A THEORY OF PICTURES: INVESTIGATING THE MEDIATING ROLE OF PICTURE MODALITY IN CHILDREN'S UNDERSTANDING OF THE PICTURE-CREATOR AND PICTURE-REFERENT RELATIONSHIPS

by

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Declaration

I declare that the thesis is my own work, and has not been submitted in substantially the same form for the award of a higher degree elsewhere.

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Abstract

This thesis investigates how 3- to 8-year-old children construct a theory of pictures with a particular focus on how children prioritise appearance and intentional cues when decoding the picture-referent relationship, and whether picture modality mediates children's understanding of how pictures relate to the world and their creators. Experiments 1, 2 and 3 explore whether appearance or intentional cues dominate 3- to 6-year-old children and adults picture interpretation when the two cues conflict. Experiment 4 investigates how 4- and 6-year-old children and adults use artists and photographers' intentions to name and judge the value of photographs and drawings. Experiment 5 addresses children's knowledge of the divergent roles played by artists and photographers in creating pictures. Experiment 6 examines children's understanding of how a picture creator's visual access to, and knowledge of, their intended referent affects their ability to depict it. Finally, Experiments 7 and 8 assess children's ability to consider the interaction between picture modality and referential content to identify whether a confederate is more likely to have created a fantasy drawing or a fantasy photograph (e.g. a unicorn). Collectively, the findings from these experiments reveal that children's early understanding of the referential nature of pictures is supplemented by modality-specific knowledge about drawing and photography. More specifically, between the ages of 3 and 8 children display a growing understanding that while drawings rely to a large extent on the minds of their artists, in particular their intentions and imagination, photographs depend on their real world referents more so than their photographer's intentions or referent knowledge. Theoretically, confirmation that children's pictorial development entails an understanding of different modalities warranted the inclusion of two modality-specific

streams, one for photography and one for drawing, into existing frameworks of pictorial understanding.

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Dedication

To my Grandparents, for everything.

Publications

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Armitage, E., & Allen, M. L. (under review). Exploring children's knowledge of the distinct roles played by artists and photographers in picture creation. *Psychology of Aesthetics, Creativity, and the Arts.*

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Epigraph

"Of all our inventions for mass communication, pictures still speak the most universally understood language"

Walt Disney

Chapter One: **General Introduction**

Since the time of Plato and Aristotle, philosophers and psychologists alike have sought to understand the unique ability of the human race to communicate via symbols (Deacon, 1997; Ittelson, 1996). While language is our dominant symbol system, "pictorial perception has more immediacy than understanding of words" (Gibson, 1979, p. 34), and representational pictures (those that share a physical resemblance to their referents) are particularly ubiquitous symbols in everyday life. Freeman (2004) states, "lay people and experts of all ages often find themselves making many types of decisions about what a picture shows, how it shows it, and how well it shows it. The decisions are made on many types of pictures, photographs, road signs, artworks on a wall, quick sketches, text illustrations, and more" (p. 359), making the acquisition of pictorial understanding a crucial developmental milestone (DeLoache, 2002, 2004; Freeman, 2004; Jolley, 2010; Piaget, 1952; Vygotsky, 1978).

Pictures offer a unique and essential contribution to our lives, both in terms of aesthetic pleasure (Winner, Rosenblatt, Windmueller, Davidson & Gardner, 1986) and efficient cognition (DeLoache, 1991). Adults visit art galleries with the sole purpose of appreciating great art, and we adorn our homes with everything from postcards to professional artwork. Over and above their visual appeal, pictures serve as an indirect source of information about the world, from which children can learn about everything from hidden properties of novel objects (Keates, Graham & Ganea, 2014) to the natural world, specifically, biological and conceptual knowledge about animals (Ganea, Canfield, Simons-Ghafari & Chou, 2014; Ganea, Ma & DeLoache, 2011; Waxman, Herrman, Woodring & Medin, 2014). Furthermore, we use pictures to navigate our everyday lives: road signs and map keys allow us to locate unfamiliar places, commercial brands can be identified by their logos, illustrated menus enable

us to select food in foreign restaurants, and smartphone icons denote the function of applications (e.g. email inboxes are typically symbolised by a picture of an envelope).

Despite their importance, the complexity of pictures and our ability to comprehend them is often overlooked since, "most people think they know what a picture is, anything so familiar must be simple" (Gibson, 1980, p. xvii). The primary function of pictures is to represent something in the world, and as such, we typically see through them to their referents (Ittelson 1996; Jolley, 2010; Liben, 2003; Schwartz, 1995). At its most basic, this only requires recognition of their visual similarities, alongside an appreciation of the referential relationship that exists between the two: a picture of a rabbit refers to a rabbit in the real world. Although pictures are often iconic, "there is no physical test that could determine what a picture represents" (Browne & Woolley, 2001, p. 389), which highlights the need for additional, non-resemblance based cues, with which to decode them. Pictures only represent the world as a result of someone's intention to communicate information, thus intention is "both necessary and sufficient to establish a symbolic relation" (DeLoache, 2004, p. 67). For instance, while an artist's line drawing of a rabbit is taken to represent a rabbit, a similarly shaped, but naturally occurring, mud puddle is less likely to be perceived as a representation of a rabbit, since it was not created with that intention in mind (Bloom, 1996; Gelman & Ebeling, 1998). A contentious debate has arisen in the literature surrounding which of these two cues is most often used to derive pictorial meaning (see Section 1.3.1), hence, the first aim of this thesis is to clarify the relative importance of appearance and intention for children's picture interpretation; this is specifically addressed in Chapter Two.

The second broad aim of this thesis is to investigate whether children develop an understanding of pictures that accommodates differences across picture modality,

specifically, photographs and drawings (see Section 1.5). Photographs do not necessarily relate to the world in the same way as drawings or paintings, and they are certainly not created in the same manner; this means that beholders experience them differently (Barrett, 1986; Cavedon-Taylor, 2014a; Friday, 2002; Gooskens, 2012; Hopkins, 2012; Pettersson, 2011; Walton, 1984). For example, if someone showed you what you thought was a photograph of your horse on fire, you would likely respond with panic, assuming your horse was burning. However, if the same person then told you the picture was in fact a painting you would cease believing your horse was on fire since you no longer assume the picture represents a real event (Gooskens, 2012). This hypothetical scenario nicely illustrates the different assumptions an adult might make about photographs compared to paintings and makes it clear that any truly complete theory of pictures must consider how children's developing pictorial competence accounts for a variety of picture types.

It is useful to examine the appearance versus intention debate, and the role picture modality plays in children's developing pictorial understanding within the context of two theoretical frameworks. Firstly, Freeman and Sanger's (1995) intentional net posits that a complete theory of pictures rests on an understanding of four factors: the picture, the artist, the world and the beholder, and the six relationships connecting them. Secondly, Liben's (1999) six-level sequence theory of representational understanding asserts that children must appreciate the unique characteristics and conventions associated with different picture modalities, for example, drawings and photographs. Combining these two approaches allows a systematic analysis of how picture modality might mediate children's understanding of two of the relationships integral to pictorial understanding: picture-world and picture-artist. Due to the explicit consideration of two modalities, drawings and

photographs, within this thesis, Freeman and Sanger's original 'picture-artist' terminology is extended to include the terms 'picture-photographer', and 'picture-creator', the latter of which is used when referring to both artists and photographers.

1.1 Intentional net framework

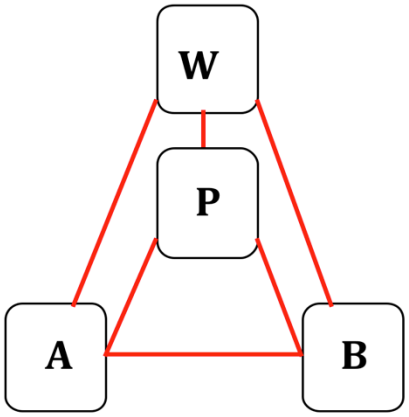

Figure 1. Freeman and Sanger's (1995) intentional net framework comprising four factors: Picture, Artist, World and Beholder

The intentional net framework (see Figure 1), devised by Freeman and Sanger (1995) predicts that six relationships must be understood before an intentional theory of pictures can be devised, including: picture-world, picture-artist, picture-beholder, artist-world, artist-beholder, and world-beholder. To test children's intuitive understanding of such a theory the authors composed a series of 10 yes/no questions, which were posed to twenty-four 11- to 14-year-old children and their teacher. Overall, the responses showed that both groups of children were aware that an artist's own feelings can influence their portrayal of particular scenes, and also that artists can manipulate a beholder's emotional reaction to their picture, for instance, by

deliberately using dull colours to convey sadness. However, significant age-related differences were found on four of the remaining eight questions, as expanded below.

When asked about the picture-world relationship in the format, "would an ugly thing make a worse picture than a pretty thing?" ten out of twelve 11-year-olds thought this would be the case, compared to only three out of twelve 14-year-olds. This suggests that up until the age of 11 children define pictures according to their content, assuming a direct and transparent mapping of the world onto the picture, with little consideration of the artist's role. When asked directly about the artist, "will a happy artist make a better picture than a sad artist?" nine out of twelve 11-year-olds said yes, whilst only three out of twelve 14-year-olds did so, thus indicating that when younger children are forced to reason about the artist's input they mistakenly assume that feelings, and not skill, are responsible for determining picture quality.

A related error was made when children were asked to consider the beholder-picture relationship by thinking about how mood could affect picture perception. Three out of twelve 11-year-olds and eight out of twelve 14-year-olds stated that their mood would not impact how they looked at the picture. Again, younger children failed to grasp the beholder's ability to actively construct their own interpretation of a picture, and therefore underestimated the role of the beholder in the comprehension of pictures. Finally, when asked "can you tell the age of an artist from his picture?" five out of twelve 11-year-olds and eleven out of twelve 14-year-olds responded affirmatively. The authors considered this to be a further reflection of the lack of awareness young children have concerning the role of the beholder. Overall, up to one third of the 11-year-olds questioned attributed some level of active pictorial perception to beholders, whereas 11 of the 14-year-olds did so, and this led to the conclusion that children's understanding of the beholder's role increases with age.

Subsequent research using behavioural tasks, which are less dependent on verbal responding (see Woolley, 2006 for a discussion of the dissociation between verbal and behavioural measures of children's task performance), have revealed that children show an appreciation of the roles of both the artist (Bloom & Markson, 1998; Callaghan, 1997; Callaghan & MacFarlane, 1998; Callaghan & Rochat, 2003; Gelman and Ebeling, 1998; Myers & Liben, 2008) and the beholder (Allen, Bloom & Hodgson, 2010; Barquero, Robinson & Thomas, 2003; Lagattuta, Sayfan & Blattman, 2010; Pillow & Henrichon, 1996) much younger than age 11. Nevertheless, this theoretical framework has proven invaluable in shaping how researchers think about how children develop an understanding of pictures. As such, it also provides the basis for the empirical chapters of this thesis, which focus on comparing how children and adults comprehend the picture-world (Chapter Six) and picture-creator relationships (Chapters Two – Five) for photographs and drawings. Since the majority of the existing empirical research has investigated how children acquire an understanding of handmade pictures, such as drawings or paintings, the subsequent discussion reviews this literature first (see Sections 1.2, 1.3 and 1.4) before turning to a consideration of what is known about children's understanding of the photographic medium (see Section 1.5). For completeness, all four of Freeman and Sanger's factors: the picture, the artist, the world and the beholder, are reviewed, although the focus of this thesis is largely on the picture-world and picture-creator relationships.

1.2 Picture-World relationship

Adults effortlessly appreciate the representational relationship pictures share with their real world referents, while children acquire this ability through a "protracted and multifaceted" (Liben, 1999, p. 307) process. In her six-level

developmental sequence of representational understanding Liben (1999) provides one of the most comprehensive accounts of how children progress from the basic ability to recognise referential content in pictures, to a mature appreciation of the varied nature of picture-referent relationships across picture modality, including knowledge of the unique rules and cultural conventions that govern their creation and use. As such, it is pertinent to discuss her levels within the confines of the picture-world relationship, since this allows a clear and organised review of the relevant literature as well as highlighting areas where empirical evidence is lacking, most notably regarding the role of picture modality (levels five & six). It is also important to note that although Liben's levels were devised to apply to what she refers to as 'external spatial representations', which includes maps and graphs as well as pictures, here the focus will be on the elements of her theory that apply to representational pictures alone.

