

# **Scepticism and Credulity in Childhood**

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## ABSTRACT

The current thesis aimed to evaluate and extend research into children's interpretation of violations of physical laws of causality. A central question of this thesis was: what factors might govern children's scepticism versus credulity with respect to magical causality? Specifically, why are some children more easily fooled than others? Study 1 provided evidence of age differences in children's beliefs with respect to mental-physical causality. Older children (11-12-year-olds) were more sceptical about the efficacy of wishing than younger children (4-5 and 6-7-year-olds). Moreover, older children were less likely than younger children to claim that mental processes can directly affect the physical world. Subsequent studies in the thesis focused on various factors that might contribute to individual differences in children's interpretation of a conjuring trick (i.e. an event that ostensibly involved a violation of object permanence). Study 2 found that 4-6-year-olds made a distinction between real magic and tricks, but that direct social influence in the form of repetitive questioning influenced children's offered verbal causal explanations. In contrast, Study 3 found that the majority of 9-11-year-olds interpreted the demonstration as a trick, had a clear understanding of conjuring as trickery and were less likely to conform to experimenter pressure in the form of repetitive questioning. Study 4 results suggested that 4-6-year-old children's verbal responses are a true representation of beliefs as evidenced by verbal judgments correlating with behavioural reactions. However, an indirect social influence in the form of a visual clue that hinted at trickery influenced level of verbal scepticism. Furthermore, children's level of social confidence was linked to their level of active exploration. The final two studies in the thesis offered

support for individual differences in children's responses that may be related to theory of mind ability. Study 5 found a link between 4-6-year-olds' level of advanced theory of mind and responses, as well as an age-related increase in scepticism. Study 6 found a link between 5-7½-year-olds' first-order theory of mind and understanding of trickery that was not affected by age. It was, therefore, concluded that young children's acknowledgement of trickery and level of scepticism about magical events is not characterized by a simple age-related developmental influence. Importantly, socio-cognitive skills may play a role.

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## PREFACE

*“And above all, watch with glittering eyes the whole world around you because the greatest secrets are always hidden in the most unlikely places. Those who don’t believe in magic will never find it”. (Roald Dahl)*

*One man’s “magic” is another man’s engineering. “Supernatural” is a null word.  
(Robert A. Heinlein)*

An important task of childhood is to separate the real from the unreal and to assign entities and events to their proper (real or not real) categories. The ability to differentiate between what is real and what is not is basic to human cognition. Much of the knowledge we acquire in childhood is learned from the testimony of other individuals. Children learn a lot from accepting what they are told by adults. Yet children in contemporary Western society are often exposed to stories, films and cultural practices that focus on and contradict what they have been told is impossible regarding physical causal principles. For instance, parents tell and encourage young children to believe in the existence of certain fantasy characters such as Santa Claus who, they are told, rides a sleigh in the sky, climbs down chimneys and visits millions of homes in a single night to deliver presents. Children are bombarded with contradictory information intended to deceive. How and when do children work out that such information contradicts what they have been taught in other contexts? More

to the point, how do they make a distinction between reality and make-believe, fact and fiction, truth and falsehood?

One area where children are deceived but invited to make such a distinction is in the context of conjuring. Conjuring creates illusions of seemingly impossible or supernatural feats that appear as if they are real and based upon purely natural means. These feats are called magic tricks, effects or illusions. By using trickery, a person appears to be able to control and violate the laws of nature. Adults do not necessarily know how a conjuring trick is done, but know that they are being fooled and that it is a trick. How does the child get to that point? Why are some children quick at getting there and others slow? In other words, why and to what extent are some children more easily fooled than others?

### **Purpose of thesis and its academic rationale**

The current thesis aims to provide an examination of, and therefore to better understand, the factors that influence how a particular anomalous event will be interpreted by children. The thesis is also concerned with understanding children's explanations of "magic" by systematically differentiating between "real magic" and "trick magic" in relation to a conjuring context. The background context for the thesis can be traced to early work by Piaget (1929, 1930). Until quite recently, there has been a general acceptance of Piaget's claim that children's thinking is fundamentally different to that of adults in that children tend to think "magically" until about the age of twelve. It was claimed that children lack an awareness of the distinction between the physical and mental worlds. It would follow from this that they would be more likely than adults to accept that certain people could themselves suspend the laws of

physics and make objects disappear or pass through solid barriers. Indeed, as mentioned previously, the social world in which children grow up actively encourages such magical beliefs (e.g., Santa Claus and the Tooth Fairy). These views have been questioned recently, not on the grounds that children never think magically but on the grounds that both children and adults sometimes entertain fantastical beliefs and engage in magical thinking.

Research has established that children do acquire an understanding of physical causality and can differentiate reality from non-reality. The challenge, therefore, is to better understand the factors that influence how a particular anomalous event will be interpreted by children. Recent research shows that children manifest behavioural and psychophysiological signs of surprise when laws of physics appear to be violated in laboratory situations and many respond that it is “magic”. However, there are inherent doubts about giving definitive answers regarding young children’s responses, as it is unclear whether young children mean that such violations are caused by a genuine suspension of the laws of physics (i.e. “real magic”) as opposed to being a conjuring trick. Therefore, it is important that developmentalists ensure that children do not confuse the term “magic” with “trick” and are able to make the distinction. The findings of previous studies (e.g., Chandler & Lalonde, 1994; Johnson & Harris, 1994; Rosengren & Hickling, 1994), while attempting to differentiate between children’s beliefs about trick magic and real magic, do not systematically address which of these more subtle descriptions most accurately characterizes children’s responses.

Children’s understanding of magic in a conjuring context has, for the most part, been ignored by developmental psychologists. How do children interpret apparent violations of laws of physics in such contexts? It seems likely that they may

initially accept that some individuals can perform “real magic” but that at some point they will begin to suspect that at least some instances of conjuring are based upon deception. Some will eventually conclude that all such instances are based upon deception – but some will believe that they have witnessed a genuine magical event. The main issue that this thesis is concerned with exploring is possible factors that may contribute to individual differences in children’s interpretation of a conjuring trick.

Much of the previous research in this area has presented classic magic tricks and shown differences in children’s interpretation of them but has not explored the underlying reasons for those differences. Examples of these will be discussed further in Chapter 1. Those that have addressed underlying reasons have been mainly descriptive and focused on external factors, such as contextual issues which affect children’s tendency to refer to such demonstrations as “magic”. Very few studies have addressed internal factors. These warrant more systematic examination.

There is a distinction between obvious “parlour magic” versus the kinds of things developmental psychologists have typically done without any of the obvious trimmings of a “magic trick”. Yet deception is being performed in both instances. Therefore, the issue is one of why some children are more easily fooled than others. Specifically, a key question is, what factors contribute to children not thinking in terms of “real” magic? Understanding deception requires a fairly sophisticated “theory of mind”, e.g., the ability to appreciate that people may sometimes deliberately mislead others into drawing false conclusions. Once children realize that they themselves and other people can have false beliefs, they can also become aware of the possibility of deceptive behaviour. Therefore, the main proposal for the thesis is that advanced forms of socio-cognitive ability may contribute to children’s understanding that they are witnessing trickery. The current thesis is the first to put

forward the suggestion of a link between advanced theory of mind (AToM) ability and responses towards a conjuring demonstration and is the first empirical assessment of the proposed association between the two areas for preschool aged children.

### **Main research questions**

There are two main questions that are relevant to the thesis: firstly, is there an underlying difference between children labelling an event that apparently violates laws of physics “magic” or “trick”? Secondly, what individual difference factors are relevant to the interpretation of a conjuring trick? Specifically, are children with higher levels of theory of mind more likely to invoke “trick” to a conjuring context?

The main focus will be on investigating why and to what extent some children are more adept at detecting trickery than others. What factors apart from the acquisition of the knowledge that magical events are incompatible with physical events enable children to understand they are being fooled (i.e. tricked)? What factors increase suspicion (i.e. levels of verbal scepticism) toward an event being trickery? The thesis aims to address these concerns in two ways: firstly, by attempting to examine external factors such as methodology used (i.e. task issues). For instance, some children may detect trickery more effectively by attending to visual clues that hint at trickery. Alternatively, children’s verbal responses may not be accompanied by appropriate behavioural responses. Secondly, the thesis includes investigations of potential internal factors. There are many developmental skills that may underpin the transition from magic to trick interpretations of a conjuring demonstration. Some are cognitive and others social. It is not possible to incorporate all of these in the current thesis. Nevertheless, some are more pertinent than others. The following cognitive

factors were considered: level of theory of mind, spatial monitoring, and verbal ability. Social factors included confidence, Machiavellianism, lie-telling ability, and ability to discriminate between lies and truth-telling in other children.

### **The format of the thesis**

Six experimental studies were carried out: one study involved interviewing children about their belief in wishing (i.e. a specific violation of physical laws by direct mental-physical causality), and five studies presented children with a violation of object permanence in a conjuring context. The experiments presented conjuring tricks and children were asked whether they thought they were witnessing “real magic” or trickery (great care was taken to ensure that by “magic” the children did not mean any form of sleight of hand or trickery but a real violation of physical laws). Children were also interviewed about their understanding of the possibility of magic in the real world.

The final two studies attempted to assess children’s understanding of conjuring from a “theory of mind” (ToM) perspective. This concept refers to a child’s ability to appreciate what other people think, believe and know (and that this may differ from the child’s own mental states). For example, much research has been directed at children’s understanding of false beliefs in others (e.g., using the “Sally-Anne task”; Baron-Cohen, Leslie & Frith, 1985). An understanding of false beliefs is essential to an appreciation of the possibility of deception and trickery. Standard first-order tasks were administered to children of varying ages to assess the sophistication of each child’s ToM, as well as empirically assessing the suggested role of AToM in children’s understanding.

Changes across different age ranges were tracked. The main focus was on 4-6-year-olds, but also included older children (up to twelve years of age) as a comparison in some studies. The reasons for the age choices will be made apparent in Chapter 1. Suffice it to say at this point that much research into magical thinking indicates that between the ages of four and six children change from thinking of magic as real to thinking of it as a trick (for a review, see Woolley, 1997). This thesis explores the underlying social and cognitive causes for the developmental transition from real magic to trick interpretations.

## CHAPTER 1 – An introduction to children’s understanding of magic

The first chapter of the thesis provides an introduction to children’s magical concepts (i.e. entities and processes involved) and magical thinking (i.e. belief in and subscribing to magical causality). The studies carried out in the thesis are mainly concerned with children’s interpretation and causal reasoning in relation to apparent violations of physical laws in a conjuring context. In order to address this in a clear and systematic way, it will be appropriate to initially clarify possible types of causal reasoning in children. The chapter then outlines models that have been theorized to account for children’s magical thinking. Following on from this, previous research dealing with children’s understanding of magic is reviewed. Although research on children’s magic concepts will be addressed, the main focus is on magical causal thinking as it is relevant to the studies carried out in the thesis. In doing so, possible factors that might influence individual differences in children’s causal reasoning will be presented. Finally, proposals for future research are briefly discussed.

### **Types of Causal Reasoning**

Almost every aspect of reasoning involves making some sort of causal inference. For example, from a developmental perspective, the grasp of such skills as conservation, categorization or object permanence involves making causal inferences. This always involves a certain theory explaining the connection between a cause (A) and an effect (B). In other words, if the occurrence of event B is in some way contingent upon event A happening, this implies a causal relationship between events A and B.

Western cultures are based on a strong belief in scientific rationality. According to this belief, all natural events are universally based on physical laws and governed by physical causality (see Frazer, 1922; Tambiah, 1990). Hence, natural-physical causality concerns causal relationships between two or more external physical events.

According to Keinan (1994, p. 48), “Any explanation of a behaviour or an experience that contradicts the laws of nature may be considered as reflecting magical thinking”. There are numerous definitions of magical thinking in the literature. Usually, it is characterised as involving attribution of causal effects on real events by either thought or an action that is physically unconnected to the events (Rothbaum & Weisz, 1988; Zusne & Jones, 1989).

Subbotsky (1984, 1997) proposed one more type of causal reasoning which is neither magical nor natural-physical but potentially open to both forms of interpretation: phenomenistic causality. According to Subbotsky, this is an elementary form of causal reasoning that is later developed. Children may acknowledge that an effect has occurred but be unable to give a specific cause. They reject a plausible physical explanation but cannot give an explanation and accept that an action is associated in some way although not via an obvious physical connection. Subbotsky also suggested that older children might be less likely to make phenomenistic judgments than younger children would simply because they are more firmly committed to a belief in the physical causes in nature. It should be noted that Piaget (1929, 2009) originally adopted the notion of “phenomenist” explanations in the form of a “primitive magico-phenomenist stage” of causal reasoning in children. According to this stage, children give explanations that are magical and

phenomenist: things are linked to certain gestures without any link that is spatial or intelligible.

### **Magical Events**

There are different views on what kinds of events should be considered as magical or scientific (Boyer, 1997; Frazer, 1922; Jahoda, 1969; Rozin, Millman, & Nemeroff, 1986; Seligman, 1948; Tambiah, 1990). Subbotsky (1997, 2001) reported several types of events that are usually classified as magical because they violate known physical laws. That is, all of them are types of causation that are incompatible with the concept of physical causality. An event is considered magical if it involves a sudden acquisition of spontaneous feelings or independent movements by a non-animate physical object (“coming to life magic”). The belief that certain objects can directly affect other objects or events (through physical contact or simple resemblance) can also be viewed as magical (“participation” or “sympathetic magic”). These include certain objects (e.g. mascots) and actions (e.g. crossing fingers) bringing luck or affecting the flow of natural events. A third type of magical event involves a violation of the fundamental law of object permanence: if a physical object spontaneously changes in shape, appears out of thin air or disappears without a trace and without a clear physical mechanism being a reason for this (“non permanence magic” or “transformation magic”). Lastly, another type of magical event involves a direct effect of mental processes on physical objects like moving or creating physical objects by sheer effort of will or thought (“consciousness over matter” or “thought over matter magic”, or “mental-physical causality”). Wishing, thinking, or casting magic spells fall into this category.

For the purpose of this thesis, children's interpretation of one particular violation is mainly explored: a violation of object permanence in a conjuring context. Piaget (1954/1986) defined the concept of object permanence as the belief that a physical object continues to exist after it disappears from the perceptual field and claimed that children begin to understand object permanence by the age of two years. According to Piaget, around two years of age children start handling manual objects in accord with the objects' physical and spatial properties. Subsequently, children's developing beliefs in object permanence have been studied in great depth by a number of researchers but are beyond the scope of the current thesis (for reviews, see Baillargeon, 1987; Bower, 1971; Goswami, 2000; Subbotsky, 1991, 2005).

### **Theories regarding Children's Causal Thinking**

Before reviewing relevant research and empirical findings regarding children's magical thinking, a discussion of causal theories must be undertaken. There is some debate as to whether magical thinking is a stage that children progressively pass through on their way to logical, scientific rationality, or that from an early age children use both what they regard as everyday causal principles and magical principles that violate those everyday ones (Bolton, Dearsley, Madronal-Luque, & Baron-Cohen, 2002).

#### *Replacement Theory*

Piaget, in his early works, quite often referred to a replacement model with regard to magical and physical causal judgments. According to this model, the development of thinking about causality goes through a series of progressive stages. Piaget (1928/2009, 1929, 1930) investigated children's explanations of cause and effect and

through his studies theorised successive stages or types of causal reasoning which a child will exhibit regardless of the phenomenon in question. So, the child generalises and displays the same type of causation across a variety of contexts and domains (Harris, 2009). During this process, early modes of causal thinking (pre-causal) are gradually replaced by more rational beliefs in physical causality.

In an experiment, children were shown a pipette full of water and instructed to make a little sign with their finger when they wanted water to fall (Piaget, 1928/2009). When the child moved their finger Piaget made a small amount of water fall from a pipette but did not allow the child to see how this was done. He identified three orientations of mind that are possible: a critical attitude, “I don’t understand it, but there must be a trick. It must be you and not me who makes the water fall” (p. 211), or a magical attitude, “it’s me who makes the water fall because I forced it to fall and it obeys me” (p. 211), or a phenomenist attitude, e.g. there is a “link between the movement of my finger and the fall of the water, but I have nothing to do with it. Probably, my finger moves the air” (p. 211).

For Piaget, children’s early notions of causation are “imbued with magical thinking” (Harris, 2009, p. 229). Young children up to seven years of age are severely limited in their understanding of causal relations in the world and so are especially susceptible to magical thought. Only at around the age of eight, do they adopt predominantly mechanical explanations for events. Piaget’s (1929, 1930) interviews with children suggested that magical beliefs are present until nine or ten years of age.

A progressive shift from pre-causal to causal thinking was observed by other researchers as well (e.g., Laurendeau & Pinard, 1962; Samarapungavan, 1992; Schultz, Fisher, Pratt, & Rulf, 1986; Smith, Carey, & Wiser, 1985). For instance, in their replication of Piaget’s (1928) early work, Laurendeau and Pinard reported that

some time between five and eleven years of age, children undergo this change in their beliefs about the physical world. So, physical explanations of natural phenomena gradually replaced “pre-causal” explanations. However, Huang (1943) opposed Piaget’s theory and in an extensive review concluded that children’s dominant mode of explanation is in terms of physical causes. Their explanations may be naive or incorrect but they rarely invoke magic.

### *Coexistence Theory*

As an alternative to Piaget’s (1929, 1930) traditional view that preschoolers and the youngest of school-aged children are prone to errors of magical thinking that they later outgrow, Subbotsky (1984, 1985) hypothesised that children possess two belief systems. These consist of both magical thinking and scientific (physical) thinking that coexist throughout the life span. He suggested that a particular belief system will surface depending on the situation encountered: naturalistic (physical) causal thinking dominates everyday reality and unusual circumstances (transformations) encourage children’s latent magical beliefs to surface (Subbotsky, 1994). Furthermore, rational (physical) causal thinking governs at the level of verbal judgments while magical causality rules at the level of practical actions.

In keeping with a coexistence theory, Johnson and Harris (1994) proposed that a particular causal belief is either suppressed or accepted according to the child’s predominant belief system. Thus credulous children offer explanations for unexpected events by reverting to magical beliefs while non-credulous children refer to physical laws and practical considerations to explain these events. Johnson and Harris suggest that children still develop a category of metaphysical or magical phenomena which penetrates their everyday world from time to time. This will allow them to bracket off

certain outcomes as special or magical, precisely because they do not fit in with everyday expectations.

### **Research on Children's Magical Beliefs and Thinking**

In the last twenty years a good deal of cognitive developmental research and theory has provided what appears to be strong evidence to support the view that the dominant mode of young children's thinking is rational and highly constrained by belief in natural physical and biological laws (e.g., Baillargeon, 1991; Lee, Cameron, Doucette, & Talwar, 2002; Phelps & Woolley, 1994; Rosengren, Gelman, Kalish, & McCormick, 1991; Rosengren & Hickling, 1994; Rosengren, Kalish, Hickling, & Gelman, 1994). For instance, Lee et al. (2002) demonstrated that 5- and 6-year-old children have knowledge of physical constraints governing objects and actions: children rejected implausible claims made by adults such as that a chair had come alive and broken glass.

Various studies, in attempting to address children's causal explanations for events, have shown that they are capable of differentiating between possible and impossible events in the light of physical laws of nature at an early age (e.g., Baillargeon, 1991; Chandler & Lalonde, 1994; Johnson & Harris, 1994; Phelps & Woolley, 1994; Rosengren & Hickling, 1994; Rosengren et al., 1991, 1994). For instance, Rosengren et al. (1994) found that 4- and 5-year-olds consistently denied the possibility of events that violated common biological principles, like animals growing younger or growing smaller, but did not deny the possibility of events that conformed to those principles (i.e. like growing older or growing bigger). Research also indicates, to quote Sharon and Woolley (2004), that "young children have clear ideas about the kinds of things real entities can and cannot do" (p. 294). For instance,

Johnson and Harris (1994) presented 3-5-year-olds with pairs of hypothetical events in which one event violated a physical principle (e.g., a picture appearing by itself) and one event did not (e.g., drawing a picture) and asked the children to decide which event had been performed by an ordinary person and which event had been performed by a magic fairy. Children of all ages tended to claim that the possible event in each pair was performed by an ordinary person and the impossible event was performed by a magic fairy, and they did so for events that violated four different physical principles (i.e. inertia, object permanence, object continuity, and the conservation of matter).

Despite evidence for this dominant rational thinking, there is a vast body of research indicating that children hold and maintain a variety of beliefs about the reality of magic. These beliefs include the existence of magical beings such as Santa Claus, as well as magical events (e.g. Johnson & Harris, 1994; Prentice, Manosevitz, & Hubbs, 1978; Rosengren & Hickling, 1994; Rosengren et al., 1994). In a survey conducted by Rosengren et al., parents of children aged between four and six reported a substantial degree of belief in specific event-related figures (Santa Claus, the Easter Bunny, and the Tooth Fairy) and supernatural fantasy figures (fairies, magicians, ghosts, witches, monsters and dragons). Interview data from children by Johnson and Harris (1991) corroborate these perceptions. When asked about their beliefs in the existence and magical powers of Santa Claus, God, fairies and witches, 3- and 4-year-olds most often regarded Santa and God as real, fairies as both real and magical and witches as magical but not real.

An increasing amount of research has explored children's credulity toward magic and when and to what extent children resort to magical explanations. In most cases this has involved establishing children's scientific, rational thoughts and then

challenging their adherence to the belief in physical causality by presenting them with actual events that appear to violate principles of familiar physical laws. In doing so, when questioned with hypothetical transformations, children are able to identify events that are possible versus impossible in the light of physical laws of nature. Yet when they witness seemingly impossible events before their very eyes, like making an object shrink or making an object disappear, many give magical explanations (e.g., Chandler & Lalonde, 1994; Johnson & Harris, 1994; Phelps & Woolley, 1994; Rosengren & Hickling, 1994; Subbotsky, 2004). For instance, Chandler and Lalonde asked children between the ages of three and four whether one object (a screen) could pass through another object (a box). Although children of all ages denied the possibility of this event when it was described to them verbally, 67% changed their mind after “witnessing” the event first hand. That is, they insisted that the event they had witnessed was not a trick but was actually “real magic”.

Much research suggests that credulity toward magic is age-related and supports Piaget’s view that children develop into rational, sceptical thinkers, as evidenced by magical beliefs and explanations declining with age (e.g., Johnson & Harris, 1994; Phelps & Woolley, 1994; Rosengren & Hickling, 1994; Subbotsky, 2001, 2004, 2005, 2007; Woolley, Phelps, Davis, & Mandell, 1999). Specifically, evidence points to 4-year-olds being credulous towards magic (Rosengren & Hickling, 1994; Subbotsky, 2004) and 5-8-year-olds being increasingly sceptical towards it (Johnson & Harris, 1994; Phelps & Woolley, 1994; Subbotsky, 2004). Phelps and Woolley have found that between the ages of four and six, children significantly change from thinking of magic as real to thinking of it as a trick. Rosengren and Hickling found this as well and specifically reported a change between the ages of four and five.

However, there are conflicting views regarding the age that children change from viewing anomalous phenomena as being caused by magic as opposed to trickery. Whereas Rosengren and Hickling (1994) found that 4-year-olds believe in magic causality and 5-year-olds claim deception, Chandler and Lalonde (1994) found that most 3- and 4-year-olds initially gave “magic” responses, but they quickly shifted from “magic” to “trick” responses when allowed repeated viewing of an unusual event and the opportunity to examine apparatus. Yet Subbotsky (2004) reported that 5-year-olds do not depart from “magic” explanations when they witness anomalous events even when they are given a hint of trickery.

Contrasting results of studies also show considerable age differences in children’s credulity toward magic and highlight that there is not a clear cut developmental trend. For instance, Rosengren and Hickling (2000) claim young preschool children show little if any familiarity with magic. In a pilot study of preschoolers’ magical explanations for physical events, they found children younger than age four did not know or use the term “magic”. Similarly, Rosengren et al. (1994) found that not only do 4- and 5-year-old children make a clear distinction between possible and impossible transformations of animals in pictures, they did not invoke magical means to produce any outcome. That is, they do not spontaneously claim that impossible outcomes such as an animal getting smaller in size can occur by magic. Yet 4-5-year-olds endorsed the idea of a magician being able to perform this type of outcome, with few claiming that magicians used trickery.

However, Rothbaum and Weisz (1988) described a “magical stage” from ages two to six, whereby children truly believe in magical entities (e.g., fairies) and magical events (e.g., wishing). Indeed, Johnson and Harris (1994) found that children aged three to five judged violations of familiar physical principles as magical. Data by

Subbotsky (2001, 2005) have shown that even 6- and 9-year-olds are still vulnerable to magical causation: they suspend their belief in object permanence in a situation where a concealed replacement is made that is difficult to explain in a rational way (i.e. according to known laws of physics). Rosengren and Hickling (2000) consider two possible time courses: one in which magical thinking declines with age from nought to twelve years, the other in which it rises between nought and five years and then declines.

It is important to note that while attempting to explore children's magical thinking, many of the studies reviewed have varied widely in terms of the methodology and the context used to test children. This may account for the conflicting age differences found. As such, this issue cannot be dismissed as will be made evident further on in this chapter. Suffice it to say at this point, that children in Rosengren et al.'s (1994) study were merely shown pictures about violations of causal principles that were unfamiliar to them, rather than observing an empirical demonstration. So there was no assurance that children's responses were based on their perceptions of magic in the real world.

#### *Factors that may Account for Magical Thinking in Children*

There are a number of characteristics that are considered to provide the basis for the emergence of and prevalence of magical thinking in children: lack of information, conditions of uncertainty, and inability to explain phenomena (Jahoda, 1969; Zusne & Jones, 1989).

Early researchers examining young children's causal reasoning have suggested that children often revert to non-naturalistic causal explanations based on magic when they are unfamiliar with the objects or events about which they are questioned (e.g.,

Berzonsky, 1971; Nass, 1956). Thus, an event was considered to be familiar if children could have possibly experienced directly the process and causal outcome of the event. Unfamiliar events were those where the underlying mechanism causing an event was “remote” or not readily observable. For instance, Berzonsky found that 6- and 7-year-olds provided more non-naturalistic (magical) explanations when asked to explain remote events (e.g., what makes the stars shine?) or events where the children’s expectations were violated (e.g., a weighing scale failing to tilt to the heavier side when support was withdrawn) than when asked to explain familiar events (e.g., a boat sinking in a tub of water due to a hole in the bottom).

However, Huang (1930) reported that 4-10-year-old children rarely used magical or supernatural causality to explain unfamiliar phenomena. In this investigation, children aged four to ten years were presented with a set of events with unexpected outcomes. These events included a few magic tricks and several perceptual illusions (e.g., the Muller-Lyer illusion), but the majority of the events involved physical phenomena with relatively unfamiliar mechanisms (e.g., a glass filled with water is covered with a piece of paper and the water remains in the glass when the glass is turned upside down). Despite this apparent violation of gravity, fewer than 3% of children’s explanations of the events made reference to magical or supernatural causality. Instead, they sought plausible physical explanations (e.g., “the paper sticks to the tube because it is wet”; “there is some glue on the rim of the tube”).

More recent researchers claim that children quite often use the word “magic” simply to mark phenomena for which they lack immediate physical explanations (e.g., Chandler & Lalonde, 1994; Phelps & Woolley, 1994). Phelps and Woolley argue that children with more physical knowledge about an event should be less likely to invoke magic. Indeed, they found that children of all ages still invoked magic to explain

otherwise inexplicable physical events. As 4-, 6-, and 8-year-old children's knowledge of the causal mechanisms underlying specific events increased, their use of magical explanations for those events decreased. According to Chandler and Lalonde (1994), one way of achieving this is to allow examination of the apparatus used or to allow repeated viewing of an event. Both Baillargeon (1994) and Chandler and Lalonde have shown (as discussed previously) that when given the opportunity to investigate apparatus, 3- and 4-year-old children reinterpret what has happened and change from "magic" to "trick" responses. Therefore, responses of "magic" may simply be a stop-gap until further information is gathered that elicits a rational explanation.

Subbotsky (1997) proposed that it may be more appropriate to view children as engaging in phenomenistic causal thinking for an unusual phenomenon if it is difficult to give an immediate physical explanation. He showed that 6- and 9-year-old children acknowledge that experimenter manipulation of cutting a piece of paper in half and finding a stamp in a box cut in half are causally connected but they are not sure how. Although most claimed it was the same stamp that had been placed whole in the box as the one cut in half, few gave spontaneous magic explanations. Hence they revealed a belief in phenomenistic causal explanation. A further study revealed that when asked directly whether the event was "magic or not magic", children were inclined to change their phenomenistic causal judgment into acknowledgement of magical causation.

Studies have shown that children of all ages (including 4-year-olds) have no difficulty in distinguishing between magical and ordinary outcomes (non-magical events) (Johnson & Harris, 1994; Phelps & Woolley, 1994; Subbotsky, 2004). Yet, children have only been given a causal choice of "magic or not magic" (e.g., Phelps &

Woolley, 1994; Subbotsky, 1997, 2004), or whether an event “could happen with or without magic” (e.g., Johnson & Harris, 1994). As a result, it is not clear if children label events as magical only to contrast with ordinary events and not because they view them as instances of real magic, particularly if they have not been given an alternative choice to magic, such as trickery. For instance, in Johnson and Harris’ study, 3-year-old and 4-year-old children were shown drawings of pairs of events as having already occurred, within which one event conformed to a given principle and the other violated it, e.g., drawing a picture versus a picture appearing by itself, and children were asked whether each event was caused by “a magic fairy” wishing or giving verbal commands (i.e. magical means), or by a real person (“Jack or Jill”, i.e. everyday means, regular but not magic). Three- and 4-year-olds judged the non-violation events to be ordinary (caused by Jack or Jill) and the other outcomes as magical (caused by a magic fairy). However, only one alternative, that is “magic”, was offered as an explanation as opposed to whether the outcome could happen in the manner described.

Subbotsky (2004) points out that the capacity of children to distinguish between magical and ordinary outcomes does not necessarily mean that they can also distinguish between real magic and similar looking tricks. In one study he found that children aged four, six, and nine show understanding of the difference between real magic (e.g., a story of a postage stamp disappearing in a box after magic words were spoken) and ordinary events (e.g., a story of a stamp not disappearing in a box after magic words were spoken). However, in another study children aged five, six, and nine failed to distinguish between real magic and similar looking trick events (i.e., a story of a wizard hiding a postage stamp in a briefcase versus a wizard saying a magic spell to make a postage stamp disappear in a briefcase). He interpreted these findings

as suggesting that children distinguished between magical and ordinary events not because they understood the true nature of magic, but because the wording of the interview only involved the change of an object in magical items (objects appeared or disappeared after magic spell words were said) but not in ordinary items (magic words were said but nothing happened).

Many investigators (e.g., Johnson & Harris, 1994; Phelps & Woolley, 1994; Rosengren & Hickling, 1994) point out that the real issue when addressing children's conceptions of apparent violations of expectations is the extent to which children engage in magical thinking (i.e., truly believe magic to be a real, supernatural force) as opposed to only being an explanation referring to "tricks" as in "parlour magic". Rosengren and Hickling provided a wide range of classic, professional quality magic tricks which could undergo seemingly impossible transformations (e.g., putting two pieces of rope together by just pulling on them), to see whether 4-5-year-old children view them as truly magical or whether they view these events as merely involving tricks or deception. Although prior to viewing these transformations, most denied the reality of impossible transformations, after witnessing them in reality, many 4-year-olds changed their minds and acknowledged these events to be really magical whereas 5-year-olds insisted that they were tricks in the form of deception. Follow-up interviews also revealed that most 4-year-olds viewed magic as real and possible under the control of an agent (magician) with special powers, whereas most 5-year-olds viewed magic as tricks that anyone can learn.

Rosengren and Hickling's (1994) findings imply that scepticism towards magical occurrences is age-related. However, Johnson and Harris (1994) suggested that although most children distinguish magical events from other types of events, children under the age of seven vary in the extent of their credulity or scepticism.

They asked 3-7-year-olds to pretend that an object was in a box and then specifically categorized them as either credulous (they wonder if an entity is actually in the box) or sceptical (claimed the box is empty). Half opened the box and responded as if they wondered whether the object was in the box and half claimed the box was empty.

Yet, there are conflicting reports about what children actually mean by “magic”. In some studies on children’s magical thinking it remains unclear if responses meant real magic that involved supernatural powers or just tricks (Chandler & Lalonde, 1994; Rosengren & Hickling, 1994). In other studies children’s responses indicated their growing awareness of magic as events different from tricks and involving violations of fundamental physical laws. For instance, Phelps and Woolley (1994) refer to behavioural reactions displaying magical thinking and propose that exhibiting true surprise (such as wide eyes and audible gasps) and reluctant admittance on the part of some children that the things they saw must be magic may be taken as anecdotal evidence in support of children saying and believing the events they witness may be really referring to the supernatural. Yet, Chandler and Lalonde (1994) propose that children’s behavioural reactions may be due to an event being unexpected and not because children regard it as necessarily magical, particularly as they have found children change from “magic” to “trick” causal responses, despite initially exhibiting surprise.

Subbotsky (2004) highlights the fact that studies such as Johnson and Harris (1994), Phelps and Woolley (1994), and Rosengren and Hickling (1994), while attempting to differentiate between children’s beliefs concerning trick magic and real magic, do not systematically address which of these most accurately reflects children’s responses. Furthermore, they do not assess the robustness of children’s tendency to invoke magic. Much research into magical thinking has focused on

children aged between three and six years of age. There has been relatively little research on older children. Subbotsky has been the most prolific by testing children aged six and nine years of age.

Subbotsky (2004) claims that in order to examine a person's magical beliefs, and the extent to which they adhere to magic, it is necessary to first establish conceptual and ontological views. Conceptually, a person has to be able to understand the difference between magical and ordinary (non-magical) events. That is the person has to have a concept of magical events as events that violate known physical laws. An ontological judgment of magic involves believing an event can happen in the real world. Once these two judgments are established, if children change beliefs after witnessing an anomalous event, then beliefs are not "entrenched". Specifically, scepticism toward magic (i.e., disbelief) can be considered entrenched if children do not then produce or accept magical explanations, even if shown an anomalous causal event that looks like an instance of magic. Conversely, magical beliefs can be referred to as "deeply entrenched" if children stick to magical explanations even after a hint that an event is a trick (by explaining the mechanism).

In a series of experiments Subbotsky (2004) tested the entrenchment of causal beliefs in preschool and various school-aged children. He found that in 4- and 5-year-olds the belief in the reality of magic is deeply entrenched, whereas the belief in the universal power of physical causality (and scepticism toward magic) is not. Specifically, 4-year-olds tended to retain magical explanations when confronted by an event that looked like magic (e.g., a transformation of a crumpled stamp into a brand new one in an apparently empty box after a magic spell was cast on the box). Five-year-olds tended to retain magical explanations even after they had been encouraged to abandon them by prompting and explaining the mechanism of the trick. Six-year-

olds fit the category of non-believers with a “not entrenched” pattern: although they denied that magic can occur in real life, their disbelief was not entrenched as most of them changed their scepticism toward magic for credulity as soon as they were confronted with the event showing the magical effect of a spell. However, children who did believe in the reality of magic were swayed by the suggestion of an event being a trick. In comparison, 9-year-olds have an entrenched disbelief (i.e. scepticism) in magic causation and entrenched belief in the universal power of physical causality. Not only did the majority of 9-year-old children deny the reality of magic in their ontological judgments, but a large number refused to accept magical causal explanations when confronted with the aforementioned transformation. Almost all 9-year-olds who accepted or produced magical explanations abandoned these explanations as soon as they were prompted and given an explanation of the mechanism of a trick event.

Subbotsky has carried out substantial research into conditions that evoke magical explanations of events concerning violations of object permanence. Many of his experiments have used a version of the invisible replacement task (Bower, 1971). As briefly mentioned previously, it uses a specially constructed trick box that could create the impression of a physical object’s disappearance or appearance from thin air or transformation into another object in such a way that the object’s non-permanence seemed genuine. Under these conditions children aged four years and older, including 9-year-olds (Subbotsky, 1994, 1997, 2001, 2004), and even adults (Subbotsky, 1991, 1993, 1997, 2001; Subbotsky & Trommsdorff, 1992) are prepared to suspend initially strong beliefs in the permanence of perceived objects. Specifically, they revealed a considerable degree of credulity towards the experimenter destroying or transforming physical objects by sheer will power.

Subbotsky (2004), in reviewing past research that examined children's verbal reactions about magic, concluded that most studies suggest that children's and adults' tendency to engage in magical practices during an experiment is a function of the "cost" of these practices. In their verbal judgments, schoolchildren and adults usually show scepticism towards magic. Yet 6- and 9-year-old children (Subbotsky, 2001) and even adults (Rozin, Markwith, & Nemeroff, 1992; Rozin, Markwith, & Ross, 1990; Rozin, Millman, & Nemeroff, 1986; Subbotsky, 1997, 2001, 2004, 2010; Subbotsky & Quinteros, 2002) show behaviours compatible with magical thinking if they are put in a context where disregarding the possibility of magic involves a potentially high cost. For instance, Subbotsky (2001) found that magic was still viewed by many 9-year-olds as a real threat to the safety of their valuable objects, as evidenced in refusing to put a personal object in a "magic box" for fear of damage. However, Subbotsky did not consider the possibility that in their refusal children might still fear that their treasured possessions might be damaged even if it is not real magic. Subbotsky (1994) has also shown that children exhibit magical thinking in their actions if there is the possibility of reward as well as high cost. Specifically, he found that the majority of 4- and 5-year-olds and some 6-year-olds tried to pass their hand through a glass wall (in order to obtain an attractive object in a box) and refused to drink "magic water" (fearing to become a toddler again). At the end of the experiment most of the children acknowledged that the box and the water were "magic".

Woolley (1997) and Subbotsky (1997, 2007) state that a task issue that must be considered when investigating children's magical thinking is whether experimenters request verbal judgments or observe a child's behaviour. Although much research supports Piaget's view that magical explanations decline (and

disappear) in later childhood, findings may be due in part to researchers' reliance on children's verbal responses (Subbotsky, 2001). When children's behaviour is examined in addition to their verbal judgments they show a considerably stronger credulity towards magic (e.g., Johnson & Harris, 1994; Subbotsky, 1985, 2001). For instance, in their actions, 9-year-olds demonstrated a significantly stronger credulity that a magic spell can destroy a postage stamp in a box than that a connected physical device can (Subbotsky, 2001).

In some instances children manifest a belief in magical causality in their actions while proclaiming disbelief in their verbal judgments (Subbotsky, 1985, 1993, 2001, 2004). In one study, Subbotsky (1985) told children aged four, five, and six years a story of a girl who had a magic box that could turn pictures into real objects when magic words were chanted. Despite the majority of the children denying the possibility in real life, when left alone with a box, they chanted magic words. Subbotsky interpreted these findings as indicative of the existence of two inconsistent belief systems: children's verbal behaviour reflected rational scientific thought, whereas their subsequent actions reflected magical thought. Yet this seemingly magical behaviour decreased significantly between the ages of four and six, demonstrating their increasing reluctance to grant credibility to magical forces operating in the real world.

Various studies have shown that the credibility of the person performing magic may be a factor in influencing children's causal explanations of a supposed violation (e.g., Chandler & Lalonde, 1994; Subbotsky, 1994). Chandler and Lalonde found that 9-13-year-old children were prepared to entertain the possibility that the laws of conservation could be seemingly suspended by the experimenter (e.g., changing the shape of a ball of moulding clay could cause it to weigh more or less

than it had previously) when exhibiting the persona of a magician (wearing a cape, having a wand). Subbotsky (1993, 1994) also indicates that explicitly talking about magic and using magic words in conjunction with an event may create a context in which children perceive magic to be real and play a crucial role in changing children's beliefs. He asked 4-6-year-olds whether saying magic words can transform a drawing of something into an object it depicted. Almost all denied the possibility of magic in an interview. Yet 90% attempted some form of magical transformation when left alone with the box.

It should be noted that research has shown other social factors that may account for an individual's magical thinking, including cultural differences (e.g., Subbotsky & Quinteros, 2002) and parental influence (e.g., Rosengren, Hickling, Jurist, & Burger, 1997). Rosengren et al. suggest that the age of the child modulates parental encouragement of magical beliefs, with less support as children get older. Indeed, Harris (2009) acknowledges that Piaget toyed with the possibility that the child's early disposition towards magic or scientific thinking is nurtured and elaborated depending on the surrounding community. However, these are not discussed further due to the constraints of the thesis and the fact that they are not relevant to the studies carried out in the thesis. The reader is directed towards Woolley (1997) for an extensive review.

### **Summary**

The research reviewed in this chapter suggests that magic is an active category in children's thinking (i.e. it is not uncommon for children to hold beliefs in the reality of supernatural beings and label certain events as "magic"). Research has been undertaken with the aim of helping to understand children's magical thinking.

Unfortunately, evidence that is already available is neither clear nor consistent and highlights several unresolved issues. Some researchers are in agreement with Piaget (1929, 1930) that preschoolers and the youngest of school-aged children progressively move from pre-causal (magical) thinking to rational thinking (natural physical laws of causality). Alternatively, other researchers (e.g., Chandler & Lalonde, 1994) discount claims about magical thinking and propose that such claims are based upon adult interpretations of children's reactions, such as physical surprise. Finally, Subbotsky (2004) claims that belief systems for magical and everyday events coexist throughout the life span and that in some situations magic beliefs come to the forefront. Indeed, Harris (2000) argues that magical thinking can persist into adulthood in ways that Piaget did not acknowledge and that young children's magical explanations are "occasional rather than systematic" (p. 231).

Studies have shown that young children are more likely than not to interpret impossible or unexpected events as "magic" and label them accordingly (e.g., Chandler & Lalonde, 1994; Johnson & Harris, 1994). Some have identified insufficient knowledge and a lack of understanding of logical physical relationships as the most important determinants of children's magical responses when shown an apparent violation of a physical law (e.g., Berzonsky, 1971; Chandler & Lalonde, 1994; Johnson & Harris, 1994; Phelps & Woolley, 1994). Hence, the more knowledge a child possesses about physical phenomena, the less likely they are to resort to magical explanations. Yet there are conflicting reports about what children actually mean by "magic". In some studies of children's magical thinking it remains unclear if responses meant real magic that involved supernatural powers or just tricks (Chandler & Lalonde, 1994; Rosengren & Hickling, 1994). In other studies, children's responses

indicated their growing awareness of magic as events different from tricks and involving violations of fundamental physical laws.

Research shows that some children explain anomalous events in terms of magic whereas others explain them in terms of physical causality. A number of studies reviewed in this chapter suggest that individual differences between credulous and sceptical children are developmentally sensitive and support Piaget's replacement theory of the development of causal thinking (e.g., Johnson & Harris, 1994; Phelps & Woolley, 1994; Rosengren & Hickling, 1994). For instance, Johnson and Harris postulated that belief in magic and associated magical thinking may be especially prevalent in young children and may be used as a form of explanation when scientific knowledge is absent.

However, there is a conflict in responses regardless of age and people do not, once they understand physical laws of nature, subscribe to a rational view in their causal ideas about the physical world all the time. In fact, research has shown that children of all ages (and even adults) are still vulnerable to magical causation and can still exhibit magical tendencies. They suspend belief in physical causation by giving "magic" causal responses for events that look like real magic (i.e., appear to genuinely violate principles of physics, such as object permanence) especially when these unusual events are presented in a supernatural context (e.g., by using magical words; Subbotsky, 1994, 1997, 2001, 2004). Furthermore, their behaviour often shows that they believe a violation can occur (e.g., Subbotsky 2001, 2004). Therefore, children's causal thinking is not a replacement whereby they develop out of magical thinking. Bouchier and Davis (2000) comment that the existence of both believers and sceptics suggests that there is not a simple developmental progression (e.g. from belief through to scepticism) that characterizes children's responses to information about magical

events during early childhood. Rather, what children believe, and how consistently they believe it, appears to also be influenced by individual differences among children of the same age.

### *Aims of Future Research*

The central question to my area of research is “Do children think under certain circumstances that natural laws of physics can be suspended?” If so, in order to address this question, future research will need to address whether magical thinking is at the heart of children’s explanation for these possible changes. Children do have a grasp of scientific concepts, with their notions of science being quite robust. Furthermore, they have a very good knowledge of the way the world works. Yet, research reviewed shows evidence of magical thinking in children. For example, Chandler and Lalonde (1994) have presented a basic idea about magical thinking that disappears and reappears in the context of magic tricks. Future research will also need to explore in depth what is meant by children’s responses of “magic”. Are children referring to notions of the supernatural? Are they referring to “tricks” as in parlour magic? In particular, research needs to investigate the distinction between magic and tricks (i.e. children’s knowledge of conjuring as deception).

The majority of the studies reviewed have used demonstrations of apparatus that violate expectations of physical laws that have not been witnessed before, such as a solid object passing through a wall. Only a few studies (Phelps & Woolley, 1994; Rosengren & Hickling, 1994) have explored the extent to which children give magical explanations for transformations involving prototypical magic tricks or deception. Magic tricks are more ecologically valid than the apparatus used in previous studies,

as most children will have experienced a magic show at either birthday parties or on the television.

Past research has mainly assessed external factors that may evoke “magic” responses. A key question that has not been addressed in the magical literature is, “what internal factors contribute to children not thinking in terms of magic?” In particular, no studies have addressed why some children are quicker than others at realizing that what they are witnessing is a trick, apart from physical knowledge of the laws of causality. There is a substantial amount of data available that shows individual differences between adults who believe and do not believe in magical causation in relation to personality traits, mental health, and intellectual ability (e.g., Haidt, McCauley, & Rozin, 1994; Nemeroff & Rozin, 1992; 1994; Rozin et al., 1992). There is also a wealth of research into the relationship between paranormal belief and intelligence. One pertinent study was undertaken by Jones, Russell, and Nickel (1977) who found a positive correlation between intelligence and global paranormal belief. However, results on this are very inconsistent with other studies finding negative correlations or no relationship (see review by Irwin, 2009). Both personality and intelligence are multi-faceted and too diverse a topic to discuss in depth in the current thesis.

## CHAPTER 2:

### STUDY 1 - Age differences in children's beliefs about wishing

*Star light, star bright,  
The first star I see tonight,  
I wish I may, I wish I might,  
Have the wish I wish tonight.*

*(unknown author)*

In Chapter 1 of this thesis, I outlined many instances in which the members of Western society seem to encourage a belief in magic in young children. Parents will often go to great lengths to inculcate and support a belief in magical entities such as Father Christmas, the Tooth Fairy and the Easter Bunny. One concept closely related to such magical belief is wishing. Young Western children are often encouraged to treat wishing as a magical process. For example, adults will sometimes encourage children to make a wish when they blow out the candles on their birthday cake. They are even told not to tell anyone the content of their birthday cake wish or, “it won’t come true”. The birthday cake ritual carries the clear intimation that wishes can come true and thereby affect events in the physical world. What do children understand about such practices? Do they believe that wishes really can affect physical events? As a first foray into children’s magical beliefs, Study 1 of the current thesis explored children’s understanding of wishing. In addition, the association between children’s

beliefs about the efficacy of wishing and another potential form of direct mental-physical causality (i.e. imagination) was explored.

Most adults know that mental effort alone cannot directly alter the physical world. Simply wanting something or thinking about something does not cause it to occur: some physical action needs to be taken. Similarly, research has shown that even 3-year-olds understand that a mental effect on the physical world is mediated rather than direct. For instance, Schult and Kalish (1993) found that children denied that just wanting to walk through a wall instead of around it would allow this action to occur. Estes, Wellman and Woolley (1989) also report that children as young as three understand that one cannot physically transform an object just by thinking about it and that actual physical contact is needed to achieve such results.

Although much research on children's theories of mind indicates that children as young as three have some understanding of the relationship between thoughts and things, evidence indicates that they also hold magical beliefs in direct mental-physical causality (e.g., Rothbaum & Weisz, 1988). Wishing is an everyday childhood phenomenon (with most children's birthday parties involving blowing out the candles on a cake and making a wish), and is a specific form of violation of a physical law whereby there is a perception that mental effort alone may directly alter the physical world. Theoretical, anecdotal, and empirical accounts suggest that most children believe in the efficacy of wishing to some degree and that children think of it as a magical process, requiring skill (e.g., Vikan & Clausen, 1993; Woolley, Phelps, & Davis, 1995; Woolley, Phelps, Davis, & Mandell, 1999). Furthermore, Woolley et al. (1999) have also found that wishing appears to have an intentional mental state component (i.e., one must be thinking of something). Woolley et al. (1995) found that many 3-6-year-old children believe wishing to be an effective means for bringing

about changes in physical reality but are sceptical after age six. Similarly, Vikan and Clausen (1993) reported considerable beliefs in wishing in 4-6-year-olds, but firmer belief in the younger children.

The existence of belief in the efficacy of wishing in young children supports Piaget's (1929, 1930) suggestion that young children (up to eight years of age) engage in illogical, magical thinking, and believe they can cause some event merely through their own thoughts or gestures, i.e. "magic by participation between thought and things" (Piaget, 1929, pp. 133-134). However, these wishing beliefs conflict with empirical evidence from the theory of mind literature, which points to a sophisticated level of understanding of mental-physical causal relations in children as young as three. Woolley et al. (1999) suggest that children's beliefs in its efficacy may be situated within the domain of emerging beliefs about magic rather than a part of their theory of mind (ToM).

Woolley et al. (1999) contrasted beliefs about wishing with beliefs about imagination and found that younger children (in a 3-6½-years old age range) are more likely than not to claim that the mental (i.e., wishing and imagining) can affect the physical. Their results also indicate that for children there is no conceptual difference between imagination and wishing. These findings conflict with previous research on children's understanding of imagination whereby it has been found that by the age three or four, children understand that simply imagining something cannot directly produce an effect in reality or in the physical world (Golomb & Galasso, 1995; Harris, Brown, Marriot, Whittall, & Harmer, 1991; Johnson & Harris, 1994; Woolley & Phelps, 1994; Woolley & Wellman, 1993a, 1993b). Despite their findings, Woolley et al. still maintain that children's beliefs about wishing potentially lie at the intersection of two domains of thought – their theories of mind and their beliefs about magic.

## **Study Aim**

On the basis of the experimental evidence from Woolley et al.'s (1999) study, the aim of the current study was to explore further children's concepts of wishing and their beliefs in its efficacy. In doing so, it was hoped that evidence would be presented on children maintaining a belief in a common phenomenon that is perceived to be able to violate a physical law. The age range of the children tested was extended to include participants aged up to 12 years old (as well as including 4- and 6-7-year-old children). No previous studies have conducted research with regards to the concept and efficacy of wishing on this older age group and it may give a greater insight into children's growing scepticism. In addition, relations between children's beliefs about different types of direct mental-physical causality were assessed (i.e. imagination, imagination with the intention of trying to get something, and wishing) to determine whether children do distinguish the mental from the physical, and in particular whether wishing is believed to be a more effective means of producing a result than imagination. In doing so, I planned to assess whether wishing beliefs might be considered situated outside their ToM as it violates the basic tenets of the theory whereas children may consider the effects of imagination in the context of their everyday ToM knowledge. In other words, wishing beliefs might belong in a separate domain from imagination and, therefore, not be part of a ToM domain.

Imagined objects can be considered as really occurring by the mere fact that they can be conceived in thoughts. Like Woolley et al., by including explicit mention of the word "trying" to imagination stories, children will not just consider that the character in a story is thinking about something, but also involves intentionality in the sense of actively trying to get something. This might increase claims of children's beliefs in its efficacy. Hence, children's belief in the efficacy of imagination actually

producing a direct effect on the external physical world would be clearly assessed. In Study 1, explicit mention of the word “trying” in imagination stories is referred to as “imagination plus trying”, and merely thinking of something mentally is referred to as “imagination only”.

Woolley et al. only concentrated on claims of efficacy of a character obtaining one item as a result of wishing, imagining, or imagining plus trying. Study 1 aimed to assess the extent of children’s beliefs in the efficacy of these different processes by also varying the quantities of items. If children claim that ten items are just as likely to be produced by wishing as one item, then there are no limits to its efficacy. The size of the target set may also affect the probability of success of wishing (as opposed to imagining), as the more items involved may result in children believing in at least one item appearing.

**It was hypothesised that:**

- 1) There will be an age-related increase in familiarity of wishing and an age-related decrease in beliefs about its efficacy. Specifically, older children (11-12-year-olds) will be more familiar with the concept of wishing and report less belief in its efficacy, than younger children (4-year-olds and 6-7-year-olds).
  
- 2) Older children will be less likely to claim the possibility of success of direct mental-physical causality than younger children (i.e. imagination only, imagination plus trying, wishing).

3) There may be a difference in the success of direct mental-physical causality according to the type of mental process. Children may be more likely to claim success in wishing if they consider it to be a magical process rather than a type of imagining.

4) There may be a difference in belief in the extent of success in wishing according to the quantity of items (i.e. wishing for ten items compared to one item).

## **Method**

### *Pilot Study*

A pilot study was conducted to help select the youngest age to be used in the experimental study. A sample of ten children aged 3-3.5 years (five white and five black, with equal numbers of males and females) was presented with a sample of Woolley et al.'s (1999) semi-structured interview questions assessing children's concepts of wishing. Finally, other potential forms of direct mental-physical causality were assessed by presenting illustrated picture stories, replicated from Woolley et al.'s study. Modifications included presenting pictures depicting the possibility of obtaining ten items versus one item. The procedure is described more thoroughly in the Materials and Procedure section below.

Results showed that children of three years of age did not understand questions about wishing. Also, only two children aged 3.5 years of age were able to answer questions about wishing, such as "Can you tell me what it means to make a wish?" It was concluded that children as young as 3.5 years of age have difficulty explaining the concept of wishing and therefore the lower age range was set at four years.

## **Participants**

Eighty-four children (42 males and 42 females) took part in the study. They ranged in age from four to twelve years of age. There were three age cohorts consisting of thirty 4-year-olds (mean 52.47 months), thirty 6-7-year-olds (mean 76.77 months) and twenty-four 11-12-year-olds (mean 137.25 months). Equal numbers of males and females were tested in each age group. The children in the study attended a S.E. London primary school and a S.E. London comprehensive school and were predominantly from middle class backgrounds although this was not directly assessed. Ethnicity was not systematically recorded (although anecdotally the children were predominantly white).

## **Design**

An independent-participants design was employed comparing across the three age cohorts. All statistical tests were two-tailed unless otherwise indicated.

## **Materials**

A modified and shortened semi-structured interview based on Woolley et al.'s (1999) study (following results of the pilot study) was used to explore children's concepts of wishing as well as their beliefs in the efficacy of wishing (details are presented in the Procedure section below). Six A4 sized illustrated picture stories depicting potential forms of direct mental-physical causality were also used consisting of "Imagination only", "Imagination plus trying", and "Wishing" (see Procedure section for illustrations and details). Please note that "imagination plus trying" refers to explicit mention of trying to obtain an item by imagining whereas "imagination only" does not.

