, Lloyd et al. (2009) manipulated the duration between their study and test phases, and were able to conclude that 4-year-olds' poorer rejection of new recombined object-background pairs relative to 6-year-olds', was partly due to a difficulty with retrieval. Thus, they demonstrated that younger children are able to construct the bindings between individual components, but that after a longer delay their retrieval of these bindings is compromised. Future research could incorporate a similar manipulation into the current paradigm. This would provide important information about the relative contributions of encoding and retrieval processes in the early development of binding processes in childhood, and the role of the self in this development.

Summary. As to whether methodological factors contribute to children's source memory difficulties, the present findings suggest that to some degree they do. Both methodologies were intended to ensure valid tests of the research questions using child appropriate procedures. Despite some limitations, by and large, this was achieved as results suggest that the procedures are useful for assessing binding in memory processes and source memory performance in children aged 4 to 6 years. That the tasks were effective in detecting SREs in both binding and source recognition further supports their utility for use with young children.

Do Young Children's Source Memory Difficulties stem from a need to construct Item-Source Bindings?

M. K. Johnson and colleagues (Chalfonte & Johnson, 1996; M. K. Johnson et al., 1993) have proposed that intact binding processes are necessary for accurate source discrimination because these processes potentially facilitate the links between the isolated informational components. This brings us to the question of whether young children's source memory difficulties stem from a need to construct and retrieve item-source bindings. If the proposal that intact binding processes are necessary for accurate source discrimination is correct, then in the present research, a particular pattern of outcomes would be expected between the binding in memory experiment, in which the operationalisation of encoding-context was self versus other (Exp. 4), and the source memory experiments (Exps. 1, 2, and 3) in which the operationalisation of encoding-context was identical. Specifically, it should be that the effect of encoding-context observed in the binding recognition experiment (Exp. 4) should also be observed in the source memory experiments (Exps. 1, 2, and 3), in terms of the direction of the effect and the age at which the effect emerges.

Findings reflected these expectations, in that the SRE observed in binding recognition in Experiment 4 was consistent with that observed in source recognition in Experiments 1, 2, and 3. Furthermore, the absence of a significant Encoding-context × Age interaction in Experiments 1 through 4 suggests that the SRE is present by 4 years of age, and does not vary significantly between 4 and 6 years of age. That children's binding recognition was more accurate when it involved self-referent and other-referent encoding (Exp. 4) than when it did not (Exp. 5) also indicates that under certain conditions, children have considerable difficulty constructing the item-source bindings that could potentially aid in subsequent source discrimination. It therefore seems reasonable to conclude that an inability to successfully construct and/or retrieve item-source bindings does, to some extent, contribute to young children's source memory difficulties.

Does the Self versus Other Distinction hold Special Status in Episodic Memory?

Turning now to the final research question about whether the self versus other distinction has special status in the early development of episodic memory. To answer this, it is informative to reconsider some main findings.

For source recognition in Experiments 1, 2, and 3, children's overall level of performance was sound in that each age group performed above chance. There was no evidence of developmental improvement as 4-year-olds' overall source recognition was comparable to that of 5- and 6-year-olds'. Also in Experiments 1, 2, and 3, self-referent encoding produced superior source recognition than other-referent encoding did. As mentioned above, the nonsignificant Encoding-context × Age interaction suggests that the SRE did not vary as a function of age.

For binding recognition, children's level of performance was such that for the old intact item-source combination conditions, accuracy was above chance for all subgroups in Experiments 4 and 5. However, for the new item-source recombination conditions, whilst several subgroups performed above chance when binding recognition involved self-referent and other-referent encoding (Exp. 4), performance was either at chance or significantly below chance for all subgroups when it involved Bull mastiff-referent and German shepherd-referent encoding (Exp. 5). For overall binding recognition, accuracy was higher when it involved self-referent and other-referent encoding (Exp. 4) than when it involved an alternative encoding context (Exp. 5). As mentioned, this was further evidenced in that children's general difficulty in rejecting new recombined item-source pairs was greater when the combinations did not involve self-referent and other-referent encoding (Exp. 5) than when they did (Exp. 4). A SRE was observed as binding recognition accuracy was higher in the self-referent condition than in the other-referent condition (Exp. 4). Finally, consistent with source recognition in the earlier experiments, encoding-context did not interact significantly with age, indicating that the self-reference advantage did not vary as a function of age.

So what do these outcomes tell us about the self versus other distinction in episodic memory? First, that 4-year-olds performed as well as 5- and 6-year-olds on the source recognition tests indicates that the self versus other distinction is reasonably developed by around age 4, and that children can utilise the contextual cues present at encoding to aid memory for source information. Second, that binding recognition was more accurate when it involved self-referent and other-referent encoding (Exp. 4) than when it did not (Exp. 5), indicates that the bindings for item-source representations produced through self-referent and other-referent encoding are more elaborated and more robust than those produced through alternative encoding contexts such as that

used in Experiment 5. Moreover, that similar SREs were observed in both paradigms supports the validity of the SREs observed in source memory.

Based on these outcomes, it would indeed appear that the self versus other distinction has special status in episodic memory, particularly during early development. Given the SREs observed in both binding and source recognition, it would seem that the self holds added importance. When information is encoded in relation to self, it would appear to facilitate the formation of robust item-source bindings which in turn likely serve to enhance source discrimination.