Levels one and two of this sequence describe how children must recognise the referential content in pictures, as well as differentiate pictures from their 3D referents. At level three children achieve representational insight, whereby they realise that pictures stand for their real world referents and thus can be used as sources of information about both generic and specific real world referents. However, even then children possess misconceptions about how pictures relate to the world. Thus, level four is characterised by deepening knowledge of the exact nature of the picture-world relationship. Here children realise that pictures and their referents are independent, which requires them to disentangle shared and non-shared features, and recognise that the relationship between the two is static; a picture of a cat does not magically update when the cat moves to a new location. Consequently, during this period children grasp the inherent duality of pictures, in that they become aware that pictures are objects in and of themselves as well as representations of something else. Finally, levels five

and six, termed correspondence mastery and meta-representation respectively, expand children's pictorial understanding across other modalities. At level five children recognise that not all pictures relate to their referents in the same way, for example, photographs and maps are governed by different rules and conventions. Subsequently, at level six children can reflect on the nature of representation, and understand that different picture types are suited to different tasks; one would not typically choose a painting to locate a place, or install a map in an art gallery. Literature relevant to the latter two levels is reviewed in Section 1.5 since they are important to a discussion of how children might acquire a modality-specific theory of pictures.

1.2.1 Referential content and global differentiation (Levels One & Two)

Two main arguments have been made regarding how children first recognise objects in pictures. Stimulus-oriented approaches argue that pictures and the world provide much of the same information to the beholder (Pirenne, 1970; Gibson, 1979), and therefore picture perception requires little in the way of specialised skills; looking at a teddy bear in the real world is the same as viewing a picture of a teddy bear. Response-oriented approaches are slightly less stringent as they demand that pictures must contain some recognisable elements of the world (Hagen, 1986), but the two need not resemble one and other completely. These requirements are only satisfied by a small sample of highly iconic pictures, and most notably exclude abstract art, which replicates none of the information we receive from the world, nor contains any recognisable elements of it. A classic study by Hochberg and Brooks (1962) supports the stimulus-oriented approach. The authors withheld all but minimal pictorial stimuli from their son, yet found that by 19 months old he could spontaneously recognise and name line drawings and photographs of everyday solid objects and familiar people.

These findings suggest that recognition of referents from pictures is an unlearned ability, requiring little pictorial experience or explicit instruction regarding the nature of picture-referent mappings. However, these conclusions are based on only one child in a study that did not provide a quantitative measure of precisely how much experience is needed to learn.

Nonetheless, more recent cross-cultural research reaffirms their claims. Walker, Walker and Ganea (2013) recruited 20-, 27- and 34-month-old children from a remote village in Tanzania, who had no prior pictorial experience, to participate in a picture-based learning task. The children were engaged in a picture book interaction, during which the experimenter labelled eight familiar items, and one novel object (blicketi). During the subsequent training phase children were presented with two pictures of the familiar objects from the book, and the experimenter asked for one of them by name. Of the 20-month-old children 92% selected the correct picture, indicating that they could recognise familiar objects in pictures. Although this can be distinguished from the spontaneous recognition reported by Hochberg and Brooks (1962), it nonetheless suggests that the ability to recognise the referential content of pictures seems to be unlearned, particularly since learning did not seem to occur for this age group - they did not retain the novel label for the depicted novel object.

Interestingly, in the test phase of the study when children were asked to select the 'blicketi' from two pictures (one of the blicketi and one of a familiar object), two objects (a blicketi and a familiar object) and two novel objects (a differently coloured blicketi and a differently coloured familiar object), the Tanzanian children were delayed relative to children from a picture-rich culture (Ganea, Pickard & DeLoache, 2008). However, they still began to treat pictures as referential symbols by 27 months

old. Thus, while experience is clearly implicated in children's *developing* pictorial competence, these findings suggest that it is not the sole determinant.

If recognition is unlearned, the question remains, from what point in development is it present? The ability to identify the similarities that exist between pictures and their referents emerges very early in an infant's life. Three-month-olds can recognise their mother's face in photographs, and discriminate her face from that of a stranger (Barrera & Maurer, 1981) and by 5 months old they can recognise the similarities between 2D photographs and their 3D referents (DeLoache, Strauss & Maynard, 1979). In this latter study, infants were habituated to a doll before it was replaced with two photographs: one depicting the doll they had previously seen and the other depicting a new doll. Infants showed a novelty preference for the photograph of the new doll, indicating that they recognised the similarity between the original doll and its photograph.

Importantly, discrimination studies show that in addition to being aware of their perceptual similarities, infants also recognise that pictures and their referents are different entities. Slater, Morison and Rose (1984) found that newborns look at 3D geometric figures of circles and crosses for significantly longer than they look at photographs of the same figures; in order to show a preference for one display over the other, it follows that the babies must have perceived a difference in the two stimuli. Estimates of the age at which children can accurately discriminate pictures from their referents vary, with some researchers reporting that it does not occur until around 3 months of age (Polak, Emde & Spitz, 1964) and others reporting that it is much later, at 6 months (Rose, 1977). Regardless, the age of onset remains within the infancy period and as such these findings provide further support for the argument that infants do not require specialised skills to recognise pictures.

Despite their early ability to visually distinguish pictures from their referents, infants do not always treat the two as dissimilar. Nine-month-old infants have a tendency to pick up objects from pictures, almost 'as if' they were the objects themselves (DeLoache, Pierroutsakos, Uttal, Rosengren & Gottlieb, 1998). These behaviours increase when infants are presented with highly iconic colour photographs, compared to line drawings (Pierroutsakos & DeLoache, 2003) or abstract images (Ziemer, Plumert & Pick, 2012). There are two possible explanations for this manual response to pictures. Firstly, children may be confusing 2D pictures with their 3D referents because they do not know the difference between them. Alternatively, it is possible that their grasps are an attempt to ascertain the exact nature of the difference between pictures and their referents.

The majority of research supports the latter proposal; infants display more grasping behaviours towards objects when presented with picture-object pairs (DeLoache et al, 1998), and their hand and finger movements differ when they are grasping for real objects versus trying to 'pick up' objects from pictures (Yonas, Granrud, Chov & Alexander, 2005). By the time they are 18 months old infants' grasping behaviours are replaced by pointing behaviour (DeLoache et al, 1998), marking the transition from viewing pictures as objects of action to viewing them as "objects of contemplation" (Werner & Kaplan, 1963, p.18).

It has been proposed that this shift is a result of social learning, specifically observing and imitating adults' behaviour towards pictures. Callaghan, Rochat, MacGillivray and MacLellan (2004) exposed infants between 6- and 18-months to an adult who either manipulated a series of photographs, for example, by moving them around, or who treated the pictures in a contemplative manner, for example, by pointing to them and repeatedly glancing between the infant and the picture. When

children were given the opportunity to interact with the photographs themselves, 12-, 15-, and 18-month-olds in the manipulative condition exhibited significantly more manipulative behaviour towards them than same-aged children in the contemplative condition. These findings indicate that the social-communicative exchanges surrounding pictures may be an important factor in facilitating children's pictorial understanding.

In summary, thus far children's developing 'picture' concept (DeLoache et al, 1998; DeLoache & Burns, 1994) consists of knowledge that although pictures and their referents are visually similar, they are distinct entities, and that the cultural convention is to look at pictures rather than manipulate them. Furthermore, there is evidence that one of the mechanisms driving development, even at this early stage, is experience acquired by observing how adults interact with pictures. However, the successful 'decoupling' of referential content from the pictorial surface (Ittelson, 1996) is insufficient to render children symbolic, or pictures useful to them, since this requires some awareness that pictures stand for, or refer to, their referents. Thus, the next stage in their pictorial development is to acquire an understanding of the referential relationship that links pictures to their referents.

1.2.2 Representational insight (Level Three)

Representational insight is the term used to describe children's recognition that pictures refer to something in the real world (DeLoache, 1995, 2002); a picture of a rabbit must be interpreted as referring to a real rabbit if it is to be utilised as a symbol. Preissler and Carey (2004) report one of the earliest demonstrations of representational insight. They taught 18- and 24-month-old children a label (e.g. 'whisk') for a picture of a novel object (a whisk) by repeatedly pairing the two

together. At test children were given a choice between the picture and the referent object (e.g. a real whisk) and the experimenter asked, 'can you show me a whisk?' If children did not understand the referential relation between the pictures and its referent they were expected to choose the picture, whereas if they were aware of the representational function they were expected to select the object alone, or the picture and the object (since labels can refer to both entities). Remarkably, none of the children in either age group selected the picture alone, while 60% of 18-month-olds and 55% of the 24-month-olds selected the real whisk, and 40% of 18-month-olds and 45% of 24-month-olds chose both the picture and the real whisk. Thus, despite the associative manner in which they were taught the pairing, children recognised that the picture was a representation of the real object and thus extended the label from the picture to the object. Two control tasks ruled out a general preference for objects over pictures, and confirmed that children of this age know that words can be used to refer to both objects and pictures. An additional two experiments further confirmed that children did not select the real object simply because it was more salient than the accompanying pictures, or because it was a perceptually similar yet novel exemplar of the 'whisk' category.

Ganea, Allen, Butler, Carey and DeLoache (2009) extended these findings. They used a more naturalistic picture book interaction, in which the experimenter labelled a series of familiar items, as well as pairing a novel label ('blicket') with a picture of a novel object. When given a choice between the picture and the real object, 75% of 15-month-olds, 69% of 18-month-olds and 75% of 24-month-olds extended the novel label to the real object, showing that even 15-month-old children treat pictures primarily as representations of their real world referents. In a second study, the authors conducted a more stringent test of symbolic understanding by

investigating whether children would extend the newly learned label from the picture (e.g. of a white blicket) to a differently coloured exemplar of the real object (e.g. a blue blicket). Under these circumstances, when given a choice between the picture and the real object, half of the 15-month-olds showed a real object bias, 18-month-olds selected the picture alone more often than same-aged children in Study 1, and 24-month-olds made an equal number of picture alone and object alone choices. Hence even the oldest children's performance was mitigated somewhat when a one-to-one mapping between a picture and its identical referent was not possible. It is plausible that the use of highly iconic colour photographs in this task led the older children to reason that the label was equally applicable to both the picture and the object, which is consistent with how adults label pictures in children's books – we typically refer to a picture of a giraffe as 'a giraffe' rather than 'a picture of a giraffe' (Ganea, Pickard & DeLoache, 2008; Preissler & Carey, 2004).

Nonetheless, when given a choice between two objects, a differently coloured exemplar of the depicted object (target object) and a novel object, while 15- and 18-month-olds chose both objects equally, 86% of the 24-month-olds correctly chose the target object despite the colour mismatch, which confirms that the oldest children have a sufficiently robust understanding of the symbolic nature of pictures to recognise that a label applied to one picture can also refer to similarly-shaped referents. Together, these findings show that from the age of 15-months children possess a fragile understanding of the representational nature of pictures, which increases with age until they are capable of extending labels from pictures to whole categories of objects.

In summary, the onset of referential picture-object mappings coincides with children's recognition that pictures are to be looked at, rather than manipulated

(DeLoache et al, 1998), which is consistent with the argument that during their second year of life children make significant gains in pictorial understanding. However, in the paradigm just described children only had to think about the picture as a representation of a general class of objects (Preissler & Carey, 2004), for example, 'blicketi' (Ganea et al, 2009). Yet in reality pictures also serve as sources of information about very specific aspects of the world, for example, the location of a hidden toy in a particular room. This realisation is imperative if children are to appropriately utilise the information provided in pictures, and has been tested rigorously by DeLoache (1987, 1991) using her classic search task (DeLoache & Burns, 1994), which involves asking children to use a picture of a room to locate a toy hidden in the corresponding real room.