## **Procedure**

### *Wishing Interview*

All the children were interviewed individually in a quiet place (i.e. in a separate room or corridor away from the classroom). In order to address children's concepts of wishing, they were asked questions such as, "Do you know what it means to wish?" Unlike Woolley et al. (1999), children were also asked, "Have you ever had a birthday cake with candles on and been asked to make a wish and blow out the candles?" This was used as a prompt for children who had claimed not to know what it means to make a wish as it was considered to be a common situation for wishing. It was also used as further clarification for children who had claimed to know what it means to make a wish. Children were also asked, "Have you ever made a wish?" Children were not interviewed further if they did not know what a wish was, responded "No" to the prompt question, and to ever having made a wish. All other children were asked, "Let's say you made five wishes right now, what would you wish for?" On beliefs in the efficacy of wishing, children were asked questions such as, "Did your wish(es) come true?", "Can wishes come true always, sometimes, never or don't know?" and, "How many wishes out of five would come true?" Other questions assessed possible magical aspects of wishing, such as who or what children thought made wishes come true, if wishes can be made any time or only on special occasions, if a special object is needed, if something needs to be said when making a wish, if something needs to be done when making a wish, and if there is someone they know who makes wishes. The complete interview questions were asked in the following order:

- 1) Do you know what it means to make a wish?
- 2) Have you ever had a birthday cake with candles on and been asked to make a wish and blow out the candles?
- 3) Have you ever made a wish, wished for something? *(If the response is “yes”, ask “What have you wished for?” If the response is “no” to this question but “yes” to question 1 or 2, go on to question 4. If the response is “no” to this question and “no” to question 1 and 2, do not ask any more questions.)*
- 4) Did your wish(es) come true?
- 5) Can wishes come true: Always, sometimes, never or don't know?
- 6) Let's say you made five wishes right now, what would you wish for?
- 7) How many wishes out of five would come true: All, some or none?
- 8) If wishes come true is it because somebody or something makes it come true or because it just happens? *(If the response is “somebody or something”, ask “who or what makes your wishes come true?”)*
- 9) When can you make a wish, anytime or just on special occasions? *(If the response is, “special occasions”, ask “when?”)*
- 10) When making a wish, do you need to use something like a special object? *(If the response is “yes”, ask “what?” If the response to question 9 is “no”, prompt with “do you need a magic wand?”, “rubbing a lamp for a genie?”, “birthday candles?”, “stars as in wishing on stars?”)*
- 11) Is there anything you have to do when making a wish? *(If the response is “yes”, ask “what?”)*
- 12) Is there anything you have to say when making a wish? *(If the response is “yes”, ask “what?”)*
- 13) Does anyone you know make wishes? *(If the response is “yes”, ask “who?”)*

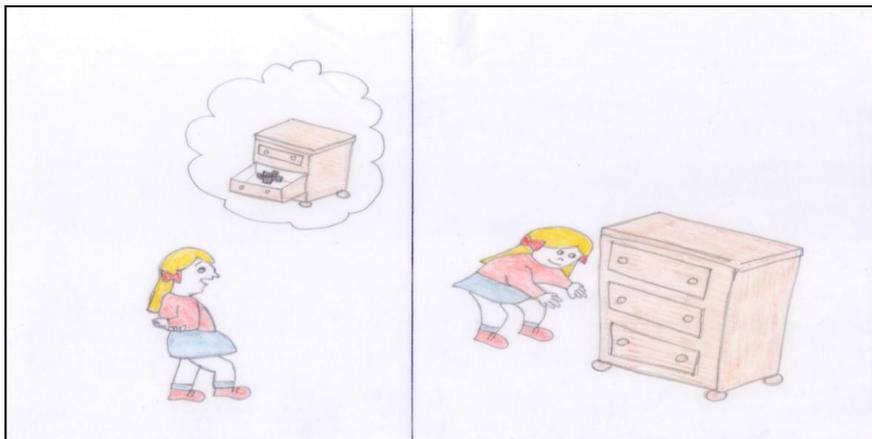
### *Mental-Physical Causality Task*

Relations between children's beliefs about different types of other potential forms of direct mental-physical causality were assessed by presenting illustrated picture stories, designed to replicate Woolley et al. (1999). However, two modifications were introduced. Firstly, pictures depicting the possibility of ten items versus one item were shown. Therefore, six illustrated stories were used instead of three. Secondly, Woolley et al. stated in two of the picture stories that a character "likes" and in two other picture stories that a character "wants". The current study stated for all stories that a character "wants" for reasons of consistency throughout and to convey a desire to obtain an item in all story types.

Quantities of items per set of picture stories were randomly presented. One set of illustrated stories consisted of "Imagination only" – about a child wanting a puzzle and imagining it. A second set of stories showed a story about a child wanting ten puzzles and imagining them. The third set of stories consisted of "Imagination plus trying" – about a child imagining to try and get a ball to appear under a bed. A fourth set of stories showed a story about a child imagining plus trying to get ten balls to appear under a bed. The fifth set of stories consisted of "Wishing" – a child wishing for a rabbit behind a tree. The sixth set of stories showed a child wishing for ten rabbits behind a tree. After each story, children were asked if what the children in the stories were imagining, imagining plus trying, or wishing for would really be in the specified location when he or she looked for it. The item choices were deliberately exaggerated in order to assess the extent children might be willing to accept mental-physical causality that was presented in fiction.

Instead of showing the whole picture relating to a story at once, parts were revealed to the children that related to each section of the story as it was read out. For

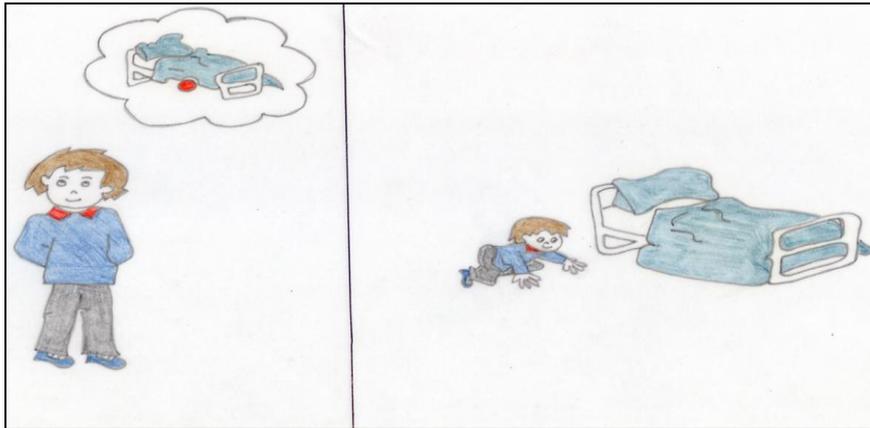
example, in one of the stories for the “imagination only” condition, children were first only shown the girl in the picture and told “This is Sally”. Then they were shown the closed chest of drawers and told, “Sally looks in the drawer but there’s nothing there. She wants a puzzle”. Next, children were shown the girl and the thought bubble containing a puzzle in a chest of drawers, and told, “So she’s imagining that there’s a puzzle in the drawer”. Finally, children were shown the girl near the closed chest of drawers again and asked, “Now, when she looks in the drawer, will there really be a puzzle there?” Stories were presented in a random order. Details of each of the pictures and story types were as follows:



“This is Sally. Sally looks in the drawer but there’s nothing there. She wants a puzzle. So she’s imagining that there’s a puzzle in the drawer”.

*Test Question:* Now, when she looks in the drawer, will there really be a puzzle there?

**Figure 1.1: Story type for Imagination only - one item**



“This is Peter. Peter looks under the bed but there’s nothing there. Peter wants a ball. So he’s going to use his imagination to try to get a ball”.

*Test Question:* Now, when he looks under the bed, will there really be a ball under there?

**Figure 1.2: Story type for Imagination plus Trying - one item**



“This is Claire. Claire looks behind a tree but there’s nothing there. Claire wants a rabbit. So she’s wishing for a rabbit behind the tree”.

*Test Question:* Now, when she looks behind the tree, will there really be a rabbit there?

**Figure 1.3: Story type for Wishing - one item**

## **Results**

The present study employed measures in the area of assessing various aspects of children's concepts of wishing as well as their beliefs in the efficacy of wishing, followed by measures of children's responses concerning the efficacy of other forms of direct mental-physical causality (i.e., imagination only, imagining plus trying, wishing). Initially the results section addresses and presents the descriptive data for the responses to the interview questions specifically related to wishing followed by consideration of differences between the three age groups in relation to responses. Next, descriptive data are presented for children's responses related to picture stories depicting direct mental-physical causality, followed by differences between the efficacy of the different types of causality. Non-parametric statistics are used throughout in the form of chi-square analyses unless otherwise mentioned.

## **Interview**

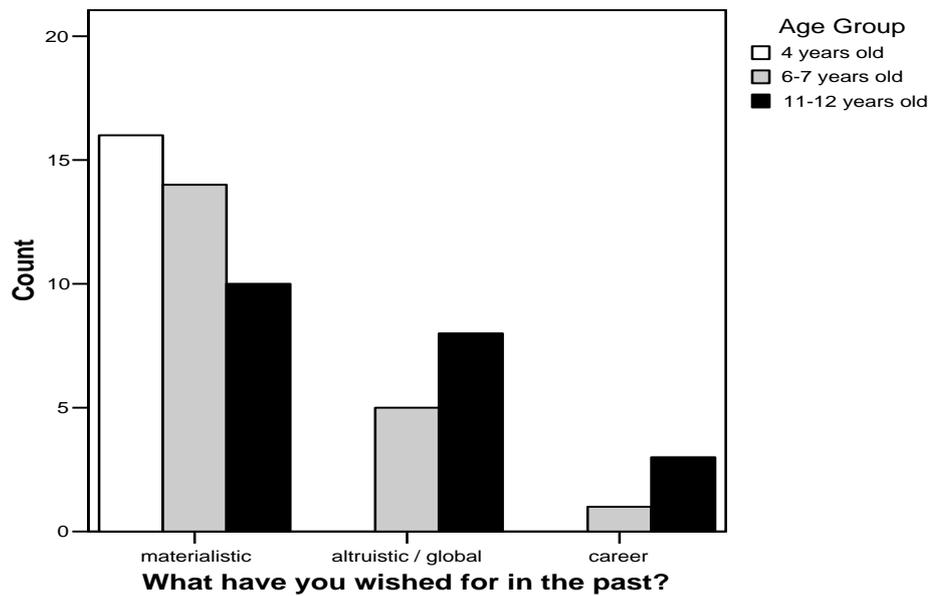
The results for the interview questions on wishing can be found in Table 1.1 and Table 1.2. In these and other tables throughout the study, *N* represents the number of children who were questioned and answered a particular question. As only a very few children refused to answer a question, or responded with "Don't know", statistical analyses were only carried out on definite responses. It should be noted that children were not interviewed further on wishing if: 1) They did not know what a wish meant, and had not blown out candles on a birthday cake; 2) If they did not know what a wish meant and had not wished in the past; 3) They did know what a wish meant but had not blown out candles on a cake and had not wished in the past. (N = eight 4-year-olds, six 6-7-year-olds, zero 11-12-year-olds).

The interview questions (that are presented in Table 1.1) showed that all three age groups were familiar with the concept of wishing, but greatest familiarity was found in the oldest group (11-12-year-olds). There was a significant age difference with regards to children claiming to know what it means to make a wish ( $\chi^2(2, N = 84) = 15.55, p = .0001$ ). More children in the 11-12-years old age group (79%) than in the 4-years-old age group (40%) and the 6-7-years old age group (27%) stated they knew what it meant. There was also a significant age difference in relation to children responding positively when prompted by the experimenter to help them decide if they had ever made a wish ( $\chi^2(2, N = 84) = 21.01, p = .0001$ ). When asked if they had ever had a birthday cake with candles on and blown them out and made a wish, fewer 11-12-year-olds (25%) claimed to have done this compared to 4-year-olds (80%) and 6-7-year-olds (77%). This implies that knowledge of wishing was not associated with having blown out candles on a birthday cake for the oldest age group. They may have either outgrown this or may have no memory of having done so whereas the opposite appears to be true for the two youngest age groups. Following on from this, the majority of children in all three age groups claimed to have made a wish in the past, with no significant differences being found ( $\chi^2(2, N = 83) = 3.84, p = .15$ ).

**Table 1.1: Frequency and Percentages of 4-12-year-olds' Understanding of Wishing**

Question	Age Group		
	4 years N=30	6-7 years N=30	11-12 years N=24
Knows what it means to make a wish: Yes No	12 (40%) 18 (60%)	8 (27%) 22 (73%)	19 (79%) 5 (21%)
Had a birthday cake and blown out candles and made a wish: Yes No	24 (80%) 6 (20%)	23 (77%) 7 (23%)	6 (25%) 18 (75%)
Has wished in the past Yes No Don't Know	21 (70%) 9 (30%) 0 (0%)	22 (73%) 7 (23%) 1 (3%)	22 (92%) 2 (8%) 0 (0%)
	<b>N = 21</b>	<b>N = 22</b>	<b>N = 22</b>
<i>(Those children who responded "Yes" to having wished in the past) - Has wished for:</i> Materialistic items Altruistic items Career Cannot remember / Don't know	16 (76%) 0 (0%) 0 (0%) 5 (24%)	14 (64%) 5 (23%) 1 (4%) 2 (9%)	10 (45%) 8 (36%) 3 (14%) 1 (4%)
<i>(Those children who responded "Yes" to having wished in the past) - Past wishes came true:</i> Yes No Cannot remember	15 (71%) 2 (10%) 4 (19%)	10 (45%) 10 (45%) 2 (10%)	7 (32%) 13 (59%) 2 (9%)

Regarding the types of things children have wished for in the past, Figure 1.4 shows that more children in all three age groups claimed to have wished for materialistic items such as toys, sweets or bicycles. Whilst some 6-7-year-olds and 11-12-year-olds responded that they had wished for altruistic things such as peace or for family members, and a few for a career, no 4-year-olds did so and this may have influenced age differences in response to whether past wishes had come true or not.



**Figure 1.4: Frequency of 4-12-year-olds' Past Wishes**

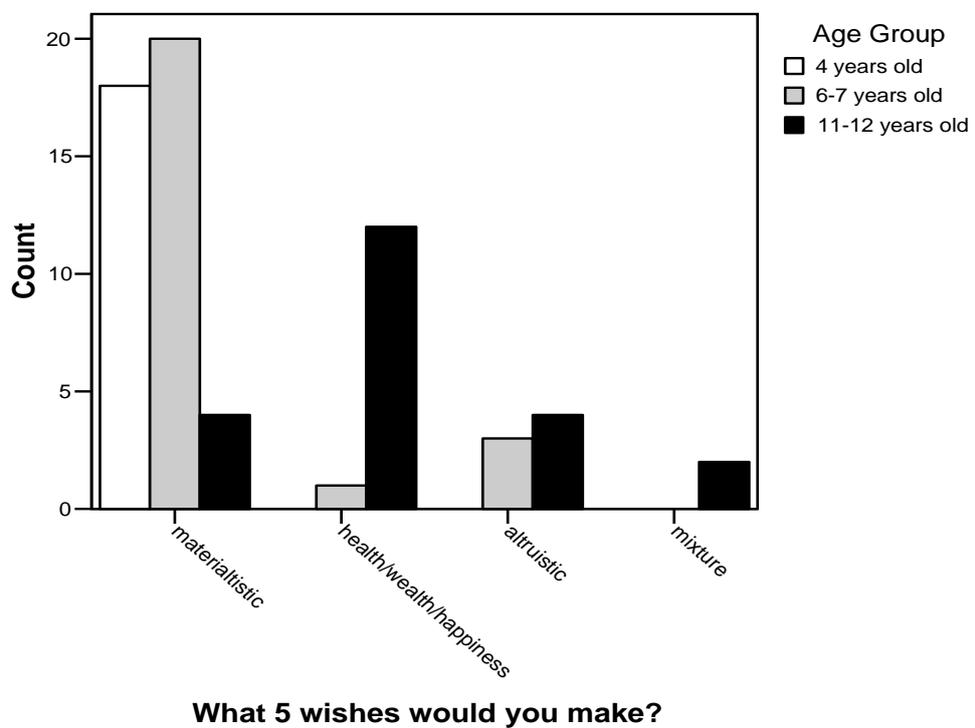
Table 1.2 presents further responses to questions regarding concepts of wishing and its efficacy. Although 11-12-year-olds were more familiar with the concept of wishing they tended to be more sceptical about its efficacy. An age-related decrease in efficacy was found: significantly more 4-year-olds stated that their past wishes came true (71%) compared to 6-7-year-olds (45%) and 11-12-year-olds (32%), (Fisher's 2x3 Exact Test,  $N = 57$ ;  $p = .0004$ , two-tailed). Furthermore, there was a significant difference between the age groups regarding their beliefs that all or some of the five wishes (that they would make) would come true (Fisher's 3x3 Exact Test,  $N = 60$ ;  $p = .00009$ , two-tailed). A higher percentage of 4-year-olds (50%) and 6-7-year-olds (54%) believed that all the wishes would come true whereas no 11-12-year-olds claimed that all of them would come true.

There was an age-related increase in children being more sophisticated in their responses by stating that wishes “sometimes” come true and that “some” wishes out of five would come true. A higher percentage of 11-12-year-olds claimed “some” wishes would come true (77%) compared to 4-year-olds (39%) and 6-7-year-olds (46%). Furthermore, significantly fewer 11-12-year-olds claimed that wishes always come true (0%) compared to 4-year-olds (32%) and 6-7-year-olds (18%), (3x3 Fisher’s Exact Test,  $N = 64$ ;  $p = .002$ , two-tailed). Again, more 11-12-year-olds were sophisticated in their responses by claiming that wishes “sometimes” come true (83%) compared to 4-year-olds (32%) and 6-7-year-olds (59%).

**Table 1.2: Frequency and Percentages of 4-12-year-olds' Understanding of Wishing and its Efficacy**

Question	Age Group		
	4 years N=22	6-7 years N=22	11-12 years N=23
Wishes come true:			
Always	7 (32%)	4 (18%)	0 (0%)
Sometimes	7 (32%)	13 (59%)	19 (83%)
Never	7 (32%)	5 (23%)	2 (9%)
Don't know	1 (4%)	0 (0%)	2 (9%)
	<b>N = 22</b>	<b>N = 24</b>	<b>N = 24</b>
If were to make five wishes right now, would wish for:			
Materialistic items	18 (82%)	20 (83%)	4 (17%)
Health, wealth, happiness	0 (0%)	1 (4%)	12 (50%)
Altruistic (peace)	0 (0%)	3 (13%)	4 (17%)
Mixture	0 (0%)	0 (0%)	2 (8%)
Don't know	4 (18%)	0 (0%)	2 (8%)
	<b>N = 18</b>	<b>N = 24</b>	<b>N = 22</b>
<i>(Those children who gave examples of what they would wish for) - How many wishes out of five would come true:</i>			
All	9 (50%)	13 (54%)	0 (0%)
Some	7 (39%)	11 (46%)	17 (77%)
None	1 (6%)	0 (0%)	2 (9%)
Don't know	1 (6%)	0 (0%)	3 (14%)
	<b>N = 18</b>	<b>N = 24</b>	<b>N = 24</b>
Who makes wishes come true:			
Someone/something	5 (28%)	8 (33%)	9 (38%)
Just happens	12 (67%)	16 (67%)	10 (42%)
Both	0 (0%)	0 (0%)	3 (12%)
Don't know	1 (5%)	0 (0%)	2 (8%)
	<b>N = 19</b>	<b>N = 23</b>	<b>N = 24</b>
Can wish:			
Anytime	8 (42%)	8 (35%)	17 (71%)
Special occasions	9 (47%)	14 (61%)	6 (25%)
Cannot	1 (5%)	0 (0%)	0 (0%)
Don't know	1 (5%)	1 (4%)	1 (4%)
	<b>N = 20</b>	<b>N = 23</b>	<b>N = 24</b>
Special object needed			
Yes	18 (90%)	12 (52%)	4 (17%)
No	2 (10%)	10 (43%)	19 (79%)
Don't know	0 (0%)	1 (4%)	1 (4%)
	<b>N = 20</b>	<b>N = 24</b>	<b>N = 24</b>
Need to do something			
Yes	13 (65%)	16 (67%)	10 (42%)
No	7 (35%)	6 (25%)	12 (50%)
Don't Know	0 (0%)	2 (8%)	2 (8%)
	<b>N = 21</b>	<b>N = 24</b>	<b>N = 24</b>
Need to say something			
Yes	14 (67%)	21 (88%)	18 (75%)
No	6 (29%)	2 (8%)	6 (25%)
Don't Know	1 (5%)	1 (4%)	0 (0%)
	<b>N = 20</b>	<b>N = 21</b>	<b>N = 24</b>
Someone you know makes wishes			
Yes	12 (60%)	12 (57%)	13 (54%)
No	8 (40%)	8 (38%)	9 (38%)
Don't know	0 (0%)	1 (5%)	2 (8%)

With regards to the types of things which the three age groups would wish for, the majority of the 4-year-olds (82%) and 6-7-year-olds (83%) wished for materialistic items such as toys, whilst 11-12-year-olds most frequently wished for health, wealth, happiness and a career (50%). Figure 1.5 illustrates children's item choices.



**Figure 1.5: Frequency of Items 4-12-year-olds would Wish for**

The oldest age group was more flexible in their use of wishing, in that more 11-12-year-olds stated wishing could be done any time (71%) as opposed to special occasions (25%). Slightly more 4-year-olds stated that they could wish on special

occasions (47%) as opposed to anytime (42%). Likewise, more 6-7-year-olds claimed they could wish on special occasions (61%) as opposed to anytime (35%). Overall, there was a significant difference between the age groups ( $\chi^2(2, N = 62) = 6.73, p = .03$ ). This indicates that although wishing is initially tied to specific situations, with age and experience it becomes something one can do any time.

There were no significant age differences with regards to children claiming that someone or something makes wishes come true as opposed to them just happening ( $\chi^2(2, N = 60) = 1.44, p = .49$ ). Children in all three age groups most often claimed that wishes just happen. Regarding components of wishing, significantly more 4-year-olds responded that a special object needed to be used when making a wish (90%) compared to 6-7 year olds (52%) and 11-12-year-olds (17%), ( $\chi^2(2, N = 65) = 22.67, p = .0001$ ). There were no significant age differences with regards to children responding that something needs to be said when making a wish (2x3 Fisher's Exact Test,  $N = 67; p = .18$ , two-tailed). All three ages groups mostly stated that something does need to be said. No significant age differences were found with regards to children believing that something needs to be done when wishing ( $\chi^2(2, N = 64) = 3.64, p = .16$ ). Most 4-year-olds (65%) and 6-7-year-olds (67%) claimed that something does need to be done whilst fewer 11-12-year-olds (42%) claimed this. Finally, no significant age differences were found in response to, "Does anyone you know make wishes?" ( $\chi^2(2, N = 62) = 0, p = 1$ ). Most children in all three age groups responded "yes" to this question and gave either family members or friends as examples.

### Mental-Physical Causality Stories

Descriptive statistics relating to the picture stories can be found in Table 1.3. These stories compared children's beliefs about wishing to their beliefs about other potential forms of direct mental-physical causality.

**Table 1.3: Frequency of 4-12-year-olds claiming that the Mental could affect the Physical**

Pictures	Age Group		
	4 years N=30	6-7 years N=30	11-12 years N=24
Imagination only (1 item)	13 (43%)	15 (50%)	2 (8%)
Imagination only (10 items)	19 (63%)	14 (47%)	3 (13%)
Imagination + Trying (1 item)	18 (60%)	19 (63%)	6 (25%)
Imagination + Trying (10 items)	15 (50%)	14 (47%)	3 (13%)
Wishing (1 item)	14 (47%)	16 (53%)	5 (21%)
Wishing (10 items)	16 (53%)	11 (37%)	2 (8%)

As can be seen from the above table, 11-12-year-olds were the least likely to claim that imagination, imagination plus trying, or wishing, could cause a direct physical occurrence. Significant age differences in beliefs about mental-physical causality were found for all story types apart from wishing for one item: Imagination only (one item): ( $\chi^2(2) = 11.16, p = .004$ ), Imagination only (ten items): ( $\chi^2(2) = 13.61, p = .001$ ), Imagination plus trying (one item): ( $\chi^2(2) = 8.63, p = .013$ ), Imagination plus trying (ten items): ( $\chi^2(2) = 9.41, p = .009$ ), Wishing (ten items): ( $\chi^2(2) = 10.9, p = .004$ ). Older children (11-12-year-olds) were less likely to claim

success in obtaining both one item and ten items by imagining only, and imagining plus trying, and wishing (ten items) than younger children (4-year-olds and 6-7-year-olds). No significant age difference was found for Wishing (one item) ( $\chi^2(2) = 4.62, p = .099$ ).

Following on from this, a series of Pearson 2x2 chi-square analyses and Fisher's Exact Tests of probability were carried out and that revealed no significant differences within each age group between claiming success for one item or ten items according to a specific mental causality. This implies that success of mental causality was not dependent on the quantities of items to be obtained.

Overall, children appeared to treat the six types of stories similarly. Table 1.4 shows that for all story types (apart from imagination plus trying for one item) children appeared to be more likely to claim that mental processes cannot produce an item(s).

**Table 1.4: Overall Total Frequency of 4-12-year-olds' Positive or Negative Responses for the Mental affecting the Physical**

<b>Pictures</b>	<b>Yes</b>	<b>No</b>
Imagination only (1 item)	30	54
Imagination + Trying (1 item)	43	41
Wishing (1 item)	35	49
Imagination only (10 items)	36	48
Imagination + Trying (10 items)	32	52
Wishing (10 items)	29	55

Chi-square analyses revealed no significant differences overall between the three story types regarding obtaining one item as opposed to not obtaining one item ( $\chi^2(2) = 4.91, p = .09$ ) or between the three story types regarding obtaining ten items or not ( $\chi^2(2) = 1.11, p = .57$ ). Furthermore, there were no significant differences overall between claiming success in obtaining one item or ten items for each story type ( $\chi^2(2) = 2.14, p = .34$ ). The non-significant findings between the different story types imply that children, overall, did not consider wishing to be more likely to cause direct changes than imagination only or imagination plus trying and may indicate similarity in beliefs about these forms of mental-physical causality. It also implies children's understanding of what mental states cannot do and that many of the children have rational beliefs about the mind and mental-physical causality. However, a sizeable minority of children believed that the items would appear and may be an indication of those children having irrational beliefs about the mind and mental-physical causality.

### **Cautionary Note**

The results of the multiple comparisons carried out in Study 1 should be accepted with some caution as multiple statistical analyses conducted on the same data set can lead to the increased possibility of Type I errors, whereby the use of several statistical tests on one data set can increase likelihood of any one of these producing a spurious statistically significant result. The same caution should be borne in mind for all of the multiple analyses conducted in the current thesis.

## **Discussion**

The main aim of Study 1 was to assess children's concepts of wishing and its efficacy by comparing three age groups and in so doing to provide a partial replication and extension of the work of Woolley et al. (1999). Evidence of developmental changes was found in the current study that supports Woolley et al.'s findings. As expected, the oldest age group (i.e. 11-12-year-olds) showed greatest familiarity with wishing as demonstrated in their response to knowing what it means to make a wish and having wished in the past, implying that knowledge about wishing increases with age. The current study also found some indication of an age-related decrease in belief in the efficacy of wishing as evidenced by the positive response across age groups regarding whether past wishes came true. Furthermore, there was also an age-related decrease in the number of children asserting that wishes "always" come true, with the vast majority of the 11-12-year-olds taking the more realistic position that wishes "sometimes" come true. An age-related decrease in belief in the efficacy of wishing may come about because older children may simply be becoming more critical or sceptical in general. Alternatively, their scepticism may be empirically based and specific to wishing; they may have tried numerous times to wish for things without success and simply deduced that it does not work. It may also be that the sort of things that younger children wish for are simpler and more likely to be obtained anyway, giving younger children the illusion that their wishing is working, whereas older children's wishes are more complex and so less likely to be realised through other means. Indeed, in the current study there was an age difference regarding the choice of wishes children have made in the past and wishes they would make; most 4-year-olds wished for both toys and animals, 6-7-year-olds most frequently wished for toys

and equipment such as a bicycle and 11-12-year-olds most frequently wished for health, wealth, happiness and a career.

The two youngest ages were less flexible in their use of wishing by claiming that wishes can only be done on special occasions. However, when probed further for an example, of those children who claimed that wishing can only be done on special occasions, 12 out of 29 of them stated that wishes can occur on a particular day (such as Wednesday or Sunday), or time (such as morning, afternoon, or evening), “sometimes”, or “when you’re feeling desperate or sad”. These statements illustrate difficulty in distinguishing between “any time” and “special occasions” as they may be interpreted as both representing the same concept due to the fact that the responses are specific days, times, or emotions and not necessarily special occasions. Somewhat unexpectedly, only seven out of 29 children who claimed that wishes can be done on special occasions gave Christmas time, birthdays or Easter as an example (with four of them being responses from 6-7-year-olds and three from 11-12-year-olds). Although this fits with most of the 11-12-year-olds responses that they have never had a birthday where they have blown out candles on a cake and made a wish, it goes against those 4-year-olds who claimed that they had, as none of them gave birthday as an example for a special occasion. Further contradiction was found when seven out of eighteen 4-year-olds claimed that a special object was needed when making a wish, in the form of candles on a birthday cake. These findings conflict with those found by Woolley et al., whereby wishing was found to be tied to Christmas and birthdays. It should be noted that differences between the two studies may be due to Woolley et al. specifically asking if Christmas and birthdays were good times to make a wish.

Although the current study confirms Woolley et al.’s (1995, 1999) finding that there is a growing awareness with age of the concept of wishing and an age-related

decrease in beliefs about its efficacy, it lends only tentative support towards an age-related decrease in children's beliefs in a magical aspect of wishing. The 11-12-year-olds were the least likely to claim that a magical being makes wishes come true, that a special object is needed, that magical words need to be spoken, that a magical action needs to be done, or a magical explanation for when a wish can be made. In contrast, 4-year-olds were the most likely to perceive wishing as involving magic. Extrapolating detailed responses to certain questions revealed wishing involving elements of magic. Yet the findings did not indicate a high degree of belief in the magical nature of wishing and interpreting some children's responses proved difficult for a number of reasons. Firstly, regarding components of wishing, significantly more 4-year-olds and 6-7-year-olds claimed that a special object was needed in contrast to 11-12-year-olds who most often claimed that a special object was not needed. Although this points towards the oldest age group not associating wishing with magic, the apparent magical interpretations of younger participants should be treated with caution. All children had been prompted with examples of special objects when being asked if a special object was needed to make a wish (e.g., a magic wand, candles on a cake). When children were then asked what object was needed, 14 out of 34 children (i.e. nine out of eighteen 4-year-olds and five out of twelve 6-7-year-olds) gave a magic wand as an example. While this may be considered a magical item and specifically linked to wishing, younger children may be more susceptible to social influence. As such, they may simply have been imitating or seeking to please the experimenter by providing the same example rather than accurately representing their magical beliefs.

A second example of ambiguous interpretation is related to the assertion that wishes coming true "just happens". Children in all three age groups most often

claimed that wishes just happen rather than someone or something makes them come true. However, children's understanding of the meaning of the phrase "just happens" is not clear. It could just as well be associated with chance as with magic. Furthermore, Corrigan (2004) examined American English-speaking children's production of "happen/happens/happening/happened" and found they were increasingly likely to use "happen" to describe negative contexts (e.g. accidents, something dreadful) as children's language progressed.

Of those children who did claim that someone or something makes wishes come true, only a few children responded that a magical entity is involved in the form of fairies, Father Christmas, or elves (i.e. two 4-year-olds and three 6-7-year-olds). No 11-12-year-olds gave a specific magical being as an example, and this was the only age group (apart from one 4-year-old) to claim that wishes are actualized by someone providing a sought after item, such as when a parent will give a child a specific item that has been bought (i.e. five out of eight children). Therefore, it would seem that as children get older they perceive wishing to be a uniquely human activity. It should be noted that some children in all three age groups ascribed God to making wishes come true (i.e. one 4-year-old, five 6-7-year-olds and three 11-12-year-olds), but the children's understanding of the concept of 'God' is unclear as it was not investigated directly. Specifically, do children think of God in human terms or superhuman terms that may reference a magical force? Woolley et al. (1999) reported numerous religious intrusions into children's beliefs about wishing. Some children when asked who makes wishes come true responded "Jesus" or when asked to teach a puppet to wish said that he "needs to ask God". Some children even explicitly confused wishing and praying when asked if they knew what wishing was. Long, Elkind, and Spilka (1967) found there was an increased recognition in 9-10-year-old children that "God [was] a

helper and not a magic genie who simply [made] one's wishes come true," (p. 107) implying that this latter form was the way in which younger children conceived of God. See Richert and Barrett (2005) for an in-depth review of the development of children's understanding of God."

Finally, only a very few children gave explicitly magic-related responses. For example, two 4-year-olds asserted that wishes could only be made, "If you've got magic in your fingers" or, "If you see a wishing star". Four 4-year-olds and one 6-year-old asserted that one needs to "do a spell", have a "special power" or "wave a wand about" in order for a wish to come true. Two 4-year-olds thought one had to say something special such as "abracadabra". Finally, when probed to explain who they know that grants wishes, only one 4-year-old and three 6-7-year-olds responded with a magical entity such as fairies or witches.

As only a few 4-year-olds (and even fewer 6-7- and 11-12-year-olds) gave a magically relevant response to these specific questions, it does not greatly provide support for Woolley et al.'s (1999) claim that most children under six years of age involve magic in wishing. The present findings bring into question whether children really do believe in a magical aspect of wishing as claimed by Vikan and Clausen (1993) and Woolley et al. However, it should be noted that there is a regrettable oversight in the present study. At no point were children asked directly about the link between wishing and magic. Instead, the link with magic can only be inferred from the children's responses to certain questions, such as whether one needs to use a special object such as a magic wand for a wish to come true. Future studies may benefit from asking children directly about their thoughts on the link between wishing and magic. Furthermore, the study only interviewed children about wishing. It did not use a task that involved making a wish and showing an actual physical outcome that

could be linked to magical causality. Woolley et al., in a second study, presented a trick box that appeared to be empty and encouraged children to make a wish for a penny. On reopening the box and finding a penny inside children were asked if their wish had made it happen and if it was real magic or a trick. Results indicated that for most children who believed in the efficacy of wishing it is a magical process, as evidenced by them giving a “real magic” causal explanation.

Various findings in the current study do not point strongly towards wishing appearing to have an intentional mental state component, since very few children verbally related the act of wishing to actual thought processes. Whilst age appears to be a factor in children associating the act of wishing with thinking about something in their head (with 11-12-year-olds most likely to acknowledge a link), responses in line with this were few. All three age groups most often claimed that something needs to be said when making a wish, and when probed further most were literal in their responses by saying that the words needed are, “I wish out loud” (27 out of 53 children) or, “Say please and thank you” (seven out of 53 children). Overall, only a few specifically acknowledged that certain thought processes were needed as in, “Think in your head” (i.e. one 4-year-old, one 6-7-year-old and four 11-12-year-olds). It is unclear whether some children’s responses represented a link between wishing and the necessity to just think of something mentally, or a link between wishing and speaking out loud (i.e. four children in response to the question, “Is there anything you have to say when making a wish?” stated, “What wished for”). Furthermore, when probed on what needs to be done when making a wish, only three children (i.e. one 4-year-old and two 11-12-year-olds) gave an explanation in the form of mental processes, such as, “think in your head” or, “believe it” or, “be positive”. In fact, more children considered wishing to be simply a physical act, as the most frequent

explanation overall was that, “You need to close your eyes” (i.e. 10 out of 39 children). These findings do not appear to strongly support Woolley et al.’s (1999) suggestion that wishing involves beliefs about mental-physical causality as they found that children implicate thinking in wishing. However, a different methodology was used in the current study compared to Woolley et al. that may have contributed to these contrasting results. In the present study, the questions were not geared specifically towards thinking and whether they consider it to be more than simply a physical act (e.g., closing one’s eyes) and so did not provide information on whether children believe thinking to be an essential component of wishing. Woolley et al. included control stories that assessed potential distinctions between wishing and wanting and other goal directed behaviour (i.e. looking). It should be noted that Study 1 of this thesis did not aim to assess children’s views of wishing as a mental process. However, had children been asked, “Do you have to say something out loud or only think about something in your head” rather than, “Do you have to say something?” and “Do you have to do something?” children’s belief or disbelief in the efficacy of wishing in terms of mental causation would be clarified.

Another aim of Study 1 was to assess possible relations in children’s beliefs about wishing with another form of potential direct mental-physical causality, namely imagining. As with Woolley et al. (1999), the stories were designed to assess differences in children’s claims about wishing and imagination and to determine whether adding explicit mention of intention to imagination stories (i.e. imagining plus trying) would increase claims of efficacy. A fairly consistent pattern in line with what was anticipated, and that supports Woolley et al.’s claim of age-related changes, was found. Significant age differences in beliefs about mental-physical causality were found for all but one of the six story types (i.e. wishing for one item). Specifically, 11-

12-year-olds were less likely than 4-year-olds and 6-7-year-olds to claim that the mental could affect the physical. This seems to reflect children's increasing understanding of physical laws of nature and more developed theories of mind. These findings, together with results showing an age-related decrease in the efficacy of wishing, support other research that has found a belief in the efficacy of mental-physical causality decreases with age (Phelps & Woolley, 1994; Rosengren & Hickling, 1994; Subbotsky, 2005; Woolley, 2000).

Children appeared to treat the six types of stories similarly; no significant differences were found overall between the three story types regarding success in obtaining one item or not, or between the three story types regarding success in obtaining ten items or not. More importantly, the findings show that children did not significantly consider wishing to be more likely to cause direct changes than imagining and may indicate similarity in beliefs about these forms of mental-physical causality. However, as Woolley et al. suggest, the presentation of the stories may be too structurally similar and so findings reflected this rather than actual conceptual differences. Alternatively, it may be that the fact that the stories were hypothetical influenced the children's concepts. Furthermore, the findings may have been influenced by the context in which the task was presented (i.e. fiction). Responses to hypothetical stories may differ from real wishing or imagining situations. For instance, Subbotsky (1994) found that almost all 4- and 5-year-olds deny that permeability of a solid body (glass wall of a box) could occur in real life but under the influence of a fairy tale, the majority of 4- and 5-year-olds revealed their credulity. In Study 1 of this thesis, children were merely shown pictures regarding mental-physical causality rather than observing an empirical demonstration. So there was no assurance that children's responses were based on their perceptions of wishing and imagination

efficacy in the real world. This might be better addressed in future work by presenting children with actual imagining and wishing situations that are separated by a filler task or in different sessions (e.g., children are shown a box and the experimenter states that he or she is going to wish for something in the box).

Children may have been focusing on the type of object being sought in the picture stories rather than the mental process being applied. Perhaps if the same item for each story type had been presented that is commonly associated with wishing, such as an illustration of a gift-wrapped item, this may yield differences between the mental processes. Perhaps younger children may not be familiar with the convention of thought patterns presented in pictures in the format of thought bubbles. If this were the case, they may have looked at the pictures depicting imagining, and imagining plus trying, and failed to realize that these depicted thought processes within thought bubbles. Instead, they may literally see the item in the picture (i.e. a puzzle in a bubble) and respond “Yes” when asked if a puzzle(s) will really be in a drawer as a result of imagining, or a ball(s) will really be under a bed as a result of imagining plus trying. However, research has found that young children as young as three years of age are capable of understanding the concept of thought bubbles as reflecting mental states (e.g., Custer, 1996; Schult, Hollander, & Wellman, 1994). For instance, Custer utilized thought bubbles to investigate young children’s understanding of various mental representations (beliefs, pretenses, and memories) that contradict reality. Three- and 4-year-olds chose “thought pictures” (depicting either the mental representation or reality) that reflected the mental state of story protagonists. While 4-year-olds performed “relatively well” on all scenario types, 3-year-olds chose the correct thought picture more often for pretense and memory scenarios than for false belief scenarios. Furthermore, whilst children conceptualized pretense as involving

mental representations, they had more difficulty understanding contradictory mental representations that purported to correspond to reality.

Somewhat unexpectedly, some children in the oldest age group stated that imagination could cause a physical occurrence. However, this does not necessarily reflect actual belief in its efficacy or lack of understanding that using one's imagination is not an effective way to alter physical reality. Indeed, three 11-12-year-olds stated that if the character imagined hard enough they could imagine a ball under a bed as opposed to it actually occurring. Alternatively, acknowledgment may depict their suspicion of the question being asked and wondering if there was a deliberate catch to the question rather than an actual belief in its efficacy.

The lack of significant differences overall between claims of efficacy in wishing versus imagination, and the fact that children overall were less likely to believe in the efficacy of mental-physical causality highlights the fact that most children do have an understanding of what mental states cannot do. It does not appear to lend support to Woolley et al.'s proposal that wishing beliefs are not subject to a theory of mind (ToM). It also does not point towards supporting claims that wishing beliefs may lie at an intersection between magic and theories of mind, or that wishing beliefs may lie in a magic domain that is separate from a ToM domain in which imagination belongs. However, as the current study did not specifically assess children's beliefs in a magical aspect of wishing, one cannot conclusively dismiss these claims. The fact that some children (even older children) acknowledged that both wishing and imagination can bring about direct change implies that, irrespective of age, these children may not have a fully developed ToM. I will be returning to issues of ToM in more detail and from a different perspective in Studies 5 and 6 of this thesis.

## **Conclusion**

Study 1 of this thesis provides further empirical documentation of the existence of an everyday childhood phenomenon that has previously received primarily anecdotal support - the development of children's beliefs about wishing. The results of the current study on wishing confirm, in line with Woolley et al. (1999), that there is a growing awareness with age of the concept of wishing and an age-related decrease in beliefs about its efficacy. As predicted, older children (11-12-year-olds) were more familiar with the concept of wishing and tended to be more sceptical about its efficacy than younger children (4-year-olds and 6-7-year-olds). The current study did not find strong evidence in support of the suggestion that young children believe that wishing is a magical process or necessarily attribute it to thought processes (i.e. thinking mentally rather than speaking out loud).

Significant age differences were also found in children's beliefs about the efficacy of other potential forms of direct mental-physical causality. Overall, 11-12-year-olds were less likely than 4-year-olds and 6-7-year-olds to claim that the mental (i.e. wishing, imagination, imagination with explicit mention of trying to actually obtain something) could affect the physical (apart from wishing for one item). These findings are in line with other research that has found that a belief in the efficacy of mental-physical causality decreases with age. However, children overall treated all story types similarly: there were no differences in the effectiveness of wishing over imagination and children were generally unlikely to believe that these processes can directly create physical objects.

Study 1 did not find substantial evidence of children's beliefs in magical causality in relation to wishing. Yet there was an implication that younger children were more likely than older children to think magically (i.e. believe in mental-

physical causality). Children were only presented with stories in a fictional format and so this study did not address children's interpretation of an actual violation of physical laws. Therefore, it is of interest to further explore young children's magical thinking directly. The next two studies in the current thesis will present children with a conjuring demonstration and focus on their interpretation of the event and address their concept of "magic".

### CHAPTER 3:

#### **STUDY 2 - Does repetition of a question regarding a magical demonstration alter children's causal explanations?**

*“Constant repetition carries conviction”. (Robert Collier)*

Children are exposed to repetition in many ways. For instance, learning multiplication tables at school or songs such as “ten green bottles sitting on a wall” both involve repetition. Chandler and Lalonde (1994) have used this principle of repetition to examine the extent to which preschool-aged children are willing to invoke magic to explain an event that appears to violate a known physical law. They claim that repetition of an unusual event causes young children to quickly shift from “magical” to “trick” explanations. However, the current study proposes that children may misinterpret repetition as conveying a necessity to alter their responses or respond inconsistently or in an appropriate way to satisfy what they perceive is expected. Therefore, Study 2 of the current thesis was concerned with investigating the effects of repetition on young children's interpretation of a coin trick. Specifically, it focused on the possible influence of a specific task demand in the form of repetitive questioning on young children's causal explanations of the event. In so doing, it aimed to critically evaluate Chandler and Lalonde's claim that young children will think in terms of trickery as opposed to magic after a series of trials because of repetitive viewing and when given the opportunity to examine apparatus. The current

study tested an alternative proposal that children may change their responses over a series of trials because of repetitive questioning.

A good deal of work in cognitive development has suggested that young children rapidly start to interpret events in the light of appropriate causal principles based on laws of physics (Gelman & Wellman, 1992). Magical events violate everyday causal principles. One type of implies violation of the fundamental law of object permanence, such as if a physical object spontaneously disappears without a trace and without a clear physical mechanism being a reason for this. Subbotsky (2001) refers to this as “non-permanence magic”. Piaget (1954/1986) defined the concept of object permanence as the belief that a physical object continues to exist after it disappears from the perceptual field. He established that children understand object permanence around the age of two years, when they start handling manual objects in accord with the objects’ physical and spatial properties.

Numerous studies have examined under what conditions children are willing to label events as “magic” that violate some law of physics (e.g., Chandler & Lalonde, 1994; Johnson & Harris, 1994; Phelps & Woolley, 1994; Subbotsky, 2004). As was discussed in Chapter 1 of this thesis, various researchers have suggested that children often revert to non-naturalistic causal explanations (based on magic) when they are unfamiliar with a phenomenon and are unable to explain it in any reasonable physical manner (e.g., Berzonsky, 1971; Chandler & Lalonde, 1994; Phelps & Woolley, 1994). Both Chandler and Lalonde, and Phelps and Woolley claim that children aged four, six, and eight years quite often use the word “magic” simply to mark phenomena for which they lack immediate physical explanations. Therefore, insufficient knowledge and lack of understanding appear to be the most important determinants of children’s magical responses when shown an apparent violation of a physical law. It seems that

the more knowledge a child possesses about physical phenomena, the less likely they are to resort to magical explanations.

Chandler and Lalonde (1994) presented young children with a display similar to that used in one of Baillargeon's infant habituation studies (Baillargeon, 1991). They found that when 3-5-year-old children initially witnessed what appeared to be one solid object passing unhindered through a space already occupied by another solid object (i.e. a blatant violation of a physical principle), over half of them labelled the event as magical. Yet over the course of three repeated viewings and further questioning almost all judged it to be a trick. They suggest that when faced with a clear violation of expectation, children are initially willing to label an event as "magic" but abandon this explanation when given the opportunity to consider alternative explanations by examining the apparatus. The authors propose that the initial responses of "magic" only refer to parlour magic because if the children had used "magic" as a reference to the notion of the truly supernatural, then after offering a magical account in trial one they should not apparently abandon this explanation in subsequent later trials by going on to search for evidence of trickery. In a review, Harris (1994) proposes that what children meant by describing the event as "magic" was precisely that it violated a firmly held physical principle (one solid object cannot pass through another). Children know this to be impossible even though it has happened before their eyes. At this point, therefore, children are categorizing the event as one that creates a conflict between what they have seen and what they know to be possible. They are not offering any explanation for how the conflict has come about, such as supernatural powers. Only when given an opportunity to explore the apparatus do they discover the explanation: the experimenter is using trick apparatus. These researchers imply that children use the term "magic" when they are unaware of

the mechanism behind an apparent violation of an event or that the underlying causal mechanism is not readily observable.

However, the switching of the child's response in Chandler and Lalonde's (1994) study from "magic" to "trick" may have nothing to do with their responses representing a true belief or realization of the demonstration as being a trick. Instead it may simply reflect the child's expectation of what they think the experimenter wants to hear, as a consequence of repeated questioning. They may mistakenly think that the experimenter asks the question again because he or she wants a different answer. The most prominent search for the effects of demand characteristics of a task has been explored in experiments on conservation whereby researchers have found that children change answers to repeated questions (e.g., Dent & Stephenson, 1979; Donaldson, 1978; Goodman & Reed, 1986; Moston, 1990; Pratt, 1990; Rose & Blank, 1974; Siegal, 1997; Siegal, Waters, & Dinwiddy, 1988). One of the most powerful empirical demonstrations was provided by Rose and Blank. They varied the traditional number conservation experiment slightly by asking one question rather than two. The usual procedure is to show the child two identical rows of counters side-by-side and ask whether they are the same in number (the answer almost invariably is "yes") and then to lengthen or shorten one of the rows and ask the same question once again. Rose and Blank's variation was to drop the pre-transformation question and only to ask the child to compare the rows after the transformation. Children who failed the traditional task often succeeded when one question only was asked. Samuel and Bryant (1984) suggest that the child's error in the conservation task has nothing to do with the transformation but is simply a misinterpretation of what the experimenter wants to hear (i.e. it implies that the first answer was not acceptable and should be switched).

Many experimental studies seeking to determine children's magical beliefs have also used repetition in one form or another. Some have shown numerous similar tasks or trials that involve similar prolonged questioning (e.g., Johnson & Harris, 1994; Phelps & Woolley, 1994; Rosengren & Hickling, 1994; Rosengren, Kalish, Hickling, & Gelman, 1994; Subbotsky, 2004). Studies have also included pre- and post-transformation questions (e.g., Johnson & Harris, 1994; Phelps & Woolley, 1994; Rosengren & Hickling, 1994; Subbotsky, 2004, 2007, 2009). For instance, children have been asked to make predictions as to whether a transformation can occur and then are shown the apparent transformation. Hence some children's earlier views may be compromised. Furthermore, in Rosengren and Hickling's study children were prompted with answers if they did not respond or stated that they did not know how an event had occurred. As a result many of the children in these studies may have been merely pressured by the experimenter to abandon firmly held causal principles. Rosengren and Hickling found that when questioned hypothetically and prior to viewing transformations, most 4- and 5-year-old children denied the reality of "impossible" transformations (i.e. classic magic tricks, such as two coloured dots changing colour by pressing on them). Yet, after seeing the impossible events many 4-year-olds changed their minds and acknowledged these events to be really magical. Subbotsky (2004) argues that if children change their minds during such experiments then it shows beliefs are not entrenched. However, this thesis proposes that change in children's responses may reflect compliance towards the experimenter. Ordinarily we do not repeat requests when an answer has already been given and this may be linked to conflicting reports about what children actually mean by "magic". Yet despite the importance of the issue, sensitivity to the experimenter's intent in these contexts has received little attention to date.

## **Study Aim**

The main aim of Study 2 was to investigate whether repetition alone influences children's causal responses regarding a demonstration of vanishing coins (i.e. a coin trick). To this end, it aimed to assess critically Chandler and Lalonde's (1994) claim that most children will initially respond "magic" following an apparent violation of object permanence, as the demonstration is inexplicable to the child, but after repeated trials or after the child explores the apparatus most will say "trick". Furthermore, the present study aimed to assess Chandler and Lalonde's claim that children will not change responses if initially they respond in terms of trickery.

Study 2 also sought to examine children's responses to further questioning about the demonstration and, finally, "magic" and "trick" concepts in general in order to systematically address which of these more subtle descriptions most accurately characterized children's responses in the coin trick. As was discussed in the opening chapter, some investigators point out that the real issue when addressing children's conceptions of apparent violations of physical laws is the extent to which children engage in magical thinking. Do they truly believe magic to be a real, supernatural force as opposed to only being an explanation referring to tricks as in parlour magic or sleight-of-hand (e.g., Johnson & Harris, 1994; Phelps & Woolley, 1994; Rosengren & Hickling, 1994)? Likewise, children may view the coin demonstration as a trick even if they labelled it as "magic". Some studies have not given an alternative choice to magic as an explanation as opposed to whether an outcome can happen in a certain manner (e.g., Johnson & Harris, 1994; Subbotsky, 1997). For instance, Subbotsky (1997) only asked children if a postage stamp splitting in half was due to magic or not. Children's explanations of causal events may be subtle and complex. Therefore, in order to minimize ambiguity in the interpretation of responses, the interview aimed

to ensure those who gave non-permanent answers did indeed mean a genuine magical change of the coins and not another term for a trick change involving an explicable though hidden mechanical change or sleight of hand. It should be noted that for this same purpose of reducing ambiguity in the interpretation of answers that contained references to magic, children throughout the studies in the thesis were given a causal response choice of “magic” or “trick” for the conjuring demonstrations.

Four- to 6-year-old children were selected specifically because most theory has tended to focus on younger children up to age six. Indeed, Rothbaum and Weisz (1988) described a magical stage up to six years of age. There is also evidence that at this age children are still prone to magical belief (Subbotsky, 2007), that 4- and 5-year-olds quite often refer to magic when asked to explain tricks (Rosengren & Hickling, 1994) and Rosengren and Hickling (2000) consider that magical thinking peaks at six years of age and declines thereafter.

**It was hypothesised that:**

If Chandler and Lalonde (1994) are right, the following hypotheses would follow:

- 1) Children who are repeatedly questioned will be less likely to switch “trick” responses than to switch “magic” responses regarding a coin trick.
  
- 2) Children who repeatedly view a coin trick will be less likely to retain “magic” responses than to retain “trick” responses.

3) Finally, children who view a coin trick once will be less likely to give “trick” responses than children who repeatedly view it, or repeatedly view it and are then given the opportunity to examine the apparatus.

## **Method**

### **Participants**

One hundred and thirty-nine children (70 males and 69 females) participated in the study. They ranged in age from four to six years of age (mean 59.27 months). The children in the study attended a S.E. London primary school and were predominantly from middle class backgrounds although this was not directly assessed. Ethnicity was not systematically recorded (although anecdotally the children were predominantly white).

### **Design**

The study used between-samples design with experimental condition as the independent variable and various verbal responses to the demonstration as the dependent variables. The details of presentation of the coin trick varied between the experimental conditions as described below. A correlational design was also incorporated that included follow-up questions on children’s concepts of “magic” and “tricks”. There were approximately equal numbers of children in the three experimental conditions (47 in Condition 1, 47 in Condition 2, 45 in Condition 3).

## **Materials**

The apparatus that was employed was a commercially available “coin trick”, consisting of an empty cylindrical metal cap and what appeared to be a genuine stack of five coins. In fact there was only one actual ten pence coin resting on an apparent stack of four coins which were stuck together (see Figure 2.1). A videotape of the trick was shown on a portable television screen, with the screen measuring 32 cm wide and 24 cm high.



**Figure 2.1: Coin Trick Apparatus**

## **Procedure**

All 139 children were tested individually in a private room by the same experimenter. The children and the experimenter sat at a table next to one another. The television was situated in front of them, approximately two feet away. The experimenter ensured that all children had a clear view of the television screen. Children were only told that they were going to be shown something on the television screen. An edited videotaped demonstration of an adult making an apparent stack of coins disappear under a gold circular container was shown individually three times via a television screen with no sound. Specifically, the children only saw someone’s hand and the

apparatus in close up. This was so that the focal point was the action on the apparatus itself and not the legitimacy of the person performing the action. Children were shown the empty cap first. Then the stack of coins was covered with the cap and pressed gently downwards. The cap was then turned over to show that the coins had disappeared. In actual fact, the coins were hidden in the cap. Children were randomly allocated to one of three conditions:

#### *Condition 1*

Children were shown the videotape of an adult making coins disappear, followed by the experimenter putting the videotape on pause and asking them, “Was that magic or a trick?” The video was then pressed to play again and the children were shown the coins being made to disappear again. The videotape was then put on pause again and children asked, “Was that magic or a trick?” Children were then shown the coins being made to disappear a final time, followed by the video being paused and being asked, “Was that magic or a trick?” In total, the videotape was paused three times and the child asked the same question three times.

#### *Condition 2*

Children were shown the videotape of an adult making coins disappear three times, without any pauses. They were then asked “Was that magic or a trick?”

#### *Condition 3*

Children were shown a videotaped demonstration of a person making coins disappear three times without a pause. They were then given the apparatus as shown at the end of the demonstration on the videotape (i.e. with the coins hiding in the container) and

told that they could handle the apparatus if they wanted to. After approximately 30 seconds of handling the apparatus the children were asked, “Was what you saw on the videotape magic or a trick?”