Implications

From a theoretical perspective, the current research contributes to a better understanding of how episodic memory develops during childhood. Episodic memory involves memory for events that include spatial and temporal information (Squire et al., 1993; Tulving, 1983; Tulving & Markowitsch, 1998; Wheeler et al., 1997). Such memories therefore involve content as well as contextual information. Intact binding processes are thought to enable the facilitation of links between these informational aspects (Chalfonte & Johnson, 1996; M. K. Johnson et al., 1993). In the present experiments, that the SRE observed on the binding recognition task (Exp. 4) was similar to that observed on the source recognition task (Exps. 1, 2, and 3) provides further support for this idea.

Perhaps more importantly, episodic memory necessarily involves the self as rememberer (Tulving, 1983; Tulving & Markowitsch, 1998; Wheeler et al., 1997). The nature of the self's involvement in this type of memory therefore represents an important aspect in understanding its development. Results from Experiments 4 and 5 in particular, have implications for this understanding. First, they provide evidence that the self versus other distinction emerges early in development and that this distinction

facilitates relational links between item and contextual information. Second, they suggest that involvement of self in the form of self-referential encoding, produces more robust bindings which aid source retrieval. The present findings also indicate that even by 4 years of age, the self represents a cognitive structure around which information can be organised to promote episodic memory.

Results from Experiment 5 provide additional insight into the nature of children's episodic memory when information is not encoded in relation to self. That performance in this experiment was not very accurate, suggests children aged between 4 and 6 years have particular difficulty remembering the source of their memories when they do not involve self-referential encoding. Children's poor performance in Experiment 5 relative to Experiment 4 further suggests that responding was based on familiarity of the items and/or sources, as opposed to responding based on recognition of the item-source bindings. This reliance on familiarity likely lead to high accuracy on the intact item-source pairs, but low accuracy on the recombined item-source pairs. From an applied perspective, that young children's source decisions are, under certain conditions, based largely on familiarity, needs to be taken into account in situations where children's memory for events is required. For example, the importance of recognising this aspect of episodic memory development within legal settings, where children serve as eye witnesses, is self evident.

More generally, a clearer understanding of the processes involved in episodic memory has implications for everyday situations including academic and educational settings. For example, students' ability to remember information to which they are exposed is vital if they are to successfully negotiate the school environment. In such settings, the importance of remembering content as well as contextual information is apparent. Understanding that the encoding of contextual information aids retrieval, and

further, that the self versus other distinction holds special status in this area is important, as it can inform the development of strategies that will facilitate children's memory development.

Regarding this, future research could examine the possibility that the self versus other distinction might serve as the basis for other contextual distinctions. Such research could examine whether binding recognition could be improved by employing analogical mapping, whereby the self versus other contextual distinction would serve as the base and an alternative contextual distinction such as that used in Experiment 5 (Bull mastiff versus German shepherd) would serve as the target. Children would be instructed to identify with, or to take the perspective of one of the dogs during the encoding phase (e.g., "Let's pretend that you are Zac [Bull mastiff]" or "Let's pretend that you are Max [German shepherd]"). The control condition would replicate that used in Experiment 5. Outcomes of this type of research would serve to further inform our understanding of the processes involved in source memory. Once such processes are better understood, we will be better placed to design interventions to facilitate episodic memory not only in normally developing children, but also in other populations whose episodic memory is impaired.

Summary of Main Findings

In five experiments, the present research examined the development of the SRE in item memory and source memory in children aged 4-, 5-, and 6-years. The main findings were as follows.

Self-referent encoding did not produce robust SREs in item memory relative to other-referent encoding for any age group. Self-referent encoding did, however, produce more accurate source recognition compared to other-referent encoding. The self-referent advantages observed in source memory were present from 4 years and did

not vary significantly with age, thereby extending the age range to which the SRE in source memory applies.

The absence of a SRE in item memory is inconsistent with Sui and Zhu (2005) as 5-year-olds in their study demonstrated SREs in recall (Exps. 1 and 2). Additionally, the SRE in source recognition is a new finding as children in Sui and Zhu's study did not show a self-reference advantage in source recognition. Potential explanations for these different findings were outlined and likely reflect the modified procedure.

For binding recognition, self-referent and other-referent encoding produced higher overall accuracy than the alternative encoding-context (Bull mastiff-referent and German shepherd-referent encoding) did. Consistent with previous binding in memory research (Kovacs et al., 2005; Lloyd et al., 2009), there was evidence of developmental improvement in binding recognition between 4 and 6 years of age, but only for the self versus other distinction. As with source recognition, self-referent encoding produced more accurate binding recognition than other-referent encoding did. In addition, children found it easier to recognise the old intact item-source pairs than to reject the new recombined item-source pairs.

This last result extends Glisky et al.'s (2001; Exps 1 and 4) finding with younger and older adults to include young children. It suggests that in those instances children are able to construct bindings between the items and sources at encoding, re-presentation of the same item-source pairs at test serves to reinstate these bindings (M. K. Johnson & Chalfonte, 1994). Taken together, findings from the binding experiments (Exps. 4 and 5) are new as no previous research has examined the SRE in binding recognition. When considered in relation to the outcomes of Experiments 1, 2, and 3, they provide evidence for the role of binding in source memory. Moreover, the present

findings provide support for the special significance of the self in the early development of episodic memory.

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