In an informative series of experiments DeLoache and Burns (1994) conducted seven variations of this task to explore whether 24-, 27- and 30-month-old children could extract the information about a toy's location from the picture, and then use it to find the toy in the real room. In Experiment 1, 24- and 30-month-old children were introduced to a Snoopy doll and the experimenter labelled each piece of furniture in the room, before presenting children with a photograph (or line drawing) of the room and pointing out the correspondence between the real and pictured items of furniture. To ensure children had understood the picture-room relationship the experimenter pointed to a location in the picture and asked them to place Snoopy there ('Snoopy wants to go to his room and sit right here [pointing] you take him and help him sit here'). The experimenter and the child then entered a small control room, and across four test trials Snoopy was hidden in the pictured room, the experimenter pointed out his hiding place on the picture, and then asked the children to retrieve

him. Success required children to treat the picture as a representation of reality, specifically, Snoopy's location.

The age-related difference in performance was dramatic: 30-month-olds retrieved Snoopy without error on 72% of trials, compared to only 13% of trials for 24-months. In the subsequent six experiments children were verbally told where to find the hidden toy, were shown pictures of toys hidden behind single pieces of furniture instead of pictures of the whole room, were given an extended orientation to each of the possible hiding locations, were instructed on how to use a Polaroid camera (for the photograph condition), saw pictures lacking any spatial information, and finally, were asked to place Snoopy in particular locations, rather than retrieve him. It was only in this latter experiment that 24-month-old children were successful, which indicates a limited understanding of the picture-room relation. By contrast, 27- and 30-month olds successfully utilised the picture as a symbolic and communicative tool, extracting information about Snoopy's location from the picture and subsequently applying it to the real room in order to retrieve him. The authors suggest that the conservative stance 2-year-olds take when linking pictures to a current state of affairs is the result of experience with decontextualized pictures. They posit that when reading picture books it is rare for a connection to be made between their content and the real world, which may inhibit children's recognition that the two are closely related; again implicating experience as a contributing factor to pictorial development.

A more recent replication of the search room task, however, suggests that a methodological issue may better explain 2-year-old children's retrieval failures. In the original version of the task children searched four different hiding places in the same room (DeLoache & Burns, 1994), whereas in Suddendorf's (2003) version they were asked to search four different rooms, thereby eliminating the possibility that they

would perseverate by searching the same location multiple times, rather than using each individual picture to identify the toy's current location. Across the four trials, 2-year-olds retrieved the toy without error 53% of the time, which was significantly above chance. Furthermore, when first trial data, the only trial on which perseveration was not possible, was analysed in isolation, it was found that children performed significantly above chance on the traditional one-room task as well. Thus, 2-year-olds' difficulty with the search task can be attributed, at least partly, to their susceptibility to perseveration rather than a lack of representational insight.

Together, these findings indicate that sometime between the age of 2 and 2.5 children's representational insight deepens from an understanding that pictures refer to *general categories* (Ganea et al, 2009; Preissler & Carey, 2004), to understanding that pictures can also refer to *specific realities*, and as such are useful sources of information about particular aspects of the world. From here children can begin to learn more extensively from picture books. Recent work by Ganea, Ma and DeLoache (2011) showed that 4-year-old children can learn new biological facts about colour camouflage in animals from a realistic picture book. Even more impressively, they could then use what they had learnt to infer which of two animals, one who was camouflaged and one who was not, was more likely to be caught by a bird of prey. This generalisation occurred for both pictures of animals (75%), and real animals (66%).

However, many children's picture books depict fantasy creatures and characters, or portray real entities in a fantastical manner, the most common example being anthropomorphised animals. Hence, the next question that arises is, how do children know what information they can and cannot transfer from picture books to reality? To date, only one study, conducted by Ganea, Canfield, Simons-Ghafari and

Chou (2014), has directly examined the effect of anthropomorphic pictures on children's knowledge of real animals. In their study, 3- and 5-year-old children were assigned to one of two conditions. In the anthropomorphism pictures condition children read a storybook containing anthropomorphic pictures of novel animals (e.g. a cavy) and factual language about the depicted animal, while in the full anthropomorphism condition children read a storybook containing both anthropomorphic pictures and language. At test children were asked questions about 'a real cavy', to examine whether they would transfer factual and anthropomorphic information or just factual information from the picture book to the real world. For example, 'do cavies eat grass' (factual) and 'do cavies talk? (anthropomorphic).

The results revealed that both 3- and 5-year-old children successfully learned and extended facts about novel animals from pictures to their real referents, when anthropomorphic pictures were presented alongside factual language. However, when anthropomorphic pictures and language were combined, children were less likely to learn and apply facts to real animals and more likely to endorse the real animals with human-like traits such as talking.

As has been discussed, the primary function of pictures is to represent, however, they are also objects in their own right, and in this sense are considered to have a dual identity (DeLoache, 1987, 1991, 2004; DeLoache, Pierroutsakos & Uttal, 2003; Gibson, 1979; Gregory, 1970; Pirenne, 1970; Troseth, Pierroutsakos & DeLoache, 2004; Sigel, 1978). Once children have learnt that pictures are not to be physically manipulated (DeLoache et al, 1998) their most salient identity is as a representation of something else. Unlike 3D scale models, which are highly tangible objects (DeLoache, 1987), the 2D nature of pictures means children are not typically confronted with a choice between 'picture as object' and 'picture as representation',

and therefore they need not appreciate the dual orientation of pictures to use them as representations (DeLoache, 1991; DeLoache & Marzolf, 1992). Nevertheless, in their pursuit of complete pictorial competence it is important that children are aware of the 'object identity' of pictures, and can consider the two simultaneously when necessary.

1.2.3 Attribute differentiation (Level Four)

Despite being related, pictures and their referents are independent entities, therefore they do not share all their respective features, and the relationship between them is static: it captures one moment in time and does not update to reflect subsequent changes made to either object. On the basis that even very young infants can visually discriminate between pictures and their referents (Polak, Emde & Spitz, 1964; Rose, 1977; Slater, Morison & Rose, 1984), one might expect older children to possess an explicit awareness of the boundaries of the picture-referent relationship (Liben, 1999). Contrary to this prediction research has consistently reported errors on the 'false picture' (Zaitchik, 1990), or more accurately, 'out of date picture' tasks (Perner, 1991) that measure this knowledge.

In the original task conducted by Zaitchik (1990), 3- to 5-year-old children watched as a puppet took a photograph of an object (e.g. a rubber duck) in one location, before moving the object to a new location. Children were asked, "In the picture, where is the rubber duck? Three- and 4-year-olds typically claimed the object was in its final location, while 5-year-old children correctly asserted that the rubber duck was pictured in its original location. Four task manipulations did not improve the performance of the younger age groups suggesting that until the age of 5 children consistently misunderstand that photographs are not affected by changes to their real world referents. A recent replication extended these findings by showing that children

also expect changes made to a real world referent to cause parallel changes in a picture of that object, for instance, if water is poured onto a photograph of a balloon when asked to retrieve the picture's referent from outside the room, 3- and 4-year-old children select a wet balloon (Donnelly, Gjersoe & Hood, 2013).

This effect is not specific to photographs; Robinson, Nye and Thomas (1994) replicated the task using drawings. In their task the experimenter drew a picture of a doll with a sticker on her tee shirt, then removed the sticker and asked children which sticker was on her tee shirt in the picture. To rule out poor recall as an explanation for poor performance a memory check question was included prior to the test question, 'Remember this picture, what sticker is drawn on the tee shirt?" While children responded correctly to the memory probe they persisted in claiming that the picture would show the sticker that was currently on the doll's tee shirt, rather than the one that was on her tee shirt when the picture was drawn.

In a further attempt to improve performance, Thomas, Jolley, Robinson and Champion (1999) tried to attenuate updating errors by drawing attention to the fact that the picture had not been changed by using an even more explicit recall question, "Remember this picture; has the sticker drawn in the picture changed?" designed to facilitate children's ability to disentangle the features shared (e.g. overall similarity in appearance) and not shared (e.g. specific sticker) by pictures and their referents. Again, 3- and 4-year-old children failed to realise that the final picture showed the original sticker, rather than the one currently on the doll's tee shirt.

These converging findings can be explained by an inability to *simultaneously* hold in mind two interpretations of the same picture (Jolley, 2008, 2010): first as a representation, which shares a static relationship to its referent, and second as an object independent of its referent, which therefore does not magically update to match

changes made to its referent. When combined with the findings from the search task, a neat developmental picture emerges, whereby children first acquire an understanding of the primary representational function of pictures, and only later, at the age of 5 (Thomas et al, 1994; Zaitchik, 1990), realise that pictures and their referents share some but not all of their characteristics, as a result of the fact that they are fundamentally independent entities, whose relationship is merely episodic. It is only when children have mastered both the representational and object identities of pictures, and can attend flexibly, and if needs be simultaneously, to their dual nature, that they can be described as having achieved pictorial competence. That is not to say this is the endpoint of pictorial development, at least not within Liben's (1999) sequence of progression.

She describes two final steps that detail how, during their school years, children come to appreciate that the nature of the picture-world relationship differs across modality. Each of the picture formats they are exposed to share a subtly different connection with their referents; cartoons exaggerate referential features, line drawings only tend to capture simple perceptual details and can depict fantasy as well as real referents, while photographs almost replicate the appearance of their referents, and maps share little visual resemblance to the locations they represent, instead being decoded via knowledge of cultural conventions: blue areas denote water, red lines signify main roads. Very little research has been conducted on children's cross-modal knowledge, however, Liben and Downs (1989) did report a task in which preschool children claimed they could not find grass on a black and white photograph because it was not at the bottom of the picture, as it typically is in drawings. Comments such as these suggest that children may generalise conventions associated with drawings to photographs, which allows the tentative suggestion that initially, children's

understanding of the picture-world relationship is localised to drawings. This possibility, alongside a more in-depth review of levels five and six of Liben's (1999) theory, are discussed in more detail in Section 1.5.

1.3 Artist-World-Picture relationship

The symbolic function of pictures as communicative vehicles is motivated and legitimised by an intentional, or human, component, which makes the artist a useful source of pictorial information (Callaghan & Rochat, 2003; Freeman, 2000; Wollheim, 1987). Humans are the only species that intentionally imbue their pictures with meaning and are capable of extracting that meaning from the work of others (Bovet & Vauclair, 2000; Herrmann, Melis & Tomasello, 2006; Ittelson, 1996; Parron, Call & Fagot, 2008). In fact, the direct relationship between an artist's mind and their pictures allows them to draw or paint what they know and what they can imagine (Cavedon-Taylor, 2014a), as well as what they can see, making the content of their pictures almost limitless. Thus, how children appraise the artist, and in particular their minds, lies at the heart of how they understand pictures as symbols, particularly if one subscribes to the philosophical view that, "the work of art has a human origin, and must be understood as such" (Dutton, 1979, p. 305).

1.3.1 Artist intention

Highlighting the communicative intent underlying a picture facilitates children's ability to use pictures to locate hidden objects (Salsa & Peralta de Mendoza, 2007), however, understanding that a picture is intended to communicate something about the world (i.e. the location of a hidden toy) is qualitatively different from understanding that artist's intentions underpin the representational status of

pictures, and thus serves as a unique cue to precisely *what* a picture represents. For instance, one intentional account of picture interpretation holds that a picture of a cat represents a cat, and therefore resembles a cat, because it was created with that intention in mind (Bloom, 1996). Indeed, Wollheim (1987) argues, "if we are interested in…paintings, we must start with the artist" (p. 36). In direct contrast to the intentional position, the realist school of thought holds that pictures should be evaluated solely on the basis of their appearance; if a picture looks like a monkey then it represents a monkey. Accordingly, proponents of this approach view the artist as an imitator (Plato, 1987), who transfers properties of the world onto the page yet is otherwise unimportant for determining pictorial meaning (Goodman, 1970; Wimsatt & Beardsley, 1946). What follows is a review of the existing literature on how children utilise both appearance and intentional cues to interpret drawings and paintings, and the attempts that have been made to elucidate which of these cues exerts the most influence on children's ability to decipher pictures.

Children recognise the value of their own creative intentions from the age of 2. Bloom and Markson (1998) asked 3- and 4-year-old children to draw two pairs of pictures: a balloon and a lollipop, and the experimenter and him or herself. Unsurprisingly, the pairs of pictures were almost identical, which allowed the authors to investigate whether the children would disambiguate the pictures using their own referential intention, for instance, to depict a balloon, when asked to name them. They did, as 76% of the 3-year-olds and 87% of the 4-year-olds correctly named their pictures, indicating that resemblance, in this case shape, is not the only cue children can use to categorise pictures. They also recognise that artists play a role in defining what their pictures represent: a picture drawn with the intention of representing a balloon cannot be a lollipop.