For children in all three conditions, the question was counterbalanced (to control for order effects) so that half of them were asked, “Was that magic or a trick?” and half of them were asked, “Was that a trick or magic?” Responses were noted down. All the children were then asked two follow-up questions about the demonstration. A post-demonstration interview was then carried out questioning children about their concepts of magic and tricks. Responses were once again noted down. The extended questions were included as simply asking children whether the demonstration was “magic” or a “trick” did not fully address children’s underlying concept or understanding of the event. The questions were in the following order:

- 1) Do you know how the person made the coins disappear? (*If the answer is “Yes”, children are asked, “Where are the coins?”*)
- 2) Can anyone make the coins disappear?
- 3) Do you know what magic is? (*If the answer is “Yes”, children are asked, “What is magic?”*)
- 4) Is magic something real or is it just tricks?
- 5) Do you know what a trick is? (*If the answer is “Yes”, children are asked, “What is a trick?”*)
- 6) Can you do magic?
- 7) Can a friend do magic?

- 8) Can a family member do magic? (*Prompt: mummy, daddy, brother, sister, aunt, uncle*)
- 9) Can your teacher do magic?
- 10) Can a magician do magic?
- 11) Can anyone learn magic or do you need special powers?

## **Results**

The present study assessed verbal responses to a coin trick, followed by consideration of children's concepts of "magic" and "tricks". Initially the Results section presents the descriptive data for the responses specifically related to the coin trick followed by differences in responses between the three conditions. Next, descriptive data are presented for children's concepts of "magic" and "tricks" followed by differences between the two concepts. Non-parametric statistics were used throughout in the form of either chi-square analyses or Fisher's Exact Test of probability and, where applicable, two-tailed tests were used. It should be noted that a small number of children failed to give definitive answers regarding some interview questions as indicated in tables by "don't know" or by stating "both" or "neither". Therefore, they were eliminated from further analyses throughout this study. This included four children in relation to the coin demonstration, and between one and eleven children in relation to magic and trick concepts.

## **Coin Trick Demonstration**

The responses to the coin trick are presented in Table 2.1. This table shows that in all three experimental conditions children were more likely to state that the

demonstration was “magic” rather than a “trick” (apart from children’s second response in Condition 1). This suggests that more children in all three conditions were credulous towards the demonstration (i.e., not sceptical). The differences between the three conditions regarding their responses of both “magic” and “trick” appear to be minimal and indicates that repeated viewing and being given the opportunity of examining apparatus may not have been necessarily linked to children giving a “trick” response.

**Table 2.1: Frequency of 4-6-year-olds’ Causal Responses in the Coin Demonstration**

<b>Condition</b>	<b>Magic</b>	<b>Trick</b>
Condition 1(N=47)		
1 <sup>st</sup> response	25	22
2 <sup>nd</sup> response	20	27
3 <sup>rd</sup> response	30	17
Condition 2 (N=47)	28	19
Condition 3 (N=45)	23	22

However, on close inspection of Table 2.2, nearly half of the children in Condition 1 changed their first response to a different one on their second response. This change is also apparent in terms of children’s second and third responses. These changes may reflect response expectation rather than actual beliefs, especially as more

children appeared to change on their third response from “trick” to “magic”, as opposed to changing from “magic” to “trick”.

**Table 2.2: Frequency of 4-6-year-olds’ Causal Responses in the Coin Demonstration for Condition 1**

<b>Differences between children’s 1<sup>st</sup> and 2<sup>nd</sup> response</b>	<b>Differences between children’s 2<sup>nd</sup> and 3<sup>rd</sup> response</b>	<b>Differences between children’s responses throughout all three responses</b>
Changed to Magic = 8 Changed to Trick = 13  Retained Magic = 12 Retained Trick = 14	Changed to Magic = 16 Changed to Trick = 6  Retained Magic = 14 Retained Trick = 11	From Magic to Trick to Magic = 10 From Trick to Magic to Trick = 4 From Magic to Magic to Trick = 2 From Trick to Trick to Magic = 6 From Trick to Magic to Magic = 4 From Magic to Trick to Trick = 3  Retained Magic = 10 Retained trick = 8
Total Changed = 21 Total Retained = 26	Total Changed = 22 Total Retained = 25	Total Changed = 29 Total Retained = 18

These data suggest that children’s change in responses may be due to a task demand effect in the form of repetitive questioning rather than their true beliefs, particularly as 14 out of 21 children’s responses consistently changed throughout, with 10 changing from “magic” to “trick” and finally back to “magic”. Conversely, only four changed from “trick” to “magic” and finally back to “trick”.

Some children appeared to be committed to and credulous of the demonstration being an example of magic as they did not switch “magic” responses throughout (10 out of 47 children) and some children appeared to be completely sceptical of the demonstration as they did not switch “trick” responses throughout (eight out of 47).

### Condition 1

In order to assess whether there were any significant changes or not between children’s first response of “magic” or “trick” and second response to the coin demonstration, a 2 x 2 chi-square analysis was carried out. A non-significant result was found ( $\chi^2 (1) = 0.61, p = 0.43$ ). Children who repeatedly viewed the demonstration and who were repeatedly questioned were just as likely to alter or retain an initial response, whether it was a “magic” or a “trick” one. Of those children who did switch responses, eight changed from a first response of “trick” to a second response of “magic” whereas 13 changed from a first response of “magic” to a second response of “trick”. Conversely, of those children who did not change responses, 12 retained a “magic” response whereas 14 retained a “trick” one. These results imply that children who changed responses may have been succumbing to experimenter demands, particularly the ones who changed from initially stating “trick” to stating “magic”. Past research predicts that once children have become aware of trickery as indicated in “trick” responses they should not then switch responses in subsequent viewings.

Following on from this, a 2 x 2 Fisher’s Exact Probability test was carried out in order to assess whether children who had responded consistently on the first two trials would be more likely to change their previous responses on the third trial if their

previous responses had been “magic” as compared with “trick”. A non-significant result was found (Fisher’s Exact Test,  $N = 26$ ,  $p = 0.22$ , two-tailed). Once again, children were just as likely to retain a “magic” response as a “trick” one (i.e., ten children retained “magic” responses and eight children retained “trick” responses) and they were just as likely to switch responses regardless of whether they stated “magic” or “trick” (i.e., six changed from “trick” to “magic” and two changed from “magic” to “trick”). Once again, the switching of children’s responses may simply be a consequence of the demands of repetitive questioning rather than of being able to examine the apparatus (and discover how the demonstration was performed) as past research predicts that fewer children should have changed responses if the first two responses were “trick” and more children should have changed if the first two responses were “magic”.

#### All Three Experimental Conditions

A 2 x 3 chi-square analysis was carried out in order to assess whether there were any significant differences between the three conditions regarding “magic” or “trick” responses to the coin demonstration. The first response was used for Condition 1 in order to compare responses following a single viewing, repeated viewing alone, and repeated viewing combined with exploring the apparatus. No significant differences were found between viewing a demonstration only once (as in Condition 1, first response), viewing it repeatedly (as in Condition 2), and viewing it repeatedly and viewing the apparatus in reality (as in Condition 3) ( $\chi^2 (2) = 0.69$ ,  $p = 0.73$ ). Repeated viewing or being given the opportunity to examine the apparatus did not elicit more “trick” responses than “magic” responses.

In order to further assess any possible influence of experimental condition on children's responses, children in Condition 1 were compared with children in Condition 3. As past research predicts that children will be less likely to alter an initial response of "trick" over a series of trials, children in Condition 1 who gave a first response of "trick" were selected, and their second responses ("magic" or "trick") were compared with children's responses in Condition 3. A non-significant result was found ( $\chi^2 = 1.29, p = 0.26$ ). Children in Condition 1 were just as likely to state "trick" or "magic" (on their second response) as children in Condition 3 (i.e. in Condition 1, of the children who had given "trick" as their first response, 14 stated "trick" and eight stated "magic" as their second response, and in Condition 3, 22 children stated "trick" and 23 children stated "magic"). This implies that "trick" responses were not dependent on exploration of the apparatus and so such exploration was not a crucial factor.

### **Questions Regarding the Coin Trick Demonstration**

The responses to the extended questions regarding the coin trick are presented in Table 2.3. As can be seen from the total count (and each condition), children were more inclined *not* to know how the coins had disappeared and claimed that *not* anyone can make them disappear. Those children who had responded "Yes" to knowing how the person had made the coins disappear were asked to give an explanation. Responses were coded as: 1= no explanation, 2 = a descriptive explanation of what they had literally seen visually (e.g., putting a lid on the coins), 3 = trickery (i.e. mentioning the word "trick" or inferring that the coins were still in the container), 4 = magical (i.e. explicit mention of the word "magic" or the use of a magical component

such as a wand). Forty-six out of 61 children gave an explanation, and the most frequent explanations were of a descriptive nature that does not necessarily reflect knowledge of the underlying mechanism of the demonstration. Children's explanations or lack of them did not specify either credulity or scepticism of the demonstration being an example of magic. Although 15 children were unable to give any explanation, this may reflect lack of verbal skills in the young children (particularly if they considered the demonstration a magical occurrence that is inexplicable by its very nature). Alternatively it may be that some children had not really known how the coins had disappeared when they had previously responded "yes" to knowing how. Importantly, only nine out of 61 children gave a magical explanation (despite more children giving a "magic" response when asked if what they had seen regarding the coin demonstration was "magic" or a "trick"). This implies that many children's "magic" causal responses may not represent real magic but possibly another term for trickery.

**Table 2.3: Frequency of 4-6-year-olds' Responses about the Coin Demonstration**

<b>Condition</b>	<b>N</b>	<b>Do you know how the person made the coins disappear?</b>	<b>Can anyone make the coins disappear?</b>	<b>How did the coins disappear? (Of those children who claimed to know how the person made the coins disappear)*</b>
1	47	Yes = 23 No = 24	Yes = 21 No = 25 Don't know = 1	No explanation = 4 Descriptive explanation = 7 Trickery = 9 Magical = 3
2	47	Yes = 18 No = 29	Yes = 15 No = 30 Don't know = 2	No explanation = 4 Descriptive explanation = 12 Trickery = 1 Magical = 1
3	45	Yes = 20 No = 25	Yes = 20 No = 24 Don't know = 1	No explanation = 7 Descriptive explanation = 5 Trickery = 3 Magical = 5
Total Count	139	Yes = 61 No = 78	Yes = 56 No = 79 Don't know = 4	No explanation = 15 Descriptive explanation = 24 Trickery = 13 Magical = 9

\* Condition 1 (N = 23), Condition 2 (N = 18), Condition 3 (N = 20), Total count (N = 61).

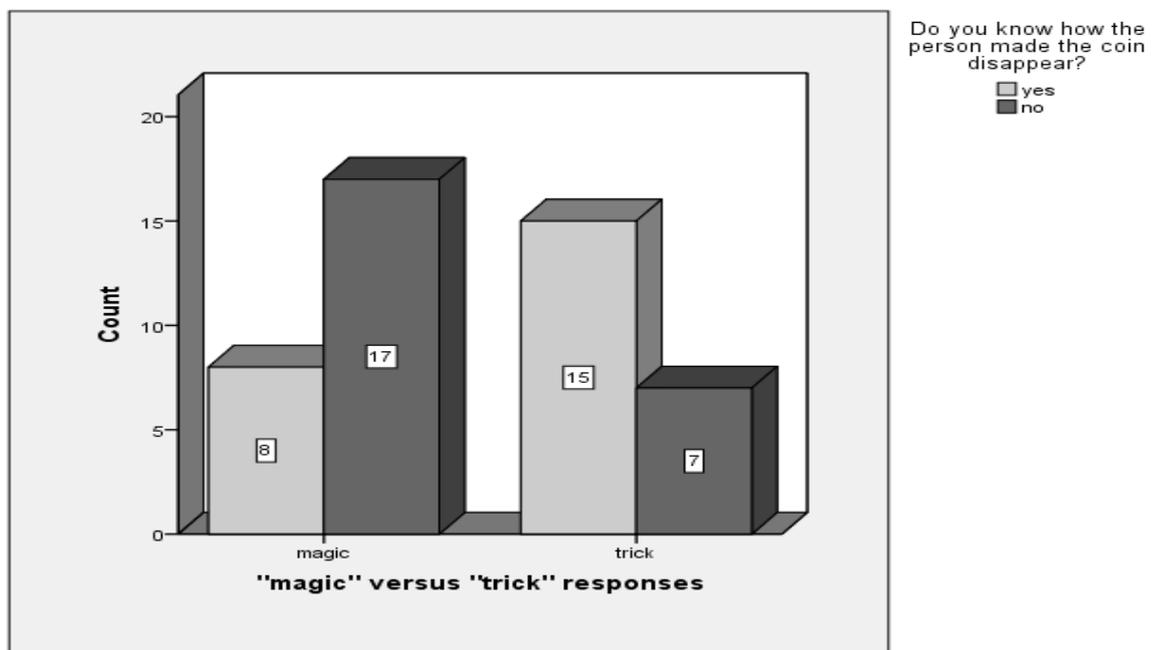
There was a significant association between children claiming to know or *not* to know how the coins had disappeared and stating that anyone can make them disappear or that *not* anyone can make them disappear ( $\chi^2 = 14.91$ ,  $N = 135$ ,  $p = .01$ ). Significantly more children who did *not* know how the coins had disappeared stated that *not* anyone can make them disappear, and conversely, significantly more children who claimed to *know* how the coins had disappeared stated that anyone *can* make

them disappear. This suggests that children who claimed to know how the coins disappeared were aware of a physical action being performed somehow on the coins. A series of analyses were carried out in order to assess possible differences between the three experimental conditions according to children's responses to further questions about the coin demonstration. No significant differences were found between the three conditions and children's responses to the question, "Do you know how the coins disappeared?" ( $\chi^2$  (2, N = 139) = 1.09,  $p$  = .580), or between the three conditions in response to the question, "Can anyone make the coins disappear?" ( $\chi^2$  (2, N = 135) = 1.85,  $p$  = .40). In all three conditions, children were more likely (although not greatly) to claim *not* to know how the coins had disappeared and that *not* anyone can make them disappear. Therefore, whatever particular condition a child was in did not appear to make them more or less likely to understand the mechanism behind the coin demonstration (i.e. repeated viewing or being given the opportunity to explore the apparatus).

### **"Magic" versus "Trick" Responses**

Further analysis was carried out in order to determine if there was a significant association between "magic" versus "trick" responses towards the coin trick and children claiming to *know* or *not* know how the coins had disappeared. "Magic" responses were taken from all three conditions and combined to give a total count. The same selection was made with "trick" responses. Data for Condition 1 was taken from children's first responses (because the first question does not imply that a prior answer was incorrect or otherwise undesirable). No significant association was found ( $\chi^2$  (N = 139) = .65,  $p$  = .42). Therefore, lack of understanding does not appear to be

implicated in children labelling the demonstration as “magic”. However, on examining the experimental conditions separately, although no significant associations were found within Condition 2 or Condition 3, a significant association was found in Condition 1 (after only one viewing of the demonstration ( $\chi^2 (N = 47) = 6.131, p = .013$ ). As Figure 2.2 shows, significantly more children who responded that the demonstration was “magic” claimed *not* to know how the coins had disappeared (i.e. 17 out of 25 children), whereas significantly more children who responded that the demonstration was a “trick” claimed to *know* how the coins had disappeared (i.e. 15 out of 22 children). These results imply that repetition of the event did not assist children in understanding the actual cause of the event or make them more likely to acknowledge trickery. Rather it may potentially obscure or hinder the likelihood of this occurring.



**Figure 2.2: Four- to Six-year-olds’ Causal Knowledge of Coins’ Disappearance (Condition 1 first response)**

### **Interview Regarding Concepts of “Magic” and “Tricks”**

Data relating to children’s concepts about magic and tricks are presented in Table 2.4. A majority of the children stated that they knew what “magic” and “tricks” are. However, they were less able to give a spontaneous definition for “magic”. Children’s definitions were not limited to assigning them to categories of only trickery or magic. This was so that any subtle differences between the two concepts would be exposed and hence the reason behind invoking “magic” rather than “trick” in the demonstration might be revealed. On close inspection of Table 2.4, the most popular answer that children gave by way of a definition for “magic” was that it involves making something disappear or appear. Children also gave this spontaneous explanation most frequently for a “trick” implying that they may interpret magic as being the same as tricks. Alternatively, they may have been responding to what they had physically seen beforehand in the conjuring demonstration. No children defined “magic” specifically in terms of a real supernatural element. However, only five children gave definitions that implied stage magic or conjuring (five children stated “tricks” and one child stated “a show and magician”).

**Table 2.4: Frequency and Percentages of 4-6-year-olds' Definitions for "Magic" and "Trick"**

<u>Question</u>	<b>Total Count (N = 139)</b>
Do you know what magic is?	
Yes	92 (66%)
No	47 (34%)
Do you know what a trick is?	
Yes	81 (58%)
No	58 (42%)
Definition of Magic ( <i>Of those who said "Yes" to knowing what magic is</i> ):	<b>*(N = 92)</b>
No definition	59 (64%)
Make something appear or disappear	27 (29%)
Tricks	5 (5%)
A show / magician	1 (1%)
Definition of Trick ( <i>Of those who said "Yes" to knowing what a trick is</i> ):	<b>*(N = 81)</b>
No definition	25 (31%)
Make something appear / disappear / change	13 (16%)
When trick somebody	12 (15%)
Ambiguous response	9 (11%)
Hide something	8 (9%)
Magic	7 (9%)
Clown/acrobat	5 (6%)
Joking	2 (2%)

\* N represents the number of children who were questioned that differ from the total count of 139 participants in the study.

Table 2.5 gives a further breakdown of children's concepts about magic. Children were questioned on the ability of certain people to "do magic". In terms of a family member, responses were categorized as "Yes" if a child claimed (after

prompting) that any one of the following people could do magic: mother, father, sister, brother, aunt, or uncle. Children appeared to be quite selective in specifying who is capable of doing magic. The majority of the children stated that a magician, and a family member can do magic, but that they themselves, a teacher, or friend cannot. As the majority of the children also stated that magic is “just tricks” as opposed to being “something real”, this suggests that magic is considered another term for trickery. Contrary to this, the majority of the children also stated that “you need special powers” rather than anyone being able to “learn magic”.

No significant association was found for children stating that “magic is just tricks” and can be learnt, or that magic is “real” and requires “special powers” ( $\chi^2 = .47$ ,  $N = 121$ ,  $p = .49$ ). Regardless of whether children claimed that magic is “real” or “just tricks” they were more inclined to state that it requires “special powers”.

**Table 2.5: Frequency and Percentages of 4-6-year-olds' Concepts about "Magic"**

Question	Total Count (N = 139)
Is magic something real or is it just tricks?	
Real	34 (24%)
Tricks	93 (67%)
Both	1 (1%)
Don't know	11 (8%)
Can you do magic?	
Yes	39 (28%)
No	99 (71%)
Don't know	1 (1%)
Can your friends do magic?	
Yes	52 (37%)
No	81 (58%)
Don't know	6 (4%)
Can a family member do magic? (mother, father, brother, sister, aunt, uncle)	
Yes	94 (68%)
No	45 (32%)
Can your teacher do magic?	
Yes	37 (27%)
No	93 (67%)
Don't know	9 (6%)
Can a magician do magic?	
Yes	91 (65%)
No	46 (33%)
Don't know	2 (2%)
Can anyone learn magic or do you need special powers?	
Learn	31 (22%)
Special Powers	99 (71%)
Both	3 (3%)
Don't know	6 (4%)

### **“Magic” versus “Trick” Responses**

In order to determine children’s underlying reasoning behind labelling the coin demonstration “magic” or “trick”, a series of chi-square analyses were carried out in relation to concepts about magic. Total counts were taken from combined “magic” causal responses for all three conditions, as were “trick” causal responses. (Please note that first responses were used for Condition 1). No significant association was found between causal responses and whether magic is considered “real” or “just tricks” or between causal responses and whether magic can be learnt or requires “special powers”. Table 2.6 shows that regardless of whether children had given a “magic” or “trick” response, they were more inclined to state that magic is “just tricks” and that it requires “special powers”. This suggests that many of the children’s “magic” responses in the coin demonstration may have been another label for trickery. However, it is unclear what children’s concepts of “special powers” are.

**Table 2.6: Four- to Six-year-olds’ Causal Responses for the Coin Demonstration and “Magic” Concepts**

<b>Magic Concepts</b>	<b>Magic Causal Response</b>	<b>Trick Causal Response</b>
<b>Is magic real or just tricks?</b>	Real = 20 Tricks = 52	Real = 14 Tricks = 41
<b>Does magic require special powers or can anyone learn magic?</b>	Need Special Powers = 52 Anyone Can Learn = 18	Need Special Powers = 47 Anyone Can Learn = 13

## **Discussion**

The main aim of Study 2 was to empirically assess the proposed link between repetition of a violation of object permanence in the form of a coin trick and 4-6-year-old children's responses in terms of magic or trickery and, in doing so, to critically assess previous claims of Chandler and Lalonde (1994). Study 2 proposed that repetition influences children so that there is a response expectation quite apart from their actual views of trickery versus magic. Therefore, children's switching of responses may be a direct result of experimenter demands through repetitive questioning. A series of non-significant results were indeed found in the current study that point towards supporting this view. Firstly, when repeatedly questioned, children were just as likely to change or retain a "trick" or "magic" response concerning a demonstration of coins that appeared to vanish. According to past research on violation of expectation, children should not alter their response if it is a "trick" one over a series of trials and should be more likely to change if it is a "magic" response as the latter may not truly represent real magic but "mundane sleight-of-hand or parlour magic" (Chandler & Lalonde, 1994, p. 90). The fact that children did change their answers to repeated questions across three trials of the coin trick seems to indicate that demand characteristics (i.e. repetitive questioning by the experimenter) may indeed be influencing children's responses. This is especially apparent as more children give a "magic" response at the end of three trials than at the beginning, and more so than a "trick" one. A second finding that contradicts Chandler and Lalonde is that children should have been more inclined to state "trick" than "magic" after a series of repeated viewings as a result of the event becoming familiar and no longer being unexpected. In fact overall, children in the current study gave more "magic" responses. A third finding that contradicts Chandler and Lalonde's claims is a lack of

significant differences between the experimental condition children were in and responses to the demonstration. Specifically, children in Condition 3 (who were given the opportunity of exploring the apparatus) should have been more likely to say that the demonstration was a “trick” than children in the other two conditions if children’s responses were dependent solely on examining the apparatus. Therefore, the findings imply that exploring the apparatus was not critical in children stating “trick”. However, it should be noted that even though children in Condition 3 saw the coin apparatus in reality, no children actually explored or touched it. They were happy to be spectators and were not interested in playing with the apparatus. As a consequence this may have resulted in the lack of significant differences between the three conditions. Yet 22 children in Condition 3 did not need to explore the apparatus to understand that the event was an example of trickery. This is highlighted in their responses of “trick”. In contrast, 23 children in Condition 3 who responded “magic” may not have been suspicious of the event being a form of deception. Instead they may have regarded the demonstration as real magic. If this was the case, then exploring the apparatus would not have been necessary.

Additional findings point towards the suggestion that physical knowledge about the event and understanding the underlying mechanism of the apparatus was not critical in predicting children’s responses. Children overall were just as likely to give a “magic” or “trick” response regardless of claiming to know or not know how the coins had disappeared. Furthermore, regardless of whether children had given “magic” or “trick” responses, most children were unable to explain how the coins had disappeared (i.e. 54 out of 76 children who had given “magic” responses versus 38 out of 63 children who had given “trick” responses). Once again, this opposes the idea

that children simply say “magic” when they do not understand the mechanism involved.

An interpretive problem created by children’s responses is one of determining what children’s underlying meaning was behind labelling the demonstration “magic” versus “a trick”. In Condition 1, a number of children appeared to start with a credulous viewpoint towards the demonstration as being magic as opposed to a sceptical one as implied by their first response (i.e. 25 children gave a “magic” response and 22 children gave a “trick” response) and even more children appeared to finish with a magic viewpoint after three repeated viewings and questions (i.e. 30 children gave a “magic” response and 17 gave a “trick” response). However, if they truly believed the demonstration to be an instance of a real supernatural force, then children who were repeatedly questioned should not have abandoned this by responding in terms of trickery. Conversely if children were truly sceptical then they should not have abandoned this by responding in terms of magic. Subbotsky (2004) suggests that children’s changing of responses may reflect a “not entrenched” belief or disbelief in either magic or physical laws of causality. The changing of responses in Study 2 of this thesis suggests that children were conforming to the demands of repetitive questioning. These children may be considered as vulnerable to the “desirability effect”. That is, they are prone to respond in accordance with what they believe adults expect from them (Siegal, 1997). Perhaps 4-6-year-olds’ susceptibility to changing responses was linked to how confident they are socially. Specifically, children may be lacking in social confidence and so judgments that they make are undermined or swayed by repetitive questioning. Similarly, social confidence levels may be linked to whether children search the apparatus or not. This will be addressed further in Study 4.

Children's first responses in Condition 1 may be a true representation of their beliefs towards the demonstration, especially as some children, on their third (and final) response returned to their original response (i.e. ten children changed back to "magic" and four children changed back to "trick"). Indeed, as was discussed previously, Piagetian type conservation experiments report that young children's responses are more accurate when they are asked only once versus several times (e.g., Gelman, Meck, & Merkin, 1986; Rose & Blank, 1974; Siegal et al., 1988). Furthermore, in a study conducted by Moston (1987), children aged six gave significantly more correct responses on first questioning about a staged event as compared to second questioning. Moston concludes that interviewers should be prepared to accept that a child's first answer is probably the best they can give. In Study 2 of the current thesis, some children appeared to be fully committed to the demonstration being an example of magic as they were not deterred throughout from giving a "magic" response when repeatedly questioned (i.e. 10 out of 47 children). Similarly, some children appeared to be completely sceptical of the demonstration as they were not deterred at all from giving a "trick" response throughout (i.e. eight out of 47 children). However, it is unclear from these causal responses alone if those children who did not waiver in their responses did so as they had a committed belief or disbelief in the demonstration being a real magical occurrence in a supernatural sense.

Extended questions regarding the coin trick were included with the aim of giving a clearer understanding of what children meant when they gave "magic" or "trick" causal responses for the demonstration. However, the inclusion of repeated viewings and questioning appeared to obscure children's underlying meaning. As mentioned earlier, in all three conditions children were more likely to claim *not* to

know how the coins had disappeared and that *not* anyone can make them disappear. Importantly, only when assessing the experimental conditions separately was a significant association found: in Condition 1 after one viewing, more children who responded that the demonstration was “magic” claimed *not* to know how the coins had disappeared (i.e. 17 out of 25) whereas more children who responded that the demonstration was a “trick” claimed to *know* how the coins had disappeared (i.e. 15 out of 22). However, no such association was found in Condition 2 or Condition 3. Repetition of the event was not necessarily linked to familiarisation and an understanding of the mechanism and hence being more likely to acknowledge trickery. Another important and key finding was extrapolated from children’s responses to specific questions in Condition 1 after only one viewing: only five percent who had given “magic” causal responses for the coin demonstration and claimed to know how the coins had disappeared, also claimed that magic is “just tricks”. It should also be noted that none of these children who had claimed to know how the coins had disappeared then gave trick explanations. The significant result found in Condition 1 points towards a clear distinction between young children’s use of “magic” versus “trick” terms: children use the term “magic” when they are unaware of why an event has occurred and the term “trick” when they are aware. Therefore, young children appeared to be using “magic” and “trick” terms appropriately: if children know that an event is a trick they should know why it has happened. If children do not know why an event has happened then it is magic. It should be stressed that this only appears to apply when children witness a single viewing of an event and results suggest that repeated viewing confuses or obscures an understanding of children’s meaning behind “trick” or “magic” causal responses and

once again highlight the influence of demand expectation on children's causal responses.

Further questioning on the coin demonstration revealed a number of findings that created ambiguity in definitively knowing what children meant by "magic" or "trick", and whether they do consider the two terms to be distinctive. Firstly, only five out of 76 children who had given a "magic" response gave a further magic explanation after claiming to know how the coins had disappeared. However, four children who had given a "trick" response also gave a magic explanation. Secondly, the most frequent explanation given by children (regardless of whether they had given a "magic" or "trick" response) was that of a descriptive nature depicting what they had literally seen. Children either stated "picking it up", "put a lid on it", or else copied the physical action itself (i.e. 36 out of 139 children). Thirdly, the majority of the children overall (and regardless of whether they gave a "magic" or "trick" response) stated that not anyone can make the coins disappear (i.e. 79 out of 139 children). For the children who gave "magic" causal responses, their lack of further magical explanations do not necessarily reflect a lack of belief in the event being genuine magic. They may have been unable to give any explanation if they consider magic to be inexplicable. Furthermore, they may not have given specific magic explanations as the demonstration was not presented in a magical context. Children were simply responding to what they were physically seeing: the action of a hand over a stack of coins. They may have regarded the demonstration as genuine magic but were unable to explain this because they were not given any other information that is commonly implicated with magic (e.g. showing someone casting a magic spell over the coins or waving a hand over them in a magical way). Perhaps if this had been supplied, children would have been able to explain how the coins had disappeared in

terms of genuine magic. They may associate magic with saying magic words or particular actions but because they didn't actually see any they were unable to say that is how the coins disappeared.

The other primary goal of the present study was to assess the nature of children's magic and trick concepts in general and, in doing so, to give a clearer understanding of what children meant when they gave "magic" or "trick" causal responses for the coin demonstration. A higher percentage of children claimed to know what "magic" (66%) and "tricks" (58%) are than not to know. However, the robustness of children's responses regarding their understanding of magic is called into question as a higher percentage of them were unable to give definitions of what magic is than were able to: 64% who stated that they knew what "magic" is were unable to give a definition whereas only 31% who had stated that they knew what a "trick" is were unable to give a definition for tricks. This may be a consequence of magic actually being a supernatural event that is inexplicable and would add further support to the proposition for why children who gave "magic" causal responses for the coin demonstration were unable to explain how the coins disappeared. Alternatively, it may be a consequence of these questions being open-ended. Indeed, Waterman, Blades, and Spencer (2000) have found that when children are asked questions that require answers other than "yes" or "no", children are unlikely to answer. Therefore, children's inability to define "magic" may reflect a lack of linguistic skills. This may also account for the majority of the children being unable to explain how the coins had disappeared. Evidence was found in support of this as children who were unable to give an explanation for "magic" were more inclined in a subsequent question to claim that it is "just tricks" (i.e. 67 out of 99 children). It is important to mention that although no children defined magic specifically in terms of

a real supernatural element, only a very few children's definitions specifically implied stage magic or conjuring (i.e. six children). In addition, children were most likely to explain that magic is when something appears or disappears which links in with the coin demonstration that they witnessed.

Study 2 provided evidence that 4-6-year-old children understand that magic is not truly genuine. Rather they consider magic the same as tricks. This is highlighted by the fact that the majority of the children claimed that magic is "just tricks". These findings are in keeping with previous research pointing to the ages between four and six being when children change from thinking of magic as real to thinking of it as a trick (e.g., Phelps & Woolley, 1994; Woolley, 1997). Study 2 also provided evidence that suggests that the majority of the 4-6-year-old children's "magic" responses in the coin trick represented another term for trickery and not genuine magic: 52 out of 76 children (in total from all three conditions) who had stated that the demonstration was "magic" subsequently claimed that magic is "just tricks". Likewise, 41 out of 63 children who gave a "trick" response claimed that magic is "just tricks". Therefore, children may have randomly labelled the demonstration as "magic" or "trick" as they considered both terms representing or meaning the same thing. It could be argued that this viewpoint is supported as children's definitions of "magic" and "trick" was both mainly of making something appear or disappear. In particular, 18 out of 27 children who defined magic as making something disappear or appear also claimed that magic is "just tricks". However, it must be stressed that it is understandable these children defined magic as making something disappear since they had just watched a demonstration that involved making coins disappear. Therefore, children's definition of magic matches their causal response for the coin demonstration.

As in other studies investigating children's understanding of magic and tricks, conflict in children's responses arose. Firstly, half of the children (69 out of 139) who stated that "magic is just tricks" appeared to contradict this statement by claiming that "special powers" are also needed. Furthermore, regardless of whether children had given a "magic" or "trick" response to the coin trick, they were more inclined to state that magic requires "special powers" rather than "anyone can learn it" (i.e. 52 out of 76 children who gave "magic" responses and 47 out of 63 children who had given "trick" responses). Secondly, children were selective in asserting who can and cannot perform magic: the majority of the children stated that a magician and family members can, whereas teachers, friends, and they themselves cannot. Children's inclusion of the capability of family members to perform magic implies that magicians are not fantastical entities. Rather they are seen as conjurors who use tricks. However, ambiguity in responses was apparent as the majority of the children who claimed that a magician and family member can do magic also stated that special powers are needed. Unfortunately, the current study did not request that children elaborate on the concept of "special powers" and so the true meaning behind this response is unclear. These findings are in keeping with Rosengren and Hickling (1994) who also found that children aged four years viewed magic as involving special powers possible under the control of an agent (magician). Yet, they also found 5-year-olds viewed magic as tricks that anyone can learn. It is not surprising that children claimed that special powers are required, since what children of four years and older generally view as magic is deeply embedded in the existing, cultural tradition. Typically, in Western cultures, children are acquainted with magic through books, films and stories in which characters with special powers are involved (e.g.,

Harry Potter, Merlin). These characters are considered to change things in the external world through sheer will power or magic spells.

### **Conclusion**

The results of Study 2 showed that 4-6-year-old children will be just as likely to change or retain their answers to repeated questions across three trials of a coin trick regardless of whether they give a “trick” or “magic” response. Therefore, the switching of responses points towards children succumbing to a demand characteristic (i.e. repetitive questioning by the experimenter) rather than a genuine change in children’s understanding of the situation. Furthermore, repetitive viewing, exploring the apparatus, or knowledge of how the coins had disappeared did not yield more “trick” responses.

The majority of the children showed an awareness of magic as just tricks that a magician and family members can perform. Therefore, when children responded that the coin trick was “magic” it is postulated that many were referring to mere conjuring. However, Study 2 created unanswered questions that need to be further investigated. Findings imply that young children’s switching of causal responses regarding a demonstration of vanishing coins may be based on direct social influence. Yet as a consequence of children switching both “magic” and “trick” responses there are inherent doubts about giving definitive answers regarding young children’s causal explanations to apparent violations of object permanence. Although findings lean towards many 4-6-year-olds regarding “magic” as another term for “tricks”, further ambiguity was created in interpreting responses as the majority of the children claimed magic required “special powers”, were discriminatory in who can do magic,

and were less able to define “magic” than “tricks”. Therefore, it remains unclear why some children have a preference for labelling the coin trick “magic” while others labelled it a “trick”, particularly as there was evidence that some children believed the event was an example of genuine magic. This was highlighted by claims that magic is “real” and involves magical elements.

Although Study 2 did not question children’s capacity to explicitly distinguish between magic and tricks, children’s responses to a single viewing of the coin trick gives an idea of what children may mean by “magic” and “trick”. That evidence points to children using the two terms in a distinct and appropriate way: they tended to give “trick” causal responses when they claimed to know how the demonstration worked and were aware of being deceived, and gave “magic” causal responses when they claimed not to know how the demonstration worked and were not aware of being deceived. Furthermore, findings suggest that children who gave “magic” causal responses regard magic as inexplicable and genuine rather than fake as in tricks.

According to Subbotsky (2004), young children (i.e. 6-year-olds) revert to “magic” responses as they may not have an “entrenched” belief in the universal power of physical causality and still hold magical beliefs. Therefore, magical and physical beliefs coexist equally and so children may be prepared to give either a magical or a physical explanation. Conversely, older children (i.e. 9-year-olds) do have an entrenched belief in the universal power of physical causality and, even if they hold magical beliefs, physical causality dominates. Perhaps 4-6-year-olds are more susceptible to magical explanations as they do not have an established knowledge of physical laws of causality. Therefore, children’s tendency to use magic to explain events may be linked to age. It may also account for the change in responses throughout: young children do not have entrenched beliefs or disbeliefs in magic.

Study 3 will attempt to address the possibility of age being a key factor in children's causal responses by testing an older age range.

## CHAPTER 4:

### **STUDY 3 - A second investigation into whether repetition of a question regarding a magical demonstration can alter children's responses**

*“Repetition does not transform a lie into a truth”. (Franklin D. Roosevelt)*

Both in school education and everyday experience children learn that scientific explanations are preferable to non-scientific ones. Children then develop scepticism towards magical events as they consider magic is something that cannot occur in reality. Past studies have shown that magical explanations decline (and disappear) in later childhood (Huang, 1930; Johnson & Harris, 1994; Phelps & Woolley, 1994; Piaget, 1929; Rosengren et al., 1994; Subbotsky, 2004). As discussed in Chapter 1 of this thesis, in their replication of Piaget's early data, Larnedeau and Pinard (1962) reported that in children between five and eleven years of age, physical explanations of natural phenomena gradually replaced pre-causal explanations based on magic. Subbotsky (2001) postulated that credulity towards magic is more difficult to elicit in older children since Westernized children are immersed in a dominant view of the physical world as rational and scientific. They assume that genuine causal violations do not really occur, but only appear to do so by virtue of trickery or deception. As a result, they adopt a more critical stance towards magic, seeking out the familiar causal principles – the trickery that constitutes its real explanation. Based on this premise, Study 3 tested the hypothesis that there may be a developmental progression in the likelihood of children giving “trick” explanations for an apparent violation of object

permanence. Therefore, the main objective was to repeat the coin trick study with an older age range than in Study 2 as there may be an age-related effect on children's causal responses.

Subbotsky (2004) tested 4-, 5-, 6-, and 9-year-old children on the entrenchment of their magical beliefs and their beliefs in the universal power of physical causality. He found that only 6- and 9-year-old children denied that magic could occur in real life (i.e. their ontological judgments). However, when confronted with an anomalous causal event (i.e. a transformation of a physical object in an apparently empty box), 4-6-year-old children accepted magical explanations of the event whereas a large number of 9-year-old children did not. Even if they saw an event that looked like magic, the oldest children discredited the anomalous data and interpreted them as tricks. Furthermore, the older children did not alter their causal explanations (i.e., drop their scepticism toward magic) even after the events that looked like instances of magic were repeatedly shown. Subbotsky proposed the reason for 4-6-year-olds retreating to magical explanations is that their belief in the universal power of physical causality and scepticism toward magic is not entrenched. Conversely, 9-year-olds do have an entrenched belief in the universal power of physical causality and an entrenched disbelief in magic.

Phelps and Woolley (1994) specifically examined developmental changes regarding children's beliefs about magical entities and events. Although they only interviewed children up to eight years of age, there was a growing awareness of magic in the form of tricks and differentiation of real magic from trickery. A majority of 8-year-olds believed magic could be learned, and be done by the experimenter and themselves. All claimed magicians could do magic and existed in the real world. However, there was a decrease with age in assertions that a magician does real magic

and also a decrease in claims that magic witnessed in physical events was real magic. This indicates further children's growing understanding of the concept of magic as trickery.

### **Study Aim**

The main aim of Study 3 was to repeat the coin trick study to extend the age range to include 9-11-year-old children. Nine- to 11-year-old children were specifically selected for the following reasons. Firstly, as past research has found an age-related increase in scepticism towards magic, it is postulated that 9-11-year-olds would be more sceptical in general and so be more inclined to give a "trick" response regarding the coin trick. Secondly, if, as Subbotsky proposed, 9-year-olds have an entrenched disbelief in magic and an entrenched belief in the universal power of physical causality, then the degree of credulity toward the coin trick being "magic" can be expected to be smaller than toward it being a "trick". For this reason, older children may be less susceptible to social influence. Hence they will not be influenced by the experimenter to change an answer if asked a second time. Indeed, Ceci and Bruck (1993) found that when questions are explicitly leading and misleading, preschoolers are more often led by such questions compared to older children. Furthermore, Poole and Lindsay (2001) assessed the impact of misleading suggestions from parents on 3-8-year-old children's eyewitness reports and found that older children are less likely to be influenced by suggestive information than younger children. Thirdly, the tasks designed to test children's understanding of magic invariably require a degree of language comprehension. It would not be implausible to suppose that 9-11-year-old children are linguistically more skilled and developmentally more familiar with the terminology of "trick" and "magic". Therefore, they may be more articulate and

forthcoming when questioned and likely to give more detailed responses. Furthermore, it is unclear whether young children view the violations as real magic (i.e. authentic) or magic tricks, as lack of linguistic skills may be influencing their responses.

The second aim of Study 3 was to refine interview questions in relation to the coin trick. The question, “Do you know how the coins disappeared?” in Study 2 was specifically changed to, “Have the coins really disappeared?” and “Do you know where the coins have gone?” It was hoped that these amendments would clarify the underlying meaning behind children’s “magic” responses. Specifically, a clearer differentiation might be made between real magic whereby the coins have truly vanished versus trick magic whereby the coins are hidden. Finally, along with closed questions requiring one word responses (e.g., “yes” or “no”, “magic” or “trick”), more open-ended questions were incorporated to assess whether children truly understand the questions being asked or are simply guessing due to a simple willingness to give an answer. In particular, a more detailed distinction between children’s “magic” and “trick” concepts might be gained.

**It was hypothesised that:**

Nine- to 11-year-old children have a firm understanding of physical laws of causality and so will tend to be sceptical with respect to the coin trick being genuine magic, and will not succumb to experimenter pressure through repeated questioning. Therefore,

- 1) In all three experimental conditions the older children will be unlikely to accept the demonstration of vanishing coins as being genuine “magic”.

- 2) Older children who are repeatedly questioned will be unlikely to change responses.
- 3) There will be developmental differences in the likelihood of children labelling the coin trick “magic” or a “trick”. Specifically, the younger children in Study 2 (i.e. 4-6-year-olds) will be less likely to give “trick” causal responses and more likely to give “magic” causal responses compared to the older children in Study 3 (i.e. 9-11-year-olds). Furthermore, 9-11-year-olds will be less likely to change causal responses when repeatedly questioned than 4-6-year-olds.

## **Method**

### **Participants**

Ninety-four children (47 males and 47 females) took part in the study. They ranged in age from nine to eleven years of age (mean = 10.7 years). The children in the study attended a S.E. London primary school and were predominantly from middle class backgrounds although this was not directly assessed. Their ethnicity was predominantly white (46 white, 25 black, 23 Asian) with an equal mixture of female and males.

### **Design**

The study used a between-samples design with experimental condition of the coin trick as the independent variable and various verbal responses to the demonstration as the dependent variables. A correlational design was also incorporated that included follow-up questions on children’s concepts of “magic” and “tricks”. There were approximately equal numbers of children in the three experimental conditions (31 in

Condition 1, 32 in Condition 2, 31 in Condition 3). All statistical tests were two-tailed unless otherwise indicated.

## **Materials**

The apparatus that was employed was the same commercially available coin trick as was used in Study 2 (Figure 2.1).

## **Procedure**

All 94 children were tested individually in a separate room by the same experimenter. The procedure was the same as in Study 2. After the coin demonstration all the children were then asked thirteen follow-up questions: three questions about the coin demonstration and then ten questions about their concepts and understanding of “magic” and “tricks”. Responses were noted down for later analysis. The extended questions regarding the coin demonstration were designed to assess more detailed aspects of children’s tendency to invoke “magic” or “trick” responses than in Study 2. It was also hoped that the interview questions would clarify similarities and dissimilarities between the two terms. The questions were in the following order:

- 1) Have the coins really disappeared?
- 2) Do you know where the coins are? (*If the answer is “Yes”, children are asked, “Where are the coins?”*)
- 3) Can anyone make the coins disappear?
- 4) Do you know what magic is? (*If the answer is “Yes”, children are asked, “What is magic?”*)

- 5) Have you seen/witnessed magic before? (*If the answer is “Yes”, children are asked, “When have you seen magic?”*)
- 6) Do you know what tricks are? (*If the answer is “Yes”, children are asked, “What is a trick?”*)
- 7) Have you seen or witnessed tricks before? (*If the answer is “Yes”, children are asked, “When have you seen tricks?”*)
- 8) Is magic something real or is it just tricks?
- 9) Who or what can do magic?
- 10) Who or what can do tricks?
- 11) Can magic occur anytime? (*If the answer is “No”, children are asked, “When can magic occur?”*)
- 12) Can tricks occur anytime? (*If the answer is “No”, children are asked, “When can tricks occur?”*)
- 13) What is the difference between magic and tricks?

## **Results**

The present study assessed verbal responses to a coin trick, followed by consideration of children’s concepts of “magic” and “tricks”. Initially the Results section presents the descriptive data for the responses specifically related to the coin trick followed by differences in responses between the three conditions. Next, descriptive data are presented for children’s concepts of magic and tricks followed by a consideration of differences between the two concepts. Non-parametric statistics are used throughout in the form of either chi-square analyses or Fisher’s Exact Test of probability, and where applicable two-tailed tests were used. It should be noted that a small number of

children failed to give definitive answers regarding some interview questions as indicated in tables by “don’t know”, or by stating “both”, or “neither”. Therefore, they were eliminated from further analyses throughout this study. This included two children in relation to the coin demonstration, and between one and three children in relation to magic and trick concepts.

### **Coin Trick Demonstration**

The responses to the coin trick are presented in Table 3.1. As can be seen from this table, children in all three conditions were more likely to state that the coin demonstration was a “trick” rather than “magic”. This suggests that the majority of the children were sceptical toward the demonstration being genuine magic. Furthermore, the differences between the three conditions, in terms of their responses was minimal and indicates that no particular condition evoked a “trick” response more than any other condition.

**Table 3.1: Frequency of 9--11-year-olds’ Causal Responses in the Coin Demonstration**

<b>Condition</b>	<b>Magic</b>	<b>Trick</b>
Condition 1 (N=31)		
1 <sup>st</sup> Response	7	24
2 <sup>nd</sup> Response	7	24
3 <sup>rd</sup> Response	8	23
Condition 2 (N=32)	7	25
Condition 3 (N=31)	5	26

On close inspection of Table 3.2, one can see that a higher number of children in Condition 1 retained “trick” causal responses. Very few children changed responses. Therefore, 9-11-year-old children were less likely to alter “trick” responses. These findings also suggest that children were not responding to fit with possible expectations of the experimenter. In fact, 18 out of 31 children did not change their response throughout (16 gave a “trick” response and two gave a “magic” response). These data suggest that the children’s change in responses was mainly in the direction of trickery. Only a very few changed in the direction of “magic” and these may be due to a task demand effect in the form of repetitive questioning rather than their true beliefs. Specifically, six out of 31 children changed their responses consistently throughout the three repeated questions. (Two had changed from “magic” to “trick” and finally back to “magic” whereas four had changed from “trick” to “magic” and finally back to “trick”).

**Table 3.2: Frequency of 9-11-year-olds' Causal Responses in Condition 1**

<b>Differences between children's 1<sup>st</sup> and 2<sup>nd</sup> response</b>	<b>Differences between children's 2<sup>nd</sup> and 3<sup>rd</sup> response</b>	<b>Differences between children's responses throughout all three responses</b>
Changed to Magic = 5 Changed to Trick = 5  Retained Magic = 2 Retained Trick = 19	Changed to Magic = 5 Changed to Trick = 4  Retained Magic = 3 Retained Trick = 19	From Magic to Trick to Magic = 2 From Trick to Magic to Trick = 4 From Magic to Trick to Trick = 3 From Trick to Magic to Magic = 1 From Magic to Magic to Trick = 0 From Trick to Trick to Magic = 3  Retained Magic = 2 Retained trick = 16
Total Changed = 10 Total Retained = 21	Total Changed = 9 Total Retained = 22	Total Changed = 13 Total Retained = 18

Condition 1

There was a significant difference in the degree to which children changed or did not change their responses depending on whether they said “magic” or “trick” first (2 x 2 Fisher’s Exact Test, N = 31,  $p = 0.022$ , two-tailed). Five out of seven children changed their first response of “magic” to a “trick” second response. In contrast, only five out of 24 children changed their first response of “trick” to a “magic” second response. Hence, children who were repeatedly questioned were more likely to retain their initial response of “trick” (i.e. 19 children) than retain their initial response of “magic” (i.e. 2 children). These results suggest that most children who were repeatedly questioned were not succumbing to experimenter pressure. Instead they may be more suspicious and aware of trickery.

Following on from this, a 2 x 2 Fisher's Exact Probability test was carried out in order to assess whether children would be more likely on a third attempt to alter their responses as opposed to retain them. Therefore, children whose first and second responses were "magic" or whose first and second responses were "trick" were compared with respect to their third response (whether they changed versus did not change responses on the third trial). A non-significant result was found (Fisher's Exact Test,  $N = 21$ ,  $p = 1$ , two-tailed). Only three out of 19 children who stated "trick" in the first two responses changed on their third response whereas neither of the two children who stated "magic" for their first two responses changed on the third response. This further implies that children were not being influenced by the demands of repetitive questioning by the experimenter.

#### All Three Experimental Conditions

A 2 x 3 chi-square analysis was carried out to assess whether there were any significant differences between the three conditions regarding responses to the coin demonstration. As in Study 2, the first response was used for Condition 1 in order to compare responses following a single viewing, repeated viewing alone, and repeated viewing plus exploring the apparatus. No significant differences were found ( $\chi^2 (2) = 0.48$ ,  $p = 0.79$ ), indicating that the condition the child was in did not affect whether the child responded "magic" or "trick" and that being given the opportunity to examine the apparatus did not elicit more "trick" responses than "magic" responses.

In order to further assess whether children in Condition 1 would be just as likely to state "trick" (rather than "magic") as those in Condition 3, children in Condition 1 who gave a first response of "trick" were selected and their second response (of either "magic" or "trick") was compared with children in Condition 3

using a 2 x 2 Fisher Exact Probability test. A non-significant result was found (Fisher's Exact Test,  $N = 55$ ;  $p = .76$ , two-tailed). Children in Condition 3 were not more likely to state "trick" as opposed to "magic" than children in Condition 1, implying that responses were not dependent on exploring the apparatus. Specifically, in Condition 1, 19 children stated "trick" and five children stated "magic", and in Condition 3, 23 children stated "trick" and eight children stated "magic".

**Comparison of Age Groups between Children in Study 2 and Study 3 regarding the Coin Demonstration**

Following on from this, a 2 x 2 Fisher's Exact Probability test was carried out in order to assess whether there were developmental differences in children's causal interpretation of the coin demonstration. Therefore, the 4-6-year-old children's first responses in Condition 1 were compared with 9-11-year-old children's first responses (i.e. whether it was "magic" or "trick"). A significant result was found (Fisher's Exact Test,  $N = 78$ ,  $p = 0.01$ , two-tailed). Nine-11-year-olds were more sceptical of the demonstration being "magic" than 4-6-year-olds. Specifically, older children were less likely to claim that the demonstration was "magic" and more likely to claim that it was a "trick" than younger children. Seven 9-11-year-olds stated "magic" and 24 stated "trick". In comparison, twenty-five 4-6-year-olds stated "magic" and 22 stated "trick". This further implies a developmental trend in scepticism towards magic causality.

Following on from this, a 2 x 2 Fisher's Exact Test was carried out to assess whether there were any significant age differences between children in Study 2 and children in Study 3 not changing "magic" versus "trick" responses. Using first and

second responses of “magic” and first and second responses of “trick” in Condition 1, 4-6-year-old’s were compared with 9-11-year-old’s. A significant result was found (Fisher’s Exact Test,  $N = 47$ ,  $p = 0.0095$ , two-tailed). Nine-11-year-olds were more likely to retain “trick” responses as opposed to “magic” responses than 4-6-year-olds (i.e. 9-11-year-olds: 19 retained “trick” responses and two retained “magic” responses; 4-6-year-olds: 14 retained “trick” responses and 12 retained “magic” responses). This implies that older children have a firmer understanding of what they are witnessing as trickery.

### **Questions Regarding the Coin Trick Demonstration**

The responses to the extended questions about the coin demonstration are presented in Table 3.3. As can be seen from the total count (and inspection of data from the three conditions), the majority of the children stated that the coins had not really disappeared and the majority of the children stated that they knew where the coins had gone. However, they were unable to give an explanation for how the coins disappeared. As most children acknowledged that the coins had not really disappeared, this suggests that children were aware that the coins were hidden in some way although not necessarily of the actual mechanism involved. This viewpoint is supported by the fact that 13 out of 14 children who gave an explanation stated that the coins were “hidden”. Although the majority of the children stated that *not* anyone could make the coins disappear, their responses do not necessarily reflect a belief that this is due to lack of magical powers. It may simply be that some people are not able to do it because they have not learnt how to, particularly as most children claimed that the coins had not really disappeared.

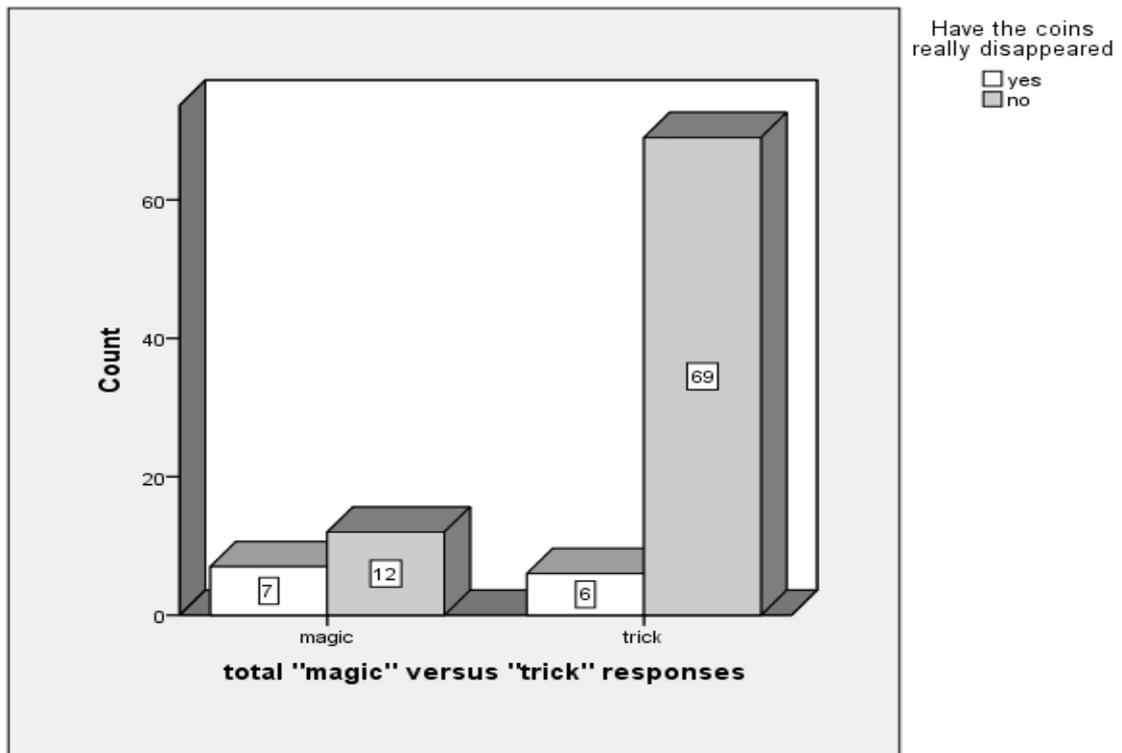
**Table 3.3: Frequency of 9-11-year-olds' Responses about the Coin Demonstration**

Condition	N	<i>Searched apparatus and found coins?*</i>	Have the coins really disappeared?	Do you know where the coins have gone?	Explanation for where the coins have gone?	Can anyone make the coins disappear?
1	31	N/A	Yes = 4 No = 27	Yes = 19 No = 12	No explanation = 25 Hidden = 6 Magic = 0	Yes = 13 No = 16 Don't know = 2
2	32	N/A	Yes = 4 No = 28	Yes = 20 No = 12	No explanation = 29 Hidden = 2 Magic = 1	Yes = 14 No = 18
3	31	Yes = 5 No = 26	Yes = 5 No = 26	Yes = 17 No = 14	No explanation = 26 Hidden = 5 Magic = 0	Yes = 12 No = 19
Total Count	94		Yes = 13 No = 81	Yes = 56 No = 38	No explanation = 80 Hidden = 13 Magic = 1	Yes = 39 No = 53 Don't know = 2

\*Observed reaction to the demonstration

Importantly, although children in Condition 3 were given the opportunity of examining the coin trick apparatus, the majority of them did not do so and as a consequence did not find the coins. All five children who did search the apparatus found the coins, and stated they knew where the coins were (but were unable to give an explanation) and responded that the demonstration was a “trick”. However, regardless of whether children searched the apparatus, most children stated “trick” anyway. Therefore, examining the apparatus was not crucial in detecting trickery.

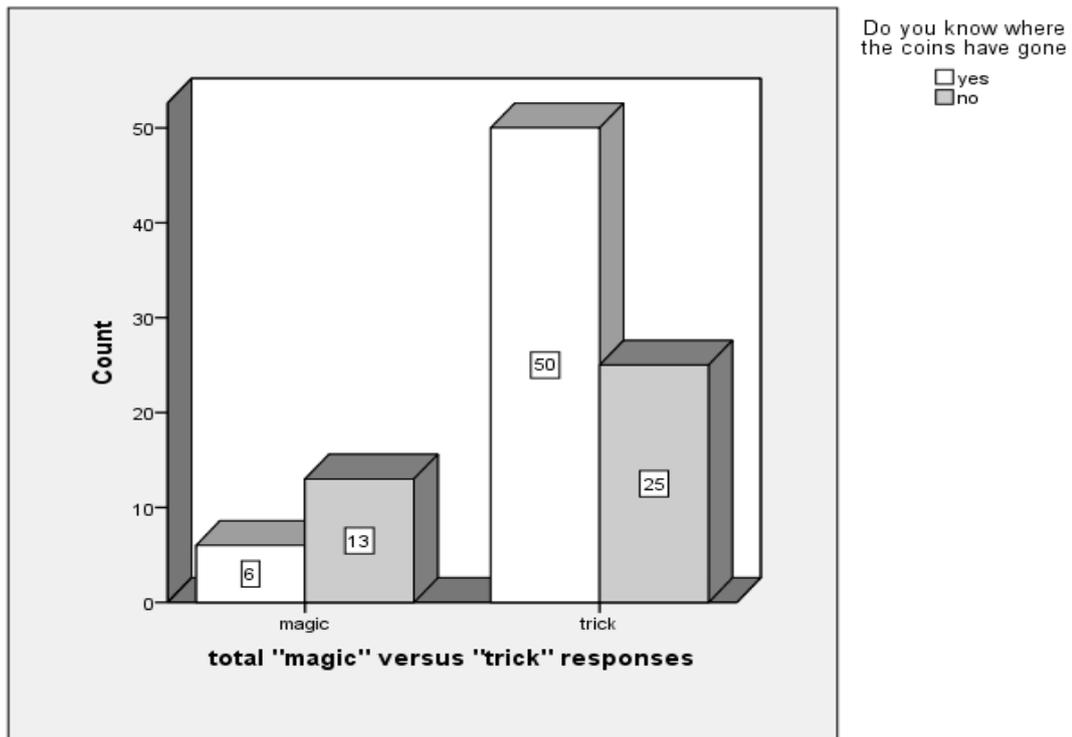
Combined “magic” responses and combined “trick” responses were totalled in order to determine if there were any significant differences regarding total “magic” versus “trick” responses and children stating whether the coins had really disappeared or not, and whether they knew where the coins had gone. As in Study 2, data for Condition 1 was taken from children’s first responses on the assumption that they should be more accurate than their responses to repeated questions because the first question does not imply that a prior answer was incorrect or otherwise undesirable. Most children who had given a “magic” or a “trick” response claimed that the coins had not really disappeared (i.e. 12 out of 19 children who gave a “magic” response versus 69 out of 75 children who gave a “trick” response). However, significantly more children who gave a “trick” response claimed that the coins had not really disappeared than had disappeared compared to children who gave a “magic” response ( $\chi^2 (1, N = 94) = 10.58, p = .001$ ). Figure 3.1 illustrates these findings.



NB: Total responses were taken from Condition 1 (1<sup>st</sup> response), Condition 2, Condition 3.

**Figure 3.1: Frequency of “Magic” and “Trick” Responses in 9-11-year-old Children**

A significant relationship was also found between children’s total “magic” versus “trick” responses and claims of knowing where the coins had gone ( $\chi^2 (1, N = 94) = 7.75, p = .005$ ). As Figure 3.2 illustrates, children who responded “magic” were significantly more likely to claim *not* to know where the coins had gone whereas children who responded “trick” were significantly more likely to claim to *know* where the coins had gone.



NB: Total responses were taken from Condition 1 (1<sup>st</sup> response), Condition 2, Condition 3.

**Figure 3.2: Frequency of Coin Location Knowledge in 9-11-year-olds who responded “Magic” or “Trick”**

Taken together, the results revealed that most children who gave “trick” responses believed that the coins had not really disappeared but did claim to *know* where they had gone. Most children who gave “magic” responses also believed that the coins had not really disappeared even though they stated they did *not* know where they had gone. Therefore, it would seem that most children’s “magic” responses represented fake magic and that the factor that determined whether children responded “magic” rather than “trick” was mainly their lack of knowledge regarding where the coins were actually hidden and not lack of knowing that they had not really disappeared.

### **Interview Regarding Concepts of “Magic” and “Tricks”**

As can be seen in Table 3.4, the interview questions revealed considerable familiarity with magic and tricks. The majority of the children stated that they knew what “magic” was and also what a “trick” was and were able to give definitions of both. Magic and trick definitions were categorized as “tricks” accordingly if children mentioned the word “trick”, “illusion”, “pretending”, or “lying”. On close inspection of children’s definitions of magic and a trick, there was a trend toward more often claiming that both involve either making something appear or disappear, or are tricks in the form of an illusion, fooling, lying or pretending. This suggests that they regard magic being the same as tricks and is supported by the fact that the majority of children claimed that magic is “just tricks” as opposed to “something real”. Only four children’s definitions of magic might be construed as involving supernatural elements: they claimed that magic is what wizards or witches do. However, these same children also stated that magic is “just tricks”. Furthermore, although eight children claimed that magic is “extraordinary happenings” and two children claimed that it is “unexpected occurrences”, all 10 of them also claimed that magic is “just tricks”. Taken together, these responses indicate that the children in the present study did not consider magic to be truly magical in a supernatural sense.

**Table 3.4: Total Frequency and Percentages of 9-11-year-olds’ Concepts of “Magic” and “Tricks”**

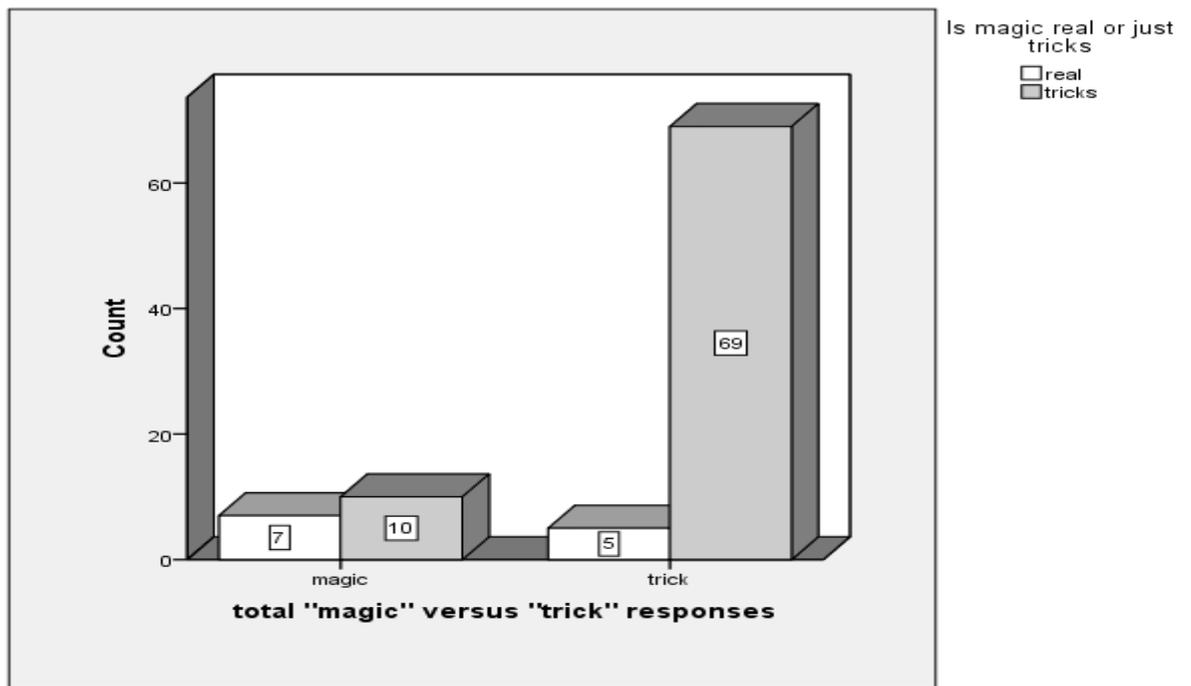
Question	Total Count (N = 94)
Do you know what magic is? Yes No	81 (86%) 13 (14%)
Do you know what a trick is? Yes No	85 (90%) 9 (10%)
Definition of Magic ( <i>Of those who responded “Yes” to knowing what magic is</i> ):	<b>*(N = 81)</b>
No explanation	9 (11%)
Make something appear or disappear	28 (35%)
Tricks / illusion/ pretending	24 (30%)
Extraordinary happenings	8 (10%)
What wizards/witches do	4 (5%)
Obscure response ( <i>unintelligible</i> )	3 (4%)
Unexpected occurrences	2 (2%)
Real things	2 (2%)
Fantasy	1 (1%)
Definition of Trick ( <i>Of those who responded “Yes” to knowing what a trick is</i> ):	<b>*(N = 85)</b>
No explanation	7 (8%)
Tricks (fooling/pretending/lying/illusion)	48 (56%)
Make something appear / disappear / change	10 (12%)
Like / Same as Magic	8 (9%)
Hide something	7 (8%)
Looks like magic but not	2 (2%)
Inexplicable occurrence	2 (2%)
Opposite of Magic	1 (1%)
Is magic something real or is it just tricks? Real Tricks Both	12 (13%) 79 (84%) 3 (3%)
Can anyone learn magic or do you need special powers? Learn Special Powers Neither	78 (83%) 15 (16%) 1 (1%)

\* N represents the number of children who were questioned that differ from the total count of 94 participants in the study.

Children revealed further an awareness of magic as being a form of trickery. The majority of children stated that “anyone can learn magic” rather than it requiring “special powers”. Regardless of whether children claimed that magic is “real” or “just tricks”, they were more inclined to state that “anyone can learn it” as opposed to requiring “special powers” and no significant difference was found between these claims (2 x 2 Fisher’s Exact Test,  $N = 90$ ,  $p = .205$ , two-tailed). Specifically, 67 out of 78 children who stated magic is “just tricks” claimed it can be learnt. Eight out of 12 children who stated that magic is “real” also claimed it can be learnt. This suggests that most children may have used the term “real” to reference a demonstration that is witnessed (i.e. performed) rather than a genuine supernatural process.

### **“Magic” versus “Trick” Responses**

In order to determine children’s underlying meaning behind labelling the coin demonstration “magic” versus “trick” a series of chi-square analyses were carried out in relation to concepts about magic. Total counts were taken from combined “magic” responses for all three conditions, as were “trick” responses. (Please note that first responses were used for Condition 1). No significant association was found between causal responses and whether magic can be learnt or requires special powers. Irrespective of “magic” or “trick” causal responses, children were more likely to claim that “anyone can learn magic”. However, a significant association was found between causal responses and whether magic is considered “real” or “just tricks” (Fisher’s Exact Test,  $N = 91$ ,  $p = .001$ , two-tailed). Children who gave a “trick” causal response were significantly more likely to claim that it is “just tricks” than “real”, compared to children who gave a “magic” causal response. This is illustrated in Figure 3.3.



NB: Total responses were taken from Condition 1 (1<sup>st</sup> response), Condition 2, Condition 3.

**Figure 3.3: Frequency of stated Belief in “Magic” versus “Trick” Responses in 9-11-year-old Children**

Further presentation of children’s concepts regarding “magic” is shown in Table 3.5 and shows that the majority of the children stated that they have seen magic before. The most frequent response children gave to having witnessed it before was, “on television”. No reference was made to a supernatural event.

**Table 3.5: Total Frequency and Percentages of 9-11-year-olds' Concepts of "Magic"**

<b>Question</b>	<b>Total Count (N = 94)</b>
Have you seen magic before?	
Yes	70 (74%)
No	24 (26%)
When have you seen magic?	<b>*(N = 70)</b>
No explanation	10 (14%)
Television	31 (44%)
Party with a magician	12 (17%)
Friend / relative	11 (16%)
Circus	5 (7%)
Can do myself	1 (1%)
Who / What can do magic?	
Magician	38 (41%)
Anyone	23 (24%)
No one	17 (18%)
Don't know	10 (11%)
Wizard / Witch	3 (3%)
God	2 (2%)
Special people	1 (1%)
Can magic happen anytime?	
Yes	40 (43%)
No	53 (56%)
Don't know	1 (1%)
When can magic happen?	<b>*(N = 53)</b>
Don't know	13 (24%)
At a party / show	11 (21%)
It can't happen	7 (13%)
Anytime / when want it to	5 (9%)
Special occasion/time/magic words	4 (7%)
When someone does it	4 (7%)
When know how to / learn / practice	3 (6%)
When someone thinks / believes	3 (6%)
Sometimes	2 (4%)
When you have apparatus	1 (2%)

\* N represents the number of children who were questioned that differ from the total count of 94 participants in the study.

Further statements also point towards a disbelief in magic being truly magical. The person or entity that most children claimed can do “magic” was a magician, followed by anyone. Only six children actually mentioned a fantastical entity (i.e. “special people”, “God” and “wizard or witch”). Most children said that magic cannot happen anytime but this response does not necessarily reflect belief in it being a supernatural process or event. Particularly as most children on explaining when magic can happen did not attach specific or genuine magic to it. Nineteen out of 53 children implied trickery of some sort by claiming it can occur at a party, when the correct apparatus is in place, when someone does it, or when it is learnt. Seven children actually asserted disbelief in the reality aspect of it by claiming, “It can’t happen”. Only seven children’s explanations could be considered qualifying as truly magical: “when magic words are spoken”, “when someone thinks or believes it”. In fact, most children who stated that magic cannot happen anytime also claimed that magic is “just tricks” and that “anyone can learn magic” (41 out of 53 children).

Table 3.6 presents children’s concepts regarding “tricks” in depth. The most frequent response that children gave for where they had seen tricks before was, “on television” or when a friend or relative had performed them. The majority of the children claimed that anyone can do tricks, with a magician being the second most frequent response. These responses appear to converge with children’s responses towards the magic questions with the notable exception of most children claiming that a trick “can happen anytime”. Conversely, most children claimed that magic cannot happen anytime. However, many children’s explanations for when magic can occur were the same for when tricks can occur: at a show, when someone does it, if it is practiced or learnt.

**Table 3.6: Total Frequency and Percentages of 9-11-year-olds' Concepts of "Tricks"**

<b>Question</b>	<b>Total Count (N = 94)</b>
Have you seen tricks before?	
Yes	80 (85%)
No	13 (14%)
Don't know	1 (1%)
When have you seen tricks?	<b>*(N = 80)</b>
Television	30 (38%)
Friend / relative	29 (36%)
A show / party with a magician	13 (16%)
Can't explain	5 (6%)
Circus	3 (4%)
Who/what can do tricks?	
Anyone	56 (60%)
Magician	19 (20%)
Don't know	16 (17%)
Trained people	1 (1%)
Special people	1 (1%)
No one	1 (1%)
Can tricks happen anytime?	
Yes	75 (80%)
No	18 (19%)
Don't Know	1 (1%)
When can tricks happen?	<b>*(N = 18)</b>
Don't know	4 (22%)
A show	3 (17%)
When someone does it/makes it	3 (17%)
If practice / learn	3 (17%)
Sometimes	2 (11%)
Need certain stuff	1 (6%)
When want them to	1 (6%)
When use brains enough	1 (6%)

\* N represents the number of children who were questioned that differ from the total count of 94 participants in the study.

Finally, children were directly asked to differentiate between magic and tricks. A breakdown of responses is presented in Table 3.7. The most popular response given by children was that magic is real in the sense that it really happens whereas tricks are not real and involve hiding something or fooling someone. In fact only five children specifically acknowledged that magic is the same as tricks. Other children implied that tricks may be deception and when someone is aware of being deceived whereas with magic you are not aware of deception and so believe that it has actually occurred. Several children made reference to magic having supernatural properties in comparison to tricks. For example, “magic is automatic”, or “magic needs a spell”, or “magic special things”. Overall though, although children distinguished between “real magic” and “tricks”, and despite the majority of the children earlier responding that magic is “just tricks” as opposed to “real”, it was not possible to ascertain whether children actually believe that “real magic” exists and are credulous of magic being possible in the real world.

**Table 3.7: Frequency and Percentages of 9-11-year-olds' Differentiation between "Magic" and "Tricks"**

<b>What is the difference between magic and tricks?</b>	<b>Total Count (N = 94)</b>
Magic is real ( <i>really happens</i> ) / Tricks are not real ( <i>involve hiding, fooling</i> )	41 (44%)
No explanation	13 (14%)
Magic is not real (not true) / Tricks are real (trying to make happen)	7 (7%)
They are the same	5 (5%)
Magic not shown or do not know how it is done /Tricks show or know how done	5 (5%)
	4 (4%)
Magic is automatic / Tricks can practice, learn	4 (4%)
Magic needs a spell, wand, click fingers / Trick use apparatus	3 (3%)
Magic only special people can do or a special time / Tricks anyone can do	2 (2%)
Use different equipment	2 (2%)
Magic think happening / Trick looks like	1 (1%)
Magic looks like happening / Trick fooling	1 (1%)
Magic small, big things / Trick with mirrors	1 (1%)
Magic do by self, hide / Trick amazing	1 (1%)
Magic big /Trick little	1 (1%)
Magic still there but magician did something	1 (1%)
Magic believe / Trick not worked out	1 (1%)
Magic special things / Trick an illusion	1 (1%)
Magic disappear / Trick do something	1 (1%)

### **Discussion**

Study 3 aimed to investigate possible effects of repetition of a coin trick on 9-11-year-old children's causal interpretation (i.e., whether they responded "magic" or "trick"). It was hypothesised that this age range would be more sceptical than credulous towards a coin demonstration being genuine magic (and more so than the younger age range in Study 2), as they have a firm understanding of physical laws of causality and so would be less susceptible to the presumed demand characteristics of repetitive questioning. As predicted, the majority of the children responded "trick" as opposed to "magic" when shown a demonstration of coins that appeared to vanish.

Consequently, no significant differences were found between the three experimental conditions (i.e. single viewing, repeated viewing, and repeated viewing with the opportunity of examining the apparatus). Therefore, in line with what was expected, viewing the same demonstration over a series of trials or being given the opportunity of exploring the apparatus were not necessary requirements in dismissing magic causality and accepting trickery. Importantly, most 9-11-year-old children did not appear to succumb to the demands of repeated questioning by the experimenter. This is evident in the children's responses in Condition 1: the majority of the children retained their original responses throughout. These findings support Subbotsky (2004) who found that 9-year-old children stuck to physical causal explanations after repetition of an event. In keeping with Subbotsky, this implies that children's disbelief in magic causation was deeply entrenched. In fact, the only significant change found was that more children altered their initial "magic" response to a "trick" one when questioned a second time. From these findings it is suggested that a substantial proportion of the children were aware of the demonstration being a form of deception from the outset. If not, then they were convinced of it after being questioned a second time. Although searching the apparatus was not crucial in children's rejection of magic causality it may have assisted children to a certain extent. This is evident in the fact that all five children (in Condition 3) who examined the apparatus actually found the coins and stated "trick". Yet none of these children were able to give a further explanation of where the coins were.

As few children responded "magic", the ability to draw any conclusions about factors that contributed to their labelling the demonstration "magic" versus "trick" is limited. The only characteristic that children who responded "trick" generally shared was that they were significantly more likely to claim to *know* where the coins had

gone (i.e. 50 out of 75 children). Conversely, children who responded “magic” were significantly more likely to claim *not* to know where they had gone (i.e. 13 out of 19 children). Furthermore, although most children believed that the coins had not really disappeared, they were significantly more inclined to state this if they had given a “trick” response (i.e. 69 out of 75 children who gave a “trick” response versus 12 out of 19 children who gave a “magic” response). In this respect, “trick” appears to refer to awareness of deception in the form of the coins being hidden in a specified location. “Magic” may also refer to the possibility of deception but children are unaware of the specific location of the hidden coins. However, irrespective of giving “magic” or “trick” responses, the majority of the children were unable to offer explanations for where the coins had gone. Therefore, it would appear that children did not revert to “magic” responses only when they were unable to explain any physical working of the demonstration. This somewhat opposes Chandler and Lalonde (1994) and Phelps and Woolley (1994) who claim that children quite often use the word simply to mark phenomena for which they lack immediate physical explanations.

The other primary goal of the present study was to assess the nature of children’s magical beliefs in general and in so doing to gain a clearer understanding of children’s labelling the coin demonstration “magic” versus “trick”. The interview questions revealed that the majority of children believed that magic is “just tricks” that anyone can learn and that anyone (including a magician) can do. Therefore, this implies that children considered magic to involve conjuring rather than supernatural processes and indicates further, older children’s understanding of the concept of magic as trickery. These findings are in keeping with Phelps and Woolley (1994).

In relation to the coin demonstration, irrespective of whether children had given “magic” or “trick” causal responses, they were more likely to claim that anyone can learn magic. However, children who had given a “trick” response were significantly more inclined to believe that magic is “just tricks” (i.e. 69 out of 75) compared to children who had given a “magic” response (i.e. 10 out of 19). It should be noted that children’s magic concepts may have been related to and influenced by the coin trick itself rather than representing beliefs in magic events per se. This was evident as a substantial proportion of the children claimed to have witnessed magic in the past on the television and said that it involves making something disappear.

Only when children were asked to specifically differentiate between the two were clear distinctions made between real magic and trick magic. Children most frequently explained that magic really happens whereas tricks are not real and involve fooling or illusion (i.e. 44%). Some children also ascribed magical properties to magic. For example, a few children asserted that “it is when you click your fingers” or “it is automatic”. These clear distinctions imply that some children consider magic as genuine. However, they appear to conflict with earlier claims that magic is “just tricks”. In fact only five children specifically stated that magic is the “same as tricks”. Perhaps 9-11-year-old children believe genuine magic is only possible in the non-real world, such as in fiction or dreams.

On comparing children’s causal responses to the coin trick in Study 3 with those of Study 2, important differences were found that need to be addressed. In Study 2, most 4-6-year-olds labelled the event as “magic” whereas, in Study 3, most 9-11-year-olds labelled it as a “trick”. Furthermore, 4-6-year-olds were just as likely to change as to retain a response regardless of whether it was “magic” or “trick” over a series of viewings. Conversely, 9-11-year-old children were more likely to retain a

“trick” response. While repetitive viewing and exploring the apparatus were not conducive to children’s tendency to respond “trick” rather than “magic”, age does appear to be a key factor in predicting responses. There appears to be an age-related decline in children succumbing to experimenter pressure and an age-related decrease in “magic” responses. This trend of older children to view a perceived physical object as increasingly permanent confirms previous research showing a decrease in verbal magical beliefs with children older than six years of age (Subbotsky, 2001, 2005; Woolley, 1997; Woolley et al., 1999). The findings also lend support to a study that has found that younger children (6-year-olds) were more likely to change their responses in the face of repeated questioning than older (10-years old) children (Moston, 1987) and a study which showed that, compared to adults and older children, 4-year-olds were more likely to shift answers to repeated specific yes/no questions (Poole & White, 1991). However, it is worth noting that there was quite a large age gap between children in Study 2 and Study 3 of the thesis. As a result, although age comparisons revealed significant age differences in causal responses, caution is needed.

Although both Study 2 and Study 3 were attempting to investigate and interpret children’s causal explanations of a violation of object permanence, various methodological limitations may have affected results. Firstly, one limitation was the exclusive use of verbal measures and reliance on verbal responses regarding the coin trick. Research has shown that when children’s behaviour is examined in addition to their verbal judgments, they show a considerably stronger credulity towards magic (Harris, Brown, Marriott, Whittal, & Harmer, 1991; Johnson & Harris, 1994; Subbotsky, 1985, 2001, 2007; Woolley, 1997). Therefore, future studies could employ

measures such as observing children during the demonstration and their reactions (e.g., levels of surprise) could be observed upon uncovering the outcome.

A second limitation was that the coin demonstration was not a great example of a magical event; it was a commercially bought trick that children may have been familiar with or seen before. In fact, in Study 3 one child declared that he had “done the trick himself”. It should be noted that the coin trick was selected on the premise that it did not create a context whereby real and authentic magic was suggested, as one of the main objectives was to clarify whether children’s labelling and meaning of “magic” was the same as that of “trick”. For this same purpose, the studies were designed so that children only viewed on a television screen a close-up of a hand touching the apparatus and putting a lid on top of the coins. However, Subbotsky (2004) argues that a trick should be presented that does not come from a traditional set of tricks available in magic shops. Instead it should look more convincingly like an instance of real magic so that it would present a serious challenge to children’s belief in physical causality in order to clearly assess children’s magical thinking.

Thirdly, the lack of significant differences between the experimental conditions in the demonstration may be due to children in Condition 3 being shown a non-working copy of the apparatus. Although children were permitted and encouraged to explore the apparatus, nevertheless, it was still a non-working copy of a magic trick apparatus and children would not have necessarily been able to find the true causal mechanism for it anyway. It is important to note that it was possible to discover the coins as they were actually hidden within the apparatus. Furthermore, the apparatus was shown after having viewed the coin trick on television. Had they been allowed to explore beforehand, fewer children may have subscribed to a “magic” response. Therefore, in future studies the experimenter should perform the action in front of the

child with the apparatus before viewing it on the television and then ask the child, “So, what you saw, was it magic or a trick?”

Based on Study 2 and Study 3, it is still not definitively clear what children mean by “magic” and “trick”. Children were too vague with their explanations in the interview tasks, particularly in Study 2. In addition, children in Study 2 were not explicitly required to make a distinction between magic and tricks. Yet the findings give an idea of what children mean and this appears to be linked to what they physically see: a concrete demonstration in the real world. Younger children (i.e. 4-6-year-olds) tend to use “trick” when they know how an object has disappeared and use “magic” when they do not know how. Although older children (9-11-year-olds) understand that an object is hidden regardless of giving a “magic” or “trick” causal response, they tend to use “trick” when they know where an object is hidden and use “magic” when they do not know where. They also regard magic as fake. Despite these findings, there is still ambiguity in children’s responses as they viewed an event on television. As discussed in Chapter 1, research shows that children do not treat an event in the same way when witnessing it live in front of them. For control reasons, it was appropriate to have children witness the demonstration on the television, but this muddied the waters. Therefore, further studies in this thesis focus on live conjuring demonstrations.

As the majority of children aged 9-11-years of age in Study 3 provided evidence of scepticism toward genuine magic, this age range will no longer be investigated in the thesis. Most differences in causal thinking were found in 4-6-year-olds and a differentiation between magic and tricks on a single viewing of a conjuring demonstration. Study 2 ascertained that young children (four to six years of age) do differentiate between magic and trick causation appropriately and regard magic as

genuine rather than fake as in tricks. As such, it is important to concentrate on this age range in the remainder of this thesis. In addition, Study 2 found evidence that 4-6-year-olds are susceptible to direct social influence in the form of repeated questioning by an adult. Therefore, Study 4 will investigate whether indirect social influence is linked to young children's interpretation of a conjuring event.

### **Conclusion**

Study 3 confirmed, as predicted, that 9-11-year-old children are more likely to give a "trick" response than a "magic" one regarding a coin trick and highlights scepticism toward magical causation in older children. Furthermore, they were more likely to retain an initial "trick" response and more likely to change a "magic" one following repeated questions across three trials. Nine- to 11-year-olds did not conform to experimenter pressure as they did not show a tendency to drop their scepticism toward magic. Furthermore, although most children were aware that the coins had not truly vanished, children appeared to respond "magic" when they did not know specifically where an object was hidden whereas children who responded "trick" did claim to know where the coins were hidden. The interview showed that the majority of the 9-11-year-olds consider magic to be "just tricks" that "anyone can learn". However, evidence also revealed that 9-11-year-olds have an understanding that genuine magic is different from stage magic and actually claimed that it "can really" or "truly" happen. This may be interpreted as children just saying what magic is and does not necessarily signify their belief in its existence. Therefore, doubt is cast on whether older children are believers in genuine magic being possible in the real world or confined to the non-real world such as fiction.

Overall, Study 3 provided evidence of the majority of 9-11-year-old children's disbelief (or scepticism) toward genuine magic (as indicated by a significant understanding of the conjuring demonstration being an instance of trickery, that magic is just tricks, and a belief that anyone can learn magic). Therefore, this implies that children considered magic to involve conjuring rather than supernatural processes and indicates older children's clearer understanding of the concept of magic as trickery.

As in other studies investigating children's understanding of magic and tricks, Studies 2 and 3 did not yield an entirely clear pattern of results. Cumulatively, the data lean towards most 4-6-year-old and 9-11-year-old children regarding magic as simply tricks and highlight that many children do view an apparent violation of object permanence as being caused by trickery rather than real magic. Although age appears to be a valid factor that needs to be taken into account, it remains unclear why some children prefer to label an event "magic" while others label the same event a "trick". The existence of a small group of believers in magic among the more sceptical in Study 3, as indicated by "magic" responses to the coin trick and references to magical concepts in general suggests that there is not a simple developmental influence that characterizes children's responses to information about magical events during early childhood. Rather, what children believe, and how consistently they believe it, and their reasons for labelling an event "magic" or "trick", may be linked to individual differences among children of the same and varying age. Therefore, a central question that is relevant and requires further exploration is: "What individual differences are associated with children's acknowledgement of an event being a trick as opposed to it being magic?" Studies 2 and 3 have focused on possible external factors. The next three studies will focus mainly on internal factors.

## CHAPTER 5:

### **STUDY 4 – Exploration of a possible association between social confidence and verbal versus behavioural responses to a conjuring demonstration**

*“The universe is full of magical things, patiently waiting for our wits to grow sharper”. (Eden Phillpotts)*

People contradict themselves in different ways. For instance, someone may not necessarily mean what they say or may say one thing and yet do another. The same might be said about children’s causal judgments regarding events that appear to violate known physical laws. Although some children verbally ascribe magic causality, it may signify fake magic rather than genuine supernatural magic. Likewise, if a child verbally assigns trick causality to the event, he or she is not necessarily implying scepticism. It may be that he or she is unwilling to reveal verbally credulity towards magic or may be unaware of in fact being credulous. Yet in his or her actions a child might show credulity (Subbotsky, 2001). Hence, verbal judgments are not always accompanied by the appropriate behaviours. According to Argyle (1996), non-verbal behaviour may amplify or disambiguate words. Indeed, when children’s behaviour is examined in addition to their verbal judgments they show considerably stronger credulity towards magic (Harris, Brown, Mariott, Whittall, & Harmer, 1991; Johnson & Harris, 1994; Subbotsky, 1984, 1985, 1991, 1994, 2001; Woolley, 1997). Even adults show behaviours compatible with magical thinking (Rozin, Markwith, & Ross, 1990; Rozin, Millman, & Nemeroff, 1986; Subbotsky, 1997, 2001, 2004, 2010;

Subbotsky & Quinteros, 2002). Furthermore, Subbotsky has shown that under certain conditions children manifest a belief in magical causality in their actions while proclaiming disbelief in their verbal judgments (Subbotsky, 1985, 1993, 2001, 2004). Therefore, Study 4 of the current thesis explores children's behavioural reactions as well as verbal responses to a conjuring trick in order to uncover possible discrepancies between the two. In addition, a possible association between children's responses and reactions and level of social confidence is explored.

Studies that have examined non-verbal responses to events that violate known physical laws have focused on preferential and prolonged looking, or exploratory actions. The violation-of-expectation paradigm is frequently used by researchers for studying the permanence of perceived objects in infants, with displays involving obstruction of objects by other objects, invisible displacement, or replacement of one object by another one behind a screen (e.g., Baillargeon, 1987, 1991; Bower, 1971; Piaget, 1986). According to Hood, Cole-Davies, and Dias (2003), the paradigm was based on the principle of the conjurer's trick: namely that a trick increased the observer's attention because it contravened an expectancy or belief about the physical world. However, there have been conflicting reports regarding behavioural reactions. Some researchers claim that infants and preschool-aged children look reliably longer at events that appear to violate their beliefs about the world than at events consistent with their beliefs (Baillargeon, 1991; Chandler & Lalonde, 1994; Hood et al., 2003). Contrastingly, a few situations have emerged in which infants have not looked preferentially at events that appear to violate their beliefs about objects (Baillargeon, 1994). It has been argued that failure to look preferentially transpired as infants had arrived at some understanding for the event, such as speculating about hidden objects. In other examples, infants' preferential looking appeared to depend on additional

clues provided by the experimental situation. For example, Baillargeon, Graber, DeVos, and Black (1990) suggested that the same type of object can appear first in one location and then in another without any visible movement between the two if, in fact, there are two identical objects involved rather than one. Infants may take advantage of these available hints to make sense of what has happened and the event is treated as being less unexpected and less surprising. Likewise, older children often rely on clues to come to conclusions about the way the world works. However, showing two identical objects at the same time would not seriously challenge beliefs in object permanence as the hint of deception is too strong. Instead providing children with a difference in the appearance of an object before and after a violation has occurred might alert children subtly to the possibility of there being two objects and hence trickery. Indeed, Michotte (1962) found that, in judgments about object identity, adults were inclined to view the object as being the same (i.e. identical to the one seen previously) if only one of the four features (form, dimension, colour and spatial location) was changed. If, however, two or more characteristics were changed, adults tended to think that one object had been replaced by another one thus revealing the dependence of identity judgments on the degree of transformation. Therefore, if a child sees an object in a new location *and* a change in appearance, then he or she might be aware of deception having taken place.

Research has shown that children who successfully search apparatus commit to principles of physical causality (e.g., Chandler & Lalonde, 1994, Hood et al., 2003). Subbotsky (2010) found that in order to elicit exploratory behaviour in children aged four years and older, an event must be incompatible with the fundamental laws of nature (such as object permanence or physical causality). He argued that such exploration is due to the fact that the violation of physical laws is

both novel and interesting. Subbotsky has carried out a substantial body of research into conditions that evoke magical forces to explain violations of object permanence using a version of Bower's (1971) invisible replacement task. The task uses a specially constructed trick box that creates the impression of a physical object's disappearance or appearance from thin air or transformation into another object in a way that the object's non-permanence seems genuine. Subbotsky argues that using such a device is needed for children to view a display as a serious challenge to their belief in object permanence rather than a trick, as it is difficult to explain in a rational way (i.e. according to the laws of physics). Indeed, children aged four years and older verbally ascribe magical causality when they witness an event that uses such a device (e.g., Subbotsky, 1994, 1997, 2001, 2004, 2010).

Past researchers have analysed children's interpretations of anomalous events with an all-or-nothing approach. That is, whether the child gives a non-scientific judgment (i.e. magical causality) or a scientific judgment (i.e. physical causality) based on a specific question. As was outlined in Chapter 1 of this thesis, children have been categorised as either credulous or sceptical; believers or disbelievers; having belief systems that are consistent or inconsistent, or co-exist. For instance, Subbotsky (1984) has hypothesised that children possess two distinct and inconsistent belief systems that are reflected in their verbalisations and behaviour: they verbally deny the possibility of transforming pictures into objects by magic words but try to use magic words when left alone. Yet children's cumulative responses to an anomalous event, both verbally and behaviourally, might be better understood by assessing levels of scepticism in the case of verbal responses, and levels of active monitoring in the case of behavioural responses. (In Study 4, active monitoring refers to looking back and forth and tactile exploration of apparatus during aspects of a conjuring demonstration.

These levels of measurement are explained further in the Procedure section). Past research (including Study 2 and Study 3 of the current thesis) has shown that most children older than four years of age are not entirely credulous of magic or entirely sceptical when asked a variety of questions. Furthermore, the level of children's scepticism that is revealed towards an event being magical may be related to how confident they are in social situations.

Some people are reserved during social contacts with strangers or casual acquaintances. They can exhibit awkward behaviour and are tense when in the presence of others. In magic causality studies and other developmental research, children are often put in a situation where they are in contact with an experimenter they are not familiar with. This may explain reported discrepancies between 4- and 6-year-old children's behaviours and their judgments about the existence of magical objects and events. That is, many children when in the presence of an experimenter deny the existence of magical objects and events, yet when left alone they search boxes or attempt to cast magic spells (e.g., Harris et al., 1991; Subbotsky, 1984, 1985). However, no studies have specifically assessed a possible link between children's social confidence and reactions towards unusual phenomena. In fact, there does not appear to be any research on social confidence *per se* as related to magical belief. Confidence research has mainly explored children's accuracy in eyewitness recall settings, and consisted of verbal self-assessments on performance (see Allwood, Granhag, & Jonsson, 2006, for a review). As a consequence, research has typically found that individuals of all ages have an inflated belief in their performance and they are over-confident with regard to what they know and/or remember (see Roebbers, Von der Linden, & Howie, 2007). In studying social behaviour, Cheek and Buss (1981) state that it is important to know whether children are shy and also whether they are

sociable as they are distinct personality dispositions. They define shyness in terms of one's reaction to being with strangers or casual acquaintances: tension, concern, feelings of awkwardness and discomfort, and both gaze aversion and inhibition of normally expected social behaviour (Buss, 1980). They define sociability as a tendency to affiliate with others and to prefer being with others to remaining alone. Factors such as shyness, sociability, social anxiety and social competence may be considered distinct traits related to social behaviour. Yet one relevant feature that they all appear to share is confidence in social situations, and behavioural traits are typically judged in terms of smiling, assuming a relaxed posture, and making good eye contact. Therefore, for the purposes of Study 4, a social confidence measure was constructed that encompassed these properties as well as freedom of speech and ease of movement. It is proposed that social confidence may be linked to performance in an actual testing session and influence children's responses and/or reactions. A child low in social confidence may feel self-conscious and inhibited when being tested and as a result be less likely to openly deny or contest an apparent violation of object permanence. Furthermore, they may be less likely to search apparatus. Conversely, a child high in social confidence may be more likely to verbally challenge a violation of object permanence. They may also be more inclined to search apparatus.

### **Study Aim**

The main aim of Study 4 was to provide a thorough, controlled investigation of children's responses to a violation of object permanence in the context of a conjuring event. In order to do this the present study included an assessment of behavioural reactions in addition to verbal responses to a conjuring event whereby the manipulation of the transference of an object was difficult to explain in a rational way.

As tasks designed to test children's understanding of magic and tricks almost invariably require a degree of language comprehension, a behavioural measure potentially bypasses the problems of children's limited verbal ability and responsiveness to demand characteristics that can be a problem, as found in Study 2 of this thesis. It is important to establish whether or not children's verbal responses reflect belief in the authenticity of the conjuring demonstration being genuine magic. Bunce and Harris (2008) found that children aged four to seven years use the words "real", "really" and "pretend" predominantly to express the notions of authenticity of things around them (i.e. whether or not something was the real or genuine version as opposed to substandard, imitation, or fake). Therefore, Study 4 will include a "real magic" versus "trick" causal choice instead of "magic" versus "trick" as used in Studies 2 and 3. Study 4 was also concerned with providing an examination of a possible association between young children's level of social confidence and level of scepticism towards the event being genuine magic. Hence, analysis of behavioural and verbal responses during a pre-test "hiding game" were included to provide a measure of children's social confidence that may be linked to responses to the conjuring demonstration that in turn may lead to a clearer understanding of children's level of scepticism towards an anomalous event being genuine magic. It should be noted that children's behavioural reactions were taken as being a measure of level of active monitoring that might be related to or contribute to their level of scepticism, but not necessarily a direct measure of it as in the case of verbal responses. This is further discussed in the Procedure section. A pre-test hiding game was included for two purposes. Firstly, it was hoped that a less formal approach would be less intrusive and provide a more naturalistic context in which to assess social confidence. Secondly, it aimed to help children feel at ease to a certain extent, so that they may be more freely

expressive and respond spontaneously in the conjuring event. Related to this, it was important to ensure that the pre-test was not an extension of the actual task demonstration. Past researchers have incorporated familiarization tasks, pre-tests, or interviews before actual demonstration trials. Yet they appear to be part of the testing situation and may influence children's responses (Johnson & Harris, 1994; Phelps & Woolley, 1994; Rosengren & Hickling, 1994; Rosengren, Kalish, Hickling, & Gelman, 1994; Subbotsky, 1994, 2004, 2005). For instance, Rosengren and Hickling (1994) presented children with hypothetical transformations, gave proposed causal mechanisms that were the same ones to be used in the actual transformations and even corrected children in the pre-test sessions.

Finally, Study 4 investigated whether the availability of a visual clue hinting at deception would have an effect on children's verbal judgments or behavioural reactions. Specifically, two soft toys were included that were not identical in appearance (one teddy-bear sported a bow while the other didn't). The discrepant appearance of the test stimuli was designed to add to the information already gained in the last two studies of the thesis (and previous research) concerning a possible link between external factors and interpretation of an anomalous event.

**It was hypothesised that:**

1) There will be an association between children's level of verbal scepticism regarding a conjuring demonstration and level of social confidence. Thus, children scoring lower in social confidence will be inconsistent in verbal judgments and so less likely to respond in terms of trickery (i.e. score lower in verbal scepticism) whereas children scoring higher in social confidence will be more likely to express scepticism (i.e. score higher in verbal scepticism).

2) There will be an association between children's level of active monitoring during a conjuring demonstration and level of social confidence. Children scoring lower in social confidence will be less likely to search the apparatus or look in a direction that may imply awareness of trickery (i.e. where a teddy was hidden) whereas children scoring higher in social confidence will be more likely to search the apparatus and look in a direction that implies awareness of trickery.

3) There will be a difference between children in Condition 1 (teddy without a bow-tie) and children in Condition 2 (teddy with a bow-tie) in terms of level of verbal scepticism or level of active monitoring. Children in Condition 2 will exhibit higher levels of verbal scepticism and/or levels of active monitoring than children in Condition 1. A visual difference between the two teddies will encourage children to spontaneously query or challenge what they have witnessed and also may lead them to more actively explore the scenario both visually and physically.

## **Method**

### **Participants**

Fifty-six children (20 males and 36 females) took part in the study. They ranged in age from four to six years of age (mean age 64 months). The participants attended a S.E. London primary school and were predominantly from middle class backgrounds although this was not directly assessed. Ethnicity was not systematically recorded (although anecdotally the children were a mixture of Asian, black, and white). Forty-three out of 56 children were videotaped in order to rate behavioural responses to the conjuring demonstration and social confidence in a testing session. Parental

permission for videotaping was withheld for 13 children and so they could not be included in the behavioural and social confidence analyses.

## **Design**

The study included the independent variable of social confidence and the dependent variables of verbal scepticism and active monitoring. There were also two independent experimental conditions (teddy with a bow and teddy without a bow) in the conjuring demonstration each with 28 children. All statistical tests were two-tailed unless otherwise indicated.

## **Materials**

The pre-test game required two chairs and one chocolate wrapped in coloured foil per participant. The pre-test game and conjuring demonstration were videotaped using a JVC 700x digital zoom, high resolution camcorder mounted on a tripod that stood in full view of the participant. The conjuring demonstration involved a light blue square box measuring 19 cm wide and 8.5 cm deep, decorated with a large lilac star on its lid (Figure 4.1). There was also a red velvet bag with a rigid rim and a lever attached to a wooden handle (Figure 4.1). The box was placed on a table within touching distance of the child and the experimenter who sat on separate chairs. There were also two small teddy bears measuring 10 cm high with a 6 cm arm span (Figure 4.1). Both bears were identical apart from one teddy-bear had no bow-tie, while the second had a relatively large for its size blue bow-tie around its neck (Figure. 4.1).



**Figure 4.1: Materials for the Conjuring Demonstration**

### **Procedure**

The study consisted of one testing session lasting approximately 10 minutes per child. All the children were tested individually in a quiet place (i.e. in a separate room away from the other classrooms). First, a pre-test game was conducted before the conjuring demonstration so that children became familiarized with the experimenter and the testing environment and to observe how socially confident he or she appeared.

#### *Pre-Test Hiding Game*

In the pre-test game the experimenter and child sat facing opposite each other on separate chairs. The experimenter explained to the child, “We are going to play a hiding game. I have a chocolate [she held up the chocolate wrapped in coloured foil for the child to see]. I am going to hide it in one of my hands and you have to guess which hand it is in.” The experimenter then put her hands behind her back and hid the chocolate in one hand. She then closed both hands into fists, held them out in front of

the child, and instructed the child to point to which hand he or she thought the chocolate was hidden. The hand the child chose was opened immediately. Lots of praise and encouragement was given. The chocolate was hidden and revealed a total of three times. At the end of the pre-test game the children did not receive the chocolate. All children in each class received sweets from the experimenter at the end of the total completed testing sessions, regardless of whether or not they took part in the experiment. The word “hiding” was deliberately included to reinforce the fact that the chocolate had not actually vanished but that deception was being implemented. This may have later assisted children’s responses in the conjuring demonstration.

### Conjuring Demonstration

The 56 children were semi-randomly allocated to the two testing conditions (counterbalancing for age). In both conditions the experimenter showed the child a box and said that this was where she could make things appear that she really liked. The box was then placed on a table in touching distance of both the child and the experimenter and in the child’s sight. The experimenter then showed the child a small teddy and said that she liked it and would make it disappear in her bag and reappear in the box. She then put it in the bag in front of the child and said “abracadabra” and waved her hand over the bag. The bag had a wooden handle with a lever attached that enabled an object to be hidden within the cloth pocket of the bag when the lever was moved across. The experimenter held the handle and inconspicuously moved the lever across after the teddy had been placed in the bag and whilst saying “abracadabra”. She then asked the child if he or she thought that the teddy had disappeared. Regardless of the response, the child was shown the apparently empty inside of the bag and then

asked, “Where is the teddy?” If the child did not give a spontaneous response a prompt was given of, “Is it in the box or the bag?” If the child responded that it was in the box, the experimenter lifted the lid off and revealed the teddy inside the box (one that had been in the box all the time, but the child had not been shown beforehand). If the child responded that the teddy was in the bag the experimenter stated, “Let’s look in the box” and the child was then shown the teddy in the box. In Condition 1, the box was opened to reveal an identical teddy to the one that was in the bag. In Condition 2, the box was opened to reveal an identical teddy to the one that was in the bag with the exception that it had a bow around its neck. The child was then asked, “Is this the same teddy that I made disappear in the bag or does it just look like the teddy I made disappear?” and, “Do you think that what I did was real magic or a trick?” Following this, the experimenter put the lid back on the box and then told the child that she would make the teddy disappear from the box and reappear in the bag again. The experimenter then waved her hand over the bag (but did not say “abracadabra”) and the child was then shown the teddy (without a bow around its neck) in the bag. The child was asked, “Is this the same teddy that was in the box or does it just look like it?” and whether it was “real magic” or a “trick”. Verbal responses were noted down. Children were not prevented from touching, searching or exploring the conjuring materials throughout the duration of the demonstration. The order of the structure of the question asking if the teddy was in the “box” or the “bag” was counterbalanced to control for order effects, as was the questions if it was “real magic” or a “trick”.

#### Scoring and Classification Criteria

Children’s verbal responses to specific questions were categorised according to: 1) “yes” or “no” (“Do you think that the teddy has disappeared?”), 2) “box” or “bag”

(“Where is the teddy? Is it in the box or the bag?”, 3) “same” or “looks like” (“Is this the same teddy that I made disappear or does it just look like it?”), 4) “real magic” or “trick” (“Do you think I did real magic or a trick?”). Children’s behavioural reactions throughout the conjuring demonstration were categorized according to : “yes” or “no” (“When the teddy disappeared from the bag, did the child search the bag?”, “Before the word “box” was mentioned, did the child look at the box when the teddy was shown to have disappeared?”, “When the box was opened, did the child search the bag? “, “As soon as the box was opened, did the child look at the bag? “, “When the teddy re-appeared in the bag, did the child search the box?”). Along with categorising children’s responses to individual questions and behavioural reactions, a separate verbal scepticism score and an active monitoring score was calculated for each participant. In addition, a social confidence score was calculated.

### Verbal Scepticism

All 56 children’s verbal responses were rated individually. For each question, a score of 1 was assigned to participants who gave a sceptical answer and a score of 0 if they gave a credulous answer. Each score was combined to give a total verbal scepticism score that ranged from 0 to 6, with 6 indicating the highest level of scepticism and 0 indicating the lowest level of scepticism. A breakdown of the scoring according to the questions was as follows:

1) “Has the teddy disappeared from the bag?”

*If the answer is “yes” = score of 0*

*If the answer is “no” = score of 1*

2) "Where is the teddy now, in the box or the bag?"

*If the answer is "box" = score of 0*

*If the answer is "bag" = score of 1*

3) (When the teddy had disappeared in the bag and was seen in the box) "Is this teddy the same one that I made disappear from the bag or does it just look like it?"

*If the answer is "same" = score of 0*

*If the answer is "looks like it" = score of 1*

4) "Was it real magic or a trick?"

*If the answer is "real magic" = score of 0*

*If the answer is "trick" = score of 1*

5) (When the teddy had re-appeared in the bag) "Is this teddy the same one that I made appear in the box or does it just look like it?"

*If the answer is "same" = score of 0*

*If the answer is "looks like it" = score of 1*

6) "Was it real magic or a trick?"

*If the answer is "real magic" = score of 0*

*If the answer is "trick" = score of 1*

### Active Monitoring

As 13 parents refused permission for videotaping, only 43 out of 56 children were analysed behaviourally. (This applied to active monitoring and to social confidence.) The experimenter reviewed the video-tape and rated behavioural responses based on direction of looking, and searching. Children were observed at the point that they saw the teddy had disappeared from the bag. Children were given a score of 0 indicating no active monitoring or 1 indicating active monitoring according to various observations. A total active monitoring score was then calculated. Each score was combined to give a total monitoring score that ranged from 0 to 5, with 5 indicating the highest level of active monitoring and 0 indicating the lowest level of active monitoring. Twelve children were scored for their reactions by a second rater for the purposes of inter-observer reliability. Excellent inter-observer reliability was achieved with 100% agreement attained for all reactions. A breakdown of the scoring according to reactions was as follows:

1) When the teddy disappeared from the bag, did the child search the bag?

*If the answer is "yes" = score of 1*

*If the answer is "no" = score of 0*

2) Before the word "box" was mentioned, did the child look at the box when the teddy was shown to have disappeared?

*If the answer is "no" = score of 1*

*If the answer is "yes" = score of 0*

3) When the box was opened, did the child search the bag?

*If the answer is “yes” = score of 1*

*If the answer is “no” = score of 0*

4) As soon as the box was opened, did the child look at the bag?

*If the answer is “yes” = score of 1*

*If the answer is “no” = score of 0*

5) When the teddy re-appeared in the bag, did the child search the box?

*If the answer is “yes” = score of 1*

*If the answer is “no” = score of 0*

Searching the bag after the teddy has disappeared from it shows active curiosity and possibly suspicion or scepticism, as does searching the box after the teddy has reappeared in the bag. For the looking behaviour, curiosity and possibly suspicion or scepticism is less clearly defined. If one takes question 2, “Before the word ‘box’ was mentioned, did the child look at the box when the teddy was shown to have disappeared?”, I am taking this to refer to when the teddy appears to have disappeared from the bag. Why might looking at the box suggest scepticism? It indicates that the child is not just passively watching the procedure, but anticipating each stage. It indicates that the child is actively curious, which is possibly related to suspicion or scepticism, but not necessarily a direct measure of it. As such, children’s behavioural reactions were taken as being a measure of level of active monitoring that might be related to or contribute to their level of scepticism.

### Social Confidence

Social confidence was rated in relation to the pre-test game. The experimenter reviewed the video-tape and rated each child in the following categories: 1) How talkative/chatty the child was, 2) If the child made eye contact, 3) If the child smiled/laughed, 4) How relaxed the child appeared in posture (e.g., leaning back, arms unfolded), 5) How tense the child appeared (e.g., arms folded or still by sides of body, hunched shoulders, covering face with hands), 6) How engaged the child appeared (e.g., looking and listening, no prompting needed). Each category was given a rating on a scale between 0 and 3: 0 = not at all confident, 1 = a little confident, 2 = somewhat confident, 3 = very confident. It was possible that different components that were taken as indicators of social confidence would not when considered separately from one another indicate how confident the children appeared to be. Thus a more subjective global score was also awarded by the observers in terms of the children's level of social confidence on a 0-3 rating scale.

Twelve children were scored for their social confidence in each category from the pre-test game by a second rater. Excellent inter-observer reliability was achieved with 100% agreement attained for five out of six categories. The category for whether the child made eye contact had 75% observed agreement and a highly significant positive correlation (Pearson's  $r = .84, p = .001$ ).

For the purposes of the current study, children's overall social confidence rating was used for further analysis. Excellent inter-observer reliability was achieved for these ratings with 83.3% observed agreement and a Cohen's kappa of .750;  $p = .001$ . The confidence scores of the two raters were highly significantly correlated (Pearson's  $r = .894, p = .001$ ).

## **Results**

The present study employed measures in the area of assessing links between levels of verbal scepticism, active monitoring, and social confidence. In addition, two experimental conditions were assessed in relation to levels of verbal scepticism and levels of active monitoring: a visual clue (i.e. teddy with a bow) versus no visual clue (i.e. teddy without a bow). Initially the results section addresses and presents the descriptive data for the verbal responses in the conjuring demonstration followed by differences in age between “trick” versus “real magic” causal responses. Next, descriptive data are presented for children’s behavioural reactions. Non-parametric statistics are used throughout and tests are two-tailed unless otherwise mentioned.