Further supporting this conclusion is work by Gross and Hayne (1999), who found that 3- and 4-year-old children could identify and describe their own relatively abstract drawings of familiar events, such as birthdays, up to 3 months after they were drawn. Five- and 6-year-old children could do so up to 6 months later. The lack of resemblance information children had to base their descriptions on suggests at least some reliance on their original picture conception, including what they intended to draw. Children could not have been relying on generic knowledge of birthdays, for instance, since they were also successful when they had to draw and later identify pictures of atypical events, such as a chocolate factory (Experiment 1b). Clearly, despite their non-representational appearance children assign symbolic content to their drawings via their referential intentions. However, while children are privy to their own intentions, they "do not have psychic access to the intentions of others" (Bloom, 1996, p. 7), which raises the question of whether they are equally competent at discerning other artist's intentions, and using them to decode pictures.

From an early age children are aware of the importance of intentionality for various facets of social communication (Behne, Carpenter & Tomasello, 2005; Carpenter, Akhtar & Tomasello, 1998; Gelman & Bloom, 2000; Meltzoff, 1995; Moore, Liebal & Tomasello, 2013; Woodward, Sommerville & Guajardo, 2001), and this includes pictures. For instance, 2-year-old children can use eye gaze to identify what an ambiguous drawing is intended to represent (Preissler & Bloom, 2008). In this task children were shown two similarly shaped novel objects, which were subsequently placed into two empty boxes. The key manipulation was whether children could follow the experimenter's eye gaze while she was drawing to identify which object she intended to draw. Eye gaze had a significant influence on children's generalisation of the novel label, 62.5% chose the object that the experimenter had

gazed at while drawing. In a second experiment where the drawing was 'discovered' instead of drawn, only 17% of children chose the object the experimenter gazed at, confirming that the results from Experiment 1 were due to sensitivity to artist intention and not associative cues. Thus, from the age of 2-years children are capable of reflecting on the referential intentions of their creators to make picture-referent mappings.

Even more tellingly, Gelman and Ebeling (1998) report significant changes in children's picture naming depending on the presence or absence of referential intent. They asked 2- to 4-year-old children to name identical drawings, which were produced intentionally ("John used some paint to make something for his teacher") or accidentally ("John spilled some paint on the floor"). Children in the intentional condition were significantly more likely to name the drawing according to its shape (i.e. the outline of a man was named 'a man') than children in the accidental condition, who instead displayed a trend towards material-based naming (e.g. paint). Children are adept at identifying and labelling a picture's referent based on whether the creator acted intentionally or not. Accidentally resembling an object is insufficient for children to consider a picture a true representation of that object, which is testament to their awareness that intentionality is key to accurately decoding pictures (DeLoache, 2004; Wollheim, 1987). However, there is a caveat to this body of work, which is that in each of these studies the pictures used were at least somewhat visually ambiguous. This is important since research shows, at least initially, children rely heavily on perceptual similarity to map the referential relationship between pictures and their referents.

Very young children direct more grasps towards highly iconic pictures, such as colour photographs, than less iconic pictures such as line drawings or cartoons,

which share fewer visual similarities with their referents (Pierroutsakos & DeLoache, 2003). If we subscribe to the 'exploration' explanation of this phenomenon, then children grasp more at pictures that are highly similar to their referents as it is harder to tell them apart than pictures that do not closely resemble their referents. Once children have successfully distinguished pictures from their 3D referents, iconicity bolsters their ability to recognise the referential nature of the picture-referent relationship, and subsequently transfer information from pictures to the real world (Callaghan, 2000; Ganea, Pickard & DeLoache, 2008; Hartley & Allen, in press; Simcock & DeLoache, 2006; Tare, Chiong, Ganea & DeLoache, 2010). For example, in a picture-based word learning task similar to that conducted by Preissler and Carey (2004), Ganea, Pickard and DeLoache (2008) found that 15-month-old children's ability to extend novel labels from pictures to a novel target object was significantly better for photographs and drawings than cartoons. Thus, at the point when representational insight is fragile, the tendency of cartoon media to exaggerate the visual features of their referents weakens children's understanding that they refer to the real world. Nevertheless, the benefits of iconicity are evident even for older children.

At age 3, when children are considered to have grasped the referential nature of pictures, they learn more new facts about animals from a book filled with realistic photographs than a comparison book filled with drawings (Tare, Chiong, Ganea & DeLoache, 2010). In this task, the experimenter told 27- to 39-month-old children facts such as 'snakes like to eat bugs' while showing them a picture of the relevant animal. In the test phase children were shown each of the target pictures individually and asked 'what does he like to eat' (fact recall). They were then shown four pictures and asked to identify 'which one likes to eat worms' (fact identification). Seventy-five

per cent of children who saw the realistic books were correct on all four fact identification trials, compared to just 46% of children who saw the book filled with drawings. These findings extend previous work by showing that even when information is presented verbally (e.g. the snake was not depicted eating a bug), seeing a realistic depiction of the referent being described facilitates learning.

To summarise, between the ages of 15-months and 4-years children acquire knowledge of two routes to picture interpretation: appearance and intention. However, thus far intention has only been shown to sway children's interpretation of visually ambiguous pictures, which leaves open the question of whether intention plays a lesser role when appearance provides a direct route to referent identification, that is, how do children decode iconic picture-referent relations? Hence, researchers began to design tasks in which appearance and intention are placed in direct conflict. One such task was devised by Browne and Woolley (2001, Study 1, Task 1), who introduced 4-year-olds, 7-year-olds and adults to a puppet who intended to draw, for instance, a bear, but whose final picture looked unequivocally like a rabbit. When asked what would be a better name for the picture – rabbit or bear – 84% of 4-year-olds, 94% of 7-year-olds, and 100% of adults preferred to name it according to what it looked like: a rabbit. Here even adults prioritised appearance over intention. Similarly, in Richert and Lillard's (2002) study, 4- to 8-year-old children heard a story about Luna, a troll doll, who lives in a land without animals. The children then watched as Luna drew a picture resembling a fish. When asked, 'is Luna drawing a fish?' the majority of children said that she was, indicating that they focused on the picture's appearance alone, without taking into account her knowledge state. However, there are alternative explanations. Perhaps, given the pictures' fish-like appearance, children simply could not think of an alternative name for it or thought Luna had drawn a fish by chance.

Nevertheless, when considered in conjunction with Browne and Woolley's findings, and in light of the realist school of thought, it is entirely plausible that children and even adults consider appearance a more reliable cue to the identity of a picture than intention.

Taking a slightly different approach, Myers and Liben (2008) tested the limits of children's understanding that intention underpins pictorial symbolism, by using appearance as a confounding variable. In one of their tasks 5- to 10-year-old children watched as two creators added coloured dots to a map of a room. The first creator did so with the intention of representing the location of a series of hidden objects (symbolic), while the other did so with the intention of making the map more colourful (aesthetic). Crucially, for half of the children the colour of the aesthetic dots (red) matched the hidden objects (red fire trucks) and for the other half they did not (yellow school bus). The experimenter then asked the children, "If you wanted to find a bunch of toy fire trucks [showing red toy fire truck] that were hidden in that room, whose drawing would help you do that?" When the aesthetic dot and hidden object were the same colour, only the 9-10-year-old children ignored the colour match to select the green symbolic map. When appearance-based responding was not an option, more children in all age groups selected the appropriate symbolic map, however, this was only significant for the 9-10-year-olds. When questioned, children in the younger two age groups knew why each creator had added the dots: to denote location or to make it prettier, yet they did not use this information to select the appropriate map. The 5-6-year-olds were seduced by the salience of the colour-match between the dot and the referent, and selected the red aesthetic map, while the 7-8-year-olds performed at chance, seemingly unsure whether to prioritise appearance or intention. It is evident from these findings that children's ability to infer and more

importantly, use a creator's intentions, to interpret their depictions continues to evolve between the ages of 5 and 9, and is influenced by the presence of other factors, such as appearance.

Based on this review of current evidence, several open questions remain concerning the importance of intention when it is conflated with appearance. One possibility is that when the two cues conflict appearance usurps intention (Browne & Woolley, 2001; Richert & Lillard, 2002). Alternatively, intention may assume a more dominant role in older children's picture interpretation, while younger children are seduced by the salience of the perceptual similarity between pictures and their referents (Myers & Liben, 2008). Moreover, the level of iconicity may play a role in mediating the interpretive power of these two cues (Browne & Woolley, 2001; Richert & Lillard, 2002; Myers & Liben, 2008). Chapter Two investigates the relative importance of appearance and intentional cues when the perceptual match between a picture and its referent is manipulated.

1.3.2 Knowledge and Ideas

Other empirical work on the role of the artist has used knowledge (Browne & Woolley, 2001; Richert & Lillard, 2002) and ideas (Olson & Shaw, 2011) to explore children's understanding that pictures are "intentional manifestations of mind" (Freeman & Sanger, 1995). The assumption regarding knowledge is that if children recognise the link between an artist's mind and their picture then they should be able to reason that he or she could not draw a referent without knowing something about it. In a second study, Browne and Woolley (2001, Study 2, Task 2) told their participants that the puppet who intended to depict a bear, but produced a picture that looked equally like a bear and a rabbit, did not know the difference between rabbits and

bears. When asked, “Which animal do you think this picture looks like? Do you think it looks like a rabbit or a bear?” 7-year-olds said the picture looked like its intended referent 30% of the time, and adults 40% of the time, compared to a respective 94% and 100% in an earlier version of the task, in which intention was not devalued by a lack of artist knowledge. These findings indicate that by the age of 7 children understand how intentions are linked to knowledge, and how knowledge affects an artist’s capacity to depict specific referents; without knowing what bears are, it is unlikely that one can intend to draw a bear. By contrast, artist knowledge had no effect on 4-year-old children’s responding; they named the picture according to the puppet’s intention more often than would be expected by chance.

In addition, when Richert and Lillard (2002) asked their 4- to 8-year-old participants “Does Luna *think* she is drawing a fish?” as well as the more objective, ‘Is Luna drawing a fish?” (see Section 1.3.1), the number of children who considered her knowledge state, and said no, increased between the ages of 6 and 8. This suggests that while children may be predisposed to focus on the appearance of a picture (e.g. agreeing that Luna is drawing a fish), highlighting the salience of the artist’s mind prompts older children to consider how her knowledge state, rather than appearance, determines the identity of her picture. This extends the findings of Browne and Woolley (2001) by showing that the capacity to map the relationship between an artist’s knowledge and the identity of his or her subsequent depictions improves until at least the age of 8.

Relatedly, recent research has investigated children’s responses to the plagiarism of artist’s ideas, defined as “creative products of the mind” (Olson & Shaw, 2011, p. 431). In their first study Olson and Shaw presented 7-year-olds, 9-year-olds and adults with scenarios in which one person drew an original picture, and

the second person deliberately or coincidentally drew the same thing, meaning the final pictures were identical. Participants were asked, “how much do you like [name of copier]?” All participants preferred the artists who drew unique pictures to the artists who copied intentionally or unintentionally, although those who drew the same picture unintentionally were liked more than those who copied intentionally. Thus, knowingly copying someone else’s picture was worse than unwittingly doing so. A second study replicated these findings with 3- to 6-year-old children using a modified procedure. These children watched puppet shows, rather than hearing vignettes, and were asked to evaluate how good or bad the artist who copied was. Only the 5- to 6-year-old children evaluated the plagiariser more negatively than the artist who drew a unique picture. A final study asked 3- to 6-year-old children to justify their responses, so after each trial they were simply asked “why?” Analyses revealed that 75% of 6-year-olds, compared to only 12.5% of 4-year-olds mentioned copying in their justifications. Those children who referred to copying were also those who gave the most negative evaluations of plagiarisers. The robustness of these findings is evident in their replication across other cultures. Yang, Shaw, Garduno and Olson (2014) report that 5- and 6-year-olds, but not 4-year-olds from the United States, Mexico and China, all evaluate plagiarisers more negatively than artists who draw unique pictures.