### **Verbal Responses**

A summary of children’s verbal responses can be found in Table 4.1. When looking at the total counts and percentages for individual questions asked in the conjuring demonstration, most children stated that the teddy had disappeared from the bag (73%) and that the teddy was “in the box” (77%). At this point, responses suggest that children believed that the object (i.e. the teddy) had in fact spontaneously vanished and transferred from its original location (the bag) to a new location (the box). Hence, children may have been credulous of the event being genuine magic. However, a number of subsequent responses point towards a higher percentage of children showing scepticism than credulity towards the transference spontaneously occurring: 55% stated that the transferred teddy that was in the box only looked like the original teddy, 54% stated that the movement of the teddy into the box was a “trick”, and 59% stated that the transferred teddy that re-appeared in the bag only looked like the teddy

that had been in the box. An equal percentage of children gave “magic” and “trick” causal responses regarding the movement of the teddy from the box back into the bag that may be indicative of an equal proportion of children being sceptical and credulous. The variation in responses to certain questions being indicative of children’s scepticism and to other questions being indicative of children’s credulity highlights the need for the assessment of levels of scepticism. This is evident in the fact that 43 children were inconsistent throughout regarding responses to different questions. Only nine children gave consistently credulous responses pointing towards magic, and four children gave consistently sceptical responses.

**Table 4.1: Four- to Six-year-olds’ Verbal Responses and Percentages during the Conjuring Demonstration (N = 56)**

<b>Has the teddy disappeared from the bag?</b>	<b>Where is the teddy?</b>	<b>Is it the same teddy that was in the bag?</b>	<b>Was the movement (into the box) real magic or a trick?</b>	<b>Is it the same teddy that was in the box?</b>	<b>Was the movement (into the bag) real magic or a trick?</b>
Yes = 41 (73%)	Box = 43 (77%)	Same = 25 (45%)	Magic = 26 (46%)	Same = 23 (41%)	Magic = 28 (50%)
No = 15 (26.8%)	Bag = 13 (23.2%)	Looks like = 31 (55.4%)	Trick = 30 (53.6%)	Looks like = 33 (58.9%)	Trick = 28 (50%)

A major indicator of children's belief in the causal effect of the manipulation was their answers in response to whether the movement of the teddy was "real magic" or a "trick". However, a Mann Whitney U test revealed no significant differences between the age of children giving a specific "real magic" versus "trick" response for the cause of the movement of the teddy from the bag into the box (Mann-Whitney  $U(26, 30) = 371; p = .760$ ) and for the teddy moving from the box back into the bag (Mann-Whitney  $U(28, 28) = 331; p = .320$ ). Regardless of age, children were just as likely to give a "real magic" or "trick" causal response. Therefore, there does not appear to be a developmental pattern in children ascribing "trick" causality to the event.

### **Behavioural Responses**

A summary of the children's behavioural responses can be found in Table 4.2. When looking at the total counts and percentages, the majority of the children did not search the bag or the box at any stage during the procedure. This could be construed as children not being suspicious of the demonstration as trickery. However, children appeared to show more active monitoring behaviour in terms of looking than searching: children were equally likely to display looking behaviour as not to. Once again, this highlights the need for levels of assessment regarding children's reactions to anomalous events rather than categorising children's responses according to simple dichotomous categories.

**Table 4.2: Frequency and Percentages of 4-6-year-olds' Behavioural Reactions during the Conjuring Demonstration (N = 43)**

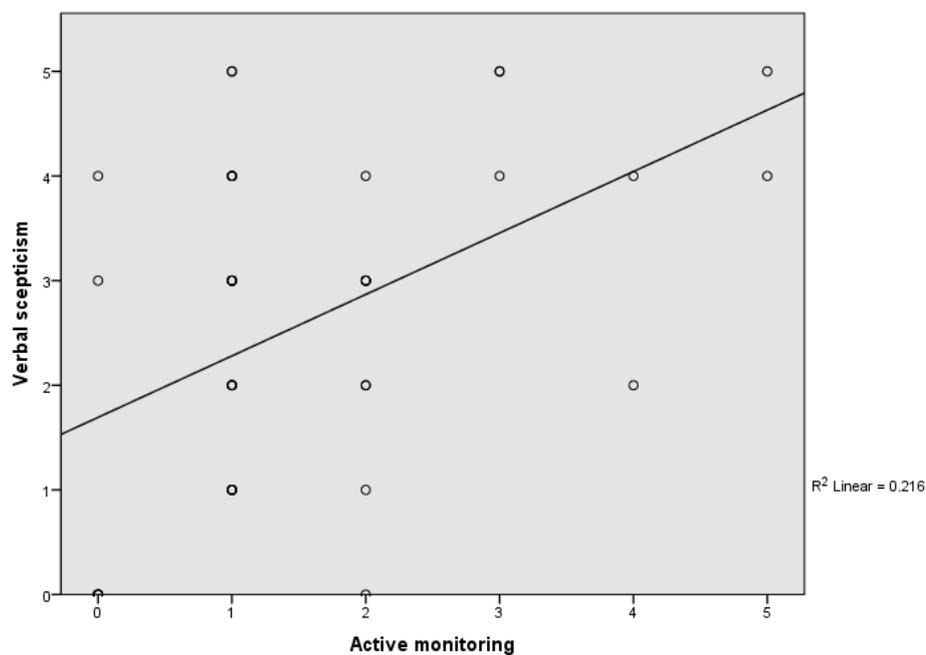
<b>Did the child search the bag?</b> <i>(When the teddy disappeared from the bag)</i>	<b>Did the child look at the box?</b> <i>(Before the word "box" was mentioned)</i>	<b>Did the child look back at the bag?</b> <i>(As soon as the box was opened)</i>	<b>Did the child search the bag?</b> <i>(When the box was opened)</i>	<b>Did the child search the box?</b> <i>(When the teddy re-appeared in the bag)</i>
Yes = 11 (26%)	Yes = 21 (49%)	Yes = 22 (51%)	Yes = 5 (12%)	Yes = 8 (19%)
No = 32 (74%)	No = 22 (51%)	No = 21 (49%)	No = 38 (88%)	No = 35 (81%)

A Mann Whitney U test revealed no significant differences between children searching versus not searching any of the apparatus (searching the bag when the teddy disappeared from the bag: Mann-Whitney U(11, 32) = 169;  $p = .855$ ; searching the bag when the box was opened: Mann-Whitney U(5, 38) = 80;  $p = .580$ ; searching the box when the teddy re-appeared in the bag: Mann-Whitney U(8, 35) = 135;  $p = .888$ ). Furthermore, in terms of looking behaviour, no significant difference was found between children glancing back at the bag or not when the teddy had appeared in the box (glancing at the bag: Mann-Whitney U(22,21) = 230;  $p = .980$ ). Therefore, there does not appear to be a developmental pattern in children's behavioural reactions to the event.

### **Level of Verbal Scepticism and Level of Active Monitoring Behaviour**

As the majority of children appeared to sway between scepticism and credulity of a genuine violation of object permanence throughout the conjuring trick, a total verbal scepticism score was calculated in order to analyse and determine children's level of verbal scepticism. A total active monitoring score was also calculated for analysis. It should be noted that all further analyses for the remainder of the study were conducted on 43 children, as 13 children were omitted due to lack of parental permission to videotape them.

Figure 4.2 shows that there was a positive linear relationship between levels of verbal and active monitoring scores, indicating that as children's verbal scepticism increased so too did their behavioural reactions.



**Figure 4.2: Linear Regression between 4-6-year-olds' Verbal Scepticism and Active Monitoring Behaviour**

A spearman's correlation was carried out in order to assess whether children's level of verbal scepticism and level of active monitoring were related. A significant positive correlation was found ( $r = .438$ ,  $N = 43$ ;  $p = .003$ ). Hence, there did not appear to be a discrepancy between levels of verbal judgments and behavioural reactions. Even when the possible effects of age, social confidence, and experimental condition were controlled for, a significant positive correlation still remained: age ( $r = .463$ ,  $df = 40$ ;  $p = .002$ ); social confidence ( $r = .440$ ,  $df = 40$ ;  $p = .004$ ); experimental condition ( $r = .488$ ,  $df = 40$ ;  $p = .001$ ). Therefore, irrespective of the child's age, their level of social confidence, and whether they were exposed to a visual clue of deception or not, levels of non-verbal and verbal responses were associated.

### **Social Confidence**

Although level of verbal scepticism and level of active monitoring behaviour were significantly correlated, a combined score was not calculated. Combining scores may have obscured a possible association between level of active monitoring (especially exploratory behaviour) towards the conjuring demonstration and social confidence that was independent of level of verbal scepticism. Therefore, a separate analysis was carried out. As Figure 4.3 illustrates, a step-wise increase was observed in social confidence and active monitoring: the more socially confident children were, the more inclined they were to explore apparatus and look in the direction of where the teddy was hidden.



**Figure 4.3: Four- to Six-year-olds’ Active Monitoring Behaviour and Social Confidence**

A significant positive correlation was found between children’s level of social confidence and their level of active monitoring in the conjuring demonstration ( $r = .364$ ,  $N = 43$ ;  $p = .016$ ). Furthermore, when a possible effect of age and condition was controlled for, a significant positive correlation still remained: age ( $r = .440$ ,  $df = 40$ ;  $p = .004$ ); condition ( $r = .449$ ,  $df = 40$ ;  $p = .003$ ). Therefore, the more socially confident a child was the more active they were in their behaviour.

Regarding level of verbal scepticism, those scoring highest in social confidence appeared to be the most sceptical. However, children who were the least socially confident appeared to be more sceptical than children who were somewhat socially confident (see Figure 4.4). Children’s level of social confidence and level of verbal scepticism were not significantly correlated ( $r = .133$ ,  $N = 43$ ;  $p = .393$ ).



**Figure 4.4: Four- to Six-year-olds' Verbal Scepticism and Social Confidence**

Taking the results together, social confidence was not linked generally to verbal scepticism in the testing session and cannot be taken as reflecting children's scepticism towards what they have witnessed *per se*. Instead it appears that behavioural reactions to the conjuring demonstration reflected social confidence in the testing session, especially as children were being videotaped. A summary of these correlations are shown in Table 4.3.

**Table 4.3: Matrix of Spearman Correlation Results for 4-6-year-old Children**

**(N = 43)**

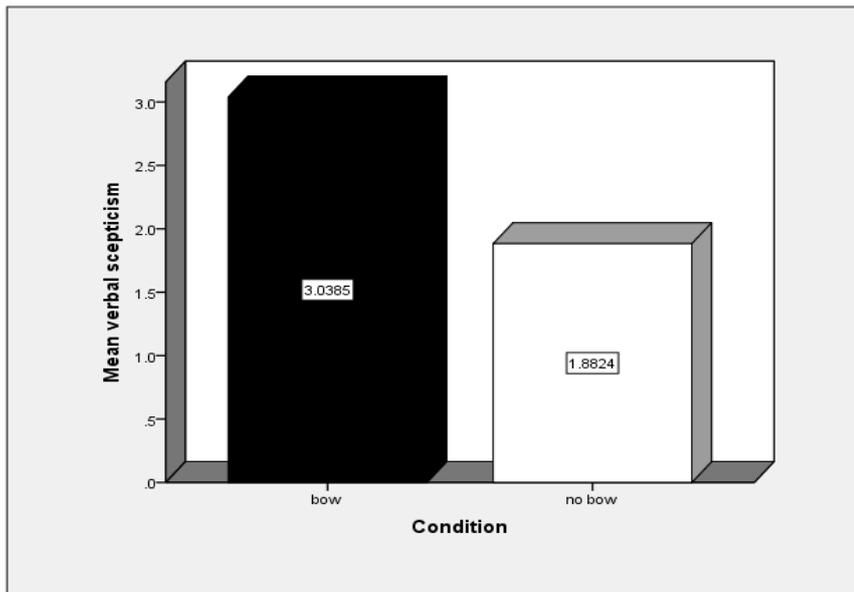
<b>Verbal scepticism</b>	.438** <i>p</i> = .003		
<b>Social confidence</b>	.364* <i>p</i> = .016	.133 <i>p</i> = .393	
<b>Age</b>	.072 <i>p</i> = .648	.153 <i>p</i> = .327	.184 <i>p</i> = .238
	<b>Active monitoring</b>	<b>Verbal scepticism</b>	<b>Social confidence</b>

**\*\* Correlation is significant at the 0.01 level (2-tailed).**

**\* Correlation is significant at the 0.05 level (2-tailed).**

**Experimental Condition (bow versus no bow)**

When comparing children who were in the bow condition (i.e. 26 children whereby the teddy that was found in the box had a bow around its neck) with those who were in the no bow condition (i.e. 17 children whereby the teddy that was found in the box had no bow around its neck) there appeared to be a difference in levels of verbal scepticism. That is, there was a tendency for children in the bow condition to be more verbally sceptical than those in the no bow condition (Figure 4.5).

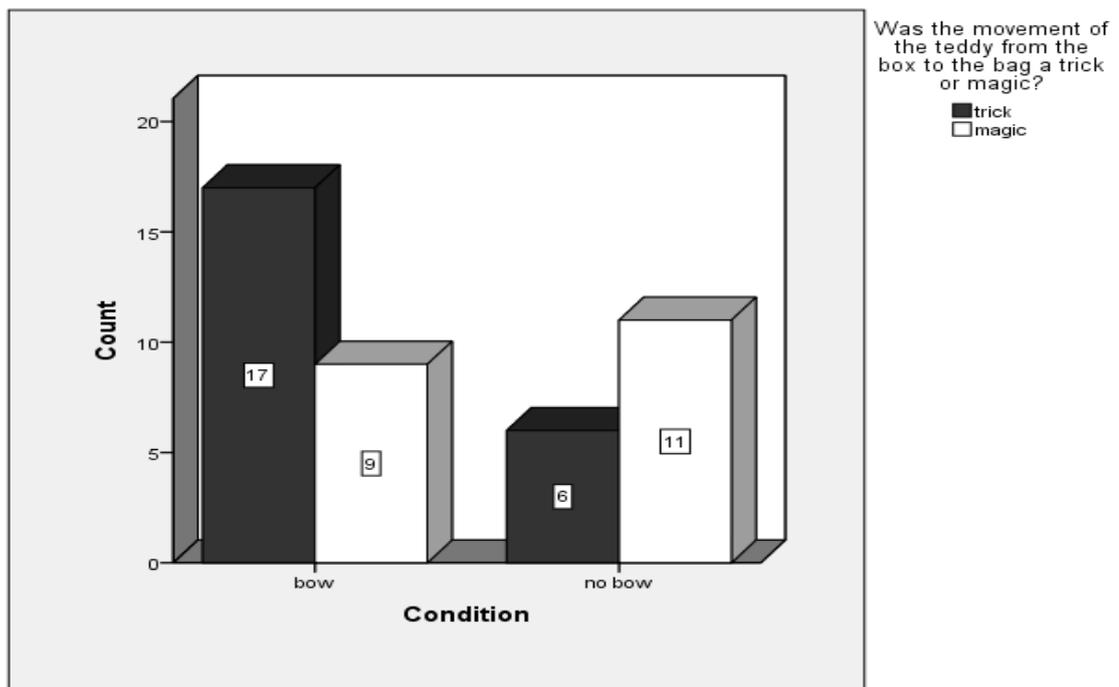


**Figure 4.5: Four- to Six-year-olds’ Level of Verbal Scepticism according to Experimental Condition**

A statistically significant difference was found between the two conditions in terms of level of verbal scepticism (Mann-Whitney U (17,26) = 135;  $p = .031$ ). However, no significant difference was found between the two conditions in terms of level of active monitoring behaviour (Mann Whitney U (17,26) = 207;  $p = .722$ ). Therefore, being exposed to a visual clue of deception appeared to only influence children’s verbal judgments.

Further analysis was carried out between the two conditions and children’s responses as to whether the movement of the teddy was “real magic” or a “trick”. As was mentioned earlier, responses to this question were a major indicator of children’s belief in the causal effect of the conjuring demonstration. No significant difference was found between the two conditions with respect to the number of children stating that the movement of the teddy from the bag into the box was “real magic” versus a

“trick” (Chi-square:  $\chi^2(1, N = 43) = .874, p = .350$ ). A near significant difference was found regarding the condition children were in and responses of whether the movement from the box back into the bag was “real magic” or a “trick” (Chi-square  $\chi^2(1, N = 43) = 3.741, p = .053$ ). Children in the bow condition appeared to be more likely to state “trick” whereas children in the no bow condition appeared to be more likely to state “real magic” (Figure 4.6). However, this near-significant result may be related to repetition of the causal question. Hence, children’s belief in the causal effect of this part of the manipulation was not necessarily related to the condition that the child was in.



**Figure 4.6: Four- to Six-year-olds’ Causal Responses for the Movement of the Teddy from the Box back into the Bag**

## **Discussion**

The main aim of Study 4 was to examine 4-6-year-old children's behavioural and verbal responses to a conjuring trick. In doing so, possible discrepancies between the two in terms of children's judgments towards the event being genuine magic might be uncovered. Irrespective of age, an association was found between children's level of verbal scepticism and level of active monitoring behaviour: as children's verbal scepticism increased, so too did their behavioural reactions towards the "spontaneous" transference of an inanimate object (i.e. a teddy). This implies that children's verbal judgments were accompanied by appropriate non-verbal behaviour. As such it opposes research that has only found children's belief in magic causality in their actions and disbelief in their verbal judgments (e.g., Subbotsky, 1985, 1993, 2001, 2004). However, a crucial difference in methodology might account for these contrasting findings. Other research has examined verbal beliefs prior to witnessing a demonstration and according to ontological beliefs. That is, whether a child states before witnessing a violation that it can occur in reality or not. Children are then tested on whether verbal responses correspond with non-verbal behaviour. For instance, according to whether a child looks inside a box after they have stated that an item cannot spontaneously appear by magic (e.g., Harris et al., 1991; Subbotsky, 1984, 1995). In contrast, Study 4 observed children's behaviour at the same time as questioning children on their interpretation of the event.

It is important to note many previous studies that have found conflict between children's verbal and behavioural reactions about magical causality have exploited the possibility of cost to the participant. As discussed in Chapter 1, in their verbal judgments school children usually show scepticism towards magic. Yet children show behaviours compatible with magical thinking if they are put in a context where

disregarding the possibility of magic involves a potentially high cost (e.g., Harris, et al., 1991; Johnson & Harris, 1994; Subbotsky, 1985, 1994, 2001), for instance, refusing to place a personal item in a box for fear of damaging it (Subbotsky, 2001).

Findings support the proposal that children's explanations for anomalous events might be better understood in terms of levels of verbal scepticism spanning a continuum as opposed to only categorising children as credulous or sceptical. In their verbal judgments, only nine children gave consistent responses throughout questioning that could be deemed as entirely credulous towards the demonstration being real magic. Six of these children also appeared to be genuinely surprised by the spontaneous transference of the teddy from one location to another. They exhibited surprise by having gaping mouths, putting their hands to their face, or to use Chandler and Lalonde's (1994) phrase, having "bugged" eyes (p. 89). Likewise, only four children gave consistent responses throughout questioning that could be construed as complete scepticism towards the demonstration. In fact, the majority of children gave a mixture of the two types of responses. Hence they conveyed different levels of scepticism towards the event. In their non-verbal behaviour, children were more inclined to look than to search. That is, equal numbers of children actively looked as did not in the direction that the teddy was hidden when the teddy was shown in an apparently different location. In contrast, the majority of children did not search the apparatus and so this might be construed as children showing credulity towards the spontaneous transference of the teddy without physical intervention. These results indicate that the children are not passively accepting of what they see, but are more curious and willing to explore. Such attitudes and consequent behaviour are likely to contribute to scepticism as it increases the possibility that the children will find alternative non-magic explanations of the events they witness.

In terms of children's verbal judgments, there was no developmental pattern in children ascribing trick causality to the event. Regardless of age, children were just as likely to give "real magic" as "trick" as an explanation for the movements of the teddy. Therefore, age was not a crucial factor in children suspending beliefs in the permanence of perceived objects. The majority of the children did not appear to be reliant on searching the apparatus in order to give a "trick" causal response. Nineteen out of 24 children gave a "trick" causal response for the transference of the teddy from the bag into the box, despite not searching the bag. In addition 17 out of 23 children gave a "trick" causal response regarding the transference of the teddy back into the bag, despite not searching the box. This implies that exploring the apparatus was not crucial in the detection of trickery and thus supports the findings of Study 2 and Study 3. A few children, who had felt the bag or opened the box after the transferences of the teddy, and gave "trick" causal responses, were able to independently work out and explain how the conjuring trick had actually been performed. For instance, after having opened the box and finding another teddy in it, one child correctly explained that one teddy was hiding in the bag and that there was just another teddy in the box. Another child clearly stated that she would have opened the box when the teddy was in the bag to "see if it's a trick" before she actually searched the box. However, other children appeared to be confused by the demonstration after having explored the apparatus. For instance, one child retrieved the teddy from the bag at the end of the demonstration, then opened the box, held both teddies in her hands, and commented that the two teddies looked different because one had a ribbon around its neck. Yet she stated that the demonstration was real magic, "Cos magic it appeared. When I blinked you put ribbon in, did it really fast and when I blinked again you put it in there". Another child felt the bag when the

teddy had disappeared (and consequently felt the hidden teddy). Yet when the box was opened and a teddy was revealed, the child hunched his shoulders and gave a “real magic” causal response. These findings somewhat oppose research that has shown that children who successfully search apparatus commit to principles of physical causality (e.g., Chandler & Lalonde, 1994; Hood et al., 2003). However, in Study 4, some children (i.e. six out of fourteen children) exhibited what might be interpreted as an element of scepticism towards the transference being genuine magic by searching the apparatus even though they gave “real magic” causal responses. It should be noted that there was an element of repetition in questioning children on the causality of the demonstration (i.e. asking whether the movement of the teddy into the box was “real magic” or a “trick”, and whether the movement of the teddy back into the bag was “real magic” or a “trick”). Despite this repetition, the majority of the children maintained a “trick” causal response (i.e. 23 out of 30 children) or a “real magic” causal response (i.e. 21 out of 26). Therefore, as only a few children changed their original causal statements, it was unlikely that children were conforming to a task demand (as in Study 2) and so the effect of repetitive questioning on results seems minimal. Instead, by providing a slightly more sensitive measure in the form of asking a second time if the demonstration was “real magic” versus “trick” reinforced children’s commitment to their causal responses.

Another aim of Study 4 was to introduce the possibility of a link between a psychological factor and responses towards a violation of object permanence. Therefore, in addition to including levels of verbal scepticism and levels of active monitoring, the current study also included ratings of children’s social confidence during a pre-test game. Although no significant association was found with levels of verbal scepticism, social confidence was associated with levels of active monitoring.

Indeed, the higher children's level of social confidence, the higher children's level of behavioural reaction was (and irrespective of the age of the child and the experimental condition they were in). Specifically, children were more likely to search the apparatus or look in the appropriate location where the teddy was hidden. Therefore, contrary to Subbotsky (2010), in order to elicit exploratory behaviour in children aged four years and older, an event does not need to be necessarily incompatible with the fundamental laws of nature (such as object permanence or physical causality). Instead, exploratory behaviour may be indicative of children's social confidence levels. Hence, a child lacking in social confidence seems less likely to explore.

The association found in Study 4 between level of active monitoring and social confidence was not unexpected. Both factors were assessed using similar criteria: direction of eye gaze and physical movements. Hence, social confidence was rated according to physical behaviour, apart from taking into account how talkative the child was, and if he or she smiled or laughed. Active monitoring assessed children's spontaneous reactions whereas verbal scepticism was assessed using judgments based on forced questions that only required one-word responses. Hence this might account for the lack of association found between verbal scepticism and social confidence, and the association found between active monitoring and social confidence. However, only two children spontaneously queried what had happened when the teddy had disappeared and re-appeared in a different location. Therefore, additional spontaneous verbal data could not be utilised.

Study 4 was also designed to add to the information already gained in the last two studies (and previous research), concerning a possible link between external factors and interpretation of an anomalous event. Therefore, it included two conditions in the conjuring demonstration (i.e. bow versus no bow around a teddy's

neck) in order to assess the effect of a visual clue on detection of trickery. Hence, children were provided with a hint of there being two teddies used in a conjuring demonstration rather than one. A non-significant trend was found regarding causal responses and the experimental condition the child was in. It would appear that an available clue was not necessary to make sense of there being a different teddy and hence trickery. The lack of a visual clue did not seriously challenge children's belief in physical causality (i.e. that an object cannot spontaneously move without physical intervention). With more power or a slightly different methodology, this aspect of their responding could and perhaps should be studied in the future.

Evidence was found of a link between children's interpretation of the conjuring demonstration and the experimental condition children were in. A significant association was found between level of verbal scepticism and the experimental condition: children in the bow condition were more sceptical in their verbal judgments than in the no bow condition. However, no association was found between children's level of active monitoring and experimental condition. This suggests that children's preferential looking and searching behaviour was not linked to additional clues provided by the experimental situation. It somewhat lends support to Hood et al. (2003) who found that preschoolers did not discriminate in searching performance between impossible and possible events: they search successfully both types of events. Instead, as stated previously, looking and searching behaviour is linked to social confidence. Therefore, social confidence appears to be a stronger influence on behavioural reactions than what may be deemed an explicit clue of trickery.

Children's level of verbal scepticism should be accepted with some caution since the inclusion of a visual clue may have biased results. Had children in the bow

condition given equal or more “real magic” causal responses than children in the no bow condition, this would have been an indication of children’s low level of scepticism instead of a response to a visual clue. Specifically, an explicit hint was provided of there being two different teddies used in the demonstration rather than one and hence a hint of deception. Although two out of six questions were asked before children were exposed to the teddy with the bow around its neck in the box, children may have been responding directly to what they saw rather than what they believed and so does not truly reflect children’s levels of scepticism towards the demonstration *per se*. Instead it reflects scepticism in response to a visual clue of trickery. This renders the results open to the possibility that it merely points to children’s sensitivity to contextual clues in interpreting events and not actual scepticism towards a violation of object permanence being genuine magic *per se*. With hindsight, it would have been appropriate not to include an explicit visual clue.

Irrespective of the experimental condition that the child was in, all participants were exposed to the suggestion of a magic context. The experimenter’s suggestion of magic by waving her hand over the bag and saying, “Abracadabra” may have influenced some children’s verbal convictions and cannot be dismissed. Indeed, Subbotsky (2004) explicitly talked about magic as well as using magic words in conjunction with an event and found that 4- and 6-year-old children accepted a magical explanation for a transformation of a physical object in an apparently empty box. In Study 4 of the current thesis, this magic suggestion was only spoken during the first transference of the teddy (i.e. when the teddy was put in the bag and was being transferred to the box) and not during the second transference (i.e. when the bag was empty and the teddy was being transferred back into it). Even so, there did not appear to be any differences between children’s first and second causal verbal

judgments and stating “abracadabra” or not. These findings contrast with Subbotsky (1994) who suggests that the experimenter’s credulity towards unusual phenomena may play a crucial role in changing children’s beliefs. As with Subbotsky (2004), magic words and action were specifically used in conjunction with the event in order to present an event that looked like authentic magic that is difficult to explain. By doing so, children’s physical causal beliefs were challenged and so, the extent to which children adhere to scepticism of magic tested. Conversely, the extent to which children subscribe to magical causality could also be explored.

### **Conclusion**

Study 4 found a significant association between 4-6-year-old children’s level of verbal scepticism and level of active monitoring behaviour towards a conjuring demonstration being genuine magic. This suggests that verbal judgments are a true reflection of their beliefs. Furthermore, although no significant association was found between children’s level of active monitoring when exposed to a visual clue of deception, children were significantly more likely to express verbal scepticism. However, a visual clue was not a crucial factor in the likelihood of children giving “trick” causal responses for an event that appeared to violate object permanence. Therefore, children’s verbal responses were somewhat dependent on whether they witnessed a teddy with a bow around its neck or not. No developmental trend was found in children ascribing “trick” causality or suspension of beliefs in the permanence of perceived objects. This implies that age may not be the crucial factor in children’s ability to acknowledge deception. Study 4 introduced a psychologically relevant factor to the thesis in the form of social confidence. No significant

association was found between level of verbal scepticism and level of social confidence. However, a significant association was found between level of active monitoring behaviour and social confidence: the more confident children were socially, the more likely they were to physically explore the apparatus or look in a relevant direction. This latter association points towards the possibility of there being individual differences between children's level of scepticism towards an event being real magic related to psychological factors. Therefore the final two studies in this thesis will explore other possible internal factors that may be associated with children's causal explanations and scepticism towards a conjuring demonstration being genuine magic. So far in the thesis the studies have looked mainly at contextual influences on children's interpretation of a violation of object permanence. The next two studies will focus on children's interpretations from a social-cognitive perspective.

## CHAPTER 6:

### **STUDY 5 – Detection of trickery and levels of sophistication of theory of mind, machiavellian intelligence, verbal ability, and spatial monitoring**

*“The power of thought, the magic of the mind”. (Lord Byron)*

There are several cognitive abilities that might be related to the development of magical belief or scepticism. Study 5 of the present thesis was conducted principally to investigate the hypothesis that scepticism with respect to conjuring tricks would be related to Theory of Mind ability. However, Study 5 also investigated the effect of levels of Machiavellian intelligence, spatial cognitive intelligence, and verbal intelligence upon magical belief.

#### **Theory of Mind and Advanced Theory of Mind**

In everyday life we form ideas about other people and about social situations. We interpret other people’s actions and we predict what they will do under certain circumstances. This requires a Theory of Mind (ToM) and is one of the most important skills to develop in early childhood with implications for the development of social interaction, emotional understanding and communication (Coull, Leekam, & Bennett, 2006). From the earliest research, a central focus has been on children’s understanding of false belief – that a person’s belief can contradict reality (e.g., Wellman, Cross, & Watson, 2001). An understanding of false beliefs is essential to an appreciation of the possibility of deception and trickery. More specifically, one must

have a fairly sophisticated ToM in order to appreciate that people may sometimes deliberately mislead others into drawing false conclusions (e.g., an object has disappeared when in reality it hasn't). Indeed, Sullivan, Zaitchik, and Tager-Flusberg (1994) postulated that advanced forms of reasoning underlie much of our social reasoning and are necessary for any sophisticated understanding of human action. These include understanding subtle forms of social deception such as bluffs and white lies (e.g., Happé, 1994). Study 5 of the current thesis explores a possible link between young children's detection of trickery in a conjuring demonstration and an advanced theory of mind (AToM). The conjuring demonstrations used in this thesis involve deception whereby an apparent violation of object permanence is shown. It seems reasonable to suppose that advanced understanding of knowledge and belief might assist children in identifying a "trick" as the underlying causal effect for the violation. So, it is likely that the more advanced one's theory of mind, the more likely one is to think, "It's a trick", and the less likely one is to think, "It's real magic". There does not appear to be any research as yet that has attempted to assess children's understanding of conjuring (which is a form of deception) from a theory of mind perspective. Study 5 also investigated different intelligence factors that might be related to children's level of verbal scepticism towards the conjuring demonstration being genuine magic: namely Machiavellian intelligence, spatial cognitive intelligence, and verbal intelligence. Once again there has been no previous research that has addressed these internal factors in relation to children's magical thinking.

ToM has been the topic of considerable research effort in the last twenty years (for thorough reviews, see Astington, 2003; Harris, 2006; Hughes & Leekam, 2004; Miller, 2009). A detailed examination of ToM development and its consequences is beyond the scope of the current thesis (as are the controversies surrounding this vast

topic). Instead, the current thesis contains a selective literature survey focusing on ToM's relevance to magical beliefs.

Studies on ToM have investigated various conceptions within the child's developing understanding and used a variety of tasks (e.g., Astington, 1993; Flavell & Miller, 1998; Wellman, 1990). As was mentioned earlier, much ToM research has focused on children's understanding of belief, especially false belief in others. The most popular topic has been first-order false belief: the realization that it is possible to hold false beliefs about events in the world. False belief tasks require children to distinguish between a mental representation (e.g., a belief that a cookie is in a jar) and the actual state of the world (e.g., the cookie really is in the cupboard). Appearance-reality tasks also require the understanding that mental representations of stimuli and the stimuli themselves may not always correspond (Flavell, 1988). The task requires the child to appreciate that an object's appearance may differ from its real status (e.g., an object can look like a rock, but in fact can be made of sponge; Flavell, Flavell, & Green, 1987). Therefore, the child needs to understand that appearance is separate from reality, in the same way that they need to understand that belief is separate from reality to complete the false belief measures. Research has established that nearly all children achieve success on standard false-belief tasks at approximately the same age (between four and five years of age). However, there are individual differences in that achievement, with some researchers (e.g., Chandler & Sokol, 1999; Coull et al., 2006) arguing that children's understanding of others' minds is a skill that develops for several years after children are successful on a typical false-belief task.

Selman (1980) theorised that progressive levels of social understanding are conceptualised in terms of increasingly advanced forms of perspective taking. Many researchers (e.g., Miller, 2009; Perner, 1991; Wellman, 1990) have noted that

advanced ToM understanding (AToM) involves not only that a person has their thoughts and beliefs about social situations and the world and that they can be false (first-order reasoning) (e.g., “he thinks that...”). It also involves thoughts about another person’s thoughts (e.g., he thinks that she thinks that...) and it can even involve thoughts about another person’s thoughts about their thoughts, involving intentions and emotions as well as beliefs. These beliefs too can be false or wrong. Miller (2009) labels them as “higher order” reasoning. AToM tasks such as Happé’s (1994) “strange stories” are considered more complex than first-order ToM tasks as the scenarios through which the task is conveyed are longer, they contain more informational units, they put more demand on working memory, and they include a more complexly worded test question. Furthermore, the AToM task is a powerful measure of children’s ToM development as not only are children required to infer mental states that are embedded in the context of a story, they must also provide causal reasons why a character has given a particular false statement. This ensures judgments reflect genuine understanding.

The consequences of ToM development have long been of interest in the literature on first-order mentalising and have been shown to relate to a wide range of social outcomes (Astington, 2003). Yet the development and consequences of more advanced aspects of social reasoning are under-investigated. Miller (2009), reporting on research that has been carried out to date, groups advanced social reasoning into three general and overlapping categories: lying and other forms of false statement, social behaviour (e.g., moral reasoning), and cognitive consequences. Lying is a relevant topic in relation to this thesis since, just as with magical trickery, it is a form of deception. As such, it will be addressed separately in Study 6.

Few studies have investigated the earliest age at which AToM emerges. There is also no clear consensus on when children become capable of attributing advanced order mental states, although it is widely assumed that this ability develops later than first-order ToM (Coull et al., 2006). Like the understanding of first-order ToM, there are different aspects of AToM understanding that may appear at different points of development and Miller (2009) reports that age of mastery varies across methods and samples. Therefore, irrespective of age, individual differences in children's level of ToM ability may account for individual differences in children's interpretation of an anomalous event.

### **Spatial Monitoring**

Another area of cognitive skill that may relate to children's understanding and acknowledgment of trickery in a conjuring demonstration is spatial monitoring ability. A basic function of spatial cognition is to keep track of the positions of objects in space. Sophian (1986) claimed this task is challenging because events are constantly occurring that change the positions of objects. At the same time, some objects remain stationary despite changes in the positions of objects around them. To function effectively, children must take account of both the changing (moving) and the stable aspects of their environment as movements occur. Sophian calls this "spatial monitoring". While much spatial monitoring can be done perceptually, by noting where various objects are at successive points in time, efficient spatial monitoring may also depend importantly on the child's ability to infer where objects will be after a movement, without perceiving them in their new positions. This is because objects are not always visible in their new positions, since they may be occluded by other objects or concealed within a container.

According to Sophian (1986), in order to evaluate children's understanding of object movements, and correspondingly their ability to monitor the positions of objects without immediate perceptual input, it is essential to look at their ability to locate objects that are not only concealed from view at the end of a movement but that also are not directly visible while a movement is taking place. Otherwise the child could locate the object simply by looking where he or she last saw it, which would not necessarily imply that he or she understood the movement. For example, on spatial transposition problems an object is hidden in one of several containers and then two of those containers are moved. Here, the object's movements are invisible as it is concealed inside the container. So the child can only infer what happens to the object from the movements of the containers. These movements may either include the container in which the object was hidden or just surrounding, empty, containers. Therefore, advances in children's understanding of what happens to an object when its container is moved enables them to infer what happens to objects that are concealed from view during a movement. It may follow that children require the same advance in spatial understanding in order to judge that a conjuring demonstration is a "trick". That is, the ability to keep track of and monitor a concealed object. The conjuring demonstration used in Study 5 (and Study 4) presents a "spontaneous" transference of an object (i.e. teddy) from one location (a bag) to another (a box). In order for children to understand that the teddy has not actually moved to a new location but is merely hidden within a bag, they need to be able to keep track of and monitor the concealed teddy. As children have not witnessed the teddy moving they may correctly infer that it is hidden in the bag by acknowledging trickery. Therefore, children may require a certain level of spatial monitoring ability in order to arrive at a "trick" conclusion to the operation of the event.

## **Machiavellian Intelligence**

A social intelligence factor that might be related to children's interpretation of a conjuring demonstration is Machiavellianism. Our beliefs about others are of fundamental importance in social interaction. We quickly form impressions and make judgments or attributions concerning people we meet, and this process can guide our behaviour towards them. Some may view people in general as untrustworthy in interpersonal situations, whereas others may have a high degree of faith in human nature, seeing people as fundamentally kind and to be treated with honesty and respect. This variation in attitudes has been described as degrees of "Machiavellianism" (Christie & Geis, 1970). Machiavellianism refers to the predisposition to cynically view others as fundamentally dishonest and gullible (Christie & Geis, 1970; Harrell & Hartnagel, 1976; Wilson, Near, & Miller, 1996). In the psychological literature, Christie and colleagues have found that Machiavellians also appear to be resistant to social influence, better able to ignore social concerns when they interfere with task performance and better able to initiate and control the structure of social interactions. It may follow in Study 5 that Machiavellian children will search apparatus in the conjuring demonstration and suspect trickery.

There has been some interest into Machiavellianism as a personality trait; however, there has been little empirical research using child samples. The majority of research on Machiavellianism in children has addressed children aged nine years and above. For example, Nachamie (1969) studied the behaviour of 11-year-old children and found that those scoring high in Machiavellianism ("high Machs") were more successful in bluffing and challenging in an experimental setting involving a dice game than those scoring low ("low Machs"). Furthermore, they were more able to distinguish lying from truth-telling in their opponents and were also more adept at

deceiving others. According to Damon (1988), the key Machiavellian view of other people as fundamentally untrustworthy, manipulable and gullible may not emerge before age eight or nine. Furthermore, according to Wellman (1990), the conceptual prerequisites of a Machiavellian orientation, namely an understanding of and capacity for deception, develop over the course of early to middle childhood. However, research suggests that Machiavellianism does exist in children as young as preschool age, with children becoming capable of deception (such as lying and misleading others in experimental settings) as young as age three or four (e.g., Russell, Mauthner, Sharpe, & Tidswell, 1991).

### **The Identity of the Magic Performer**

Although the current thesis has specifically used a conjuring demonstration in order to differentiate between children who give a “trick” or “magic” causal response, it may not have been sufficient to convince children that genuine magic had occurred and thereby challenge children’s adherence and commitment to natural physical laws of object permanence. Therefore, in Study 5 the conjuring demonstration included a variety of “magical” elements. Firstly, children were exposed to the appearance of someone who had the attribute of being a magician (i.e. wearing a cape and pointed hat, claiming to have special powers, and casting a magic spell). In doing so, the credibility of the agent might increase the potential for being able to somehow summon up magical powers and cause the transference of an object by magic. Previous research has established that children’s causal reasoning about events in the natural world appears predominantly rational, not magical. Yet when there is inclusion of a magician young children accept the power of magic to violate laws of physicality (e.g., Chandler & Lalonde, 1994; Phelps & Woolley, 1994; Rosengren &

Hickling, 1994; Rosengren, Kalish, Hickling, & Gelman, 1994). Indeed, Study 2 of this thesis found that the majority of 4-6-year-olds subscribed to magicians being able to “do magic” and having “special powers”. However, they also said magic was “just tricks”. In Study 5 it was hoped that by providing the agent (i.e. a magician) and a specific causal mechanism (i.e. “real magic” or a “trick”) in the conjuring demonstration instead of questioning children hypothetically about the abilities of magicians after having watched a conjuring event, children’s conflicting thoughts about magic in Study 2 would be clarified. Therefore, by having the experimenter appear as a magician, if children gave “real magic” causal responses instead of “trick” causal responses for the conjuring demonstration in Study 5, then responses can be considered as reflecting belief in genuine magic (as children claimed that magicians have special powers and can perform magic) and not that magic is “just tricks”.

### **Study Aim**

Study 5 aimed to find a possible link between AToM and responses to a conjuring demonstration. It is proposed that children with a higher level of ToM skills will be less likely to reason magically as they are more socio-cognitively developed. Therefore, children scoring higher on an AToM test will be more likely to think in terms of deception and trickery and actually suspect deception in a conjuring demonstration. Conversely, those with a lower AToM score will be less likely to think in terms of deception and trickery and be credulous of a conjuring demonstration being genuine magic. However, children may show limited AToM ability related to first-order ToM ability. Therefore, a series of standardised first-order ToM tasks were included alongside an AToM test in order to provide a fuller picture of children’s level of ToM ability.

Study 5 also tested children's Machiavellian beliefs in order to examine whether there is a link between level of Machiavellian intelligence and interpretation of a conjuring demonstration. As mentioned earlier, research has found that Machiavellians are more adept at detecting deception, able to distinguish lying from truth-telling and view people in general as untrustworthy. Furthermore, they have been found to be resistant to social influence, better able to ignore social concerns when they interfere with task performance and better able to initiate and control the structure of social interactions. Therefore, it is proposed that children with a higher level of Machiavellianism may be more likely to explore the apparatus and challenge the demonstration by judging in terms of trickery (and thereby adopt a high level of scepticism).

Spatial monitoring ability was also investigated in order to find a possible link with level of verbal scepticism towards a conjuring demonstration. It is proposed that a child with a higher level of spatial monitoring ability is better able to understand that objects move with their containers and to keep track of concealed objects that are both moving and stationary despite other objects moving around them. Furthermore, they are better at allocating their attention to key parts of the spatial field, and can monitor multiple as well as single objects at the same time. Therefore, they may be more capable of keeping track of the teddy in the conjuring demonstration and understand that it was concealed within the bag. Hence, they may be more sceptical of the conjuring demonstration being an instance of genuine magic. Conversely, a child with a lower level of spatial monitoring ability may be less sceptical of the demonstration.

Finally, an assessment of verbal ability was included in the present study due to the large verbal requirements of the measures of first-order ToM and AToM and as

a measure of verbal intelligence in relation to level of verbal scepticism. Vocabulary has been found to be the best single index of school success (Dale & Reichert, 1957) and to be one of the most important contributors to measures of intelligence (Elliot, 1982). Furthermore, correlations between language ability and ToM performance have now been established. Happé (1995) showed that verbal ability, as measured by the British Picture Vocabulary Scale (BPVS), was clearly linked to children's ability to pass false-belief tasks.

A 4-6-year-old age range was selected, as research reviewed in this thesis has shown that it is within this age range that children are most likely to subscribe to magic causality. It was also hoped that the inclusion of this age range would make more transparent any developmental influences and variations in theory of mind ability. In particular, individual variations in rates of developing false belief understanding are most apparent in four-year-olds (Wellman, Cross, & Watson, 2001).

**It was hypothesised that:**

1) There will be an association between an AToM and children's verbal responses to a conjuring demonstration. Children with a higher AToM score will be more likely to suspect deception and state that the demonstration is a "trick". Children with a lower AToM score will be less likely to suspect deception and so be more likely to state the demonstration is "real magic". Therefore we might expect that children who give consistent "trick" responses will have higher AToM scores than those who give consistent "magic" responses, with those giving inconsistent responses having intermediate AToM scores.

2) There may be a correlation between children's level of verbal scepticism towards a conjuring demonstration being genuine magic and level of Machiavellian intelligence. Specifically, children's level of scepticism may increase along with level of Machiavellian belief.

3) There may be a correlation between children's level of verbal scepticism towards a conjuring demonstration and level of spatial monitoring ability. Children with higher scepticism scores may be more likely to score higher in spatial monitoring ability as they are more capable of tracking movements of concealed objects.

## **Method**

### **Participants**

Forty children (22 males and 18 females) participated in the study. They ranged in age from four to six years of age (mean 64.6 months). The children in the study attended a S.E. London primary school and were predominantly from middle class backgrounds although this was not directly assessed. The ethnicity was predominantly white (31 white, eight black, one Asian).

### **Design**

The study used an independent samples design that included the independent grouping variable of response category group ("trick", "mixed", or "magic") and dependent variables of AToM ability and first-order ToM ability. A correlational design was also incorporated that included spatial monitoring ability, Machiavellian

intelligence, verbal ability, and level of verbal scepticism. All statistical tests were two-tailed unless otherwise indicated.

### **Materials**

The conjuring demonstration involved the same apparatus as used previously in Study 4 (i.e. a light blue square box, a red velvet bag with a rigid rim and a lever attached to a wooden handle that enabled an object to be hidden within a cloth pocket when the lever was moved across; see Figure 5.1). There were also two identical small teddy bears (the same as in Study 4 with the exception of no bow-tie on either teddy; see Figure 5.1). The “magic box” was placed on a shelf approximately ten feet away from the experimenter and the child who sat on separate chairs. The experimenter wore a pointed black hat and cloak so as to look like a magician/wizard.



**Figure 5.1: Materials for the Conjuring Demonstration**

The first-order ToM test for unexpected location used the following materials: one task used two small dolls each measuring 40 cm high with a 34 cm arm span with contrasting coloured hair and contrasting clothes (Figure 5.2), a basket measuring 22 cm in diameter with a cloth cover (Figure 5.2), a gold box measuring 5 cm wide and 5 cm deep (Figure 5.2) and a toy orange ball measuring 3 cm in diameter (Figure 5.2).



**Figure 5.2: Materials for one Unexpected Locations Task**

A second task used two small dolls each measuring 19 cm high and with a 14 cm arm span with contrasting coloured and length hair and contrasting clothes (Figure 5.3), a silver box with a lid measuring 12.5 cm wide and 6.5 cm deep (Figure 5.3), a red box measuring 5 cm wide and 5 cm deep (Figure 5.3) and a wrapped sweet measuring 5 cm long and 1.5 cm wide (Figure 5.3).



**Figure 5.3: Materials for a second Unexpected Locations Task**

A third task used a red teddy bear measuring 26 cm high with a 27 cm arm span (Figure 5.4), a brown teddy bear measuring 25 cm high with a 24 cm arm span (Figure 5.4), a green paper bag with handles measuring 19.5 cm long and 16 cm wide (Figure 5.4), a woven basket with a lid measuring 7 cm wide and 7 cm deep (Figure 5.4), and a deflated yellow balloon (Figure 5.4).



**Figure 5.4: Materials for a third Unexpected Locations Task**

The first-order ToM test for unexpected contents used a “Smarties” tube containing a red pencil, a green pencil and a blue pencil (Figure 5.5); a plasters box containing four 20 pence pieces (Figure 5.5); and a toothpaste tube box containing a necklace (Figure 5.5).



**Figure 5.5: Materials for the Unexpected Contents Tasks**

The first-order ToM test for appearance-reality used a candle that looked like a flower (Figure 5.6), and a sharpener that looked like a toy car (Figure 5.6).



**Figure 5.6: Materials for the Appearance-Reality Task**

The AToM Test consisted of a set of Happé's (1994) "strange stories": 12 short stories each accompanied with an A4-sized picture. (Details of the story types including pictures can be found in the appendices.) Verbal ability was tested using the short-form British Picture Vocabulary Scale (BPVS; Dunn, Dunn, Whetton, & Pinitilie, 1982). This consists of a standardised series of line drawings displayed in a booklet. The booklet contains 32 test item plates preceded by six training plates. A separate Individual Test Record was used that lists the stimulus words to be used with both the training and test plates and gives the answer key to the correct choices. Machiavellian intelligence was tested using a modified and condensed version of the "Kiddie-Mach" Scale (Christie & Geis, 1970). The spatial monitoring task consisted of three red boxes each measuring 5 cm wide and 5 cm deep (Figure 5.7), a ring, a deflated balloon, and a tea light (Figure 5.7).



**Figure 5.7: Materials for the Spatial Monitoring Task**

NB: A single-object condition used only two red boxes and a ring. A three-object condition used all three red boxes and the three objects shown in Figure 5.7.

### **Procedure**

The study consisted of two testing sessions, each lasting approximately 25 minutes. The first testing session included first-order ToM measures, the “Kiddie-Mach” Scale, and the spatial monitoring tasks. The second testing session included the AToM test, the short-form BPVS test, and the conjuring demonstration. All children were tested individually in a separate room. The same experimenter tested all 40 children.

#### ***First-order ToM Measures***

Three measures of first-order ToM were used in the present study, two assessing aspects of false belief understanding and the third examined appearance-reality understanding.

1) The Unexpected Locations Task

The unexpected locations task was carried out three times, involving different scenarios to provide a more stringent measure of ability and to reduce the possibility that the results gained could be due to chance responding.

The first scenario was based on the “Sally-Ann” task (Baron-Cohen, Leslie, & Frith, 1985). The child was shown two dolls that were labelled as “Sally” and “Ann”; the dolls were distinguishable in terms of both hair colour and clothing colour. The child was shown two containers: a basket with a cloth cover and a box with a lid. The child was then told that Sally has a toy ball and that she has to go out for a while and wants to put the ball somewhere to keep it safe. They were shown Sally putting the ball into the basket and putting the cloth cover over it. Sally then left the scene. While Sally was out the child was shown that Ann had moved the ball to the box and put the lid on it (an unseen transfer). Sally then returned and the child was asked the test question, “Where will Sally look first for her ball?” Two control questions were also asked: “Where did Sally leave her ball?” (memory question) and “Where is the ball really?” (reality question). The questions were based on those used by Eisenmajer and Prior (1991), as these included the element of asking where Sally will look *first*, which is believed to be a clearer pragmatic wording of the question.

The next scenario was based on the “Maxi” task (Wimmer & Perner, 1983), whereby the child was shown two different dolls to those of the first task. These included a small boy doll called “Maxi” and a small girl doll called “Mary”. The child was shown two boxes: one red and the other silver. The child was then told that Maxi likes chocolate, so he has got some chocolate. Maxi needs to go to the toilet so he puts the chocolate in the red box and then leaves the scene. While Maxi was out, the child was shown that Mary had moved the chocolate to the silver box and closed the lid.

Maxi then returned and the child was asked the test question, “Where will Maxi look first for his chocolate?” Two control questions were also asked: “Where did Maxi leave the chocolate?” and, “Where is the chocolate really?”

The final scenario involved showing the child a red teddy and a brown teddy. The child was also shown a bag and a basket with a lid on. The child was then told that it was the red teddy’s birthday so he has a balloon. But red teddy needs to make his birthday cake so he puts his balloon in the basket, puts the lid on and leaves the scene. While red teddy is out the child was shown that brown teddy had moved the balloon to the bag. Red teddy then returned and the child was asked the test question, “Where will red teddy look first for his balloon?” Two control questions were also asked: “Where did red teddy leave his balloon?” and, “Where is the balloon really?”

### Scoring Criteria

Scores were only given for the task if the child correctly answered the control questions. Had any child failed a control question, they would have been excluded from the sample on the grounds that responses to false belief test questions are meaningless if critical information is misunderstood. For each of the scenarios, a score of 1 point was given if the child correctly answered the test question and the two control questions, with a possible maximum total score (for all three scenarios combined) of 3 points.

### 2) *The Unexpected Contents Task (Perner, Leekam, & Wimmer, 1987)*

The child was shown a container (e.g., a Smarties tube) and was asked what they thought was inside the container, “What do you think is inside this tube?” Once the

child had guessed the contents, the container was opened and the actual, unexpected contents were revealed (e.g., coloured pencils). The contents were then replaced, the container resealed and the child was asked two questions. Firstly, they were asked, “If your teacher came in now and we showed her this Smarties tube all closed up like this and we didn’t let her look in it, what would she guess was in the Smarties tube, Smarties or coloured pencils?” This assessed whether they could predict the false belief of another person. Secondly, they were asked, “What did you think was inside the Smarties tube before you had a look inside, Smarties or coloured pencils?” This question assessed whether they were aware of their own earlier false belief regarding the contents of the container. A control question about the actual contents of the container was also asked to assess the child’s memory, “What is really in the Smarties tube, Smarties or coloured pencils?” The order of the alternative possible contents mentioned in the questions, for example coloured pencils or Smarties was switched for each question.

The unexpected contents task was carried out three times, using a Smarties tube containing coloured pencils, a plasters box containing coins and a toothpaste tube box containing a necklace.

### Scoring Criteria

Scores were only given for the task if the child correctly answered the control question. Had any child failed a control question, they would have been excluded from the sample for the same reason as stated for the unexpected locations task. A score of 1 point was given if the child correctly answered the test question relating to another’s false belief. A score of 1 point was given if they correctly answered the test question related to their own previous false belief. Therefore, two separate measures

of false belief understanding were ascertained: a measure of the child's understanding of his or her own false beliefs and a measure of the child's understanding of another's false beliefs. On each of these separate measures each child could accrue a maximum total score (for all three contents combined) of 3 points. So a maximum score of 3 points was possible for questions concerning the child's own previous false belief, and a maximum score of 3 points was possible concerning their understanding of the false belief of another.

3) *The Appearance-Reality Task (Flavell, Flavell, & Green, 1987)*

The child was shown two objects with a misleading appearance; a flower-shaped candle, and a car-shaped sharpener. The child was asked two questions to assess their understanding of the object's appearance, e.g., "When you look at this with your eyes right now, does it look like a candle or does it look like a flower?" and its real form, "What is this really and truly, a candle or a flower?" Therefore, the two questions assessed children's ability to appreciate that an object's appearance may differ from its real form. The questions were counterbalanced for the objects, so for one of the objects the child was asked about appearance first and for the other one about reality first.

*Scoring Criteria*

A score of 1 point was given if the child correctly answered both the reality and appearance questions for each object, thereby yielding a maximum total score (for both objects combined) of 2 points.

### Measure of Machiavellian Intelligence

To date, there has been no verbal measure of Machiavellianism for children under age nine. Therefore, a modified and condensed version of the “Kiddie-Mach” Scale (Christie & Geis, 1970) was used to assess children who might be high or low Machiavellians. The scale was condensed from 20 items to 14 items that were age-appropriate for the children being tested so that hopefully they would all understand the items. Due to the young ages in the study, instead of using a Likert scale, agreement with statements was indicated according to the response, “True” and disagreement with the statements was indicated according to the response, “False”. The experimenter read out 14 items to the children individually and responses were noted down. The items were as follows:

- 1) Never tell anyone why you did something unless it will help you.
- 2) Most people are good and kind.
- 3) The best way to get along with people is to tell them things that make them happy.
- 4) You should do something only when you are sure it is right.
- 5) It is smartest to believe that all people will be mean if they have a chance.
- 6) You should always be honest, no matter what.
- 7) Sometimes you have to hurt other people to get what you want.
- 8) Most people won't work hard unless you make them do it.
- 9) It is better to be ordinary and honest than famous and dishonest (tell lies).
- 10) It is better to tell someone why you want him to help you than to make up a good story to get him to do it.
- 11) Successful people are mostly honest and good.
- 12) Anyone who completely trusts anyone else is asking for trouble.

13) A criminal is just like other people except that he is stupid enough to get caught.

14) Most people are brave.

### Scoring Criteria

Machiavellian items (1, 3, 5, 7, 8, 12, and 13) were awarded 1 point each for a “true” response and 0 points each for a “false” response. Non-Machiavellian items (2, 4, 6, 9, 10, 11, and 14) were reverse scored for consistency with the Machiavellianism construct, so that high scores on these items indicated disagreement and therefore, Machiavellianism. So, “true” responses were awarded 0 points and “false” responses were awarded 1 point. An overall Machiavellian score was calculated for each child by totalling how many items they achieved 1 point for, with a total possible range of scores of 0-14.

### Spatial Monitoring Task (Sophian, 1986)

Spatial monitoring becomes more complex when there is more than one object to keep track of, so that the child must determine which objects are affected and which are not by a given movement. Therefore, level of spatial monitoring ability was assessed by children’s ability to track both single and multiple movements. The child participated in a single-object condition, in which the experimenter hid one object (i.e. a ring) in a red box (in full view of the child), and a three-object condition in which the experimenter hid three different objects, one in each of three red boxes (in full view of the child). The objects were a ring, a deflated balloon and a tea light. In the single-object condition, the experimenter selected in advance of testing a positioned box in which a ring was to be hidden. In the three-object condition, the experimenter chose

randomly which object to put in each box. The boxes were arrayed in a line so that all were approximately equidistant from the child.

In both conditions a mixture of transposition and control problems were presented. For the transposition problems, after hiding the object(s) in full view of the child, the experimenter picked up two of the boxes, one in each hand, and moved them to each other's places, passing one above the other so that both remained in view throughout. (Please note that in the single-object condition for irrelevant transposition problems, only one box out of two was moved. This is explained and illustrated in detail under the heading of *Single-object Condition*). For the control problems, the experimenter simply paused after hiding the object(s) in the box(es) for a period of time equivalent to that needed to carry out the transpositions (about two seconds) but did not move any box. The experimenter then asked the child to point to the box where a named object was. In the single-object condition, the object they requested was the only one they had hidden. In the three-object condition, it was a pre-designated object from the three hidden objects. If the child made an error, the experimenter encouraged them to try again until they found the object. In the three-object condition, if the child's first attempt was correct, the experimenter asked the child to find a second object as well, in one of the two remaining boxes.

The final location of the box containing the object the experimenter requested and the position of the box in which it had been hidden at the outset of the problem were counterbalanced across the set of problems each child received. The particular problems used varied across participants in such a way that all possible combinations of which boxes (if any) were interchanged and which box was correct occurred equally often. On three-object problems, which of the two remaining objects was tested second when the child pointed correctly for the first object was also varied

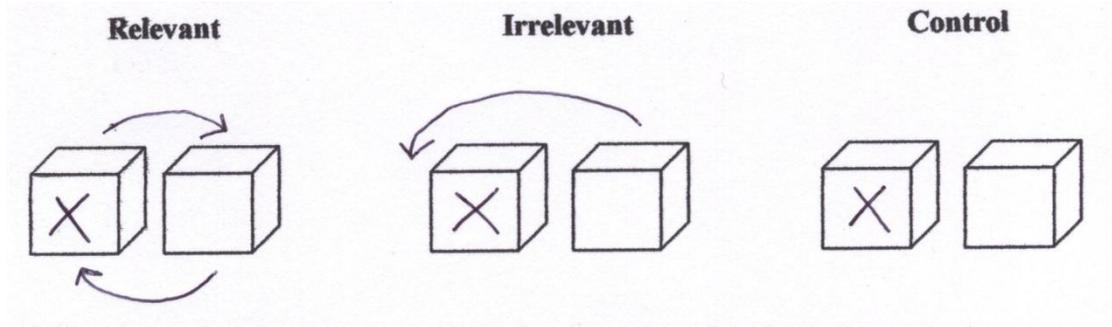
systematically across participants. All of the problems within each condition were intermixed and their order randomised independently for each child and each condition.

### Scoring Criteria

Each child was scored on their transposition performance in the single-object condition and the three-object condition, according to whether they made a correct search (by pointing and finding) or whether they made an error.

### Single-object Condition

Each child received seven problems in the single-object condition: two control problems (where no movement of two boxes occurred), three transposition problems in which the object the experimenter asked for was in one of two moved boxes (relevant transpositions), and two transposition problems in which the object the experimenter asked for was in one box out of two that had not been moved (irrelevant transpositions). Figure 5.8 shows an example of each problem. (All transposition problems can be found in the appendices.)



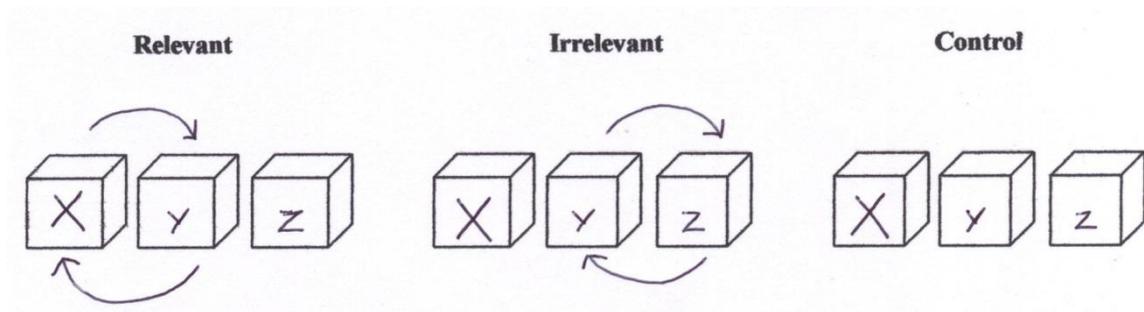
NB: X represents the object hidden in a box that the child had to locate. The arrows represent the movement of specific box(es).

**Figure 5.8: Single-object Transposition Problems**

A score of 1 point was given for each correct response for the position of the object and a score of 0 points for each incorrect response. Therefore, the maximum correct score possible was 7 points.

*Three-object Condition*

Each child received ten problems in the three-object condition: two control problems, three transposition problems in which the object the experimenter asked for first was in one of two moved boxes (relevant transpositions), three further transposition problems in which the second object the experimenter asked for was in one of the other two boxes (relevant transpositions), and two transposition problems in which the object the experimenter asked for first was in the box that had not been moved (irrelevant transpositions). Figure 5.9 shows an example of each problem. (All transposition problems can be found in the appendices).



NB: “X” represents the object hidden in the box that the child had to locate. “y” and “z” represent objects in separate boxes. The arrows represent the movement of specific boxes.

**Figure 5.9: Three-object Transposition Problems**

A score of 1 point was given for each correct response for the position of an object and a score of 0 points for each incorrect response. Therefore, the maximum correct score possible was 10 points.

The total score for the single-object condition was combined with the total score for the three-object condition to give an overall spatial monitoring score for each child.

*Measure of Verbal Ability (The Short-form BPVS; Dunn et al., 1982)*

This task required children to view a series of plates each showing four pictures. The experimenter stated a word and the child responded by pointing to the picture (from four options) that best illustrated the word’s meaning. The questions broadly sample words that represent a range of content areas such as actions, animals, toys and emotions and parts of speech such as nouns, verbs or attributes, across all levels of

difficulty. The task consisted of a training phase whereby as many training series items were administered as necessary to secure four consecutive correct responses. Following on from this, a testing phase was carried out. A series of plates were administered as necessary until four consecutive correct responses were not given. The scoring procedure was exactly the same as that outlined in the scoring manual by Dunn et al. (1982) so that a standardised score was calculated for each child.

*AToM Test – The Strange Stories (Happé, 1994)*

The “strange stories” task was selected as O’Hare, Nash, Happé, and Pettigrew (2009) found it is possible to test children using this AToM measure across the age range of five to twelve years. Twelve stories were administered randomly to children about everyday situations where characters say things they do not mean literally. They were simple accounts of events, which concern the different motivations that can lie behind everyday utterances that are not literally true (i.e. subtle forms of social deception). According to Happé (1994), they present a somewhat more naturalistic challenge to children than acted out ToM battery tasks. Children were required to infer mental state concepts when the ToM elements were embedded in the context of the stories. The stories consisted of Lie, White Lie, Joke, Pretence, Misunderstanding, Persuasion, Appearance/Reality, Figure of Speech, Sarcasm, Forgetting, Double Bluff, and Contrary Emotions. The child was read a story out loud by the experimenter and shown a picture that remained in front of the child (together with the story) whilst the experimenter read it out. This was to minimise memory requirements. At the end of the story the child was asked two test questions. The first question was, “Was it true what X said?” Although the first response was recorded,

the datum was not used for analysis as it was purely a test of comprehension. The second question, “Why did X say that?” was then asked. Figure 5.10 shows an example of an illustrated ‘Lie’ story type. Repetition of the question was only given once if the child did not respond the first time. This was in contrast to the methodology described by Happé, in that the story was re-read until it was either answered correctly or the child justified their answer. This adjustment was made in order to keep the time for administration manageable in the experimental setting and to not impose pressure on the child. The child’s answers were recorded in full on scoring sheets for later analysis. Positive encouragement was given but there was no direct feedback on the correctness of the answers.



One day, while she is playing in the house, Anna accidentally knocks over and breaks her mother’s favourite crystal vase. Oh dear, when mother finds out she will be very cross! So when Anna’s mother comes home and sees the broken vase and asks Anna what happened, Anna says, “The dog knocked it over, it wasn’t my fault!”

*Question:* Was it true what Anna told her mother?

*Question:* Why did she say this?

**Figure 5.10: Illustrated Story-type for Lie**

### Scoring Criteria

In accordance with Happé (1994), the justifications and scoring given in response to the “Why” questions were: either correct involving mental states (2 points) or correct involving physical states (1 point) or incorrect involving neither (0 points). For example, in the lie story, in which Anna breaks a vase but tells her mother that the dog did it, this can be correctly explained by the physical justification “so she won’t get told off” or the mental justification “She’s lying”. Mental state answers included all those that refer to thoughts, feelings, desires, traits, and dispositions (i.e. like, want, happy, cross, afraid, know, think, joke, pretend, lie, to fool someone, expecting). Justifications were scored as physical state when they referred to non-mental events – physical appearance, action of objects, physical events, and outcomes (i.e., big, looks like, is shaped like, to get rid of them, to sell them, because of the object, to not get physical outcome). A justification could be incorrect because it involved errors about the facts given in the story or because it involved an inference that was inappropriate as a reason for the story character’s utterance. For example, in the lie story, the justification “Anna did not break the vase,” would be scored as incorrect because it includes a factual error. A justification that “Anna was just joking” would also be scored as incorrect, because in the context of the story it is not appropriate to interpret her utterance as a joke. If the child’s answer appealed to both physical and mental states, the justification was scored as mental state.

In each case a maximum score of 2 points was given per story with a total possible score of 24 points for the twelve pictures. The subjective judgment of justification made co-validation of the scoring necessary to establish validity. The justifications given to each story by every child was given to a second independent rater, who was blind to the identity of the children. The degree of concordance

between the two raters was calculated for each story-type separately, and inter-rater reliability was 100% for all answers.

### Conjuring Demonstration

The experimenter put on a hat and cloak in front of the child and stated that she had special powers and could make an object disappear and reappear where she wanted it to. The experimenter showed the child a “magic box” and said that this was where she could make things appear that she really liked. The box was then placed at the opposite end of the room on a shelf but still in the child’s sight. The experimenter then showed the child a small teddy and said that she liked it and would make it disappear from her bag and reappear in her magic box. She then put it in the bag in front of the child, waved her hand over the bag and said “abracadabra”. She then asked the child if he or she thought that the teddy had disappeared. Regardless of the response, he or she was shown the apparently empty inside of the bag and then asked, “Where is the teddy?” If the child did not give a spontaneous response a prompt was given of, “Is it in the box or the bag?” If the child responded that it was in the box, the experimenter lifted the lid off and the child was then shown the teddy in the magic box (one that had been in the box all the time, but the child had not been shown). If the child responded that the teddy was in the bag the experimenter showed the child the apparently empty inside of the bag again and stated, “Let’s look in the box” and the child was then shown the teddy in the magic box. The child was then asked, “Is this teddy the same teddy that I made disappear in the bag or does it just look like the teddy I made disappear?” and, “Do you think that what I did was real magic or a trick?” The structure of the question asking if the teddy was in the “box” or the “bag”

was counterbalanced to control for order effects, as was that for the question whether it was “real magic” or a “trick”. Verbal responses were noted down. Children were not prevented from touching, searching or exploring the conjuring materials throughout the duration of the demonstration.

### Scoring and Classification Criteria

Children’s verbal responses to specific questions were categorised according to: 1) “yes” or “no” (“Do you think that the teddy has disappeared?”), 2) “box” or “bag” (“Where is the teddy? Is it in the box or the bag?”), 3) “same” or “looks like” (“Is this the same teddy that I made disappear or does it just look like it?”), 4) “real magic” or “trick” (“Do you think I did real magic or a trick?”). Along with categorising children’s responses to individual questions, a separate verbal scepticism score was calculated for each participant. For each question, a score of 1 was assigned to participants who gave a sceptical answer and a score of 0 if they gave a credulous answer. Each score was combined to give a total verbal scepticism score that ranged from 0 to 4, with 4 indicating the highest level of scepticism and 0 indicating the lowest level of scepticism. A breakdown of the scoring according to the questions was as follows:

1) “Has the teddy disappeared from the bag”?

*If the answer is “yes” = score of 0*

*If the answer is “no” = score of 1*

2) “Where is the teddy now, in the box or the bag”?

*If the answer is “box” = score of 0*

*If the answer is “bag” = score of 1*

3) (When the teddy has disappeared in the bag and appeared in the box) “Is this teddy the same one that I made disappear from the bag or does it just look like it”?

*If the answer is “same” = score of 0*

*If the answer is “looks like it” = score of 1*

4) “Was it real magic or a trick”?

*If the answer is “real magic” = score of 0*

*If the answer is “trick” = score of 1*

## **Results**

The present study employed measures in the areas of AToM, first-order ToM, spatial monitoring ability, Machiavellian intelligence, verbal ability, verbal responses to a conjuring demonstration, and level of verbal scepticism towards a conjuring demonstration. Initially the results section presents the descriptive data for these measures, followed by presentation of the inter-relations and connections among AToM, first-order ToM and verbal responses to a conjuring demonstration and then inter-relations and connections among level of verbal scepticism to the conjuring demonstration, verbal ability, spatial monitoring ability and Machiavellian intelligence. Non-parametric statistics are used throughout in the form of Kruskal-Wallis tests, Mann-Whitney U tests or Spearman correlations unless otherwise stated.

Examination of Table 5.1 shows that the mean score is well within the normal range for the short-form BPVS task (mean score 100.60) indicating that the children were capable of comprehending instructions given to them and that their verbal intelligence was in line with their age. Children's total scores on the Kiddie-Mach task varied widely between 3 and 11 points. No child scored a maximum possible score of 14 points and the mean score (6.28) indicates that children did not have high levels of Machiavellian intelligence. The maximum score possible for total spatial monitoring ability was 17 and the mean score (13.80) indicates that children were capable of monitoring a hidden object. These observations indicate a competence in spatial monitoring ability for majority of the children tested.

Although the range of children's AToM scores varied widely between 0 and 11 out of a maximum possible score of 24, the mean score was extremely low (4.52). These low scores imply a lack of sophistication in children's social intelligence. This may be related to the age range selected and will be addressed. As expected and in line with past ToM research, children were more proficient at passing first-order ToM tasks as indicated by the mean scores. In particular, children were adept in the appearance-reality task whereby a ceiling effect was found, with all children attaining the maximum score possible of 2 points. This indicates that all children were able to differentiate between appearance and reality. As there was no variation in scores, this task was omitted from analysis.

**Table 5.1: Descriptive Statistics for 4-6-year-olds' Scores obtained for Tasks**

**(N = 40)**

<b>Task</b>	<b>Range</b>	<b>Minimum</b>	<b>Maximum</b>	<b>Median</b>	<b>Mean</b>	<b>Std. Deviation</b>
<b>Short –form BPVS</b>	68	69	137	97.50	100.60	15.850
<b>Kiddie-Mach</b>	8	3	11	6.00	6.28	1.948
<b>ToM – Unexpected location</b>	3	0	3	3.00	2.52	.987
<b>ToM - Unexpected contents (own false belief)</b>	3	0	3	3.00	1.95	1.300
<b>ToM - Unexpected contents (another's false belief)</b>	3	0	3	3.00	2.30	1.114
<b>ToM – Appearance-reality</b>	0	2	2	2.00	2.00	0
<b>AToM</b>	11	0	11	4.00	4.52	3.202
<b>Spatial monitoring</b>	13	4	17	14.00	13.80	2.534

**Conjuring Demonstration**

Table 5.2 gives a detailed breakdown of verbal responses obtained in the conjuring demonstration.

**Table 5.2: Frequency and Percentages of 4-6-year-olds' Responses in the Conjuring Demonstration (N = 40)**

<b>Has the teddy disappeared from the bag?</b>	<b>Where is the teddy?</b>	<b><i>Did the child feel the bag?*</i></b>	<b>Is this the same teddy?</b>	<b>Was the movement real magic or a trick?</b>	<b>Pattern of responses throughout</b>
Yes = 24 (60%)	Box = 32 (80%)	No = 31 (77.5%)	Same = 17 (42.5%)	Magic = 16 (40%)	Magic = 8 (20%)
No = 16 (40%)	Bag = 8 (20%)	Yes = 9 (22.5%)	Looks like = 23 (57.5%)	Trick = 24 (60%)	Trick = 5 (12.5%)  Mix = 27 (67.5%)

\* Observed reaction

When examining responses, the majority of the children stated that the teddy had disappeared from the bag (60%) and was in the box (80%). This suggests that the majority of the children believed that the object (i.e. the teddy) was no longer in the bag and had transferred from its original location to a new location and may be interpreted as children being credulous of a spontaneous transference (i.e. without physical intervention). Hence it may represent children having a magical (i.e. non-sceptical) stance rather than a “trick” (i.e. sceptical) stance. However, although only a slight majority of the children stated that the teddy only “looks like” the original teddy (57.5%), a higher percentage gave a “trick” causal response for the movement of the teddy from the bag into the box (60%) than a “magic” one (40%) which is more indicative of a “trick” viewpoint. This implies that the children were sceptical of the demonstration being genuine magic and so appeared to be aware of the demonstration involving deception in some way. Children’s responses throughout the demonstration

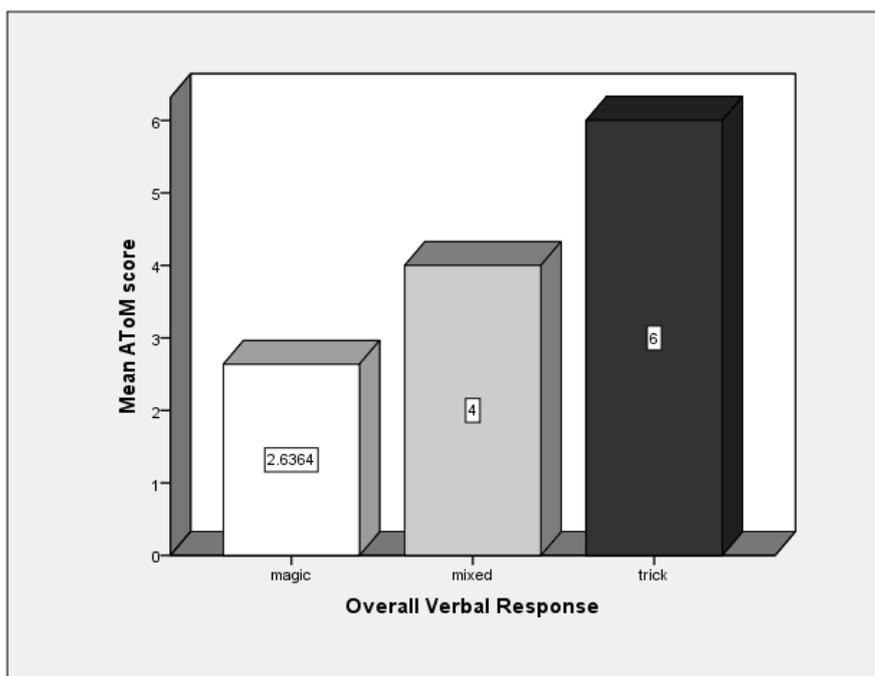
(as indicated by “pattern of responses throughout”) were mainly a mixture of scepticism (trickery) and credulity (magic) (67.5%), rather than consistent scepticism (12.5%) or consistent credulity (20%). This variation in responses once again highlights the need for an assessment of levels of scepticism that was first proposed in Study 4.

### **AToM and the Conjuring Demonstration**

In order to explore a possible relationship between AToM ability and the likelihood of children interpreting the conjuring demonstration in terms of trickery, children were assigned to different categories based upon their pattern of overall responses to selected questions about the demonstration. Children were assigned to a “magic” category if they stated that the teddy in the box was the same teddy as the one in the bag, and that the transference was real magic. Children were assigned to a “trick” category if they stated that the teddy just looked like the original teddy, and that the transference was a trick. Lastly, children were assigned to a “mixed” category if they gave a combination of responses throughout.

This set of criteria was used as it might be considered more indicative of a true “magic” or “trick” viewpoint (i.e. whether the teddy in the box was the same teddy that was in the bag or just looked like it, and whether the movement of the teddy from the bag to the box was “real magic” or a “trick”). Responses to the question, “Has the teddy disappeared?” and, “Is the teddy in the bag or the box?” were omitted as, on reflection, it was realised that children who stated “yes” may simply have responded literally to the fact that they could not see the teddy in the bag. Likewise, responses to the question, “Is the teddy in the bag or the box?” were also omitted as children who

stated “box” may have known that it was trickery and as such were expecting something in the box. Using these criteria, 11 children gave consistently “magic” responses, 18 children gave consistently “trick” responses, and 11 children gave “mixed” and therefore ambiguous responses. Figure 5.11 illustrates a step-wise increase in AToM scores across the three response categories.

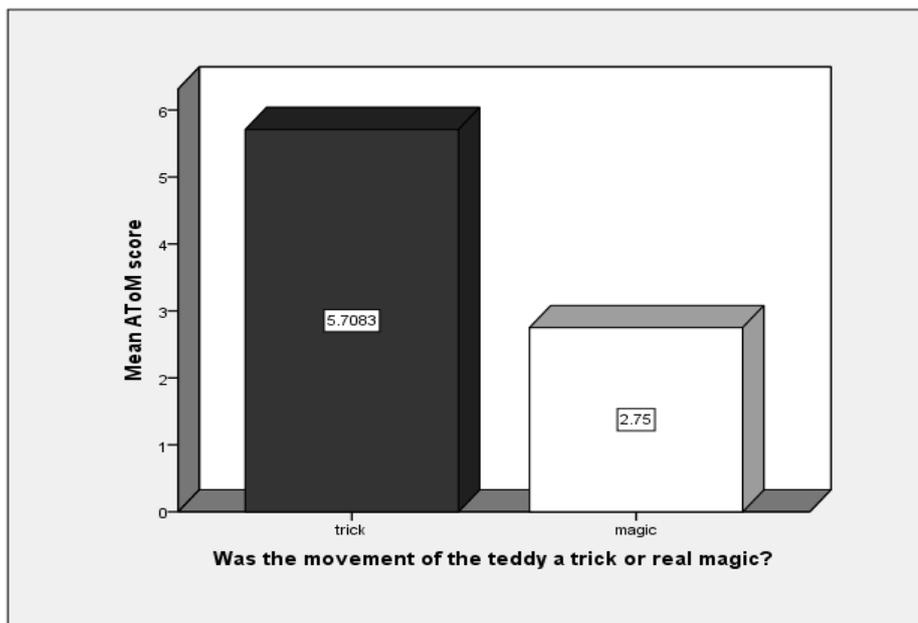


**Figure 5.11: Four- to Six-year-olds’ AToM Score in relation to Overall Verbal Response for the Conjuring Demonstration**

In order to investigate whether a significant difference in AToM scores would be found between the overall response category groups, AToM scores were analysed using a Kruskal-Wallis test. A significant result was found ( $\chi^2 = 8.433$ ,  $df = 2$ ;  $p = .015$ ) indicating that children in the “trick” category had higher AToM scores than

those in the “mixed” category who in turn had higher AToM scores than those in the “magic” category. A Mann Whitney U test revealed a significant difference between AToM scores of children giving overall “magic” versus “trick” responses (Mann-Whitney  $U(11, 18) = 34; p = .003$ ). Children giving “trick” responses had higher AToM scores than those giving “magic” responses. This was the only significant difference found between the three groups.

Responses as to whether the transference of the teddy into the box was “real magic” or a “trick” was considered indicative of children’s belief in the causal effect of the manipulation. Twenty-four children gave a “trick” causal response compared to 16 children who gave a “real magic” causal response. Comparing children’s total AToM scores with respect to their response to this question, there appeared to be a clear difference (Figure 5.12). Children who gave a “trick” response had higher AToM scores than those who gave a “real magic” response.



**Figure 5.12: Four- to Six-year-olds’ AToM Score in relation to Causal Response about Teddy’s Movement.**

A statistically significant difference was found between AToM scores of children giving “magic” versus “trick” causal responses (Mann-Whitney  $U(16, 24) = 84$ ;  $p = .002$ , one-tailed). Children giving “trick” responses had higher AToM scores than those giving “magic” responses.

### **First-order ToM and the Conjuring Demonstration**

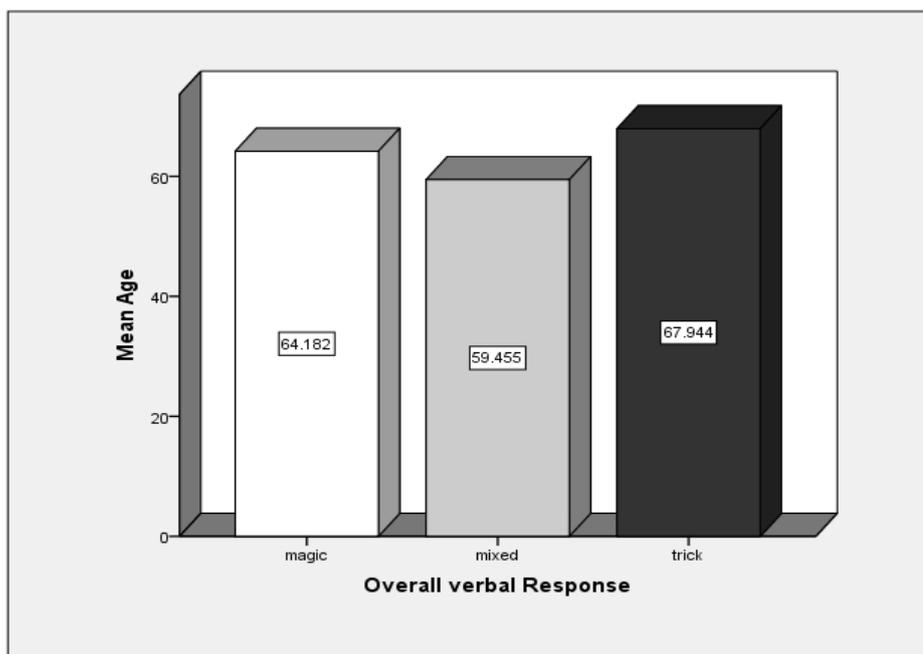
Exactly the same tests were carried out on the first-order ToM task scores with respect to responses to the conjuring demonstration as were carried out on the AToM task scores in order to ascertain whether there would be an association between standard false belief understanding and interpretation of a conjuring demonstration as either being a form of trickery or genuine magic. No significant results were found. Table 5.3 gives a summary of the results found for responses to the conjuring demonstration in relation to the first-order ToM and AToM tasks.

**Table 5.3: Summary of 4-6-year-olds’ Results for the Conjuring Demonstration, First-order ToM and AToM Tasks**

<b>Conjuring Demonstration</b>	<b>ToM Unexpected location (Sally-Ann, Maxi, Teddy)</b>	<b>ToM Unexpected contents (Own False Belief)</b>	<b>ToM Unexpected contents (Another’s False Belief)</b>	<b>AToM</b>
<b>Was the movement of the teddy a trick or real magic?</b>	Mann-Whitney U = 155 Sig = .148	Mann-Whitney U = 140 Sig = .112	Mann-Whitney U = 140 Sig = .090	Mann-Whitney U = 84 Sig = .002 (one-tailed)
<b>Overall response (magic, trick, mixture)</b>	Kruskal-Wallis $\chi^2 = 2.399$ df = 2 Sig = .301	Kruskal-Wallis $\chi^2 = 3.710$ df = 2 Sig = .156	Kruskal-Wallis $\chi^2 = 2.577$ df = 2 Sig = .276	Kruskal-Wallis $\chi^2 = 8.433$ df = 2 Sig = .015

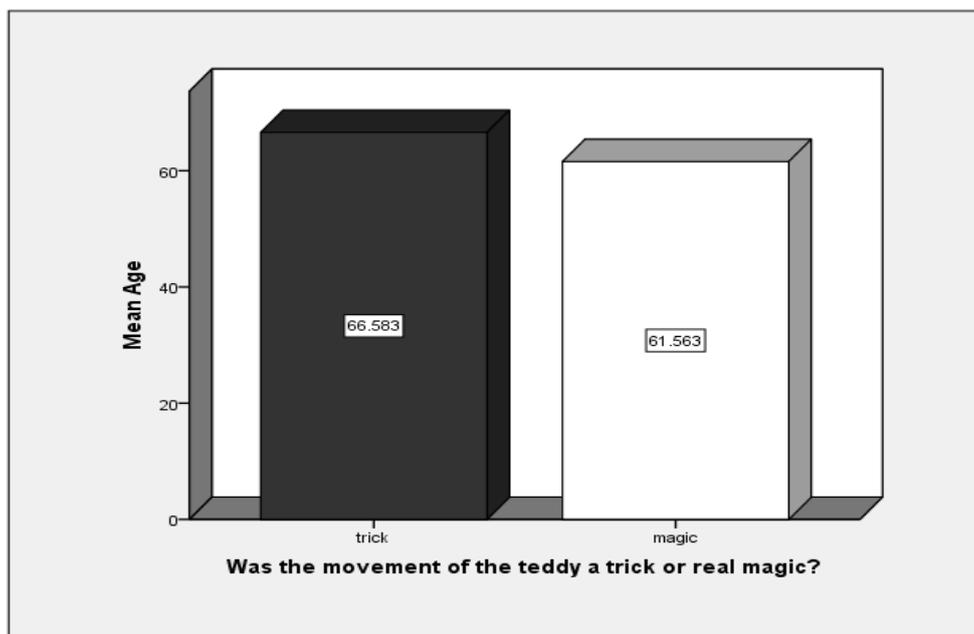
### Other Variables and the Conjuring Demonstration

Following on from these results, a Kruskal-Wallis test was then carried out comparing other variables with respect to overall verbal response type as described above. No significant differences were found between the groups for verbal intelligence ( $\chi^2 = 5.155$ ,  $df = 2$ ;  $p = .076$ ), for Machiavellian intelligence ( $\chi^2 = 2.714$ ,  $df = 2$ ;  $p = .257$ ) or for spatial monitoring ability ( $\chi^2 = 348$ ,  $df = 2$ ;  $p = .840$ ). Therefore, children's interpretation of the conjuring demonstration was not dependent on these factors. However, a significant result was found with respect to age ( $\chi^2 = 9.675$ ,  $df = 2$ ;  $p = .008$ ). Figure 5.13 suggests that children who gave "trick" responses were older than those who gave "mixed" responses and those who gave "magic" responses.



**Figure 5.13: Four- to Six-year-olds' Overall Response to the Conjuring Demonstration**

A Mann Whitney U test revealed a significant difference between age of children giving overall “mixed” versus “trick” responses (Mann-Whitney  $U(11, 18) = 26; p = .001$ ). Children who gave a “trick” causal response were older than those who gave “mixed” responses. Likewise, a Mann Whitney U test revealed a significant age difference between those children who gave “magic” versus those who gave “trick” as the causal response for the transference of the teddy ( $U(16, 24) = 115, p = .034$ ). Children who gave a “trick” causal response were older than those who gave “real magic” responses (Figure 5.14). Therefore, age was considered an influencing factor in children’s causal interpretation of the conjuring demonstration. More importantly, age may be an important factor that needs to be taken into consideration when ascertaining a link between AToM ability and detection of trickery in a conjuring demonstration.



**Figure 5.14: Four- to Six-year-olds’ Causal Response to the Conjuring Demonstration**

### **Relations Among the Tasks**

Spearman correlations were carried out in order to assess the relations among all the tasks. Importantly, links between levels of verbal scepticism and levels of theories of mind, Machiavellian intelligence, and spatial monitoring ability were explored. Total levels of verbal scepticism scores were used for the conjuring demonstration (as the majority of the children gave a mixture of responses throughout that could be deemed as both magic and trick responses). The verbal scepticism scores incorporate responses to the entire set of questions asked in the conjuring demonstration. This follows the same response criteria and justification for assessing levels of verbal scepticism as in Study 4. A matrix of results can be found in Table 5.4.

**Table 5.4: Matrix of Spearman Correlation Results for 4-6-year-old Children**

**(N = 40)**

<b>AToM</b>	.455** <i>p</i> = .003							
<b>ToM 1</b>	.181 <i>p</i> = .263	.404* <i>p</i> = .010						
<b>ToM 2</b>	.203 <i>p</i> = .208	.440** <i>p</i> = .004	.117 <i>p</i> = .474					
<b>ToM 3</b>	.245 <i>p</i> = .128	.547** <i>p</i> < .001	.481** <i>p</i> = .002	.398* <i>p</i> = .011				
<b>SM</b>	-.041 <i>p</i> = .803	.331* <i>p</i> = .037	.411** <i>p</i> = .008	.129 <i>p</i> = .427	.080 <i>p</i> = .625			
<b>BPVS</b>	.202 <i>p</i> = .211	.417** <i>p</i> = .007	.464** <i>p</i> = .003	.408** <i>p</i> = .009	.658** <i>p</i> < .001	.233 <i>p</i> = .148		
<b>Age</b>	.363* <i>p</i> = .021	.540** <i>p</i> < .001	.217 <i>p</i> = .178	.346* <i>p</i> = .029	.348* <i>p</i> = .028	.377* <i>p</i> = .016	.244 <i>P</i> = .129	
<b>KM</b>	-.165 <i>p</i> = .310	-.069 <i>p</i> = .672	-.032 <i>p</i> = .843	-.009 <i>p</i> = .958	-.176 <i>p</i> = .276	-.054 <i>p</i> = .740	-.135 <i>p</i> = .407	-.221 <i>p</i> = .170
	<b>VS</b>	<b>AToM</b>	<b>ToM 1</b>	<b>ToM 2</b>	<b>ToM 3</b>	<b>SM</b>	<b>BPVS</b>	<b>Age</b>

\*\* Correlation is significant at the 0.01 level (2-tailed).

\* Correlation is significant at the 0.05 level (2-tailed).

**Key: VS – verbal scepticism, ToM 1 – unexpected location task, ToM 2 – unexpected contents task (own false belief), ToM 3 – unexpected contents task (another’s false belief), SM – spatial monitoring ability, BPVS – (verbal ability), KM – kiddie-mach (Machiavellian intelligence).**

As can be seen from the matrix a number of associations were found. Most importantly, a significant positive correlation was found between AToM and level of verbal scepticism, and between age and level of verbal scepticism. This implies that both increased AToM ability and age were linked to children’s increased levels of

verbal scepticism toward the conjuring demonstration. Further analysis was carried out in the form of partial correlations, in order to assess whether items remained correlated when age and verbal ability were controlled for. No significant correlation remained between AToM and level of verbal scepticism ( $r = .290$ ,  $df = 37$ ;  $p = .073$ ) when age was controlled for. However, when verbal ability was controlled for there was still a significant correlation ( $r = .372$ ,  $df = 37$ ;  $p = .020$ ). Therefore, although verbal ability did not appear to contribute to the association between AToM and level of verbal scepticism to the conjuring demonstration, age was an important contributing factor and may play an important role in children's overall verbal scepticism towards a violation of object permanence being genuine magic.

No significant correlations were found between level of verbal scepticism and any of the first-order ToM tasks, or Machiavellian intelligence, or spatial monitoring ability. Therefore, these factors were not linked to children's level of verbal scepticism towards a conjuring demonstration being genuine magic.

It is worth mentioning other positive correlations that were found. AToM was positively correlated with all of the first-order ToM tasks implying that both abilities increased in line with each other. However, it is unclear if children needed to succeed in a first-order ToM in order to then succeed in AToM. A significant positive correlation was also found between verbal ability and all the theory of mind tasks (including AToM) implying that verbal intelligence is required in order to comprehend the tasks. A number of associations were found in relation to age that imply a developmental advance in certain tasks: spatial monitoring ability, first-order ToM ability (apart from unexpected location), and AToM ability. Therefore, increased proficiency on these tasks was influenced by increase in the age of the child.

A significant positive correlation remained between AToM and first-order ToM (unexpected contents for another's false belief) once the effect of age was controlled for ( $r = .438$ ,  $df = 37$ ;  $p = .005$ ). However, no significant correlation remained between AToM and first-order ToM (unexpected contents for own false belief;  $r = .247$ ,  $df = 37$ ;  $p = .130$ ). When verbal ability was controlled for, a significant positive correlation remained between AToM and first-order ToM (unexpected contents for another's false belief;  $r = .437$ ,  $df = 37$ ;  $p = .005$ ). However, no significant correlation remained between AToM and first-order ToM (unexpected contents for own false belief;  $r = .246$ ,  $df = 37$ ;  $p = .131$ ) or between AToM and first-order ToM (unexpected location;  $r = .247$ ,  $df = 37$ ;  $p = .130$ ). Therefore, both age and verbal ability contributed to the association found between AToM and first-order ToM to a certain extent (apart from unexpected contents for another's false belief).

## **Discussion**

The main aim of Study 5 was to investigate a possible relationship between 4-6-year-old children's responses to a conjuring demonstration and an advanced theory of mind (AToM). The rationale behind the study (and one of the main hypotheses of the thesis) is that children with a high level of theory of mind skill will be less likely to reason magically as they are social-cognitively developed. Therefore we might expect that children who give consistent "trick" responses will have higher AToM scores than those who give consistent "magic" responses, with those giving inconsistent responses having intermediate AToM scores. A series of findings appear to support this association.

Firstly, children who gave “trick” causal responses had higher AToM scores than those who gave “magic” causal responses. Secondly, regarding the overall response type to the conjuring demonstration (i.e. combined response of whether the teddy was the actual teddy that had disappeared or just looked like it, and whether it was real magic or a trick), children in the “trick” group had significantly higher AToM scores than those in the “magic” group. Thirdly, Study 5 also included a measure of children’s level of verbal scepticism towards the conjuring demonstration being genuine magic, in order to assess a possible relationship with level of AToM ability. Once again, a positive correlation was found, irrespective of verbal competence, with children who scored higher in AToM ability showing a higher level of verbal scepticism towards the event than those scoring lower in AToM ability. All these pieces of evidence suggest that a more advanced theory of mind understanding may open the way for detection of trickery that may not be possible in the absence of such a mentalistic orientation.

However, the above mentioned findings may be attributed to age. Indeed, a significant age difference was found between the groups categorized according to overall response type. That is, children who gave “trick” type responses were significantly older than those who gave “mixed” type responses. A similar pattern was found regarding causal responses for the event (i.e. the “trick” response group were older than the “real magic” group). An association was also found between increased level of verbal scepticism and increasing age, and increased AToM and increasing age. Furthermore, age was found to be a contributing factor regarding the association between children’s level of verbal scepticism and AToM. As such, this casts doubt on the credibility of AToM being singly responsible for children’s “trick” responses in Study 5.

Nevertheless, there is still reason to maintain that age may not be the main attribute and that there is something more than a developmental change that is occurring (i.e. AToM ability), which influences children's responses towards the conjuring demonstration. If children's causal responses are due to age, why were there individual differences, with some older children still stating "trick" while others stated "real magic"? Furthermore, Study 4 of the thesis did not find any significant age differences in children's causal responses and suggested that reasoning in relation to the conjuring demonstration is not just about age.

It could be argued that the significant link found in Study 5 between AToM ability and children's responses to the conjuring demonstration was due in part to the inclusion of magical elements (i.e. the experimenter wearing a hat and cloak in order to look like a magician, claiming to have special powers, and casting a spell). In addition, the distance of the location of the transferred inanimate object (i.e. teddy) was manipulated and may have influenced children's causal reasoning behind the transference; children may have suspected deception, taken the stance that the object was in a location more proximal to the original location (i.e. the bag) and given an explanation in terms of trickery. Alternatively, children may have been more credulous, taken the stance that the object was in a location more distant to the original location (i.e. the box) and given a magical explanation. Therefore, as the "magic box" was at a distant location from the "magician" it had the effect of encouraging some children to accept magical reasoning behind the demonstration. Conversely, other children may have doubted the plausibility of the transference of the teddy from the bag into the box being "real magic" due to the distant location and had the effect of discouraging some children to accept magical reasoning and hence give "trick" causal responses.

Yet, as Subbotsky (1997) postulated, indirect social influences are a legitimate and necessary way to test the firmness and permanence of children's beliefs in the impossibility of certain events. Therefore, if children gave "magic" responses surely their thinking was not rational in the sense of having a solid belief in the physical laws of nature? If children do not believe in magic causality then this manipulation should not affect them. According to Subbotsky, creating a more magical context that may then increase the likelihood that magical explanations would be given by children, challenges children's adherence to a sceptical point of view. Furthermore, the inclusion of the experimenter adopting the persona of a magician clarified children's conflicting responses in Study 2, whereby 4-6-year-olds were asked hypothetical questions about magicians. In this earlier study, although they had claimed that magicians can do magic and have special powers, children also claimed that magic is just tricks. As some children in Study 5 gave "magic" causal responses (as opposed to "trick" responses), it can be considered as evidence for children's responses reflecting genuine magic and not just tricks.

There were a series of important findings in terms of children's responses to the conjuring demonstration that need to be addressed. Firstly, on examining children's verbal responses to the conjuring demonstration itself, evidence shows that most children adopted a mixed credulous and sceptical stance. In fact, very few children were consistently credulous or consistently sceptical throughout. Once again, this is consistent with the findings of, and further supports the proposal that was made in, Study 4. That is, in order to fully understand children's interpretation of an anomalous event, rather than simply categorising children as believing or disbelieving in magic causality, measures should be incorporated that assess levels of scepticism.

Secondly, in terms of causal responses for the demonstration, irrespective of whether children felt the bag (where the original teddy was hidden) or not, more children gave a “trick” causal response than a “real magic” response (i.e. seven out of nine children who did not feel the bag, and 17 out of 31 who did feel the bag stated “trick”). Once again, as has been the finding throughout the studies carried out in this thesis, it would appear that examining apparatus was not a crucial factor in children acknowledging that “trickery” had occurred. Hence, the success of deception to some degree did not depend upon the child’s ignorance of the technical details. In fact, two children, despite feeling the bag and thereby feeling the teddy hidden inside at the bottom of it, still gave a “real magic” causal response. This goes against Chandler and Lalonde’s (1994) findings that young children are more likely to discount the notion of magic as the cause if they are given an opportunity of exploring the apparatus and hence discovering the experimenter’s use of a piece of trick apparatus. However, there must have been an element of doubt in the minds of all the nine children as to what they were witnessing as “real magic” and whether they believed that the “magician” could make the teddy really disappear as a result of “real magic”. Feeling the bag in the first place (possibly to justify their doubt) suggests suspicion on their part about the legitimacy of the demonstration. It should be noted that no 4-year-olds felt the bag where the teddy had originally disappeared from, and as such implies a lack of suspicion (at least at a behavioural level).

Study 5 also investigated a possible link between children’s responses to the conjuring demonstration and first-order ToM ability, by including a series of standardised false belief measures (i.e. the unexpected contents task and unexpected location task). No significant associations were found in terms of children’s detection of trickery, or level of verbal scepticism. The main reason for incorporating a series of

first-order ToM tasks was to assess children's level of ToM skill. The majority of children showed that they had an understanding that both beliefs and verbal statements can be false by achieving success in all the first-order ToM tasks. This was most evident in the ceiling effect found regarding the appearance-reality task which proved that children were capable of appreciating that appearance is separate from reality. Out of all the first-order ToM tasks, children were least successful on their own false belief in the unexpected contents task. One possible explanation for this may be that it was the only one to focus upon children's recall of their own mistaken beliefs. Children may have succumbed to the desire to give the "right" answer by denying their previous false belief, in order to create a favourable impression of their knowledge of things.

A positive correlation was found between AToM and first-order ToM implying children's abilities increase in line with each other. However, due to the correlational design, it is unclear if children need to succeed in a first-order ToM task in order to then succeed in an AToM task. It is important to note at this point that the mean score for AToM ability was extremely low (4.52) out of a possible maximum score of 24. This would suggest that success on first-order tasks was not predictive of good performance on the AToM task (especially as most children were proficient in first-order ToM). What is clear is that both increasing age and verbal ability were found to be contributing factors regarding the association between AToM and first-order ToM for own false belief (on the unexpected contents task). That is, the correlation disappeared when age and verbal ability were controlled for. This implies that verbal competence is required in order to comprehend these tasks and supports Happé's (1995) findings. The developmental pattern found for AToM ability and first-order ToM (unexpected contents task) ability is also consistent with previous

literature (e.g. Baron-Cohen et al., 1985; Happé, 1994; Happé, Winner, & Brownell, 1998; Perner et al., 1987).

Study 5 also included measures of spatial monitoring ability and Machiavellian intelligence to assess a possible relationship between children's level of verbal scepticism in a conjuring demonstration and other forms of social and cognitive intelligence. It was hypothesised that increased competence in spatial monitoring ability and Machiavellianism may be linked to the likelihood of children being more sceptical of genuine magic having occurred. No such correlations were found throughout. Spatial monitoring ability was specifically included in the present study as it was considered to involve the same required ability as in the conjuring demonstration: it required keeping track of a concealed object and identifying where the object was after a movement had occurred. The majority of children were successful in all aspects of the spatial monitoring task, showing that they were competent in monitoring the movement of a hidden object when it was being moved (and when it was stable while other objects were moving around it). In keeping with previous research by Sophian (1986), on close examination of the spatial monitoring trials, children found the single-object condition easier than the three-object condition. This was expected as the one-object condition focuses on monitoring just the one box that contains an object, whereas in the three-object condition all boxes are equally important to monitor.

It is worth mentioning that a positive correlation was found between age and spatial monitoring, with children's competence in this task improving with age. Therefore, there were developmental advances in children's understanding of what happens to an object when its container is moved, or other containers around it are moved. This enabled older children to infer what happened to objects that were

concealed from view during the movement more effectively than younger children. This fits with the developmental pattern found in other research (e.g., Sophian, Larkin, & Kadane, 1985; Sophian, 1986). However, the association found in Study 5 may reflect improvements in children's attentional capacity rather than increases in their understanding of the movements of the objects, especially as children were required to partake in many trials. Hence, many children may have had difficulty monitoring objects through movements because of lack of focused attention or boredom.

Regarding Machiavellianism, the questions asked in the task were adapted so that they would be age-appropriate and therefore understandable for the ages being tested. Indeed, the range of children's scores varied widely (i.e. between 3 and 11 points out of a possible score of 14). However, it was not clear if children fully understood the questions that were asked. It may be that children were still too young to verbally agree (with a "true" response) that for example, "The best way to handle people is to tell them what they want to hear". Yet they may still demonstrate a tendency toward behaviour that might be considered as relatively Machiavellian, for instance "by lying when cornered" (Repacholi, Slaughter, Pritchard, & Gibbs, 2003, p. 78). There may be measurable individual differences in the extent to which children's behaviour tends toward Machiavellianism, compared to verbal statements. However, only one study has developed a Machiavellian scale for children under nine years of age. Slaughter and Pritchard (2000) developed a 12-item Machiavellian rating scale designed to be used by adult informants who were familiar with the child's behaviour within the peer group such as teachers. However, the scale items reflect the overt behavioural, but not the subjective attitudinal, components of the Mach construct.

## **Conclusion**

Study 5 found a significant association between 4-6-year-old children's responses to a conjuring demonstration and AToM ability: children giving "trick" responses had significantly higher AToM scores than those giving "magic" responses. Furthermore, there was supporting evidence of an association between AToM ability and levels of verbal scepticism towards a conjuring demonstration being genuine magic: children scoring higher on AToM showed higher levels of scepticism. This latter association points towards the possibility of there being individual differences between children's level of scepticism towards an event being real magic related to social-cognitive ability. Children's level of verbal scepticism towards a conjuring demonstration was not found to be associated with specific intelligence factors: spatial monitoring ability, verbal ability, or Machiavellianism. However, a developmental change was found for specific abilities: AToM, first-order ToM, spatial monitoring, and verbal ability. In all cases children showed increased ability with age that is consistent with previous literature.

Children's ability to understand and identify a conjuring demonstration as trickery (i.e. false and misleading) may require sophisticated social-cognitive understanding, suggesting the possibility that detection ability is related to AToM. However, as age was found to be a contributing factor in results, further investigation needs to be carried out if the reliability of the present findings and the possible implications which they have for children's levels of scepticism are to be accepted. It is unclear if children's scepticism in relation to magic causality is specifically age-related or a developmental process that changes across time. Clearly there were individual differences in causal responses for the conjuring demonstration irrespective of age, with some children still stating "trick" while others stated "real magic".

Furthermore, Study 4 of the thesis gives clues that imply children's reasoning is not just due to age, as evidenced by the lack of significant age differences in 4-6-year-olds. Study 6 will test a slightly older group so that age effects may be slightly more delineated. As AToM was found to be positively correlated with age in Study 5, and as the AToM scores were extremely low for all children, this further confirms the importance of testing an older age range.

## CHAPTER 7:

### STUDY 6: Association between levels of theory of mind and deception

*“Art is magic delivered from the lie of being truth”. (Theodor Adorno)*

Lies are a common social phenomenon that children experience from an early age. This includes having lies told directly to them, witnessing lies told to others, and their own lie-telling behaviour (Talwar, Crossman, Gulmi, Renaud, & Williams, 2009). A lie is a form of deception: it is a verbally false statement intended to deceive (Stern & Stern, 1909). Talwar et al. (2009) claim that in order to detect lies, children must first be able to identify them. This includes understanding the defining features of a lie: a message that a sender knows to be false, but which is told deliberately to mislead. If this is not understood, lies can be confused with truth. Similarly, the conjuring demonstration used in this thesis is a form of deception, in which children are being deliberately misled into thinking that a teddy has spontaneously disappeared from one location and reappeared in another location. Therefore, children’s understanding of a conjuring demonstration as being an example of trickery may be linked to their experience with everyday deception in the form of lies. Study 6 aims to explore children’s ability to deceive and to discriminate between truth and lies. Specifically, children who can successfully lie or can successfully discriminate between lies and truth-telling in other children may be more likely to give “trick” explanations for a conjuring event than “magic” explanations as they are tapping into their own experiences of deception. Even though they may be unaware of the mechanics behind

it, they are appreciative of and acknowledge trickery. In addition, and of foremost importance, Study 6 is concerned with providing further support for a link between children's interpretation of a conjuring demonstration and an advanced theory of mind (AToM). The findings of Study 5 appear to indicate a link between social-cognitive intelligence (in the form of higher levels of AToM) and detection of deception (in the form of trickery). However, as age was found to be a contributing factor, it is important to assess an older age range in order to delineate age effects, especially as Study 4 implies that children's detection of trickery is linked to more than just age.

There has been extensive research on the development of lying that dates back to the beginning of developmental psychology (e.g., Binet, 1896; Darwin, 1877; Piaget, 1932). Only a limited number of studies have investigated children's actual lie-telling behaviour, most of which have involved preschool children (e.g., Chandler, Fritz, & Hala, 1989; Leekam, 1993; Lewis, Stanger, & Sullivan, 1989; Newton, Reddy, & Bull, 2000; Peskin, 1992; Polak & Harris, 1999; Sodian, 1991; Talwar, Crossman, Gulmi, Renaud, & Williams, 2009; Talwar, Gordon, & Lee, 2007; Talwar & Lee, 2002; Talwar, Murphy, & Lee, 2007). Overall, these studies have found that lie-telling behaviour emerges in the early preschool years and the ability to tell intentional lies increases with age. Yet the question of how well a child can succeed in the deception of lying is largely unexplored. Moreover, little work exists regarding children's ability to be deceptive in more naturalistic situations at any age. Although there are some studies on children's ability to detect deception (DePaulo, Jordan, Irvine, & Laser, 1982; Feldman, Devin-Sheeham, & Allen, 1978; Morency & Krauss, 1982), most of this work has involved children who are six years or older.

To lie successfully one must have knowledge of another's knowledge and beliefs, recognise the information required to sway the beliefs of the listener, and

communicate such that this information, rather than information which suggests one's intent to deceive, is passed on (Vasek, 1984). So, for instance, one must be able to not only produce a false statement but also ensure consistency between their initial lie and subsequent statements. Any inconsistencies in one's statements may lead to the detection of one's lies. The ability to maintain consistency between statements during deception is referred to as "semantic leakage control" (Talwar & Lee, 2002). Young children are poor at concealing their deception in their verbal statements (e.g., blurting out the name of a toy that they claimed not to have peeked at: Polak & Harris, 1999; Talwar, Gordon, & Lee 2007; Talwar & Lee, 2002, 2008). Indeed, Talwar and Lee (2002) have found a developmental trend in children's ability at semantic leakage control. Whereas the majority of children between three and five years blurted out the name of a toy that they denied having peeked at, about half of 6- and 7-year-olds feigned ignorance of the toy's identity.

A successful lie-teller will also maintain consistency between verbal and non-verbal behaviour in order to avoid giving any cues to their deceit (e.g., making eye contact while lying: Talwar, Crossman, Gulmi, Renaud, & Williams, 2009). Of the various studies that have been carried out, results show that by three or four years of age children can deceive others by hiding or changing a facial expression or emotion (e.g., Cole, 1986; Lewis et al., 1989; Saarni, 1984; Talwar & Lee, 2002). For example, Lewis et al. had difficulty sorting out liars from honest children. Children who were judged to be telling the truth when they were actually telling lies maintained relaxed and smiling expressions as they did so. This suggests that children understood that in order to deceive, one should speak a non-truth as though one was speaking the truth. In contrast, children who did not confess but remained mute tended to wear very nervous facial expressions. Furthermore, research with both

adults and children (aged six years and older) has found evidence that people have greater inconsistency between their verbal and nonverbal communication when they are lying than when they are telling the truth (DePaulo, Stone, & Lassiter, 1985; Ekman & Friesen, 1969; Feldman & White, 1980).

Miller (2009) argued that as the purpose of a lie is to implant a false belief it is difficult to see how lies could be either produced or understood without some realization that beliefs can be false. He postulated that an understanding of lying is probably the most direct consequence of false belief mastery. As Talwar, Gordon, and Lee (2007, p. 804) put it, "Lying, in essence, is theory of mind in action." Research appears to suggest that children's theory-of-mind understanding may be related to their lie-telling abilities (e.g., Chandler, Fritz, & Hala, 1989; Polak & Harris, 1999; Talwar & Lee, 2002, 2008). With development, the frequency of lying increases and the sophistication of the lies also increases. Referring back to the studies by Polak and Harris (1999) and Talwar and Lee (2002), initial false denials of peeking at a toy were related to children's first-order belief understanding. Yet maintaining a lie in follow-up questions was related to a child's more advanced belief understanding. However, the role of false belief understanding in relation to deception is controversial. For instance, Newton, Reddy, and Bull (2000) have found no link between genuine deception and children passing a false belief task.