Perhaps even more impressively, Li, Shaw and Olson (2013) have shown that 6-year-olds place such value on their own ideas that they would rather own a picture that contains their idea than one in which they invested physical labour. Conversely, 4-year-olds only wanted the picture containing their idea if the picture also contained their idiosyncratic preferences. Although speculative, the importance 5- to 9-year-old children place on ideas may be indicative of their developing understanding that ideas originate in the mind, and as such are unique to individual artists and should be

appropriately valued and guarded. Chapter Three reports on whether information about a picture creator's intentions contribute to how children assign pictorial value. Overall, research investigating the importance of artists' knowledge and ideas complements that conducted on the role of intention. Together, they suggest a developmental progression in children's understanding of artist's minds, and a corresponding move away from evaluating pictures on the basis of surface appearance alone. Also of interest is how children understand the process by which pictures are physically created. One of the reasons artist's minds provide a direct line to the meaning of their pictures is because they are created entirely by hand, however, this also means artists must possess the requisite motor skills to accurately transfer their knowledge, ideas and intentions from their mind to the paper.

1.3.3 Picture creation process of drawings and paintings

"Every work of art is an artifact, the product of human skills and techniques" (Dutton, 1979 p. 305), and how impressed a person is with the act of creating these things is an important factor in their level of appreciation. Thus, if they are to understand the artist's role in its entirety children must acknowledge the importance of an artist's skill set, and the effort he or she invests in picture creation (Dewey, 1958; Dutton, 1979). Perhaps even more importantly, how pictures are created has a fundamental impact on the content they can depict and how it is portrayed, and thus it has been posited that technical knowledge of picture creation affects how children respond to the pictures themselves (Liben, 1999). For instance, if children misunderstand how difficult it is to draw well they might underestimate the age at which a child should be able to draw a recognisable picture. Existing research

provides some insights into how knowledge of creation might relate to pictorial understanding.

An early study by Gardner, Winner and Kircher (1975) tested children's broad conceptions of works of art by presenting 4- to 16-year-olds with a particular piece of art and asking them a variety of open-ended questions, upon which the experimenter could elaborate depending on the child's response. Some of the questions pertained to how the pictures were created, for example, "where did it come from?" and "could you make it too?" As would be expected, the youngest children, those between 4- and 7-years, possessed the most misconceptions about art; less than ten per cent spontaneously mentioned that paintings are created by people, preferring the notion "paintings…just begin, or…arise out of paper and paint" (p. 64). While some children were able to explain why animals cannot make pictures, one reason being "they can't hold a brush" (p. 66), others claimed they could as, "a tiger puts a pen in his mouth" (p. 66). It would appear from these responses that before the age of 7 children are aware of the tools used to create pictures, yet lack any explicit knowledge of how artists wield them to create pictures. Furthermore, most children in this age range thought anyone could create art, as it is not difficult. By contrast, 8- to 12-year-olds expressed the view that artistic creation can be difficult and were aware that it could take a long time to become proficient.

Using a more structured behavioural task Callaghan and Rochat (2003) showed that 4- and 5-year-old children can anticipate the skill level of an artist based on his or her age and mood. In their first study these authors manipulated two artist characteristics, sentience and age level. Children aged between 2 and 5 were shown photographs of four artists: a machine, an adult, an older child and a younger child. Children were then presented with pairs of line drawings and told, for instance, "some

of the pictures will be made by the grown up Dad, but I want you to find just the pictures made by the little brother, OK?" Children received all possible artist pairings across several trials. Four-year-olds could successfully identify the correct artist when they did not have to make person-machine comparisons. Five-year-olds could make these comparisons except when trying to distinguish whether an adult or the machine made a drawing. It is not until 4-years that children can use artist characteristics to categorise pictures, and by 5-years this ability is relatively well developed with only the most subtle distinctions, machine versus (a presumably skilled) adult, providing difficult.

In a second study, Callaghan and Rochat (2003) manipulated two further artistic features, the artist's emotion (calm versus agitated) and her subsequent affective style. Three- and 5-year-old children watched videos of two artists, one who was seen to be drawing in a calm manner and the other who appeared agitated whilst drawing. The resultant line drawings varied on line density, line gap, line overlap and line asymmetry in order to convey 'calm' or 'agitation'. For instance, thick lines and large gaps between the lines in a picture were considered signs of agitation. In some drawings all four of these features were manipulated, whilst in others only one was altered, until all possible pairings had been created. The children were then presented with two drawings, which were either both agitated or one of which was calm and the other agitated. Their task was then to identify which picture had been produced by the artist in the video (children saw one of the artists in the first testing session, and the other artist in a second session). Five-year-olds performed significantly above chance across all trials, indicating an understanding that how an artist feels when he or she is drawing can be reflected in their picture. However, they did find artist-picture pairings more difficult when they were shown an agitated artist and had to choose which of

two agitated pictures was hers since this comparison was considerably more subtle, in terms of the manipulated line features, than a calm-agitated pairing which contained more easily discriminable 'line' differences. Line thickness and the extent to which lines overlapped were found to be the easiest stylistic differences to detect and match with an artist, whereas line gap and asymmetry were less influential. Together, these findings indicate that between the ages of 4 and 5 children become increasingly proficient at inferring an artist's attributes, including mental state, from their pictures.

Finally, recent research indicates that even very young children value the effort that artists invest in creating pictures. In a clay modelling task Kanngiesser, Gjersoe and Hood (2010) gave 3- and 4-year-old children and the experimenter three animal-shaped pieces of clay. In one condition the experimenter told children that they were each going to make something new out of the clay, and the child was given a choice of two plastic cutters (one shaped like an elephant and the other shaped like a gingerbread man). Once the child and experimenter had reshaped their clay the experimenter pointed to each shape and asked the child, "Whose [elephant/gingerbread man] is it?", "Who gets to keep it?" and "Why do you/I get to keep this one?" In two control conditions the experimenter and child held each others pieces of clay without transforming their identity, or cut off a small piece of each others clay. When the clay had been reshaped both 3- and 4-year-old children said it belonged to the person who created it, rather than the person who owned the raw materials from which it was crafted. Interestingly, it was only at age 4 that children began to justify this decision by referring to creation: 41% of 4-year-olds made statements such as, "Because I/you made it" (p. 1238). However, since this transfer of ownership occurred significantly less in the control conditions it seems likely that 3-

year-olds were also basing their decision on perceived effort, yet were less able to verbalise their reasoning than 4-year-olds.

As discussed in section 1.3.2, Li, Shaw and Olson (2013) report that 6-year-old children place more value on the ideas that underpin a picture than on the physical labour invested in its creation, which suggests that between the ages of 4 and 6 there is a transition in what aspects of picture creation children value. Of course this might also be an artifact of the task procedure used by Li and colleagues; if they did not have to choose ideas *or* labour older children may also show an appreciation for artistic effort. The importance of effort is explored further in Chapter Three. Overall, there is some discord regarding when children appreciate how artists create pictures, and the skill they require to do so (Gardner, Winner & Kircher, 1975), with newer research suggesting that even 3-year-old children value artistic effort (Kangiesser, Gjersoe & Hood, 2010), and that if their attention is explicitly drawn to it 4- and 5-year-olds can accurately assess an artist's skill level relative to their age and mood, respectively (Callaghan & Rochat, 2003). Nevertheless, important questions remain regarding children's understanding of how an artist's attributes, such as knowledge and skill, affect the content of their pictures. For example, when do children become aware that the unique ability of artists to draw from imagination allows them to draw fantasy creatures, such as unicorns, or to change the appearance of real world referents? Chapter Four addresses such questions.

1.4 Beholder-World-Picture relationship

Pictures are communicative symbols, and as such their meaning is derived from a dyadic interaction between their audience and their creator: "if ordinary perception is about the existence of the real world, markings are about the affectances,

the thoughts and feelings of the observer" (Ittelson, 1996, p.185). The preceding sections have addressed some of the factors that mediate children's ability, as beholders, to extract information from pictures. However, children must also be able to reason about how other people function as beholders, in particular, they need to understand how beholders derive information from pictures, and secondly, how they play an active role in constructing independent picture interpretations (Gombrich, 1969; James, 1890/1995) on the basis of their own knowledge or experiences.

1.4.1 Deriving information from pictures

From 18 months old children have a, "basic understanding of the mental and cooperative nature of human communication" (Grosse, Behne, Carpenter & Tomasello, 2010, p. 1710), which is demonstrated by the repairs they make when they are misunderstood by their interlocutor. A similar pattern emerges when young children receive feedback that their drawings do not clearly communicate their intended message. In a social-communicative task Callaghan (1999) asked 3- and 4-year-old children to draw pictures of objects, which included several similar balls and a black stick. Children then used the pictures to communicate to the experimenter which object to drop down a tunnel. In a later phase of the study the experimenter attempted to pair the child's drawings with their referent objects, pointing out problems matching ambiguous drawings: these were common since all the objects could be drawn using a circle or a line. Children were then asked to draw another set of pictures so she could be sure which object each picture represented. Both 3- and 4-year-olds made more distinctions between their drawings after receiving negative feedback from a beholder regarding their inability to make picture-referent mappings. Thus, when pictures are being used in a communicative exchange, children

acknowledge that the beholder is the recipient, and make a concerted effort to ensure their picture accurately conveys the intended message. This is an important foundation on which children can construct a more precise understanding of how beholders own characteristics and knowledge affect the picture interpretations that are formed.

Research conducted by Allen, Bloom and Hodgson (2010) provides insight into how children appraise the influence of a beholder's knowledge. In the second of their three experiments children were told that the experimenter had a friend named Daxi who lives faraway and so does not know a lot about the things you find in England and Scotland (where the studies were conducted). They were then shown pairs of pictures, one depicting a detailed but atypical example of a category, such as a penguin, and the other showing a less detailed but prototypical instance of the same category, for example, a robin. Children were asked, "Which picture should we show to Daxi so he knows what a (bird/house/cat/fish) looks like?" Children chose the less detailed but prototypical image significantly more often than would be expected by chance. This suggests that children considered Daxi's knowledge insufficient to understand the penguin picture, whereas a more typical representation of a bird, the robin picture, was deemed more appropriate for introducing Daxi to this new category.

In their third and final study these authors introduced 3- and 4-year-old children to a novel object, which was labelled using a novel word, such as 'dax'. Children then watched the experimenter draw a crude representation of the object. After two more pictures were placed next to the experimenter's drawing: a detailed drawing of the dax and a distracter picture, children were asked which picture they should give John (who has never seen a dax) so he knows what a dax looks like.

Seventy-nine per cent of the time children chose the detailed drawing of the dax, and only 19% of the time chose the picture they knew to represent the dax, but which did not clearly resemble it. Thus, children succeeded in disregarding their knowledge to select the picture that would best represent 'a dax' to a naïve beholder.

Together these findings show that by age 3 children are astute at reasoning about how a beholder's knowledge affects the information they derive from a picture. When the goal is to teach someone about a new category they select a drawing that lacks detail but depicts a typical category exemplar, whereas when the picture is intended to show someone what a novel object looks like they select a highly detailed drawing. Hence, these judgments also demonstrate an awareness of how two pictorial features - detail and content - can impact a beholder's interpretation.

1.5 Picture Modality

As has been alluded to in previous sections, it has been suggested that pictorial development does not necessarily follow the same trajectory for all types of picture, particularly as they possess media-specific qualities and therefore share different relationships with the world and their creators. The majority of work thus far discussed has used hand drawn or painted stimuli, although as noted in Section 1.2.2, photographs and drawings have been compared for the purpose of assessing the effects of iconicity on children's ability to distinguish pictures from their referents (Pierroutsakos & DeLoache, 2003), transfer information from pictures to the real world (Ganea, Pickard & DeLoache, 2008; Simcock & DeLoache, 2006; Tare, Chiong, Ganea & DeLoache, 2010) and use pictures as symbols (DeLoache & Burns, 1994). In line with Liben's (1999) fifth and sixth levels of representational development, this section will consider children's understanding of the differences

that exist across picture modalities, both in terms of the picture-world and picture-creator relationships.