Currently, children's ability to detect lies (and whether children can be easily deceived by another's lies) is a relatively understudied issue. Lie detection involves using a number of strategies to avoid being fooled by another person's lies, most of which involve detecting certain inconsistencies. A common strategy used by adults is to detect inconsistencies between verbal and non-verbal behaviours displayed by the lie-teller. Once inconsistencies are detected, a lie recipient may have reason to suspect

that the speaker has lied (Ekman & Friesen, 1969). With age children start to be able to detect lack of congruence between the lie teller's non-verbal expressive behaviour (which may reveal their true feelings) and their verbal behaviour (e.g., Rotenberg, Simourd, & Moore, 1989).

Another major strategy for detecting lies is based on semantics (Lee & Cameron, 2000). It involves comparing the spoken message of the lie teller and the listener's knowledge about the truth, along with the listener's knowledge about the intentions of the lie teller. Research suggests that children even as young as four years of age are able to detect lies when they are aware of intention to deceive (i.e. give a deliberate false statement), the intent of the deception, and they understand the distinction between what is said and what is believed by the speaker and that the two do not always correspond (e.g., Bussey, 1992, 1999; Lee & Cameron, 2000). During the elementary school years, children become increasingly aware of these discrepancies (Cole, 1986; Gnepp, 1983; Gnepp & Hess, 1986; Saarni, 1979).

Furthermore, individuals can use their world knowledge to identify inconsistencies in the content of a lie teller's statement. Inconsistencies arise when the statement violates world knowledge which in turn raises suspicion that the speaker's statement should not be believed. Lee, Cameron, Douchette, and Talwar (2002) found that older preschoolers (5-6-year-olds) could use their knowledge of the world to detect an implausible, scapegoating lie, which younger children tended to believe. Hence, older children could infer a speaker was lying with deceptive intent when they heard implausible statements. However, it is important to mention that most research on children's ability to detect lie-telling has focused on lies that are based on fantasy versus reality. For instance, Lee et al. (2002) used a storybook paradigm in which a protagonist claimed that a ghost in a story jumped out of a book and broke a glass and

children questioned as to whether this really happened or not. Furthermore, to date, there have been only a handful of studies that have examined children's abilities to detect real, spontaneous true and false statements by other children, and findings have been mixed. For instance, two studies found children's abilities to accurately detect other children's true or false reports about their feelings was at chance level and did not improve with age (Feldman & White, 1980; Morency & Kraus, 1982). However, Feldman, Devin-Sheehan, and Allen (1978) found that 7-year-old children were able to distinguish between facial expressions resulting from untruthful communication and truthful communication in other 7-year-old children. Talwar, Crossman, Gulmi, Renaud, and Williams (2009) appear to have carried out the only study that has examined both children's and adults' ability to make judgments of children's true and false reports and found that older children (aged 7- and 9-years old) were better at detecting lies than both younger children (aged 4- and 6-years old) and adults.

### **Study Aim**

The current study aimed to provide a further possible link between levels of theory of mind (ToM) skill and responses to a conjuring demonstration. That is, children with higher advanced theory of mind (AToM) ability may be more likely to think in terms of deception and suspect trickery. Conversely, children with a less sophisticated AToM may be more likely to think in terms of genuine magic. In addition, different levels of verbal scepticism towards a conjuring demonstration being genuine magic may be associated with level of AToM. A standard first-order ToM task was included as an additional measure for level of theory of mind. Study 6 also investigated other forms of deception (i.e. both active and passive participation in the form of lying) in relation to level of scepticism towards the conjuring demonstration. Specifically,

children who are more adept in deception (i.e. can successfully lie, or who can successfully discriminate between truth and lies in others) may be more likely to suspect trickery in the conjuring demonstration. It might be that children's past experience with telling lies both successfully (i.e. they were not detected) and unsuccessfully (i.e. they were detected) helps them to understand the features of a successful, intentionally false event. Likewise, children who are suspicious of the content of a lie teller's statement may also be suspicious of a violation of object permanence (i.e. the conjuring demonstration) being genuine magic.

A 5-7½-year-old age range was selected in the present study in the likelihood that higher scores in AToM ability would be attained and wider variance in scores. This in turn might give a greater differentiation between level of AToM ability and "trick" versus "magic" interpretations of the conjuring demonstration.

**It was hypothesised that:**

- 1) There will be an association between an AToM and children's verbal responses to a conjuring demonstration. Children who give "trick" responses will have higher AToM scores than those who give "magic" responses.
  
- 2) There may be an association between children's ability to successfully lie (i.e. not be detected when lying) and level of verbal scepticism towards the conjuring demonstration being genuine magic. Children who are successful at lying will have higher scepticism scores.
  
- 3) There may be an association between children's level of ability to discriminate between truth and lies and level of verbal scepticism towards the conjuring

demonstration being genuine magic. Children who are successful at truth/lie discrimination will have higher scepticism scores.

## **Method**

### **Participants**

Forty-eight children (25 males and 23 females) took part in the study. They ranged in age from five to seven-and-a-half years of age (mean age: 76.12 months). The children in the study attended a S.E. London primary school and were predominantly from middle class backgrounds although this was not directly assessed. There was a mixture of white, black and Asian children (27 white, 18 black and nine Asian). Twenty-two volunteer adults also provided data on the lie/truth discrimination task used in this study (see Procedure section for details).

### **Design**

The study included various independent variables including response category (“trick” vs. “magic”), ability to lie, and ability to discriminate between truth and lies (both high vs. low) and a number of dependent variables including AToM and first-order ToM scores and verbal scepticism. There were two experimental groups (as described below) each consisting of 24 children. Each group had equal numbers of males and females (bar one) and equal ages taken from six separate classes (i.e. eight 5-year-olds, eight 6-year-olds, and eight 7-year-olds). All statistical tests were two-tailed unless otherwise indicated.

## Materials

The conjuring trick used the same apparatus as in Study 5 (i.e. a light blue square box, a red velvet bag with a rigid rim and a lever attached to a wooden handle that enabled an object to be hidden within a cloth pocket when the lever was moved across, and two identical small teddy bears; Figure 5.1). The box was placed on a table within touching distance of the child and the experimenter who sat on separate chairs.

The first-order ToM test for unexpected contents (Perner et al., 1987) used the same apparatus as in Study 5: a “Smarties” tube containing a red pencil, a green pencil and a blue pencil (Figure 5.5); a plasters box containing four 20 pence pieces (Figure 5.5); and a toothpaste tube box containing a necklace (Figure 5.5).

Exactly the same AToM test using the “strange stories” (Happé, 1994), and short-form British Picture Vocabulary Scale (BPVS; Dunn et al., 1982), were used as in Study 5 (details can be found in the Method section of Study 5, and the appendices).

All 48 children were videotaped actively lying and telling the truth using a JVC 700x digital zoom, high resolution camcorder mounted on a tripod that stood in full view of the participant. A laptop (with a 16.4 inch screen) with headphones attached was set up to show pictures and to give instructions. It was positioned so that the experimenter could not see the screen. A digitized tape was devised in such a way that from a choice of 30 pictures, four were randomly selected separately instructing the child to lie and four were randomly selected separately to tell the truth. The pictures were chosen from 30 line drawings in the short-form BPVS so that the pictures were age-appropriate and were presented in A4 size format on the screen. (These pictures with the written instructions can be found in the appendices.) For the *truth/lie discrimination* sessions, a video was shown on a laptop screen of 11 children

in Experimental Group 1 or 11 children in Experimental Group 2, who were able to correctly lie and tell the truth to all eight pictures that were presented to them. The laptop had been set up to store responses keyed in by the experimenter. Each child's responses were entered on the laptop keyboard as follows: "L" for "lie", "T" for "truth", "D" for "doesn't know".

*Information stored on the laptop when testing children*

The computer was set up so that the following information would be stored: During the recording of children actively lying or telling the truth the participant number and the experimental group number was entered. The data logged showed the participant number, the experimental group, the session number, picture number and whether it was a lie picture or a truth picture that the child was instructed to describe. For example, in the case of a truth picture children were shown a picture of a lady and man dancing and instructed to state out loud that it was a picture of a lady and man dancing. In the case of a lie picture children were shown a picture of a boy and girl looking at books from a book shelf and instructed to state out loud that it was a picture of a lady and man dancing (see Figure 6.1).

During each child's ratings of the videos (i.e. the truth/lie discrimination task), the participant number and the experimental group number was entered and the trial number selected (e.g., 1 or 2 or 3, etc., up to 8). The data were logged in chronological order in the file data so that they showed the participant number, the experimental group, and the images shown to the participant (e.g., numbers 1-24 for Experimental Group 1, numbers 25-48 for Experimental Group 2). All participants were appended to the file so that one session did not overwrite another. The data also

showed whether the picture number was actually for a “lie” or “truth” picture, and also whether the participant rated the description as a “lie”, “truth” or “doesn’t know”.

### **Procedure**

All 48 children were tested individually by the same experimenter in a separate room. The study consisted of eleven testing sessions. The first three sessions each lasted approximately twenty minutes per child. The following eight sessions each lasted approximately eight minutes per child. The first session included a first-order ToM false belief measure (i.e. the unexpected contents task), followed by the short-form BPVS, and lastly the conjuring demonstration. (The conjuring demonstration followed the standard ToM test and the short-form BPVS so that the children became familiarized with the experimenter, felt less intimidated and hopefully gave an honest response.) The second session tested AToM and the third session included the “ability to lie” task. Finally, the following eight sessions tested children’s ability to discriminate between truth and lies.

#### *First-order ToM Test - The Unexpected Contents Task (Perner et al.,1987)*

The same measures and scoring that was used in Study 5 were used in the present study. (See the Procedure section of Study 5 for details.) Since the previous study found that most children achieved success on a variety of false-belief tasks and all children achieved success on an appearance-reality task, only the unexpected contents task was selected for Study 6.

### *AToM Task*

This measure was administered and scored in exactly the same way as described in the procedure section of Study 5. (Details of the story types and pictures can be found in the appendices.)

### *The short-form BPVS (Dunn et al., 1982)*

This measure was administered and scored in exactly the same way as described in the Procedure section of Study 5.

### *Conjuring Demonstration*

The procedure was the same as in Study 5, with the exception that the “magic box”, instead of being placed on a shelf approximately ten feet away, was placed on a table in touching distance of both the child and the experimenter, and the experimenter did not wear a hat and cloak.

As in Study 5, as well as categorising responses to individual questions separately, a total verbal scepticism score was calculated according to each child’s responses. (Details of questions and scoring can be found in the procedure section of Study 5.)

### *Ability to Lie Task*

In session three, all 48 children individually took part in actively lying. The experimenter initially showed them an example of what was required. They were given four practice trials beforehand (using pictures from the short-form BPVS that were not being used in the actual testing session). The purpose of this was to make sure children understood what they were doing (i.e. two lie trials and two truth trials).

In order to make the instructions as clear as possible, each child was told that they would see on the laptop screen a clip of film with someone either saying, “Ssh” and putting their finger to their mouth if the child was being instructed to lie or thumbs pointing upwards if the child was being instructed to tell the truth. They were also told that they would then see a picture appear on the laptop screen and hear instructions via headphones telling them to either lie or tell the truth about the picture that appeared on the screen and that the experimenter would not be able to hear or see what they were being told or shown. Furthermore, the child was prompted what to say the picture was showing via the headphones and a written description appeared on the bottom of the screen. A picture then randomly appeared and remained on the laptop screen. For example, if a child was required to tell the truth when a picture was shown of a bed, they might have been instructed via headphones, “Tell the truth and describe the picture as a bed”. When the child was required to lie, they might have seen a picture of a bus and been instructed via the headphones, “Don’t describe the picture as a bus. Pretend and describe a picture of a bed”. The experimenter then asked, “What is the picture on the screen?” and gave the child approximately five seconds to respond. The child was then asked (if the child hadn’t already done so) to describe the picture if possible by asking, “What else can you tell me about the picture?” The experimenter waited five seconds for the child to respond and after the child’s response then looked at the picture on the laptop monitor and either verbally confirmed or disconfirmed the child’s description by stating for example, “It was a bed” or exclaiming, “It wasn’t a bed! It was a picture of a bus”. The experimenter’s verbal response was kept light-hearted so that the child did not feel that they had done something wrong when lying.

For the actual testing session the child was asked randomly to lie four times and to tell the truth four times to the experimenter when describing eight individual pictures (in the same way as previously described). If too many pictures were introduced, then the child may have become bored and distracted and may have simply repeated the same description throughout. Alternatively, if only one picture from each category was used, the task may not have tapped into whether or not the child could consistently or convincingly lie.

The prompted instructions for the picture descriptions in the lying trials were selected from the pictures used in the truth trials for that particular experimental group being videotaped at the time. For example, a picture of a lady and a man dancing in the truth trial was used as a description when the child was told to lie about an actual picture of a boy and girl reading a book (Figure 6.1).



Lie statement: a lady and man dancing.

Truth statement: a lady and man dancing.

**Figure 6.1: Picture and Description for a Lie and a Truth Instruction**

The videotape had been edited so that 15 pictures were mixed up and randomly selected to show eight pictures individually to each child for one experimental group and a further 15 pictures randomly selected for the other experimental group. Different pictures were shown to each experimental group, so that when these same children were trying to discriminate between truth and lies, they would not rate according to having recalled pictures they had described themselves. A lengthy debriefing period followed at the end of the task with a discussion about the advantages of telling the truth.

#### Scoring Criteria for Ability to Lie

Children's individual ability to lie was scored according to the total number of incorrect lie ratings and "don't know" lie ratings made by children in the opposing experimental group.

#### Truth/Lie Discrimination Task

In sessions four to eleven, 47 children were individually asked to watch a video recording on a laptop screen and to decide whether each child was lying or telling the truth on each trial (or to report if they did not know). One child from the original sample was omitted from this task due to his absence from school. The videotape showed only 11 children from Experimental Group 1 and 11 children from Experimental Group 2. They were selected on their ability to correctly lie and tell the truth to all eight pictures that were presented to them. Specifically, 23 children in Experimental Group 1 were now required to try to discriminate between truth and lies in 11 children in Experimental Group 2. Likewise, all 24 children in Experimental

Group 2 were now required to try to discriminate between truth and lies in 11 children in Experimental Group 1. The experimenter entered on the laptop keyboard each child's rating as follows: key 'T' for "truth", key 'L' for "lie" and key 'D' for "doesn't know".

The videotape was edited so that 11 children in Experimental Group 1 had their eight trials randomly shown on a laptop screen to all 24 children in Experimental Group 2 and 11 children in Group 2 had their eight trials randomly shown on a computer screen to 23 children in Group 1. This randomization was intended to prevent the child who was trying to discriminate between truth and lies (for a total of 88 pictures) from getting bored. Hence, it hopefully accurately measured how convincingly each child could lie. It was also spread over eight sessions in order to reduce mental and attentional pressure.

Children's ability to fool adults was also explored, in order to investigate how good a liar a child was, and in particular to compare children's ability to discriminate between truth and lies with adult's ability. External raters (adults) were asked to watch the videotape of children in both experimental groups (i.e. 22 children) and asked to rate whether the child was lying or telling the truth or to indicate if they didn't know, and to indicate their rating by using the key system on the laptop as described earlier. Adults watched the videotape in one sitting with a break between each trial if required.

#### *Scoring Criteria for Truth/Lie Discrimination*

The children's and adults' ability to successfully discriminate between truth and lies was assessed by totalling up the number of times they correctly judged whether the children in the film clips were lying or telling the truth.

Adults were included in order to compare with children's ability to discriminate between truth and lies. It could be that children are better at truth/lie discrimination than adults, but if children do very poorly the data on its own will not tell us much. Therefore, adults were included as a comparison group. In addition, it might be impossible for anyone to discriminate between children's lies and truth-telling in the methodology used. Therefore, as a benchmark, adults were included. It would not be inappropriate to suppose that adults would be more skilled at discriminating between truth and lies than children. If both adults and children were equally unable to discriminate, this might be taken as evidence for children's lies as being undetectable using the current methodology, regardless of whether children were not deemed skilled in the "ability to lie" task. Hence, it attempted to expose possible chance ratings.

## **Results**

The present study employed measures in the areas of AToM, first-order ToM, verbal ability, verbal responses and levels of verbal scepticism in a conjuring demonstration, ability to lie, and ability to discriminate between truth and lies. Initially the results section presents the descriptive data for these measures, followed by consideration of the relationship between AToM, first-order ToM and verbal responses to the conjuring demonstration. Finally, the relationship between verbal scepticism to the conjuring demonstration, ability to lie and ability to discriminate between truth and lies was investigated. Non-parametric statistics are used throughout the current study in the form of Kruskal-Wallis tests, Mann Whitney U tests or Spearman correlations unless otherwise stated.

Examination of Table 6.1 shows that the mean score was within the normal range of responses for the short-form BPVS task (mean score 94.77) indicating that the children were capable of comprehending instructions given to them and that verbal intelligence was in line with age. Although the range of AToM scores varied widely between 0 and 12 out of a maximum possible score of 24, the mean score was low (6.17). These low scores imply a lack of sophistication in children's social-cognitive intelligence. As expected, and in line with past ToM research, children were more proficient at passing the first-order ToM task as indicated by the mean scores.

**Table 6.1: Descriptive Statistics for 5-7½-year-olds' Scores for Short-form BPVS, ToM and AToM (N = 48)**

<b>Task</b>	<b>Range</b>	<b>Minimum</b>	<b>Maximum</b>	<b>Median</b>	<b>Mean</b>	<b>Std. Deviation</b>
<b>Short-form BPVS</b>	55	75	130	92.50	94.77	13.358
<b>ToM - Unexpected contents (own false belief)</b>	3	0	3	3.00	2.27	1.198
<b>ToM - Unexpected contents (another's false belief)</b>	3	0	3	3.00	2.58	.846
<b>AToM</b>	12	0	12	6.00	6.17	2.927

### **Conjuring Demonstration**

Table 6.2 gives a breakdown of verbal responses obtained in the conjuring demonstration. When examining overall totals, the majority of the children stated that the teddy was “in the box” (71%) and that it was the “same teddy” that had been in the bag (75%). This suggests that the majority of the children believed that the object (i.e. the teddy) had transferred from its original location to a new location and may be interpreted as children being credulous of a spontaneous transference (i.e. without physical intervention). Only a marginal majority of the children stated that the teddy had not really disappeared from the bag (52%) and gave a “trick” causal response for the movement from the bag into the box (56%). This implies that children were overall slightly sceptical of the demonstration being genuine magic. They appeared to be aware of the demonstration involving deception in some way. Children’s responses throughout the demonstration (as indicated by “pattern of responses throughout”) were generally a mixture of scepticism (trickery) and credulity (magic) (75%), rather than consistent scepticism (8%) or consistent credulity (17%). This variation in responses once again highlights the need for an assessment of levels of scepticism that was initially proposed in Study 4.

**Table 6.2: Frequency and Percentages of 5-7½-year-olds’ Responses in the Conjuring Demonstration (N = 48)**

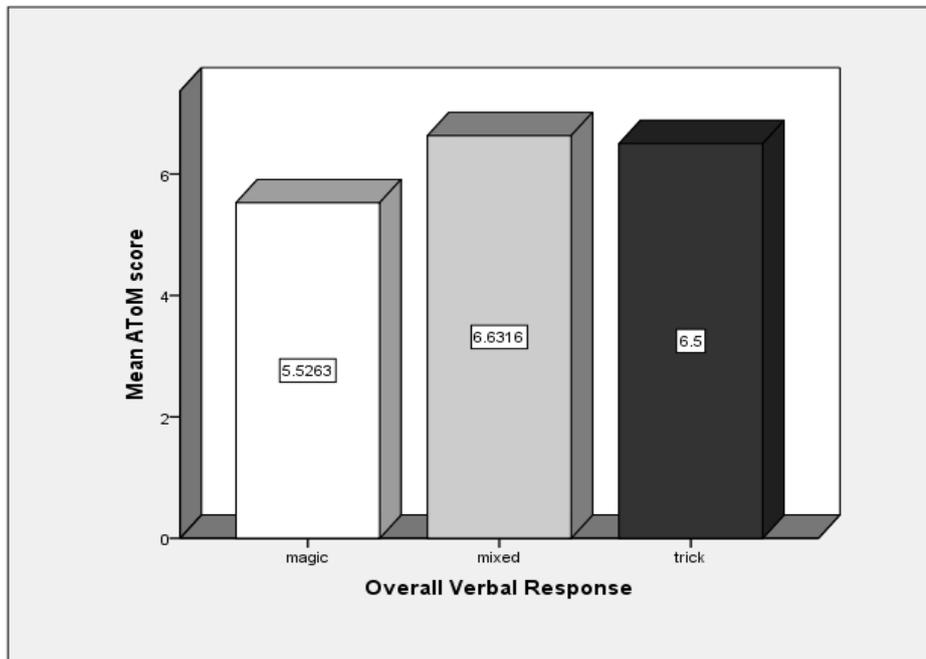
<b>Has the teddy disappeared from the bag?</b>	<b>Where is the teddy?</b>	<b><i>Did the child feel the bag?*</i></b>	<b>Is it the same teddy that was in the bag?</b>	<b>Was the movement real magic or a trick?</b>	<b>Pattern of responses throughout</b>
Yes = 23 (48%)	Box = 34 (71%)	No = 35 (73%)	Same = 36 (75%)	Magic = 21 (44%)	Magic = 8 (17%)
No = 25 (52%)	Bag = 14 (29%)	Yes = 13 (27%)	Looks like = 12 (25%)	Trick = 27 (56%)	Trick = 4 (8%)  Mixture = 36 (75%)

\*Observed reactions

**AToM and the Conjuring Demonstration**

In order to explore a possible relationship between AToM ability and the likelihood of children interpreting the conjuring demonstration in terms of trickery, each child was allocated to an overall “magic”, “trick”, or “mixed” response category group. This was based upon their pattern of overall responses to the same selected questions about the demonstration as was used in Study 5. Children were assigned to the “magic” category if they stated that the teddy in the box was the same teddy as the one in the bag and that the transference was real magic. Children were assigned to the “trick” category if they stated that the teddy just looked like the original teddy and that the transference was a trick. Lastly, children were assigned to a mixed category if they gave a combination of responses throughout. Figure 6.2 shows that children in the

“trick” category appeared to have higher AToM scores than children in the “magic” category.

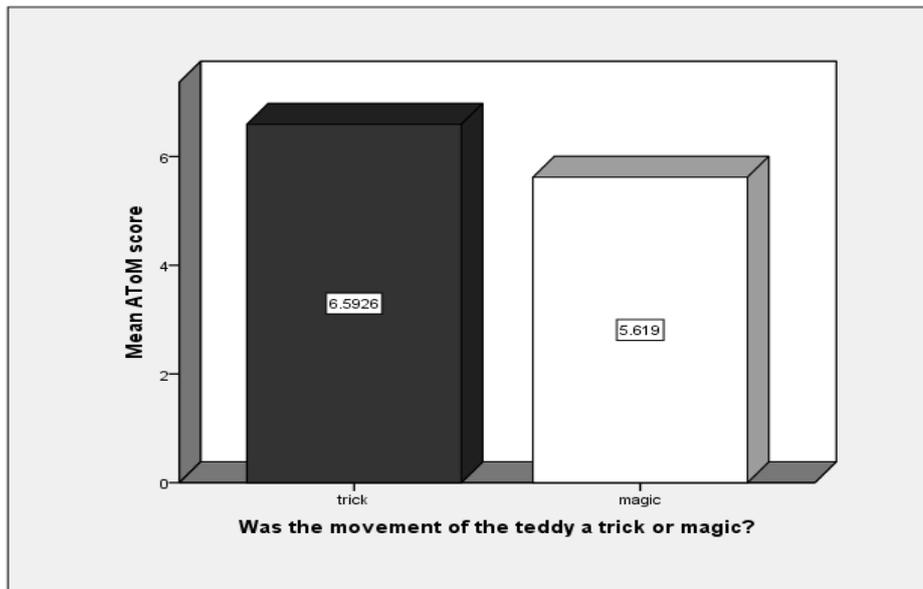


**Figure 6.2: Five- to Seven-and-a-half-year-olds’ AToM Score in relation to Overall Verbal Response for the Conjuring Demonstration**

However, there were no significant differences in AToM scores between the groups based on the overall response categories (Kruskal Wallis:  $\chi^2 = 1.399$ ,  $df = 2$ ;  $p = .497$ ).

There appeared to be a difference between children’s AToM scores between children giving different causal responses as to whether the transference of the teddy into the box was “real magic” or a “trick” (Figure 6.3). Children giving “trick”

responses appeared to have higher AToM scores than those giving “real magic” causal responses.



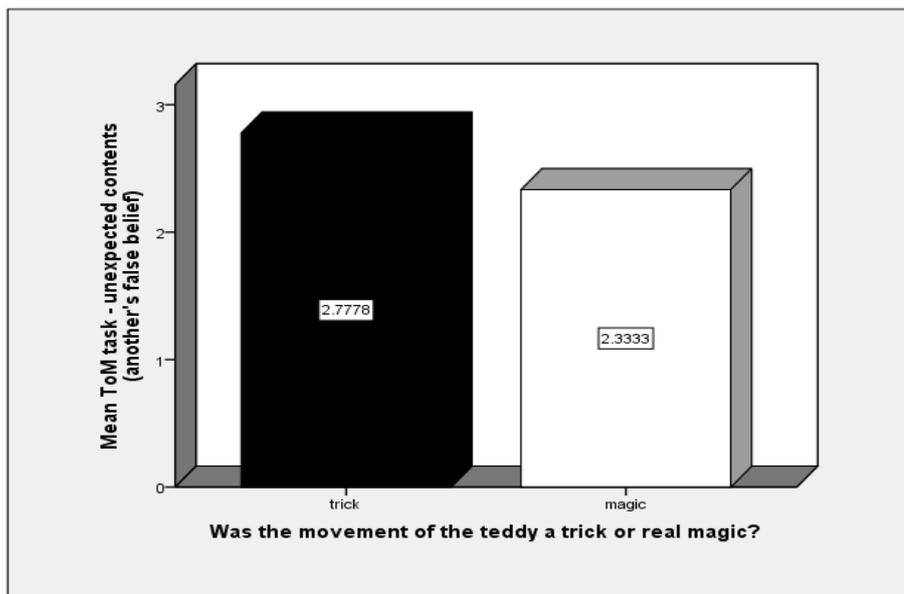
**Figure 6.3: Five- to Seven-and-a-half-year-olds’ Causal Response in relation to AToM Score**

However, once again no statistically significant difference was found (Mann-Whitney  $U(21, 27) = 232; p = .14$ , one-tailed), thus failing to support the hypothesis that children giving a “trick” causal response would have higher AToM scores than those responding “magic”.

### **First-order ToM and the Conjuring Demonstration**

Exactly the same tests were carried out with the first-order ToM unexpected contents scores with respect to responses to the conjuring demonstration as were carried out on

the AToM task scores. The purpose was to ascertain whether there might be a link between first-order false belief understanding and interpretation of a conjuring demonstration in the form of trickery. There were no significant differences in first-order ToM scores between the overall response category groups. Table 6.3 gives a summary of the results found for responses to the conjuring demonstration in relation to the first-order ToM and AToM tasks. When comparing children's false belief scores with respect to their causal responses to a direct question of whether the movement of the teddy was a "trick" or "real magic", a significant difference was found for another's false belief ( $U(21, 27) = 209; p = .035$ ) but not for own false belief ( $U(21, 27) = 260; p = .550$ ). Children giving "trick" responses had a higher ToM score for another's false belief than children giving "real magic" responses. This is illustrated in Figure 6.4.



**Figure 6.4: Five- to Seven-and-a-half-year-olds' Causal Response in relation to First-order ToM Score for Another's False Belief**

**Table 6.3: Summary of 5-7½-year-olds’ Results for the Conjuring Demonstration in relation to First-order ToM and AToM tasks**

<b>Conjuring Demonstration</b>	<b>ToM Unexpected contents (Own False Belief)</b>	<b>ToM Unexpected contents (Another’s False Belief)</b>	<b>AToM</b>
<b>Was the movement of the teddy a trick or real magic?</b>	Mann-Whitney U = 260 Sig = .550	Mann-Whitney U = 209 Sig = .035	Mann-Whitney U = 232 Sig = .14 one-tailed)
<b>Overall response (magic, trick, mixture)</b>	Kruskal-Wallis $\chi^2 = .082$ df = 2 Sig = .960	Kruskal-Wallis $\chi^2 = 3.685$ df = 2 Sig = .158	Kruskal-Wallis $\chi^2 = 1.399$ df = 2 Sig = .497

**Age Trends in the Data**

A Kruskal-Wallis test was then carried out comparing other variables with respect to categorization with respect to overall verbal response type. No significant differences were found between the groups for age ( $\chi^2 = 3.190$ ,  $df = 2$ ;  $p = .142$ ). Therefore, children’s interpretation of the conjuring demonstration was not dependent on this factor.

A Mann Whitney test was carried out to compare age with respect to grouping based upon children’s causal responses to whether the movement of the teddy was “real magic” or a “trick”. Once again, no significant result was found ( $U(21, 27) = 217$ ,  $p = .166$ ). Therefore, age was not considered an influencing factor in children’s causal interpretation of the conjuring demonstration in this study.

### Relations among the Tasks

Spearman correlations were carried out in order to assess the relations among all the tasks. Total levels of verbal scepticism scores were used for the conjuring demonstration (as the majority of the children gave a mixture of responses throughout that could be deemed as both magic and trick responses). The verbal scepticism scores incorporate responses to the entire set of questions asked in the conjuring demonstration. Once again, this follows the same response criteria and justification for assessing levels of verbal scepticism as in Study 4 and Study 5. A matrix of results can be found in Table 6.4. It was hoped that an analysis of levels of verbal scepticism might reveal a link with AToM.

**Table 6.4: Matrix of Spearman Correlation Results for 5-7½-year-old Children (N = 48)**

<b>AToM</b>	.124 <i>p</i> = .401				
<b>ToM (own false belief)</b>	-.055 <i>p</i> = .713	.038 <i>p</i> = .798			
<b>ToM (another's false belief)</b>	.251 <i>p</i> = .085	.294* <i>p</i> = .043	.209 <i>p</i> = .154		
<b>Verbal ability</b>	-.071 <i>p</i> = .630	.279 <i>p</i> = .055	.066 <i>p</i> = .654	.037 <i>p</i> = .805	
<b>Age</b>	.110 <i>p</i> = .457	.369* <i>p</i> = .010	-.010 <i>p</i> = .945	.299* <i>p</i> = .039	-.014 <i>p</i> = .926
	<b>Verbal Scepticism</b>	<b>AToM</b>	<b>ToM (own false belief)</b>	<b>ToM (another's false belief)</b>	<b>Verbal ability</b>

\*\* Correlation is significant at the 0.01 level (2-tailed).

\* Correlation is significant at the 0.05 level (2-tailed).

As can be seen from the matrix above, no significant correlation was found between level of AToM and level of verbal scepticism or between age and level of verbal scepticism. This reinforces the previous results, implying that both AToM and age were not linked to children's level of verbal scepticism in this study. No significant correlations were found between children's first-order ToM and level of verbal scepticism. Therefore, although first-order ToM ability was linked to children's causal responses, it was not linked to level of verbal scepticism throughout the demonstration. However, a significant positive correlation was found between age and first-order ToM for another's false belief: ( $r = .299$ ,  $N = 48$ ;  $p = .039$ ) and between age and AToM ( $r = .369$ ,  $N = 48$ ;  $p = .010$ ) that further supports the importance of increasing age in passing the theory of mind tasks. A significant positive correlation was also found between first-order ToM (for another's false belief) and AToM ( $r = .294$ ,  $N = 48$ ;  $p = .043$ ) implying that as first-order ToM ability increases so too does AToM ability. However, as in Study 5, it is unclear if children need to succeed in a standard first-order ToM task in order to then perform well in an AToM task. A near-significant positive correlation was found between verbal ability and AToM ( $r = .279$ ,  $N = 48$ ;  $p = .055$ ).

Further analysis was carried out in the form of partial correlations, in order to assess whether the items remained correlated when age and verbal ability were controlled for. No significant correlation remained between AToM and first-order ToM for another's false belief once the effect of age was controlled for ( $r = .197$ ,  $df = 45$ ;  $p = .186$ ). However, a significant positive correlation remained when verbal ability was controlled for ( $r = .333$ ,  $df = 45$ ;  $p = .022$ ). These results show that age was linked to a child's increasing AToM and first-order ToM performance whereas verbal ability was not.

### **Discriminating Between Truth and Lies**

Forty-seven children were assessed on their ability to discriminate between lies and truth-telling in other children and it was initially intended that a subset of 22 children would also be assessed on their ability to successfully lie without being detected. These 22 children were selected on the basis that they were able to lie and tell the truth to all questions when requested by the experimenter during recordings, something that the majority of the children proved unable to do.

The children's and adults' ability to successfully discriminate between truth and lies was assessed by totalling up the number of times they correctly judged whether the children in the film clips were lying or telling the truth. Obviously, it would not make any sense to produce separate scores for "truth detection" and "lie detection" because of the possibility of response bias. For example, if a respondent chose to respond "lie" to every single clip, they would get a score of 100% correct for the lie trials, but 0% correct for the truth trials. It would clearly be nonsensical to say that this respondent was skilled at lie detection but poor at detecting truth. They would simply be showing no ability whatsoever to discriminate between truth and lies. By adding together scores on lie trials and scores on truth trials, we end up with a measure of the ability to discriminate between the two types of trial that is not affected by response bias. As children were only presented with half of the film clips for judging (i.e., they were only presented with clips of the children in the experimental group that they were not part of), the maximum theoretical score that a child could obtain was 88 compared to a maximum theoretical score for an adult of 176. Table 6.5 shows the mean scores on the discrimination task for both adults and children. Given that random deciding whether to respond "true" or "lie" on each trial would give a mean score for children of around 44, it is immediately apparent that the

children were very poor on this task, typically responding at around the level that would be expected on the basis of pure guesswork. The adults, on the other hand, appear to be responding at a mean rate somewhat above what would be expected on the basis of guesswork alone (i.e., 88). On first inspection, it appears that the children are completely incapable of discriminating between lies and truth-telling in other children, whereas the adults do show some ability.

**Table 6.5: Combined Lie and Truth Scores for 5-7½-year-old Children**

	<b>N</b>	<b>Range</b>	<b>Minimum</b>	<b>Maximum</b>	<b>Mean</b>	<b>Median</b>	<b>Std. Deviation</b>
<b>Adults</b>	22	61	75	136	104.35	103.50	18.131
<b>Children</b>	47	28	25	53	42.53	43.00	5.897

In order to further investigate the performance of the children and adults on this discrimination task, performance was assessed at the level of each individual respondent using the binomial test (see Appendix D). Trials for which the respondent had responded “don’t know” were excluded but it was assumed that the chances of being correct for the remaining trials was .5. Thus it was possible to calculate how many of the respondents in each age group performed at a level that was significantly above (or, for that matter, significantly below) the range that might be expected on the basis of chance alone.

**Table 6.6: Frequency of 5-7½-year-olds’ and Adults’ Scores Outside Chance**

**Range**

	<b>Children N = 47</b>	<b>Adults N = 22</b>
<b>Score significantly above chance range</b>	3	16
<b>Score significantly below chance range</b>	0	0

Whereas the majority of the 22 adults were able to discriminate between lies and truth-telling at a level significantly above mean chance expectation, only 3 of 47 children were able to do so at the .05 level of significance (unadjusted for multiple testing). This clearly indicates that as a group the children were simply unable to discriminate between other children telling the truth or telling lies in this experimental context. Thus, no further analyses were made of these data.

**Discussion**

The main aim of Study 6 was to extend and further investigate the findings of Study 5. Specifically, it investigated a possible link between 5-7½-year-old children’s level of advanced theory of mind (AToM) and responses to a conjuring demonstration. It was proposed that children with a higher AToM ability would be less likely to reason magically, as they are social-cognitively more adept. The statistical findings did not support the proposal (and findings of Study 5) that children giving a “trick” causal response for a violation of object permanence would have higher AToM scores than those giving “real magic” responses. Study 6 also included a measure of children’s

level of verbal scepticism towards the conjuring demonstration being genuine magic. Once again, no relationship was found with level of AToM ability.

One potentially important finding is that children who gave “trick” responses for the conjuring demonstration had significantly higher first-order ToM scores for another’s false belief compared to those who gave “real magic” responses. Furthermore, no significant differences were found between age and children’s causal statements and so it would appear that age was not a contributing factor in this respect. This evidence points to first-order ToM ability being associated with acknowledgement of trickery. Hence, the findings of Study 6 suggest that it is not specifically AToM ability that is linked to children’s detection of trickery in a conjuring demonstration, as indicated by the results of Study 5. It is unclear why the results of Study 5 and Study 6 are discrepant in this respect. Future replication attempts may help to answer the question of which set of results (if any) reflects the true state of affairs.

Despite a wide variation in individual AToM scores, children did not appear to be accomplished in advanced social-cognitive reasoning skills. This is made evident by the low scores attained. Having said that, the mean AToM score was higher in Study 6 than in Study 5, so the lack of association between AToM scores and responses to the conjuring demonstration cannot be due to low scores on the AToM measure. The “strange stories” task was selected as an AToM measure as it is possible to measure an advanced theory of mind in typically developing children across the age range of five to twelve years. In addition it is a powerful measure in which to assess level of AToM ability as it has a possible score between 0 and 24 points. Yet children found stories about forgetting, sarcasm, and persuasion, difficult to understand compared to stories about lies, white lies, pretence, appearance-reality,

and joking. These latter story types are more straightforward examples of false statements than the former ones. In particular, children found stories about double bluff, and contrary emotion too difficult. These story types are even more complex as they require an even higher understanding than the other types. As Happé (1994) states, contrary emotion and double bluff require understanding at a third-order theory of mind level (e.g., double bluff; he *knows* they *think* he will *lie*).

Age was found to be a contributing factor towards an association between AToM scores and ToM (another's false belief) scores, suggesting that both abilities increase according to increasing age. In all instances first-order judgments proved to be easier than advanced judgments and in most instances substantially so. Indeed Study 6 (and Study 5) found evidence for this in the fact that majority of children achieved maximum possible scores in first-order ToM tasks (i.e. 33 out of 48 children in the own false belief, 37 out of 48 for another's false belief), but less than half the maximum possible scores in the AToM task (i.e. 46 out of 48 children). There was also a positive correlation between AToM and first-order ToM for another's false belief, implying that both abilities increase in line with each other. However, due to a correlation design, it is unclear if first-order understanding is a necessary component in advanced reasoning. As Miller (2009) acknowledges, it may simply reflect the fact that relatively competent children tend to remain competent, with no functional relation between the measures.

On examining children's verbal responses in the conjuring demonstration, a number of similarities were found between Studies 5 and 6 of the thesis. Firstly, the majority of the children's responses throughout questioning were a mixture of credulity and scepticism towards the conjuring demonstration being genuine magic. These findings further support the proposition made in the thesis that children tend to

sway between the two modes. Therefore, levels of scepticism might be an appropriate measure in which to additionally assess children's interpretation of an event whereby a violation of known physical laws has occurred. Secondly, evidence points towards examining apparatus not being crucial in children's acknowledgement of trickery and dismissal of genuine magic. Although the majority of the children *did not* feel the bag (and thereby *did not* feel the teddy hidden inside the bottom of it), they were still more inclined to give a "trick" causal response for the transference into the box (i.e. 21 out of 35 children). Furthermore, despite 13 out of 48 children feeling the bag (and thereby the teddy hidden inside the bottom of it), children were just as likely to give a "real magic" or "trick" causal response. Once again findings refute the importance made by Chandler and Lalonde (1994) of children examining apparatus and discovering how a trick is performed in order for them to acknowledge trickery has occurred.

Another aim of Study 6 was to explore the possibility that children's previous experience and awareness of deception in a more naturalistic context may be associated with levels of verbal scepticism. So, children who are more adept at lying, or discriminating between truth and lies in others may be more likely to detect trickery in a conjuring demonstration as opposed to interpreting such demonstrations as genuine magic. However, the present study was unable to pursue this line of investigation due to the children's general inability to discriminate between other children lying and telling the truth. Study 6 did find evidence of a significant difference between adults and children in their ability to discriminate between truth and lies, with adults capable of doing so whereas children were not able to do so. Similarly, Talwar, Crossman, Gulmi, Renaud, and Williams (2009) found that overall adults perform better than children in detecting when other children are lying. In

Study 6 of the current thesis, the majority of the children did not score above mean chance expectation in the discrimination task. In fact only 3 out of 47 children were able to do so above chance expectation. These findings are in keeping with research carried out by Vasek (1984) who examined children's abilities to recognise a lie occurring in a particular social context and found that young children (5-6 years old) had difficulty detecting a lie.

There are various explanations that may account for children and adults not being equal in their ability to discriminate between lies and truth-telling. Firstly, there may have been insufficient cues to deception for children to detect. For instance, there may not have been enough information in the verbal statements made by children who lied for other children rating them to detect falsity and hence state that they were lies. This is highlighted by the fact that the majority of the children, after having given an initial prompted lie statement, then repeated exactly the same statement for a further description or gave very basic further descriptions such as, "It's small", or else did not give any further description to enable children to detect lies. In fact only eight out of 22 children were able to give further descriptions of all lie pictures. In comparison, 17 out of 22 children were able to give further descriptions of truths. Seven children were unable to give further descriptions at all. Therefore, this lack in verbal information resulted in children who were rating trying to rely on fairly unreliable non-verbal clues (such as facial expression) in order to make a decision as to whether a child was lying or telling the truth. However, children in Study 6 may not have acquired a high level of this skill and this might account for adults being more successful than children at discriminating between truth and lies. This lack of skill is in keeping with past research: most studies report that children under nine years of age fail to use nonverbal information effectively to determine the truth when encountering verbal-

nonverbal inconsistencies (DePaulo & Jordan, 1982; Feldman, Jenkins, & Popoola, 1979). Also, adults may have used the relative paucity of description on some trials as an indication in itself that the child was lying (not very persuasively). Furthermore, children are not as adept as adults at detecting inconsistencies between verbal and non-verbal behaviours displayed by a lie-teller (Ekman & Friesen, 1969).

A second possible explanation that may have affected children's ratings is that the ability to successfully discriminate between truth and lies in Study 6 required children to partake in a task that was repetitive and time-consuming. Attempts were made to try and reduce the length of the task by testing children over eight sessions. However, children were still required to watch and rate a total of 88 picture descriptions. Hence they may have become bored with the task or cognitively exhausted and simply guessed or repeated the same responses in order to finish the sessions quickly. It is important to stress that this quantity of pictures was chosen in order to attain robust scores rather than analysing only a few ratings. Thirdly, children may have interpreted a lie as a truth because it was purely a statement about an observation, such as, "It's a picture of a man digging" and was not necessarily considered a statement that someone is not supposed to say. Piaget (1932, 1965) was one of the first to look at children's conceptions of lying and found that children prior to the age of six equated lies with things that one is not supposed to say.

In terms of lie-telling ability, only ten out of 22 children were able to successfully lie for more than 50 percent of the time (i.e. give initial false statements followed by further lie descriptions). However, methodological limitations may account for this. Although the lying tasks were meant to provide a naturalistic context in which to assess children's deceptive abilities, children's ability to successfully lie may have been affected by them being instructed and prompted what to say initially in

terms of giving either a “true” or “false” statement. It was designed so that there would be sufficient videotaped footage of children verbally lying and not just sitting silently. Even so, these were not natural and spontaneous utterances made by the children. Hence, children may not have believed the false statements as they were not of their own doing. As a consequence they may not have the inclination to deceive when required to give further descriptions. Furthermore, as mentioned at the beginning of Study 6, a skilled liar will attempt to conceal their deception in their nonverbal expressive behaviour, as well as their verbal expressive behaviour, to avoid giving any cues to their deceit. However, children had to concentrate on the instructions being given to them through headphones and on the laptop screen and may not necessarily have been concentrating on deliberately trying to conceal their deception. It should be noted that although children were prompted with initial statements they were subsequently required to independently lie. This involved engaging in spontaneous acts of deception more prolonged than an initial false statement. Specifically, children were asked to give further true or false descriptions that went beyond the prompted statement that the child was given regarding pictures presented to them (i.e. without any assistance).

As was mentioned earlier, methodologically, the lie stimuli used were videotapes of children who were instructed to tell the truth and to lie. These reports may not be similar to the natural, day-to-day situations in which people spontaneously lie. For example, research has found that examining motivated deceivers is more representative of the lies told in day-to-day settings (Frank & Ekman, 1997; Frank & Feeley, 2003). An alternative method of examining children’s lies might involve an adaptation of the temptation-resistance paradigm originally pioneered by Sears, Rau, and Alpert (1965). In this paradigm, children are told explicitly not to peek inside a

closed container or to touch a toy, they are left alone, and upon the experimenter's return they are asked whether they have complied with the instructions. According to Talwar et al. (2009), the advantage of this paradigm is that it creates a situation in which children can make a decision of their own accord either to lie or to tell the truth, and so it elicits spontaneous lies from children attempting to conceal their transgression and who are self-motivated to lie. In such situations, children reveal subtle, non-verbal cues to their deceit (e.g., big smiles), which even children are able to detect (Crossman & Lewis, 2006). However, due to time constraints, it was not possible to use this paradigm in Study 6 of the thesis, as it would require testing children until an adequate sample of children was attained who could spontaneously lie or tell the truth.

The findings of Study 6 imply that it was possible to detect whether children were lying or telling the truth in the lie/truth-telling discrimination task used as evidenced by most adults correctly rating above chance expectation (and despite rating 176 statements in one sitting). However, as majority of children's scores did not differ significantly from chance expectation, they were deemed not to have skill in this task. Furthermore, children were not more adept than adults at discriminating between lies and truths in their peers even though they may have more experience of interacting with them. Nevertheless, although it was not inappropriate to use the specified lying stimuli task in Study 6, as discussed previously, children were exposed to task overload: they were required to not just lie, but were also given auditory and verbal stimuli. Therefore, a simpler task may have been more productive in addressing individual differences.

Based on the findings of Studies 5 and 6, there are a series of proposals for future research. Firstly, despite conflicting results in the final two studies of the thesis

regarding links between level of AToM ability and an understanding of witnessing trickery, it is important not to dismiss the possibility of an association outright. Until further studies are carried out using other AToM tests, we cannot assume that levels of sophistication in advanced theory of mind cannot assist children in their detection of trickery. Like the understanding of first-order ToM, there are different aspects of AToM understanding that may appear at different points of development (Wellman, Cross, & Watson, 2001). As children's individual scores were extremely low for a specific AToM test, future studies should be conducted that will assess an alternative to the "Strange Stories" task or incorporate it with a series of other AToM tests: namely, the "Eyes task" (Baron-Cohen, Jolliff, Mortimore, & Robertson, 1997; Baron-Cohen, Wheelright, Spong, Scahill, & Lawson, 2001) or the "Faux-Pas task" (Baron-Cohen, O'Riordan, Stone, Jones, & Plaisted, 1999). The Eyes Task is a presentation of photos of the eye region of the face, and the task is to identify what the target is thinking or feeling. This may assess children's ability to read social clues, and may also be considered more appropriate than the complex task on lying that was administered in Study 6. The Faux-Pas task is a presentation of a series of stories in which a character inadvertently says something awkward or embarrassing and measures the ability to identify the awkward statement.

Indeed, the Strange Stories task is considered higher-order reasoning that requires abilities not only more advanced than those tapped by the standard first-order tasks, it is considered more difficult than second-order false beliefs (Miller, 2009). O'Hare et al. (2009) found that the total score of the strange stories did not reach ceiling level even at the age of twelve years. With this in mind, perhaps children would show greater ability in second-order tasks. Second-order reasoning requires children to distinguish between the cause of an outcome and the reason for believing

in the outcome (Astington, Pelletier, & Homer, 2002). Research has shown successful attribution of second-order beliefs in 6-year-olds (Perner & Howes, 1992) and even in some 5-year-olds (Leekam, 1990). Moreover, in one study Leekam (1990) found that 4-year-olds succeed in attributing a second-order intention.

Specifically, a future study should be conducted using a second-order false belief scenario as a measure of advanced theory of mind (e.g., Perner & Wimmer 1985; Sullivan, Zaitchik, & Tager-Flusberg, 1994). This task offers a simpler, more child-friendly assessment, due to it being shorter, having fewer characters and fewer scenes, and containing frequent reminders and probe questions. Furthermore, it includes deception and Sullivan et al. reported some success even among 4-year-olds and close to perfect performance at age five that is relevant to the age range that was tested in Study 5 of the thesis.

Finally, as a significant relationship was found between first-order ToM and children's interpretation of the conjuring demonstration, further research might test children's ability to deceive by using first-order ToM tasks that require them to leave false trails and thereby incorporating an element of deliberate deception. For instance, Chandler, Fritz, and Hala (1989) have shown that even 2½- and 3-year-olds can be induced to deceive in the form the fabrication of false evidence. A person could not know that treasure is hidden in a particular vessel if they had not seen it in there and had no clues as to its whereabouts. If they had not seen it there, they would be depending on clues. If clues are destroyed, they will remain in a state of ignorance. If they are supplied with false clues, then they will formulate a belief as to the whereabouts of the treasure, but one that is false. Hence, being able to destroy evidence and fabricate false evidence tells us something about the child's competence

in understanding how information is essential to the mind and how the mind can be host to misinformation and, therefore, duped.

### **Conclusion**

Study 6 explored how children's understanding of trickery may be linked to social-cognitive intelligence in the form of level of theory of mind understanding. The findings of this study do not appear to indicate an association between AToM ability and detection of trickery in a conjuring context, in contrast to the findings of Study 5. Furthermore, there was no supporting evidence of an association between AToM ability and level of verbal scepticism in response to a conjuring demonstration. Therefore, advanced understanding of knowledge and belief did not appear to facilitate detection of trickery in children in this study. However, and most importantly, a significant link was found between first-order ToM ability (i.e. another's false belief) and children's "trick" causal responses for the transference of an object from one location to another, irrespective of age. Study 6 did find a developmental trend for AToM ability and first-order ToM ability in relation to age. Hence, the findings of Study 6 suggest that it is not specifically AToM ability that is linked to children's detection of trickery in a conjuring demonstration, as indicated by the results of Study 5. Instead, evidence points to first-order ToM ability being associated with acknowledgement of trickery. It is unclear why the results of Study 5 and Study 6 are discrepant in this respect. Future replication attempts may help to answer the question of which set of results (if any) reflects the true state of affairs.

## CHAPTER 8:

### GENERAL CONCLUSIONS FROM THE THESIS

The current thesis was concerned with extending previous research regarding how children conceive of actual or potential violations of natural laws of physics as they understand them. Specifically, it was concerned with exploring why and to what extent some children think in terms of magic and others think in terms of trickery. To this end, the thesis aimed to provide identification and examination of a variety of factors and their links to individual differences in children's interpretation of an anomalous event. The primary questions that the thesis set out to answer are: What factors, apart from the acquisition of the knowledge that magical events are incompatible with physical events, enable children to understand they are being fooled (i.e. tricked)? What factors increase suspicion (i.e. levels of verbal scepticism) toward an event being based upon trickery?

The thesis started in a very general place and then focused on children's interpretation of a live conjuring trick that appeared to violate the physical law of object permanence. In actual fact, the demonstration involved deception in the form of a hidden compartment which allowed an object to "spontaneously" disappear and transfer without a visible trace in a way that was not obvious to the viewer. These experiments were aimed at providing an insight into why some children grasp what they are witnessing as trickery faster than others.

As magic covers a vast area, the first study concentrated on children's beliefs and dealings in a common everyday phenomenon that researchers class as "thought over matter" magic: namely wishing. Findings established that most children ranging

from the ages of four to twelve years are familiar with wishing. Older children (11-12-year-olds) tended to be more sceptical about its efficacy than younger children (4-year-olds and 6-7-year-olds). Regrettably, at no point were children asked directly about the link between wishing and magic. Instead, the link with magic can only be inferred from the children's responses to certain questions, such as whether one needs to use a special object such as a magic wand for a wish to come true. Although there was not strong evidence in support of the suggestion children believe that wishing is a magical process, a few younger children did spontaneously mention magical properties.

As discussed in Study 1, wishing for something that comes true can be considered as magical thinking if it involves belief in the ability of a person's own thought or desire alone producing direct effects on physical objects (i.e. mental-physical causality). Children in general did not regard wishing to be more or less effective in directly having an effect on the physical world than other mental processes (i.e. imagination). In fact, findings indicated children's reasoning to be rational and subscribing to natural laws of physics as evidenced by children being more likely to claim that wishing and imagination cannot directly cause objects to materialise. However, a sizeable minority of children believed that the items would appear and this may be an indication of those children having irrational beliefs about the mind and mental-physical causality. Study 1 provided evidence of significant age differences in claims of mental-physical causality: young children were more likely than the oldest age group to believe that imagination and wishing can directly cause physical objects to materialise. As such, this suggests that understanding the limitations of the mind appears to be age-related.

A problem with Study 1 was that it did not specifically address children's concept of "magic". Initially, a key issue of the thesis was to identify children's meaning when they use the term "magic" in their causal response for an event that apparently violates laws of physics. The purpose of this was to clarify whether children's responses actually mean that such a violation is caused by "real magic" (i.e. genuine suspension of the laws of physics) and the extent to which children truly believe that "magic" causation (seen as a supernatural force or mechanism) is possible. Alternatively, children may merely use "magic" as another label for "tricks". Therefore, Studies 2 and 3 assessed whether there is an underlying difference between children labelling a conjuring trick "magic" or "trick".

Children's responses to a single viewing of a videotaped coin trick (whereby a stack of coins seemingly disappear spontaneously) in Study 2 gave an idea of what 4-6-year-old children mean by "magic" and "trick". Evidence points to children using the two terms in a distinct and appropriate way: they tended to give "trick" causal responses when they claimed to know how the demonstration worked and were aware of being deceived and gave "magic" causal responses when they claimed not to know how the demonstration worked and were not aware of being deceived. Furthermore, findings suggest that children who gave "magic" causal responses regard magic as inexplicable and genuine rather than fake and explicable as in tricks. Only 5% who had given "magic" causal responses for the coin demonstration and claimed to know how the coins had disappeared also claimed that magic is "just tricks". It should also be noted that no child who had given "magic" causal responses and claimed to know how the coins had disappeared then gave "trick" explanations. The majority of the children also associated "magic" with requiring special powers and were quite selective in qualifying entities as being able to do "magic" (i.e. only a magician and

family members). In this respect, the findings support Subbotsky (2009) who distinguished between the two terms by claiming that “real magic” violates known physical principles and “tricks” resemble magical events but can be accounted for with non-magical, e.g., physical, explanations.

In contrast, Study 3 found that 9-11-year-olds regard “magic” as fake and, therefore, trickery. Whatever term they use, they understand that an object cannot spontaneously disappear. This was shown in their understanding that a stack of coins had not truly vanished implying that they were aware of them being hidden. The only difference between children’s responses is that with “trick” responses they know where something is hidden whereas with “magic” responses they do not know where. The majority of the children in Study 3 provided further evidence of disbelief toward genuine magic as referenced by claiming that “magic is just tricks” and a belief that anyone can learn magic. Therefore, this implies that older children consider “magic” to involve conjuring rather than supernatural processes and indicates older children’s clear understanding of the concept of “magic” as trickery.

The central question of the thesis that was relevant and required further exploration is, “What factors are associated with children’s acknowledgement of an event as being a trick as opposed to it being magic?” Studies 2 to 6 addressed this issue.