1.5.1 Theoretical importance

Philosophical and theoretical work on picture comprehension converges on the notion that the picture, the world it depicts, and the artist, are crucial factors for developing a complete theory of pictures (Blumson, 2009; Freeman & Sanger, 1995; Hagen, 1974; Ittelson, 1996; Parsons, 1987; Wollheim, 1987). Although these factors are inextricably linked, they do not interact in the same way across different picture modalities (Beilin, 1991; Liben, 1999, 2003). In addition to the common properties most representational pictures share, such as their status as visual representations and function as social-communicative vehicles of meaning, there are properties unique to each picture modality. Each picture format is underpinned by a unique symbol-referent relationship (DeLoache & Burns, 1994; Troseth, 2010) and associated with distinctive rules (Beilin, 1999). For instance, photographs are often characterised as reliable sources of information due to their veridical relationship with the world, while drawings are often appreciated as one artist's perspective. Consequently, it has been suggested that children develop different expectations of, and use different skill sets, to comprehend the various picture formats that exist (Barrett, 1986; Beilin, 1991). Thus, there is scope for broadening existing theories of pictorial development by comparing how children respond to assorted picture types (O'Connor, Beilin & Kose, 1981; Seidman & Beilin, 1984). The specific focus of this thesis is how children's perception of the picture-world (Chapter Six) and picture-creator relationships (Chapters Two, Three, Four and Five) differs for drawings and photographs.

To date, Liben (1999) is the only researcher to directly address the issue of modality. Levels five (correspondence mastery) and six (meta-representation) of her sequence theory posit that children must learn that the picture-referent relationship is not the same for all visual representations, that is they are underpinned by unique rules and conventions and as such are suited to different tasks. For example, it would be unusual to see a drawing rather than a photograph used as evidence in a courtroom, since photographs are assumed to have more epistemic authority (Arnheim, 1974; Atencia-Linares, 2012; Cavedon-Taylor, 2014b) due to their causal relationship to the depicted referent. Furthermore, Liben, along with Barrett (1986) and Beilin (1983, 1991) propose that knowledge of picture production will be linked to developmental changes in the understanding of pictorial representation. For instance, if children misunderstand how difficult it is to draw well they might underestimate the age at which a child should be able to draw a recognisable picture. Likewise, if children do not grasp the mechanical nature of cameras they may mistake an underexposed photograph for a dark room, or fail to recognise that photographs cannot depict fantasy creatures as readily as drawings can. Notably, Liben did not anticipate that children would reach levels five and six until adolescence. However, given the lack of extant cross-modal research this has yet to be empirically tested; a gap this thesis aims to fill.

Just as Gibson (1980) pointed out that most people consider pictures simple, Liben (2003) asserts that photographs are often viewed as "very simple kinds of representations" (p. 2), since in their most amateurish form they are easily created, and the realism with which they recreate their referents allows beholders to bypass the representational surface with ease, and focus on the depicted referent. However, Liben contends that there is more to photographs than meets the eye. Being able to take a

canonical photograph of a panda is not the pinnacle of photography, nor is recognising that a photograph shows a panda, without appreciating how the shot was set up to portray the panda in a specific light. To illustrate her point more clearly, and in direct relation to other picture formats, Liben (2003) recreated Magritte's famous 'this is not a pipe' painting as a photograph (see Figure 2). In doing so she emphasised that despite the heightened perceptual similarity between photographs and their referents it is as important to look beyond photographic content, as it is to see past the subject matter of a painting. In particular, we need to appreciate the representational surface of the image, and the effort and skill the photographer invested in creating it.

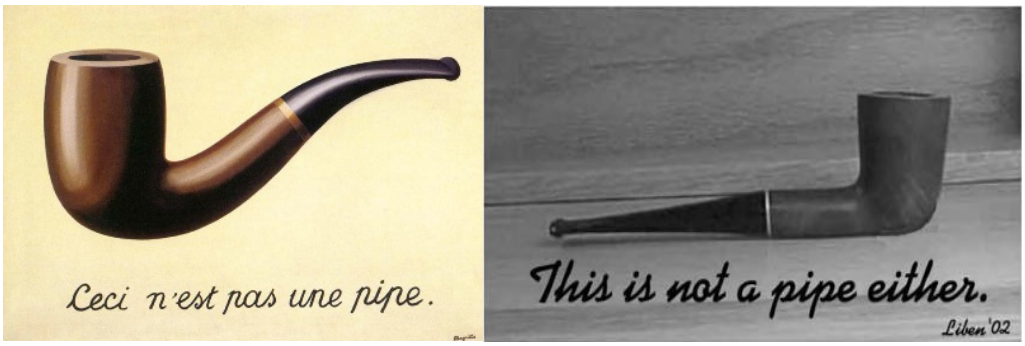

Figure 2. Rene Magritte's 'this is not a pipe' painting (L), and Liben's (2003) 'this is not a pipe' photograph (R)

1.5.2 Photographs versus Drawings

Comparing photographs and handmade pictures, such as drawings, is particularly interesting for four main reasons. Firstly, the skills and tools required by artists to create drawings or paintings can be directly contrasted with those required by a photographer to take photographs. Most notably, while artists depend solely on

their own motor skills to draw, photographers also rely on the causal-mechanical nature of cameras (Cavedon-Taylor, 2014a; Gooskens, 2012; Ross, 1982; Scruton, 1981). Secondly, and as a result of their differing creation, photographs and drawings relate to the world differently. Photographs are causally as well as intentionally related to their referents, and thus are typically confined to depicting physically present real world referents, whereas drawings often depict fantasy as well as real referents since artists can draw from their imagination (Marriott, 2002; Woolley & Cox, 2007). Technology is eroding this boundary somewhat (Cavedon-Taylor, 2014b; Liben, 2003); advancing photograph manipulation and computer generated imagery techniques mean children are being exposed to ever more realistic static, and animated, images of fantasy creatures and characters (Troseth, 2003, 2010), which adds a new variable to investigations of this cross-modal difference. Thirdly, it has been posited that knowledge of the aforementioned differences means viewers' subjective experience of photographs and drawings differs (Cavedon-Taylor, 2014a, 2014b; Gooskens, 2012; Pettersson, 2011; Walton, 1984). Lastly, the explosion of digital media means children are being exposed to photography at a younger age than ever before (Rideout, Saphir, Pai, Rudd & Pritchett, 2013; Troseth, Casey, Lawver, Walker & Cole, 2007), which might affect what, and how, children learn about this medium.

1.5.3 Photograph literature

Much less is known about how children interpret photographs compared to drawings, and how their conception of photographers compares to their understanding of artists (Liben, 2003; Szechter & Liben, 2007). Nevertheless, the research that has been conducted provides some insight into the trajectory this developing

understanding might follow, and hints at places where cross-modal differences may arise. As reviewed in Section 1.3.1, research into the early referential understanding of pictures indicates that iconicity facilitates children's ability to transfer novel labels from pictures to their real world referents (Ganea, Pickard & DeLoache, 2008), use pictures to guide their actions (Callaghan, 2000) and learn new facts about animals (Tare, Chiong, Ganea & DeLoache, 2010). In short, the higher the level of visual similarity between a picture and its referent object the easier it is for children to recognise that one refers to the other.

As the most iconic picture format, photographs have been argued by some to bear a transparent relation to their referent, that is we see only the referent and not the picture's surface (Currie, 1995; Liben, 2003; Freeman, 2004; Walton, 1984). Indeed, despite the advantages iconicity affords children in making the referential link between the symbolised content of a picture and its real world referent, it has also been found to draw attention away from the representational surface of the picture. This was demonstrated in a simple behavioural task conducted by Liben (2003). She showed 3, 5-, and 7-year-old children and college students pairs of photographs in which the subject matter was held constant while angle or distance from the referent was manipulated. Participants were asked to state whether the pictures were different, and if they were, whether this was because something had happened to the referent or if it was attributable to something the photographer had done. The majority of 3- and 5-year-old children focused on referential content; 3-year-olds tended to make irrelevant comments about referential content, such as "I like tulips. My Mom likes tulips" (p. 15), whereas 5-year-olds tried to explain the difference by incorrectly claiming that a change had been made to the referential content, "this one [tulip] is open, and this one is closed" (p. 15). Contrastingly, the majority of the 7-year-old

children and the college students correctly described how the photographer's use of angle had created the distinct appearance of the two tulips. By age 7 then children acknowledge the photographer's ability to use technical manipulations to create a specific picture.

Unlike for handmade pictures, understanding photography also necessitates that children understand the mediating role cameras play in the photographer-picture relationship. When Kose (1985) asked 7- and 11-year-old children questions such as "are there things you can't take photographs of?" and "what makes a photograph good (or bad)?" 7-year-olds spontaneously referred to the camera's role in production with statements such as, "sometimes cameras make things dark and fuzzy and you can't see them" (p. 376) and "you can't take a picture of the sun because there's too much light for the camera" (p. 377). However, Wellman and Hickling (1994) expose flaws in children's understanding of the *mechanical* nature of cameras up until age 8. They asked 6-, 8-, and 10-year-old children to explain how instant photographs were made. Approximately 70% of the 6-year-old children gave answers such as "the camera gets the idea of it and draws the picture" (p. 1572), which suggests they construe photography as an agentive, rather than a mechanical process, whereby the camera makes a conscious decision to 'draw' something. Contrastingly, 8- and 10-year-old children described the physical or mechanical stages of production. It is apparent from these studies that navigating the photograph-world and photographer-picture relationships is complicated by two photograph-specific characteristics: the involvement of a mechanical intermediary, in the form of a camera, and the subsequent reliance of photographs on real and physically present referents. It is these features around which two main cross-modal debates have arisen.

Firstly, it has been posited that the mechanical production of photographs lessens the importance of the photographer for picture comprehension (Bloom, 2004; Browne & Woolley, 2001; Costello & Philips, 2009). By contrast, it is argued that handmade pictures require that we understand the image as a realisation of the artist's intentions (Scruton, 1981). This distinction is not absolute: it is not the case that photographers' have no influence over their pictures, or that we must always use an artist's intention to interpret handmade pictures. Nonetheless, photographers and artists are separated, to a greater or lesser degree, on the spectrum of intentionality. Perhaps this separation is best characterised by how easily children can track intention from the picture creator's mind to their pictures. While both artists' and photographers' intentions can be inferred from their choice of referent, beyond this photographers' intentions are evident in their use of angles, lighting and shutter speed, to name just a few.

Photographs are also causally as well as intentionally related to their referents, due to the fact that cameras capture whatever is in their field of vision; a photograph of a monkey is always a photograph of a monkey regardless of whether it is underpinned by the intention to depict a monkey. By comparison knowledge of the artist's intentions can sway children's interpretation of drawings (Gelman & Ebeling, 1998). Thus, familiarity with the photographic medium may lead children to disregard intention and focus instead on the picture-world relationship when naming and evaluating photographs. This possibility receives some support from a task conducted by Browne and Woolley (2001, Study 1, Task 3), in which they assessed children's use of intentional cues when naming a traced drawing. Here, 4-year-olds, 7-year-olds and adults watched as a puppet announced his intention to make a picture of a cow by tracing a picture he already had. The puppet then showed participants two pictures,

one of a horse and one of a cow, before proceeding to 'accidentally' trace the picture of the horse. Without seeing the puppet's finished picture, participants were asked the test question: "What would be a good name for this picture – what do you think it's a picture of? A horse or a cow?" While 47% of the 4-year-old children named the picture 'a cow' in line with the puppet's intention, all of the 7-year-old children and adults named the picture 'a horse', according to what was underneath the tracing paper. The responses of the latter two groups led the authors to conclude that intention is disregarded when the picture concerned has been produced through a causal rather than an intentional process, like that of freehand drawing. However, these claims can be challenged on two main grounds.

Firstly, tracing is not a causal process, and the testing paradigm used cued participants into this by showing them how tracing worked during a warm up task. Secondly, just because participants were not shown the final picture does not mean that they did not infer what the picture would look like (based on seeing the picture that had been traced), in which case their 'causal' responses could be interpreted as 'inferred appearance' responses. The latter explanation is particularly plausible given the importance of appearance cues for interpreting pictures (Browne & Woolley, 2001; DeLoache & Burns, 1994; Richert & Lillard, 2002). Although tracing does diminish an artist's input, the picture creator is still a human agent and therefore he or she retains ultimate control over the picture. If we want to assess how children construe intentionality across the picture spectrum a better comparison would be between artists and photographers. Photography relies partly on camera mechanics, which reduces the photographer's input to a greater degree than in tracing, and the causal link cameras forge between photographs and their real world referents increases the relevance of appearance cues beyond that seen for traced pictures,

thereby providing a stronger alternative cue to intention. Chapter Three directly compares the extent to which children rely on the intentions of artists and photographers for naming and judging the value of drawings and photographs.

Aside from intention, the use of a camera also transforms the photographer's role in a broader sense. Photographers can produce photographs quickly and in rapid succession, yet can capture their referents in exquisite detail. By contrast, artists tend to draw relatively slowly, and although they too can include great detail in their pictures, they do not typically replicate the level of realism associated with photographs. Moreover, while photographers benefit from knowledge of angles and lighting, artists must master specialised motor skills to enable them to use pencils and paint to depict recognisable referents. In one of the only cross-modal studies to date, Seidman and Beilin (1984) explored how 4- to 10-year-old children perceive the roles of artists and photographers by asking them to talk aloud as they drew pictures or took photographs. Children's verbalisations were compared on four dimensions across the two conditions: 'knowledge of their role in creating a picture', 'knowledge of specific skills or techniques required to create pictures', 'naming the visually depicted object' and 'descriptions of ideas and events associated with drawing or photography'. Two particularly interesting differences emerged.

Children of all ages were significantly more likely to describe what they were planning to draw, than what they intended to photograph. In fact, the authors report that the youngest children, in particular, were focused on the camera and appeared eager to press the button, rather than to create a picture, suggesting less concern for the photographer's role, compared to the camera, in determining picture content. Furthermore, overall children in the photograph condition were more likely to comment on the technical aspects of picture creation than children in the drawing

condition. For example, if their referent was moving they knew to wait until it stopped before pressing the capture button. These findings provide some evidence that children do not necessarily approach picture creation in the same way across these two mediums, specifically, they seem to show a greater regard for the artist's role in selecting and depicting a particular referent when drawing, compared to the camera-focused approach that is adopted when taking photographs. Since this is the only cross-modal study on this topic further work is necessary to elucidate how an understanding of the divergent roles of artists and photographers may feed into a theory of pictures that can account for differences across modality. One of the most important open questions concerns how children use their knowledge of picture creation to reason about what artists and photographers can and cannot depict. For instance, are they equally capable of depicting a unicorn, or creating a picture of an absent referent, or is one more equipped to do so than the other? Chapter Four investigates these questions by asking children to use their knowledge of the relative competences of artists and photographers to decide which of the two picture creators would be better equipped to make a series of requested pictures.

The second cross-modal debate revolves around the fact that, as a result of cameras' reliance on real world referents, photographs are typically constrained to depicting real and physically present referents. As such it has been argued that, "the principal belief held in respect to photographs is their fidelity to reality" (Beilin 1991, p. 46), which does not extend to handmade pictures, whose artists can distort reality or depict non-existent referents using their imagination. Expanding upon this, Cavedon-Taylor (2014a, 2014b) states that as viewers we expect photographs to provide us with indisputable information about the world, largely as a function of how they are treated in society. Photographs, far more commonly than drawings or

paintings, act as 'evidence' that an event has occurred. Hoax photographs of spaceships or the Loch Ness monster cause a furore as a direct result of violating these expectations. Reports that adults experience an increase in electrodermal activity when cutting up a photograph of a sentimental possession compared to a control photograph (Hood, Donnelly, Leonards & Bloom, 2010) confirm how closely we associate photographs with their real world referents. This is reinforced by our tendency to find offensive content more disturbing when it is captured in a photograph, than when it is depicted in a drawing or a painting (Currie, 1999).

What about children? A task by O'Connor, Beilin and Kose (1981), which investigated 5- to 7-year-old children's belief in photographic fidelity, provides some empirical support for Beilin's (1991) argument. O'Connor et al showed their participants a live demonstration of Piaget's liquid conservation task, and a series of photographs or drawings depicting the same task. Importantly, the pictures showed either a logical ('unequal' fill levels in both glasses) or an illogical (equal fill levels in both glasses) outcome. To distinguish children who could and could not pass the conservation task, before presenting the outcome picture the experimenter asked the child to predict the amount of water that would be in each glass. Then, having seen the outcome picture children were asked whether they saw any difference between the picture and the level of water in the glasses from the live demonstration. Finally, in the illogical outcome condition children were asked the fidelity question: "which is the way it really should look, should it be way down low as it is here, or should it be way up high as it is here?" (p. 860). Six-year-old children treated photographs of an illogical outcome (glass containing more liquid than it should) as the "correct" representation of the world, more often than the equivalent drawings. They did so in the presence of the physical conservation task materials in their logical final state, i.e.

when the picture and the world contradicted each other, which supports the claim that at least until the age of 6 children adhere to some extent to the 'fidelity to reality' principle.

Of course, due to the increasing popularity of photography – by the age of 2 most children have used a digital camera, and on average, 2- to 4-year-old children spend 1-2 hours per day on some form of mobile media device, including camera-enabled tablets and smartphones (Rideout et al, 2013) – this expectation of veracity may be outdated (Troseth et al, 2007). Children growing up in a society dominated by technology might know far more about photographs from a young age, including that they can be manipulated to depict non-real referents, than has previously been the case. This societal shift provides an excellent opportunity to examine children's understanding of how picture modality affects the content that can be depicted. However, if children pay insufficient attention to the representational surface of pictures, as Liben's (2003) findings suggest, they may fail to note whether a given picture is *a photograph* or *a drawing*, in the first instance, thereby inhibiting the activation of media-specific knowledge, such as 'cameras take pictures of real things' or 'drawings can depict imaginary creatures'. This is potentially detrimental to children's ability to discriminate photographs from drawings on a richer conceptual, as well as a perceptual level.

Chapters Five and Six tackle children's understanding of the dependence of photography on the real world from two different perspectives; the former focuses on the picture creator, and the latter on the picture's referent. More specifically, Chapter Five investigates whether children recognise that photographers can only depict referents to which they have immediate visual access, whereas artists can draw absent referents if they have prior knowledge of them. Finally, Chapter Six explores

children's ability to consider the interaction between content and modality by asking them to consider whether fantasy creatures, such as unicorns, are more likely to be depicted in photographs or drawings.

1.6 Thesis Aims

In light of the reviewed evidence there are several unanswered questions concerning both the relative contribution of appearance and intentional cues to children's picture interpretation, as well as the broader role that picture modality plays in their developing understanding of pictures (Freeman & Sanger, 1995). This thesis will explore the possibility that the factors mediating children's picture interpretation differ for photographs and drawings. Chapters Two to Five explore how children conceptualise the relationship between a picture and its creator, while Chapter Six places more emphasis on the picture-world relationship. More specifically, Chapter Two investigates the relative importance children place on intention and appearance as cues to what a picture represents. Chapter Three builds on Chapter Two by exploring whether there are any differences in the extent to which children rely on artists' versus photographers' intentions when decoding pictures. Chapter Four tracks the developmental trajectory associated with children's understanding of how artists and photographers create pictures. Chapter Five addresses whether children are aware that a picture creator's visual access to, and prior knowledge of, the intended referent are differentially important in deciding the content that artists and photographers can depict. Finally, Chapter Six uses fantasy pictures to investigate whether children expect photographs and drawings to share unique relationships with the world.

The empirical work of this thesis is embedded within two theoretical frameworks. While Freeman and Sanger (1995) provide a comprehensive account of

the various factors, and relationships, that children must master to acquire pictorial understanding, they do not account for differences in understanding across picture modality. By contrast, Liben's (1999) sequence theory of representational development includes two levels (5 & 6) that specifically address possible cross-modal differences in understanding, yet provides little empirical evidence to support these claims. Thus, by comparing children's understanding of the picture-world and picture-creator relationships for photographs and drawings, the principle aim of this thesis is to provide supporting evidence for Liben's theory that children acquire modality-specific knowledge of pictures, with a view to refining Freeman and Sanger's intentional net framework.

Chapter Two: **The relative importance of appearance and intentional cues for children's ability to decode picture-referent relations**[1]

Visual symbols can be arbitrary, bearing no resemblance to their referent, or iconic, closely resembling what they refer to in the world. Although pictures are often iconic, what a picture looks like is not always sufficient to identify its referent or communicative function (Browne & Woolley, 2001; Myers & Liben, 2012). A long-standing debate in the literature addresses exactly how children develop a theory of pictures and link pictures to real world referents (Callaghan, 2013; Callaghan et al, 2012; DeLoache, 1987, 1995; Freeman, 2000; Gibson, 1954, 1979; Gombrich, 1961; Goodman, 1976; Preissler & Carey, 2004; Wollheim, 1987), as these skills represent significant developmental achievements (DeLoache, 2004). One possibility is that young children are *realists*, deciphering a picture solely in terms of what it looks like. Alternatively, they may rely upon the *intention* of the artist when interpreting the picture-referent relationship. The current set of experiments investigates these two potential picture interpretation strategies in children aged 3- to 6-years and adults.

The realist and intentional strategies can be deduced from Freeman and Sanger's (1995) intentional net framework, which posits that a theory of pictures is formulated by analysing relations between the picture, the artist, the world, and the beholder (see Section 1.1). The realist strategy privileges the relationship between the picture and the world, whilst the intentional strategy focuses on the picture-artist relationship. Philosophers adopt divergent positions regarding which of these relationships is more important for picture interpretation (Barthes, 1977; Bazin & Gray, 1960; Dewey, 1958; Ittelson, 1996; Walton, 1984; Wimsatt & Beardsley,

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[1] Based on Armitage, E., & Allen, M. L. (revision under review). Children's picture interpretation: Appearance or Intention? *Developmental Psychology.*

1946). Plato (1987) for instance, advocated the realist perspective, relegating the artist to the role of imitator and denying their ability to communicate anything deeper than that which can be physically seen in their work. Contrastingly, Wollheim (1987) adhered to the intentional picture interpretation strategy. He credits the artist with a pivotal role in the interpretation of his or her work and limits the artwork itself to the role of communicative vehicle, arguing, "if we are interested in…paintings, we must start with the artist" (1987, p. 36). Contemporary developmental studies also reveal conflicting positions regarding this debate.

On one hand, what a picture looks like appears critical to the early understanding of pictures. Highly iconic pictures facilitate generalisation of labels from pictures to their real world counterparts (Ganea, Pickard & DeLoache, 2008; Tare, Chiong, Ganea & DeLoache, 2010), the imitation of actions seen in a picture book (Simcock & DeLoache, 2006), and the symbolic use of pictures, for instance, using photographs to identify which toys to place in a box (Callaghan, 2000). As described in Section 1.3.1, in some studies, even older children have been shown to consistently focus on a drawing's appearance despite receiving explicitly contradictory information regarding what it was intended to represent (Browne & Woolley, 2001; Richert & Lillard, 2002).

Other evidence suggests that complete pictorial competence requires a deeper understanding of the complex relationships that "can exist between depiction and reality" (Pierroutsakos & DeLoache, 2003, p. 155). That is, one must consider the artist's role in shaping a picture's appearance; an unconscious awareness of which has recently been demonstrated empirically in work with adults (Taylor, Witt & Grimaldi, 2012). Sensitivity to artist intention emerges between the ages of 2- and 3-years, when children can use eye gaze to identify which of two referents an artist intends to depict

(Preissler & Bloom, 2008), and can successfully identify their own drawing from two identical pictures (Bloom & Markson, 1998). Furthermore, Gelman and Ebeling (1998) provide evidence that 2- and 3-year-old children's picture naming is underpinned by assumptions about intention. In their task, children were significantly more likely to name intentionally created drawings according to shape (i.e. the outline of a man was named 'a man') than accidental drawings, which were more often assigned material-based names (e.g. paint). See Section 1.3.1 for elaboration.