As was discussed in Chapter 1, an individual difference factor that Phelps and Woolley (1994) argue is critical in children’s explanations of causal events is children’s level of knowledge of physical mechanisms. They claim that children with more physical knowledge should be less likely to invoke “magic” as an explanation. Past research has proposed that one way of achieving this is to allow children to examine apparatus or allow repeated viewing of an event (e.g., Chandler & Lalonde,

1994). Yet the studies carried out throughout the thesis (and in particular Studies 2 and 3) did not find evidence in support of this proposal. Exploring apparatus or allowing repeated viewing of a demonstration did not appear to be an important contribution to children's understanding and acknowledgement of having witnessed trickery or shifting to non-magical explanations. As such, contrary to Chandler and Lalonde, an evolving pattern does not emerge whereby children realize that what they are witnessing is trickery. Furthermore, findings in the current thesis did not support Chandler and Lalonde's view that by being given repeated demonstrations of the same event, children search when given the opportunity for an explanation compatible with standard causal principles.

However, apparent variability in the findings of past research regarding children's causal judgments may be due to task issues rather than children's actual beliefs. Therefore, one aim of the current research was to provide additional insight into factors that compromise or enhance the amount and accuracy of the information interviewers gain from young children. As such, the thesis investigated the effect of two types of social influence on children's interpretation of a conjuring event: Studies 2 and 3 focused on a direct social influence in the form of repeated questioning by an adult, and Study 4 focused on an indirect social influence in the form of a visual clue hinting at trickery.

Study 2 found evidence that 4-6-year-olds are susceptible to social influence as they switched causal responses regarding a demonstration of vanishing coins when prompted to do so by repeated questioning in conjunction with repeated viewing across three trials. One cannot say definitively that children change responses as a consequence of succumbing to a demand characteristic rather than a genuine change in children's understanding of the situation. However, it certainly muddied the waters

in terms of understanding children's underlying concepts of "magic" versus "trick". In contrast to a single viewing, children overall were just as likely to give a "magic" or "trick" response to a conjuring trick, regardless of claiming to know or not know how an object had disappeared. Furthermore, regardless of whether children had given "magic" or "trick" responses, most children were unable to explain how an object had disappeared. Instead of repeated viewing assisting children in realizing that what they are witnessing is trickery, the current thesis has found that it appears to cause confusion in children.

In contrast to 4-6-year-olds, the majority of the 9-11-year-olds in Study 3 did not conform to experimenter pressure as they did not show a tendency to drop their scepticism toward "magic". Unlike younger children, the majority of the older children's beliefs are not undermined or swayed by the suggestion of the event being "magic" as a result of repetitive questioning. According to Subbotsky (2004), those children who do not abandon magical explanations, that is do not waiver, are "entrenched believers" whose magical beliefs are stable, and those children who do not abandon natural physical explanations are "entrenched non-believers" whose sceptical beliefs are stable. Although Subbotsky found that 4- and 5-year-old children have an entrenched belief in magic, Study 2 of this thesis found that 4-6-year-olds belief towards "magic" was not entrenched as referenced by swaying in causal responses between "magic" and "trick". However, as with Subbotsky, it is only in 9-year-olds that the scepticism toward "magic" appears to be sufficiently entrenched to withstand a personal encounter with anomalous causal events and not switch away from "trick" responses.

Subbotsky (2004) reported that the belief in the universal power of physical causality or magic can vary in its degree of entrenchment. Studies 4 to 6 of the thesis

took this into account by assessing children's level of verbal scepticism towards an event as being genuine "magic", rather than simply categorising children as sceptical (i.e. disbelievers in "magic" causation) or credulous (believers in "magic" causation). By including a sensitive measure of children's responses to a conjuring demonstration, the extent to which they subscribe to "magic" causality was tested as children's interpretation may be subtle. In doing so, Study 4 (as with Study 2) points towards social influence being somewhat linked to 4-6-year-old children's interpretation of a live conjuring trick. When exposed to a visual clue of deception, they were significantly more likely to verbally suspect trickery as evidenced by higher levels of verbal scepticism scores. However, it did not affect the likelihood of specifically giving a "trick" causal response. As such, these findings somewhat support Subbotsky (2004) who reported that 5-year-olds do not depart from "magic" explanations when they witness anomalous events even when they are given a hint of trickery.

Study 4 investigated another task issue that might be related to apparent differences in children's causal responses and which researchers report should be considered in evaluating conclusions about children's belief in magic causality: whether verbal judgments or behaviour is observed. Verbal judgments may have been muddying the waters if children really don't understand the difference between "magic" and "trick", as tasks designed to test children's understanding almost invariably require a degree of language comprehension. Therefore, both nonverbal and verbal responses were measured. The study did not find a conflict between these two measures (i.e. verbal responses and behavioural reactions) in 4-6-year-old children's responses towards a conjuring trick as reflected in a positive correlation between the two. These findings reinforce the view that children's verbal statements

to a single viewing of a conjuring demonstration are a true representation of their beliefs.

According to Subbotsky (2004), social influence tests the firmness and permanence of children's beliefs in the impossibility of certain events. Therefore, children's changing of responses as a consequence of social influence displays a lack of firmness of children's beliefs and disbeliefs in magic and natural-physical causality. Yet the current thesis proposed that children's inconsistent causal responses might be linked to children's level of confidence in a social situation. Study 4 assessed children's level of social confidence with a stranger (i.e. the experimenter). While no evidence was found in support of a link between 4-6-year-old children's level of social confidence and level of verbal scepticism, findings did point towards an association with level of behavioural reactions. Specifically, the more confident children were socially, the more likely they were to engage in active monitoring behaviour (i.e. tactile exploration of apparatus, or look back and forth at apparatus during aspects of the conjuring demonstration). These findings suggest that children's failure to search the apparatus is not necessarily linked to an underlying belief in "magic". A child may be suspicious of deception in the form of trickery but not search for an object in a compartment where it has disappeared from if lacking in social confidence. Therefore, they do not necessarily spontaneously examine material if sceptical.

To summarise, Studies 1 to 4 of the current thesis have met the original aim of not only presenting evidence relating to young children's concepts of "magic" and "trick" but also of extending the empirical examination of task issues that may have affected some of the key previous findings in research. However, the aim of the current thesis was to provide an assessment of possible internal factors that may

contribute to individual differences in children's causal thinking. As such, Studies 5 and 6 investigated individual differences in aspects of social and cognitive development that may be related to young children's causal responses and level of verbal scepticism towards a conjuring demonstration being genuine magic.

Neither study found evidence for a link between children's level of verbal scepticism towards a conjuring demonstration in relation to levels of competence in certain social (i.e. Machiavellian) or cognitive (i.e. verbal and spatial monitoring) intelligence factors. Despite this, the most important findings of the thesis were gained from evidence pointing towards the possibility of there being individual differences between children's interpretation related to specific socio-cognitive ability. Study 5 found that 4-6-year-old children's ability to understand and identify a conjuring demonstration as trickery was related to level of Advanced Theory of Mind (AToM) skills. However, age was found to be a contributing factor and as so it was difficult to ascertain if this is the crucial link in children's detection of trickery or a developmental process that changes across time.

With this in mind, Study 6 tested a slightly older age group (5-7½-year-olds). In doing so, even though no association was found between AToM ability and detection of trickery, or level of verbal scepticism, a degree of significance was found in a relationship between first-order ToM ability and trickery ratings for the transference of an object from one location to another, over and above age effects. More specifically, understanding false beliefs (i.e. namely that beliefs involve representations of reality and so can be mistaken) appears to be important in order to understand what they are witnessing as trickery (i.e. detect deception) and thereby dismiss magic causality. Hence, the findings of Study 6 suggest that it is not specifically AToM ability that is linked to children's detection of trickery in a

conjuring demonstration as indicated by the results of Study 5. At first glance, the findings of Study 6 suggest that children's AToM ability was not advanced enough and that is why no significant relationships were found with regard to these scores. In contrast, standard ToM tapped into children's actual ability level and then revealed a significant relationship, over and above age. However, the mean AToM score was higher in Study 6 than in Study 5, so the lack of association between AToM scores and responses to the conjuring demonstration cannot be due to low scores on the AToM measure. Studies 5 and 6 suggest a link between children's interpretation of a conjuring event and level of theory of mind ability. However, as the two studies produced discrepant results, it is unclear why and which set of results (if either) reflects the true state of affairs.

The current thesis sought to provide clarification of whether children's causal interpretation of a conjuring event lends support to Piaget's (1929, 1930) progressive stage-based model of causal development or Subbotsky's (1984) coexistence model. As Chapter 1 discussed, Piaget theorized that children's logical reasoning (rational beliefs in physical causality) gradually replaces pre-logical reasoning (magical thinking) regardless of the context and domain in question. Young children up to seven years of age are severely limited in their understanding of causal relations in the world and so are especially susceptible to magical thought. In contrast, Subbotsky hypothesised that children possess two belief systems that allow for a coexistence of magical reasoning and natural physical causal reasoning that persist throughout the lifespan and depend on the situation encountered.

There is evidence throughout the thesis of age-related differences regarding children's magical versus sceptical thinking. As such, it adds to previous research (presented in Chapter 1) supporting Piaget's view that children develop into rational,

sceptical thinkers. In general, it has established that 4-6-year-old children are more likely to think magically than children nine years of age and older. Indeed, the majority of the 9-11-year-old children in Study 3 adopted a “trick” stance toward a conjuring event and so were more sceptical of the demonstration being “magic” than 4-6-year-old children in Study 2. Furthermore, they were more likely to retain an initial “trick” response as opposed to a “magic” response following repeated questions across trials. This implies that older children have an increased awareness of being deceived and an understanding of what they are witnessing as trickery. Study 5 also found a developmental pattern in 4-6-year-olds, with older children more likely to take a sceptical stance compared to younger children who were more likely to take a magical stance.

Although findings in the current thesis imply that older children may be more adept at detecting trickery and that younger children are more susceptible to “magic” explanations, age changes were not clear-cut. No developmental trend was found in Study 2 or Study 4 between 4-6-year-olds subscribing “trick” causality or suspension of beliefs in the permanence of perceived objects, nor was there in Study 6 between 5-7½-year-olds. In addition, the existence of a small group of believers in “magic” among the more sceptical in Study 3 for example, as referenced by “magic” responses in the coin trick and references to “magic” concepts in general, suggests that there is not a simple developmental influence that characterizes children’s responses to information about magical events during childhood. Indeed, although children were more inclined to claim that “magic is just tricks” that anyone can learn, they also showed an understanding that magic is real in the sense that they claimed it really happens (whereas tricks are not real and involve hiding something or fooling someone). Although this may be interpreted as children believing in the authenticity

of magic, it does not necessarily signify their belief in its existence in reality. A similar theme ran throughout the current thesis: children appeared to make a similar distinction between “real magic” and “trick” in their causal responses, but it is unclear if they were just saying what the demonstrations were. Therefore, doubt is cast on whether children are believers in genuine magic being possible in the real world.

Subbotsky (1994) accounts for such a discrepancy in children’s causal thinking by claiming that children’s causal belief systems are dependent on the situation that is encountered as to whether they consider an event in rational or magical terms. Naturalistic (physical) causal thinking dominates everyday reality and unusual circumstances (transformations) encourage children’s latent magical beliefs to surface. Furthermore, these inconsistent belief systems are reflected in 4-6-year-old children’s verbalisations and behaviour, with rational (physical) causal thinking governing at the level of verbal judgments while magical causality rules at the level of practical actions. However, as discussed previously, Study 4 of the current thesis did not find a discrepancy between children’s verbal and behavioural responses. Yet, the thesis has found that the context in which an anomalous event is witnessed has a bearing on children’s verbal judgments.

The research described in this thesis has found that despite children understanding how the physical world operates, they still sometimes appear to subscribe to magical thinking. Therefore, this does not support Piaget’s (1929, 1930) theory that young children’s magical thinking may be a consequence of having limited understanding of physical laws of causality. According to Subbotsky (2004), young children revert to “magic” responses as they may not have an “entrenched” belief in the universal power of physical causality and still hold magical beliefs. Conversely, older children do have an entrenched belief in the universal power of

physical causality and, even if they hold magical beliefs, physical causality dominates. Furthermore, Subbotsky (2005) suggested that children develop an ontological theory of mind (ToM) along with a cognitive ToM. That is, along with being able to hold cognitive false beliefs, children and adults can also hold ontological false beliefs. In the same way that cognitive false beliefs misguide people in their search for hidden objects, ontological false beliefs can lead people to conclusions and behavioural reactions that are incompatible with known physical principles.

Woolley (1999) also appears to support Subbotsky's claim of children having two belief systems by proposing a magic domain that is separate from a ToM domain to account for this inconsistency in children's causal thinking. She arrived at this proposal for a separate ToM domain and magic domain based on the assumption that children from three years of age have a ToM and therefore can distinguish the mental from the physical. She suggested that children may sustain beliefs in wishing as an effective form of mental-physical causality by viewing it as a magical process and therefore lies in a magic domain whereas imagination lies in a theory of mind domain.

Yet Woolley appears to have overlooked empirical evidence showing that there are different aspects of ToM understanding that may appear at different points of development. For instance, as mentioned in Study 5, research has established that although nearly all children achieve success on standard false-belief tasks at approximately the same age (between four and five years of age), there are individual differences in that achievement, with some researchers (e.g., Chandler & Sokol, 1999; Repacholi & Slaughter, 2003) arguing that children's understanding of others' minds is a skill that develops for several years after children are successful on a typical false-belief task. In contrast to Woolley, Chandler and Lalonde (1994) suggest that young people can make effective use of the concept of "magic", but only "parlour magic", as

a way of “mentally quarantining” evidence that appears to contradict their emerging theories of mind and matter. Later, after a developmental time when children’s ToM has broadened, children do think much about magic that is truly supernatural.

The current thesis proposes that, based on the findings of Studies 5 and 6, there is good reason to suggest that children’s ability to understand that they are being tricked in a conjuring event is linked to level of theory of mind skill that a child is proficient in and is, therefore, subject to their ToM. Therefore, magic beliefs are not in a separate domain from a ToM domain. Level of ToM ability may also account for individual differences in children’s belief in the efficacy of wishing and imagination causing a direct effect on the physical world in Study 1. Those children who are sceptical towards the efficacy of magic, including wishing, may have a more sophisticated and developed ToM. Indeed, the fact that some children (even older children) acknowledged that both wishing and imagination can bring about direct change, implies that irrespective of age, these children may not have a fully developed ToM.

Furthermore, children’s non-commitment to causal beliefs (as referenced by the changing of responses in Study 2) may also be linked to ToM ability. Perhaps younger children are susceptible to changing responses as a result of social influence due to not having a developed ToM.

### **Future Studies**

The current thesis has explored a variety of internal individual difference factors and their possible links with children’s interpretation of a conjuring event. There does appear to be something there in terms of social confidence and Machiavellianism that warrants further exploration. As such, concrete future studies are required regarding

these factors. Furthermore, the inclusion of an adult comparison should be used in some way. Specifically, the questions used to test children's level of Machiavellianism in Study 5 were too complex for children to comprehend (e.g., "It is smartest to believe that all people will be mean if they have a chance: True or false?"). However, to date there has only been one measure that has been designed for children under nine years of age, and that has not been validated (i.e. the 12-item Machiavellian Scale: Slaughter & Pritchard, 2000). Furthermore, it only measures children's overt behaviour within the peer group via adults' subjective views. It does not measure the child's attitude. Therefore, a different way to test Machiavellian levels should be found.

Social confidence and individual differences warrant further research in order to better understand how children at different ages interact with strangers. Future studies need to look at different ways of measuring social confidence. Indeed, as discussed in Study 4, many factors may be involved, including shyness, sociability, social anxiety, and social competence. If, as research has suggested, these are distinct personality traits related to social behaviour, they may need to be examined individually (Cheek & Buss, 1981). A key ingredient would be to examine adults and see what they do in terms of social confidence and then apply this to children. In addition social confidence measures need to be further explored in a setting whereby children are being tested on their responses to a magic occurrence, as opposed to Study 4 in which children were given a pre-test "hiding game" that was separate from the conjuring demonstration.

The current thesis was mainly focused on children's cognition and why some children are more sceptical than others. Although there were not very strong conclusions, Studies 5 and 6 suggest that ToM ability may be a relevant factor. This

opens up the scope for further research in terms of different aspects of children's ToM reasoning and beliefs about magic. As discussed in Study 6, there is a need to include other ToM tasks. For instance, a future study might use a reverse false-belief contents condition and a false-belief contents condition (He, Bolz, & Baillargeon, 2011). The false-belief condition presents children with an unexpected-contents situation, whereas the reverse false-belief condition presents them with a change of location situation. This involves switching back an item in a container after an agent has been shown their belief is false (e.g., crayons in a cereal box but the agent thought they were in the crayon box. Then change back to the crayon box again). The agent is present when the contents of a package are found switched but absent when the experimenter restores the box's original contents. Therefore, the child is required to understand that the agent falsely believes that the cereal box holds crayons.

Furthermore, it is suggested that future studies should incorporate a second-order ToM task. Studies have found that including an ignorance question followed by a false belief question improves second-order reasoning (Coull et al., 2006; Sullivan et al., 1994). For instance, in a story J thinks that M thinks X. But the child being tested knows that M thinks Y. Miller (2006) points out these are two incompatible representations of the same reality. Ignorance requires only attending to lack of critical information (e.g., does J know that M knows where?) followed by a false belief question (where does J think that M thinks X?). A legitimate question that might be asked is, "Does a person who correctly answers a second-order false belief task that includes an ignorance question believe in magic?" Children who give a "magic" causal response for an event may be more likely to do so if they are unable to pass judgements of ignorance and judgements of false-belief. Conversely children may give a "magic" causal response even if they correctly make ignorance

judgements. In conjunction with further probing of children's meaning of magic, their causal response might not represent a belief in magic.

The thesis has highlighted a need for reformulating and adapting established AToM tests as a means for assessing children's level of ability at all ages. To date, six AToM tests have been designed: "Strange Stories" (Happé, 1994), "Eyes task" (Baron-Cohen, Jolliff, Mortimore, & Robertson, 1997), "Faux-Pas" (Baron-Cohen, O'Riordan, Stone, Jones, & Plaisted, 1999), "Preadolescent Theory of Mind" (Bosaki & Astington, 1999), "Awkward Moments" (Heavey, Phillips, Baron-Cohen, & Rutter, 2000), "Stories from Everyday Life" (Kaland, Moller-Nielsen, Callsen, Mortensen, Gottlieb, & Smith, 2002). However, all of these tasks bar one (i.e. Preadolescent theory of mind) were designed to test autistic children, with normal children only used as a control. Furthermore, they require children to reason about and articulate interpersonal interactions (i.e. why) and not just about a person's actions. To date, (apart from the current thesis) only two studies have tested children under seven years of age (Adrian, Clemente, Villaneuva, 2007; Brent, Rios, Happé, & Charman, 2004). Yet, both used a reduced version of the strange stories test whereby only two types of false statements were made (i.e. irony and white lie). Therefore, this is not a powerful measure with which to test children's level of AToM skill. There is a need to simplify the AToM tasks so that they do not require verbal justifications.

Regarding magic itself, future research should explore how we can get at what children mean by "magic" and "tricks". Past research (including the current thesis) has highlighted the difficulties involved in defining "magic" and that the term covers a variety of phenomena. For the purpose of the current thesis the main focus was on children's interpretation of violations of object permanence in a conjuring context. As such, the research looked at a constrained example of magical beliefs in the form of a

conjuring trick. A broad range of things may be categorized as “magic”. This could be done in some way by having conditions that incorporate different types of magic. For example, a study could use different mind-reading events and get participants to categorize them as “magic or not” and “magic or trick”.

Future studies should also look further at children’s behavioural reactions, and include cost and reward consequences. As discussed previously in this thesis, past research has found children show behaviours compatible with magical thinking if they are put in a context where disregarding the possibility of magic involves a potentially high cost, such as refusing to place a personal item in a box for fear of damaging it (Subbotsky, 2001). In the current thesis, the behavioural measure only focused on children searching the apparatus and the direction in which children were looking at a particular point in time. It would be worthwhile to address specific facial reactions such as “gawping”. However, it should be noted that this would not necessarily address children’s belief in the existence of magic, but simply a reaction of surprise. As Woolley (2006) states, “Behavioural measures can reflect emotional responses or other goals rather than cognitions” (p. 1551). Therefore, further exploration of children’s use of the word “magic” is needed. This might involve using or adapting the Magical Thinking Questionnaire (MTQ) (Bolton, Dearsley, Madronal-Luque, & Baron-Cohen, 2002). The MTQ is applicable through the age range from childhood to adolescence. It comprises 30 questions asking whether something is possible. A “thought” subscale questions whether it is possible to make some events happen just by thinking about them (e.g., “Is it possible to move an object across a room just by thinking about it?”). An “action” subscale questions whether it is possible by some actions to make events happen, the specified actions being causally unrelated to the

specified events (e.g., “Is it possible to make something bad happen by standing on cracks in the pavement?”).

Finally, future research may also consider children trying to do the conjuring trick (that was performed in the thesis) themselves in order to ascertain whether children are capable of carrying out the trick and tricking others.

This thesis essentially looked at children’s gullibility but was framed in a different way by focusing on magical thinking. This topic is more relevant than ever before with many adults showing gullibility, as referenced by an increase in television programmes featuring psychics and mediums. The question remains, what makes us gullible? Conversely what makes us break the rules? What makes children not gullibly conform versus gullibly conforming? It is not necessarily about children’s ability but about expectation. Indeed, the current thesis has shown that children conform to social expectation in specific situations. Study 2 found that 4-6-year-olds made a distinction between real magic and tricks, but that direct social influence in the form of repetitive questioning influenced children’s offered verbal causal explanations. It would make sense to explore this concept further by testing children working in pairs to assess whether children are influenced by their peers.

Imitation studies explore children’s problem-solving skills and have found that children interpret what they witness visually as “what are you expecting me to do?” and hence copy actions. Even adults gullibly conform in over-imitation studies whereby irrelevant actions are demonstrated to open apparatus (e.g., Flynn & Smith, 2012). Nielsen and Tomaselli (2010) had an adult show children between two and 13 years old how to retrieve a toy from a closed box (e.g., by pushing open a trap door). Although the box could be easily opened by hand, the adult complicated the demonstration by using a miscellaneous object to open the door after first wiping it

across the top of the box in a way that was clearly unrelated to the outcome. Remarkably, the children replicated the model's object use and incorporated the irrelevant actions into their response. A pertinent question might be, "Is there a link between children and adults who copy purposeless actions and belief in sympathetic magic?" Specifically, do children who gullibly conform by over-imitating, believe that there can also be a transfer of properties from one object to another by brief contact? For example, Rozin, Millman, & Nemeroff (1986) found that drinks that had briefly contacted a sterilized, dead cockroach became undesirable to drink.

To summarise, the current thesis has highlighted the need for adapting and/or re-designing a variety of social and cognitive measures in order to assess individual differences in children of all ages: namely AToM ability, social confidence, and Machiavellianism.

Furthermore, children's meaning of "magic" and "trick" needs to be further explored by assessing the types of things that they categorize as magic. This would involve children witnessing different types of magical occurrences. The inclusion of verbal and behavioural reactions, and an adult comparison should also be used in some way. Finally, further exploration of children's social expectations involving different categories of magic occurrences is required.

### **Final Conclusions**

In Western society, where the framework is secular, magic is still part of our culture. A pertinent question is whether magical thinking and beliefs start at a young age. The current thesis illustrates that young children do engage in magical thinking. A broad remit of the thesis was to assess why some children are quicker at interpreting ostensibly anomalous events as tricks than others. In doing this, the research reported

has found evidence which supports and extends previous findings concerning young children's interpretation of anomalous events. It has identified a variety of factors that may contribute to individual differences in how an anomalous event will be interpreted by children. One hypothesis is that children do not understand physical laws which results in magical thinking. However, the thesis has found that children do understand the physical world. Yet understanding of the physical world was not a requirement for arriving at a "trick" conclusion in response to the presentation of a conjuring demonstration. The research supported the proposal that there are numerous task issues that must be considered in drawing conclusions about children's causal responses to violations of apparent physical laws. Factors, such as context appears to over-ride physical understanding of how the world works. The thesis questioned whether children's causal thinking is a developmental process. It has found evidence that age is important but may not be the only factor involved. Indeed, age was an important factor in younger children but not in older children. By incorporating an older age range in the thesis, evidence pointed to children being gullible to start with and then getting to an age where most are sceptical and not taken in. Yet some older children were found to still believe in "magic". In addition, the thesis has shown children of all ages to be variable and inconsistent in their causal beliefs. The research reported suggests that disbelief in magic is linked to social factors such as social cognition. Most importantly, theory of mind (ToM) appears to be possibly more predictive of how children will interpret a situation rather than simple physical understanding of how the world operates. Therefore, social understanding may be more important than physical understanding. Indeed, this may account for why both adults and children have been found to subscribe to magical thinking and beliefs.

Specifically, this thesis has presented evidence to suggest that ToM may play a role in children's understanding of trickery and level of scepticism towards genuine magic.

At present there is only limited evidence in support of such an account and future studies are needed in order to fully examine whether level of ToM skills provides a valid account of individual differences in children's interpretation of anomalous events. The current thesis is the first to put forward the suggestion of a link between ToM ability and responses towards a conjuring demonstration and is the first empirical assessment of the proposed association between the two areas for preschool aged children. In conclusion, level of ToM ability is a new approach to the study of children's causal reasoning regarding interpretation of an anomalous event and it offers the promise of a social-cognitive view of development within children's magical thinking. The differences found between responses in a conjuring demonstration may be due to real underlying differences in understanding of mental states (i.e., theory of mind). Therefore, it is important to study their possible associations further.

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## APPENDIX A – “Strange stories” task materials



### *Story Type: Appearance-Reality*

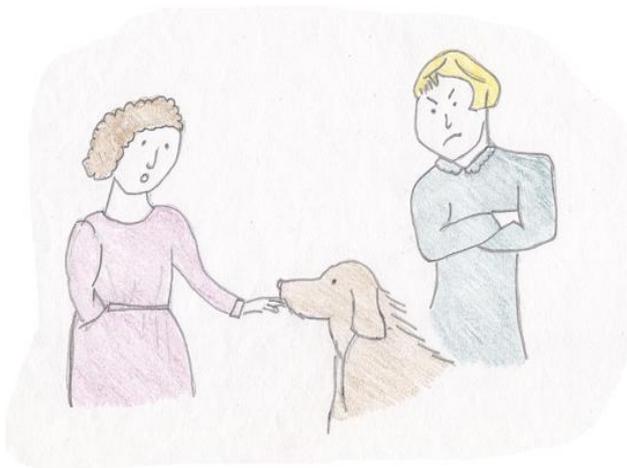
It's Halloween and Chris is going to a fancy-dress party dressed as a ghost. He wears a big white sheet with eyes cut out to see through. As he walks to the party in his ghost costume he bumps into Mr Brown. It's dark and Mr Brown says "Oh! Who is it?" Chris answers "I'm a ghost Mr Brown".

*Question:* Is it true what Chris says?

*Question:* Why does Chris say this?

*Mental state justification:* He's pretending.

*Physical state justification:* Because he looks like one.



### *Story Type: Lie*

One day, while she is playing in the house, Anna accidentally knocks over and breaks her mother's favourite crystal vase. Oh dear, when mother finds out she will be very cross! So when Anna's mother comes home and sees the broken vase and asks Anna what happened, Anna says, "The dog knocked it over, it wasn't my fault!"

*Question:* Was it true what Anna told her mother?

*Question:* Why did she say this?

*Mental state justification:* She's lying.

*Physical state justification:* So she won't get told off.



*Story Type: Figure of Speech*

Emma has a cough. All through lunch she coughs and coughs and coughs. Father says, “Poor Emma, you must have a frog in your throat!”

*Question:* Is it true what Father says to Emma?

*Question:* Why does he say that?

*Mental state justification:* It’s just an expression people use.

*Physical state justification:* Because she’s coughing. It sounds like it.



*Story Type: White Lie*

Helen waited all year for Christmas, because she knew at Christmas she could ask her parents for a rabbit. Helen wanted a rabbit more than anything. At last Christmas Day arrived, and Helen ran to unwrap the present her parents had given her. She felt sure it would contain a rabbit.

But when she opened it, with all the family watching, she found her present was just a boring old set of books which Helen didn’t want at all! Still, when Helen’s parents asked her how she liked her Christmas present, she said, “It’s lovely, thank you. It’s just what I wanted.”

*Question:* Is it true what Helen said?

*Question:* Why did she say that to her parents?

*Mental state justification:* reference to white lie or wanting to spare her parents feelings (e.g., she doesn’t want to upset them).

*Physical state justification:* more general reference to trait (e.g., she’s well brought up) or emotion (e.g., she got a present and thinks it’s better than no present at all).



*Story Type: Pretend*

Katie and Jack are playing in the house. Jack picks up a banana from the fruit bowl and holds it up to his ear. He says to Katie, “Look! This banana is a telephone!”

*Question:* Is it true what Jack says?

*Question:* Why does Jack say this?

*Mental state justification:* He’s just pretending.

*Physical state justification:* Because it looks like a telephone.



*Story Type: Misunderstanding*

A burglar has just robbed a shop and is making a getaway. As he’s running home a policeman sees him drop his glove. He doesn’t know the man is a burglar. He just wants to tell him he’s dropped his glove. But when the policeman shouts out to the burglar “Hey, you, stop!” the burglar turns round, sees the policeman, puts his hands up and admits he did the break-in at the local shop.

*Question:* Was the policeman surprised by what the burglar did?

*Question:* Why did the burglar do this, when the policeman just wanted to give him back his glove?

*Mental state justification:* reference to burglar’s ignorance of policeman’s true intention/knowledge state (e.g., he didn’t know the policeman just wanted to return his glove. He thought the policeman was going to arrest him).

*Physical state justification:* more general reference to burglar’s state of mind (e.g., he had a guilty conscience) or outcome (e.g., he thought the police might shoot otherwise or because the policeman was chasing him).



*Story Type: Joke*

James is going to Claire's house to see her dog for the first time. When James arrives at Claire's house, her dog jumps up to greet James. Claire's dog is huge, it's almost as big as James! When James sees Claire's huge dog he says, "Claire, you haven't got a dog at all. You've got an elephant!"

*Question: Is it true what James says?*

*Question: Why does James say this?*

*Mental state justification: He's joking.*

*Physical state justification: Because the dog is big.*



*Story Type: Irony*

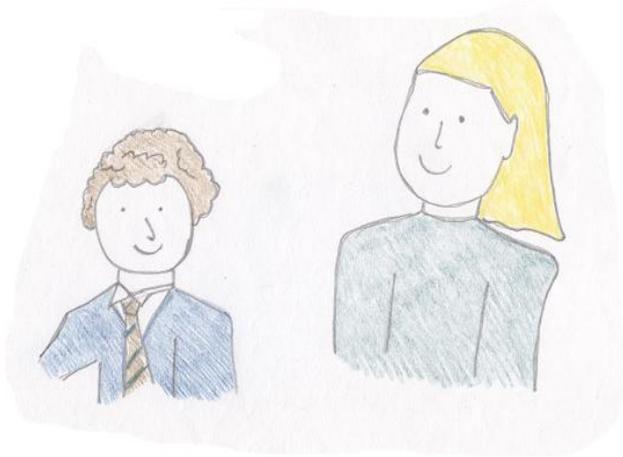
Ann's mother has spent a long time cooking Ann's favourite meal; fish and chips. But when she brings it in to Ann, she is watching TV, and she doesn't even look up. Or say thank you. Ann's mother is cross and says, "Well that's very nice isn't it! That's what I call politeness!"

*Question: Is it true what Ann's mother says?*

*Question: Why does Ann's mother say this?*

*Mental state justification: She's cross.*

*Physical state justification: Because Ann doesn't say thank you.*



*Story Type: Forget*

John was not at school today because he was ill. All the rest of Ben's class was at school though. When Ben got home after school his mum asked him "Was everyone in your class at school today?" Ben answers, "Yes mummy".

*Question:* Is it true what Ben said?

*Question:* Why did Ben say that?

*Mental state justification:* He forgot.

*Physical state justification:* He didn't want to get told off.



*Story Type: Double-bluff*

During the war, the green army captures a member of the brown army. They want him to tell them where his army's tanks are: they know they are either by the sea or in the mountains. They know the prisoner will lie to save his army. The prisoner is clever and will not let them find his tanks. The tanks are really in the mountains. Now when the other side ask him where his tanks are he says "They are in the mountains".

*Question:* Is it true what the prisoner said?

*Question:* Where will the other army look for his tanks?

*Question:* Why did the prisoner say the tanks were in the mountains?

*Mental state justification:* reference to fact that other army will not believe and hence look in other place, to prisoner's realisation that that's what they'll do, or reference to double bluff (e.g., to trick them).

*Physical state justification:* reference to outcome (e.g., to save his army's tanks or so they will look in the wrong place) or simple lying (to mislead them, to lie).

*Story Type: Contrary emotion*



Jane and Sarah are best friends. They both entered the same painting competition. Jane wanted to win very much but it was her best friend Sarah who won, not her. Jane was very sad she hadn't won but she was happy for her friend. Jane said to Sarah "I'm so happy you won!" Jane said to her mum "I'm sad I didn't win the competition!"

*Question:* Is it true what Jane said to Sarah?

*Question:* Is it true what Jane said to her mum?

*Question:* Why does Jane say she is happy and sad?

*Mental state justification:* She feels happy her friend won but sad she lost.

*Physical state justification:* Because she won the competition.



*Story Type: Persuasion*

Jill wanted to buy a kitten, so she went to see Mrs Smith, who had lots of kittens. Now Mrs Smith loved the kittens and she wouldn't do anything to harm them, but she couldn't keep them all herself. When Jane visited she wasn't sure she wanted one of Mrs Smith's kittens. Mrs Smith said, "If no one buys the kittens I'll just have to drown them!"

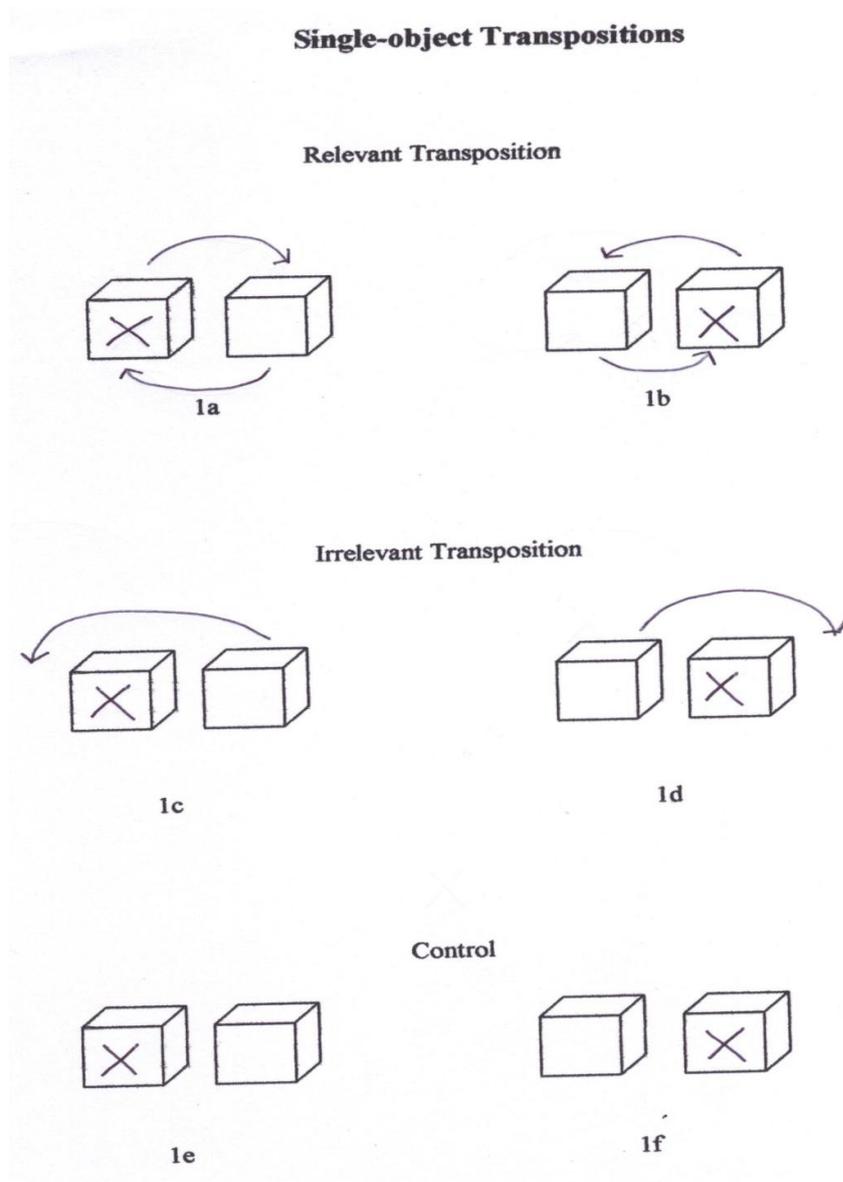
*Question:* Was it true what Mrs Smith said?

*Question:* Why did Mrs Smith say this to Jane?

*Mental state justification:* reference to persuasion, manipulating feelings, trying to induce pity/guilt.

*Physical state justification:* reference to outcome (e.g., to sell them).

## APPENDIX B – Spatial monitoring task materials



NB: “X” represents a specific object hidden in a box that needs to be located. The other box is empty. The arrows show the movement of specific box(es).

1a shows the left box containing object “X” swapped over with the empty box on the right.

1b shows the right box containing object “X” swapped over with the empty box on the left.

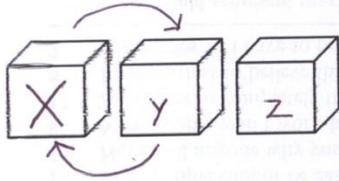
1c shows the movement of the empty box only over to the left side.

1d shows the movement of the empty box only to over to the right side.

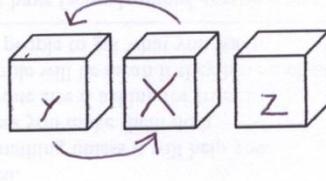
1e and 1f show no movement of boxes.

### Three-object Transpositions

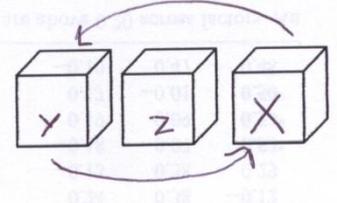
#### Relevant Transposition



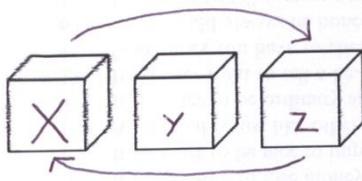
2a



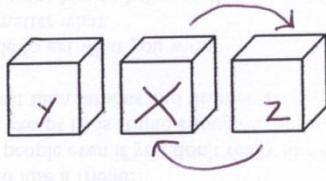
2b



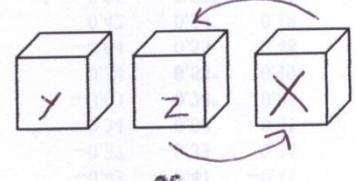
2c



2d

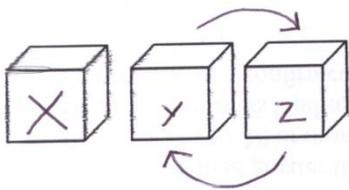


2e

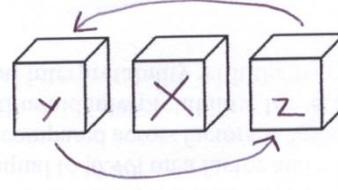


2f

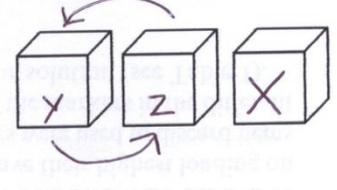
#### Irrelevant Transposition



2g

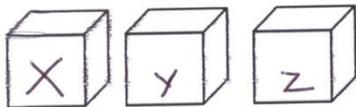


2h

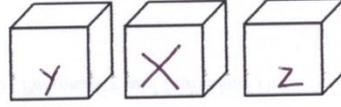


2i

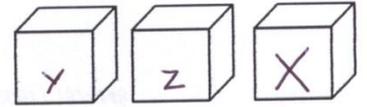
#### Control



2j



2k



2l

NB: “X” represents a specific object hidden in a box that needs to be located first. “y” and “z” represent non-designated objects each hidden in a different box. The arrows show the movement of specific box(es).

2a shows the far left box containing object “X” swapped over with the middle box containing object “y”.

2b shows the middle box containing object “X” swapped over with the far left box containing object “y”.

2c shows the far right box containing object “X” swapped over with the far left box containing object “y”.

2d shows the far left box containing object “X” swapped over with the far right box containing object “z”.

2e shows the middle box containing object “X” swapped over with the far right box containing object “z”.

2f shows the far right box containing object “X” swapped over with the middle box containing object “z”.

2g shows the movement of the middle box with the far right box.

2h shows the movement of the far right box swapped over with the far left box.

2i shows the movement of the middle box swapped over with the far left box.

2j, 2k, and 2l show no movement of boxes.

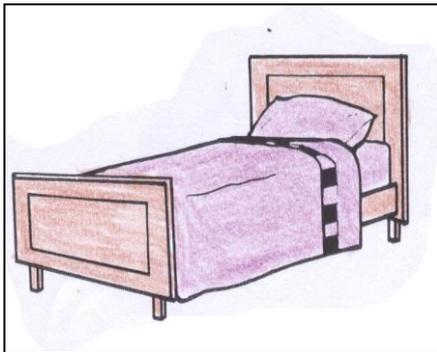
**APPENDIX C - Practice lie and truth pictures and statements**



Lie statement: flowers in a vase.



Lie statement: a bed.



Truth statement: a bed.



Truth statement: flowers in a vase.

NB: Lie statements and Truth statements represent what the participant is instructed to say each picture shows.

**APPENDIX C - Lie pictures and statements for Experimental Group 1**



Lie statement: a baby crawling.



Lie statement: a lady delivering a baby.



Lie statement: a boy walking.



Lie statement: a boy drinking from a glass.



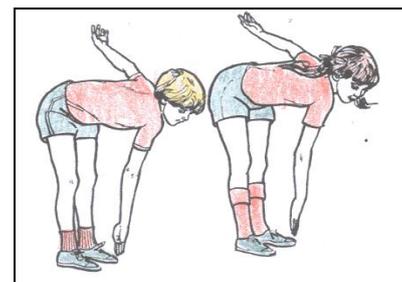
Lie statement: two men arguing.



Lie statement: a lady vet fixing a dog's leg.



Lie statement: a man jumping over a hurdle.



Lie statement: a lady fixing a bicycle.

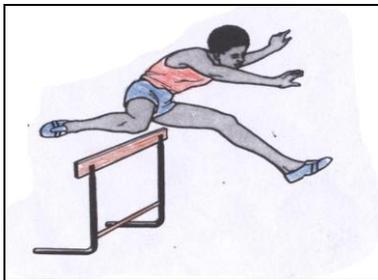
**APPENDIX C - Truth pictures and statements for Experimental Group 1**



Truth statement: two men arguing.



Truth statement: a lady fixing a dog's leg.



Truth statement: a man jumping over a hurdle.



Truth statement: a lady fixing a bicycle.



Truth statement: a lady delivering a baby.



Truth statement: a boy walking.



Truth statement: a boy drinking from a glass.



Truth statement: a baby crawling.

**APPENDIX C - Lie pictures and statements for Experimental Group 2**



Lie statement: someone peeling an apple.



Lie statement: a boy taking biscuits out of a jar.



Lie statement: an ambulance.



Lie statement: a lady and man dancing.



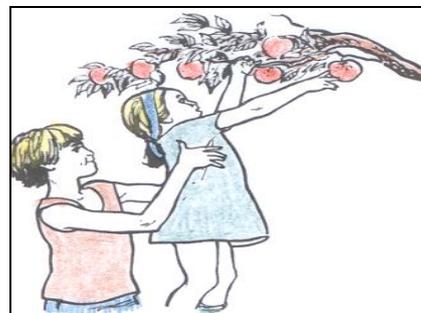
Lie statement: a girl crying.



Lie statement: a boy and girl skating.



Lie statement: a boy and girl playing a board game.

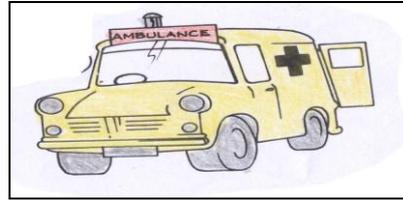


Lie statement: a man washing a floor.

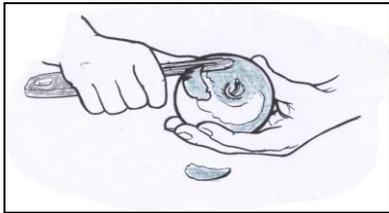
**APPENDIX C - Truth pictures and statements for Experimental Group 2**



Truth statement: a girl crying.



Truth statement: an ambulance.



Truth statement: someone peeling an apple.



Truth statement: a boy taking biscuit out of a jar.



Truth statement: a lady and man dancing.



Truth statement: a man washing a floor.



Truth statement: a boy and girl playing a board game.



Truth statement: a boy and girl skateboarding.

**APPENDIX D – Binomial Test Results**

Adults

Subject	Total correct truth	Total correct lie	<b>Total combined correct lie and truth ratings (i.e. Number of successes - X)</b>	Total incorrect truth	Total incorrect lie	Total combined incorrect lie and truth	<b>Total combined correct &amp; incorrect lie and truth ratings (i.e. Number of trials)</b>	<b>P (X ≤)*</b>	<b>P (X ≥)**</b>
1	65	48	<b>113</b>	18	31	49	<b>162</b>	<b>.999</b>	<b>.0001</b>
2	56	68	<b>124</b>	31	20	51	<b>175</b>	<b>.999</b>	<b>.0001</b>
3	70	64	<b>134</b>	12	19	31	<b>165</b>	<b>1</b>	<b>.0001</b>
4	50	60	<b>110</b>	37	25	62	<b>172</b>	<b>.999</b>	<b>.0001</b>
5	38	55	<b>93</b>	41	30	71	<b>164</b>	<b>.963</b>	<b>.050</b>
6	76	47	<b>123</b>	10	40	50	<b>173</b>	<b>.999</b>	<b>.0001</b>
7	46	35	<b>81</b>	40	51	91	<b>172</b>	<b>.246</b>	<b>.799</b>
8	69	49	<b>118</b>	16	35	51	<b>169</b>	<b>.999</b>	<b>.0001</b>
9	32	43	<b>75</b>	51	39	90	<b>165</b>	<b>.137</b>	<b>.893</b>
10	63	35	<b>98</b>	21	51	72	<b>170</b>	<b>.980</b>	<b>.027</b>
11	54	49	<b>103</b>	32	37	69	<b>172</b>	<b>.996</b>	<b>.0058</b>

Appendix D (continued)

Subject	Total correct truth	Total correct lie	Total combined correct lie and truth ratings (i.e. Number of successes - X)	Total incorrect truth	Total incorrect lie	Total combined incorrect lie and truth	Total combined correct & incorrect lie and truth ratings (i.e. Number of trials)	P (X ≤)	P (X ≥)
12	40	47	<b>87</b>	40	32	72	<b>159</b>	<b>.897</b>	<b>.133</b>
13	61	75	<b>136</b>	18	10	28	<b>164</b>	<b>1</b>	<b>.0001</b>
14	58	60	<b>118</b>	27	18	45	<b>163</b>	<b>.999</b>	<b>.0001</b>
15	65	64	<b>129</b>	16	19	35	<b>164</b>	<b>.999</b>	<b>.0001</b>
16	55	33	<b>88</b>	29	48	77	<b>165</b>	<b>.824</b>	<b>.218</b>
17	21	70	<b>91</b>	66	18	84	<b>175</b>	<b>.727</b>	<b>.325</b>
18	51	43	<b>94</b>	31	33	64	<b>158</b>	<b>.993</b>	<b>.010</b>
19	44	34	<b>78</b>	31	38	69	<b>147</b>	<b>.795</b>	<b>.254</b>
20	61	43	<b>104</b>	26	41	67	<b>171</b>	<b>.998</b>	<b>.0028</b>
21	53	43	<b>96</b>	28	35	63	<b>159</b>	<b>.996</b>	<b>.0054</b>
22	63	44	<b>107</b>	23	45	68	<b>175</b>	<b>.998</b>	<b>.0019</b>

Appendix D (continued)

**Children**

Subject	Total correct truth	Total correct lie	<b>Total combined correct lie and truth ratings (i.e. Number of successes - X)</b>	Total incorrect truth	Total incorrect lie	Total combined incorrect lie and truth	<b>Total combined correct &amp; incorrect lie and truth ratings (i.e. Number of trials)</b>	<b>P (X ≤)</b>	<b>P (X ≥)</b>
1	15	30	<b>45</b>	29	14	43	<b>88</b>	<b>.625</b>	<b>.457</b>
2	24	24	<b>48</b>	20	20	40	<b>88</b>	<b>.831</b>	<b>.227</b>
3	29	16	<b>45</b>	15	28	43	<b>88</b>	<b>.625</b>	<b>.457</b>
4	19	20	<b>39</b>	25	24	49	<b>88</b>	<b>.168</b>	<b>.879</b>
5	7	33	<b>40</b>	36	10	46	<b>86</b>	<b>.295</b>	<b>.774</b>
6	18	26	<b>44</b>	24	17	41	<b>85</b>	<b>.667</b>	<b>.414</b>
7	17	24	<b>41</b>	17	13	30	<b>71</b>	<b>.923</b>	<b>.117</b>
8	12	36	<b>48</b>	32	8	40	<b>88</b>	<b>.831</b>	<b>.227</b>
9	14	28	<b>42</b>	30	16	46	<b>88</b>	<b>.374</b>	<b>.702</b>
10	17	24	<b>41</b>	25	17	42	<b>83</b>	<b>.5</b>	<b>.586</b>
11	22	16	<b>38</b>	20	28	48	<b>86</b>	<b>.165</b>	<b>.882</b>
12	11	22	<b>33</b>	26	16	42	<b>75</b>	<b>.177</b>	<b>.875</b>
13	22	25	<b>47</b>	22	19	41	<b>88</b>	<b>.772</b>	<b>.297</b>

Appendix D (continued)

Subject	Total correct truth	Total correct lie	Total combined correct lie and truth ratings (i.e. Number of successes - X)	Total incorrect truth	Total incorrect lie	Total combined incorrect lie and truth	Total combined correct & incorrect lie and truth ratings (i.e. Number of trials)	P (X ≤)	P (X ≥)
14	35	6	<b>41</b>	6	33	39	<b>80</b>	<b>.631</b>	<b>.455</b>
15	8	21	<b>29</b>	26	11	37	<b>66</b>	<b>.194</b>	<b>.866</b>
16	29	24	<b>53</b>	15	20	35	<b>88</b>	<b>.978</b>	<b>.034</b>
17	13	22	<b>35</b>	18	6	24	<b>59</b>	<b>.941</b>	<b>.096</b>
18	10	39	<b>49</b>	34	5	39	<b>88</b>	<b>.879</b>	<b>.168</b>
19	14	21	<b>25</b>	16	13	29	<b>54</b>	<b>.341</b>	<b>.751</b>
20	16	24	<b>40</b>	23	15	38	<b>78</b>	<b>.632</b>	<b>.454</b>
21	28	18	<b>46</b>	16	25	41	<b>87</b>	<b>.739</b>	<b>.334</b>
22	13	22	<b>35</b>	25	10	35	<b>70</b>	<b>.547</b>	<b>.547</b>
23	27	25	<b>52</b>	17	19	36	<b>88</b>	<b>.965</b>	<b>.054</b>
24	18	28	<b>46</b>	25	16	41	<b>87</b>	<b>.739</b>	<b>.334</b>
25	17	24	<b>41</b>	23	17	40	<b>81</b>	<b>.58</b>	<b>.5</b>
26	10	32	<b>42</b>	32	10	42	<b>84</b>	<b>.543</b>	<b>.543</b>
27	44	0	<b>44</b>	0	44	44	<b>88</b>	<b>.542</b>	<b>.542</b>

Appendix D (continued)

Subject	Total correct truth	Total correct lie	Total combined correct lie and truth ratings (i.e. Number of successes - X)	Total incorrect truth	Total incorrect lie	Total combined incorrect lie and truth	Total combined correct & incorrect lie and truth ratings (i.e. Number of trials)	P (X ≤)	P (X ≥)
28	14	22	<b>36</b>	29	17	47	<b>83</b>	<b>.136</b>	<b>.906</b>
29	31	16	<b>47</b>	13	28	41	<b>88</b>	<b>.772</b>	<b>.297</b>
30	20	23	<b>43</b>	22	18	40	<b>83</b>	<b>.669</b>	<b>.413</b>
31	31	15	<b>46</b>	13	29	42	<b>88</b>	<b>.702</b>	<b>.374</b>
32	38	7	<b>45</b>	6	37	43	<b>88</b>	<b>.625</b>	<b>.457</b>
33	28	16	<b>44</b>	16	28	44	<b>88</b>	<b>.542</b>	<b>.542</b>
34	44	1	<b>45</b>	0	43	43	<b>88</b>	<b>.625</b>	<b>.457</b>
35	23	16	<b>39</b>	14	15	29	<b>68</b>	<b>.909</b>	<b>.137</b>
36	12	22	<b>34</b>	26	18	44	<b>78</b>	<b>.154</b>	<b>.893</b>
37	27	12	<b>39</b>	16	29	45	<b>84</b>	<b>.292</b>	<b>.777</b>
38	28	14	<b>42</b>	11	29	40	<b>82</b>	<b>.629</b>	<b>.456</b>
39	12	24	<b>36</b>	30	17	47	<b>83</b>	<b>.136</b>	<b>.906</b>
40	33	20	<b>53</b>	11	24	35	<b>88</b>	<b>.978</b>	<b>.034</b>
41	21	24	<b>45</b>	23	19	42	<b>87</b>	<b>.665</b>	<b>.415</b>

Appendix D (continued)

Subject	Total correct truth	Total correct lie	<b>Total combined correct lie and truth ratings (i.e. Number of successes - X)</b>	Total incorrect truth	Total incorrect lie	Total combined incorrect lie and truth	<b>Total combined correct &amp; incorrect lie and truth ratings (i.e. Number of trials)</b>	<b>P (X ≤)</b>	<b>P (X ≥)</b>
42	25	19	<b>44</b>	19	25	44	<b>88</b>	<b>.542</b>	<b>.542</b>
43	15	37	<b>52</b>	25	2	27	<b>79</b>	<b>.998</b>	<b>.003</b>
44	9	34	<b>43</b>	33	7	40	<b>83</b>	<b>.669</b>	<b>.413</b>
45	25	17	<b>42</b>	18	26	44	<b>86</b>	<b>.457</b>	<b>.626</b>
46	30	18	<b>48</b>	14	25	39	<b>87</b>	<b>.858</b>	<b>.195</b>
47	22	25	<b>47</b>	21	17	38	<b>85</b>	<b>.861</b>	<b>.192</b>

\* Cumulative probability that the value of getting less than or equal successes falling within the specified range.

\*\*Cumulative probability of getting more than or equal to successes falling within the specified range.

NB: Probability of success on a single trial set at 0 .5.