The key insight derived from previous literature is that different testing paradigms have given rise to conflicting conclusions about children's picture interpretation. When pictures are ambiguous children may use the intentional cues provided by the picture-artist relationship to interpret them (Bloom & Markson, 1998; Preissler & Bloom, 2008). However, when a picture's appearance conflicts with what it was intended to represent (Browne & Woolley, 2001; Richert & Lillard, 2002) it appears that children, and adults, might rely on the picture-world relationship and prioritise appearance cues. Thus, it is critical to combine these distinct methodologies in a single experiment using the same stimuli to determine whether the transparency of the picture-world relationship predicts the use of appearance and intentional cues. This is one aim of Experiment 1.

Beyond methodological differences, it is also important to look at the modality of picture production to determine its influence on picture interpretation strategies. Most studies focus upon drawings, the handmade creation of which establishes a clear and salient link between an artist and his or her picture. Photographs provide an interesting comparison since, arguably, the role of the artist is less clear-cut, not least because picture creation is mediated by the mechanics of a camera and printer. In Liben and Szechter (2002) and Szechter and Liben's (2007) work, 7- to 13-year-old

children demonstrated an overwhelming tendency to evaluate, sort, and pair photographs according to their content. These findings fall in line with prior work on drawings, which show that pictures are primarily evaluated on their appearance. However, Liben and Szechter (2002) also found that when critiquing photographs they disliked, around 15% of 7- to 8-year-old children's comments referred to the photographer's actions. Although not a significant proportion, this suggests that children have at least some awareness of the importance of the image creator in evaluating photographs. An empirical comparison of photographs and drawings would contribute to a more global understanding of how children develop a theory of pictures.

In Experiment 1, condition and modality manipulations were used to investigate when and how 3- to 6-year-old children use appearance and intentional cues to interpret pictures. In order to explore whether there is a developmental trajectory associated with children's cue use two age groups were used: 3- and 4-year-old children, who have only recently begun using intentional cues to interpret pictures (Bloom & Markson, 1998; Gelman & Ebeling, 1998; Preissler & Bloom, 2008), and 5- and 6-year-old children, who have a more sophisticated conception of the relationship between artists and their pictures (Callaghan & Rochat, 2003), and a keener understanding of others' minds (Callaghan et al., 2005; Keysar, Lin & Barr, 2003; Wellman, Cross & Watson, 2001). For these reasons it was anticipated that the older age group would rely more on intentional cues for interpreting pictures than the younger age group. In summary, the current experiment assesses how two distinct age groups of children use intentional cues to interpret pictures, both when intention acts as a solitary cue and when it conflicts with appearance.

Including children of an age where considerable pictorial experience is assumed (5-6 years) allowed the investigation of any differences in how the two age groups employ appearance and intentional cues when interpreting photographs compared to drawings. It was anticipated that the 3- and 4-year-old children would give fewer intentional responses in the photograph task than the line drawing task because the addition of a camera and printer may make it harder to track how the photographer's intentions map onto their picture. By contrast, it was expected that 5- and 6-year-old children would successfully incorporate these mechanical intermediaries into their understanding of the photographer-picture relationship due to additional experience with this modality. To explore the effect of modality two tasks were used: a photograph task and a line drawing task, each of which consisted of 4 trials. In each trial children were introduced to three objects: one target object (e.g. blue duck), a second object varying only in colour (e.g. pink duck) and a distractor object (e.g. teddy). In two conditions the appearance of a picture was changed in order to create a conflict between what the picture creator intended to depict and what her final picture resembled. In the colour change condition the picture creator intended to depict one object (e.g. a blue duck) yet the final picture clearly resembled a differently coloured object (e.g. a pink duck). It was predicted that the transparency of the picture-world relationship, combined with children's early and repeated exposure to the perceptual similarity between pictures and their referents, (Ganea, Pickard & DeLoache, 2008; Simcock & DeLoache, 2008) would facilitate reliance on appearance rather than intentional cues in this condition.

In the black and white condition the picture creator intended to depict a coloured object, however, the final picture depicted the object in greyscale. Thus, here the relationship between the picture and the world was much less transparent since the

picture could represent *either* of the relevant objects (e.g. a pink or a blue duck). However, the artist's intention identified one of these objects as the picture's referent. Here it was predicted that children would rely on intentional cues due to their sensitivity to the role of artist intention in picture comprehension (Bloom & Markson, 1998; Gelman & Ebeling, 1998; Preissler & Bloom, 2008) and the lack of clarity offered by the picture's ambiguous appearance.

Children were asked three test questions. They were asked to name the picture ("what is this a picture of?"), to retrieve the referent object ("can you pass me this") and to recall what the artist had intended to depict ("what did I mean to take a picture of?"). The first two questions were intended to test the dual representation hypothesis. It was anticipated that the verbal question would focus attention on the picture as an object in and of itself and bias children to answer based upon what the picture looks like, but that the behavioural question might highlight the symbolic nature of the picture (see Callaghan, 2000, 2013; Callaghan et al, 2012; DeLoache, 1987, 1991, 2004; DeLoache & Burns, 1994; Dow & Pick, 1992; Jolley, 2008) eliciting an intentional focus from children. However, it was also noted that if children gave the same answer to both questions, the behavioural question could then serve as a corroborative measure of children's verbal responding, as it has been suggested that children's aesthetic understanding can be underestimated due to their inability to verbalise what they know (Bloom, 2004; Jolley, Zhi & Thomas, 1998).

Experiment 2 explored the influence of an additional factor, artist knowledge, on children's choice of picture interpretation strategy. It was hypothesised that in Experiment 1 the artist's lack of surprise about her picture's changing appearance (e.g. a blue duck instead of a pink duck) may have invalidated her earlier intention. Thus, I manipulated the artist's knowledge about the appearance of her picture and

contrasted it with the knowledge of a second experimenter, in order to assess the impact of this variable on children's use of appearance and intentional cues. Finally, since previous research has found strong similarities in how children and adults interpret pictures (Browne & Woolley, 2001; Gelman & Ebeling, 1998) Experiment 3 assessed whether, in the current paradigm, adults would use appearance and intentional cues in the same way as children.

By manipulating the extent to which pictures resemble their real world referents, and contrasting this with what the picture creator intended to depict, it is possible to identify whether participants prioritise the picture-world or picture-artist relationships when interpreting pictures. Furthermore, this can also identify the role that an artist's knowledge plays in evaluating his or her intention. Together these experiments will contribute a deeper understanding of the order in which children and adults utilise the relationships in Freeman and Sanger's (1995) intentional net, and the factors that influence their usage.

2.1 Experiment 1

Experiment 1 explored whether children think appearance or intention is more important for interpreting pictures. A between subjects design was used; children took part in the photograph *or* the line drawing task and in the colour change *or* the black and white condition. In both conditions the appearance of a series of pictures was changed to create conflict between what the picture creator intended to depict and what the picture resembled. In the colour change condition the colour of the referent was changed (e.g. if the experimenter intended to draw a blue duck, the final picture showed a pink duck) and in the black and white condition the picture appeared in

greyscale, rather than colour. The modality manipulation also made it possible to examine whether children's cue use differs for photographs and drawings.

2.1.1 Method

Participants

One hundred and fifty-one typically developing children between the ages of 3 and 6 participated in the Photograph (N = 76) and Line drawing tasks (N = 75). Children were split into two age groups: 3- and 4-year-olds (M_{age} = 46m; Range = 37-59m) and 5- and 6-year-olds (M_{age} = 71m; Range = 60-82m), and two conditions, yielding four experimental conditions (see Table 1). Children were recruited from six primary schools, three nurseries, one holiday play scheme, and the database of the Centre for Research in Human Development and Learning (CRHDL) at Lancaster University. Families were predominantly white and middle class.

Table 1

Number of children in each age group per task and condition in Experiment 1

	Photograph		Line drawing	
	Colour Change	Black and White	Colour Change	Black and White
3- and 4-year-olds	20	18	18	19
5- and 6-year-olds	17	21	19	19

Apparatus and stimuli

Photograph task. A 9.1 megapixel Sony digital camera and a HP Photosmart printer were used. Twelve familiar objects arranged into four sets of three object

arrays formed the object stimuli. Each array was composed of two test objects and a third distractor object approximately matched in size to the test objects (see Figure 3). Ten colour or greyscale photographs (8 x 4in and presented landscape on A4 photographic paper) of these objects acted as the pictorial stimuli.

Line Drawing task. Eight colouring crayons and plain A4 paper were used. To permit direct comparisons across tasks the same objects, arranged in the same three-array configurations as in the photograph task were used here. Pictorial stimuli comprised 10 colour or greyscale line drawings (8 x 4in and presented landscape on A4 paper) of these objects.

Blue duck, pink duck, teddy bear

Yellow balloon, caterpillar, red balloon

Pink ball, orange ball, red glass

Blue spoon, yellow spoon, pink pen

Figure 3. Object arrays used in Experiments 1, 2 and 3

Design

A 2 x 2 x 2 x 3 mixed design was used for both tasks. Condition ('colour change' and 'black and white'), Modality ('photograph' and 'drawing') and Age group ('3- and 4-year-olds' and '5- and 6-year-olds') acted as the between-subject factors. The within-subject factor was Question Type ('verbal', 'behavioural' and 'memory control'). Intentional responses per question type were summed across trial to form three composite scores (see Coding section).

Procedure

Photograph task. Children each took part in four trials. In each trial the experimenter set up an array of three familiar objects, drawing attention to each individually ("oh look a pink duck, a blue duck, and a teddy bear"). She then photographed one of the objects ("I'm going to take a picture of the blue duck"); the objects were segregated to ensure it was clear which one was being photographed. The photograph was printed ("let's print the picture"), and the children were told, "the printer isn't working very well today" to provide a plausible reason for the picture printing incorrectly. The printer was set up to simulate printing, but pre-printed photographs were loaded into the paper tray ready for the experimenter to retrieve. The participant's view of the printer was obscured to hide this deception.

In the colour change condition, the photograph printed in the colour of the shape-matched object from the array. For instance, if the blue duck was photographed, the photograph showed a pink duck. In the black and white condition, the picture printed in greyscale, and thus could plausibly represent both the target and perceptually matched distractor object. Once the picture had 'printed', the experimenter held it up for the child and said, "oh look, it printed like this". To probe

for participants' understanding, three explicit questions were asked about the picture. The verbal question required participants to name the depiction ("what is this a picture of?"). If children responded without using a colour term, e.g. "duck" the experimenter asked, "which one?" The behavioural question asked children to provide an overt behavioural response and retrieve the object ("can you pass me this"); the experimenter pointed to the object in the picture to indicate what 'this' referred to. Throughout testing, all children indicated that they understood they were being asked to pass the object that they thought the picture referred to, rather than the picture itself. The verbal *and* behavioural questions were included to test the possibility that they tapped different aspects of the dual representation hypothesis (DeLoache, 1987). To ensure this could be adequately explored, question order was counterbalanced to avoid order effects. The memory control question ("what did I mean to take a picture of?") was included to ensure children correctly understood the artist's intention and had not forgotten what the experimenter originally took a picture of. This question was always asked last to minimise the risk of biasing the child towards intentional responses to the first two questions.

Line Drawing task. Children participated in four test trials. The procedure followed that of the photograph task with some minor instructional changes. Children were told the experimenter was going to draw one of the objects ("I am going to draw a picture of the blue duck"). In the colour change condition, when choosing a crayon the experimenter looked at the selection (which included both correct and incorrectly coloured crayons) and said, "I'm going to use this one" before picking up the 'wrong colour' crayon. For instance, if the experimenter chose to draw the blue duck, she picked up the pink crayon. In the black and white condition the crayon chosen was

always black. Highlighting the creator's intention to choose a particular marker (in this case, a particular coloured crayon) is a method that has been successfully used in previous work to assess children's understanding of the role intention plays in representation (Myers & Liben, 2008).

Coding

In the colour change condition, responses were coded as either intentional, appearance, or 'other'. Responses were coded as appearance-based if the child's label for, or physical choice of object, matched the colour of the object in the photograph or line drawing. Intentional codes were assigned if the child's physical object choice or verbal label matched the colour of the object initially photographed. The 'other' code was reserved for responses that did not conform to either of the above response types, for instance, choosing the distractor object.

In the black and white condition, responses were coded as intentional, non-intentional or 'other'. Intentional codes were assigned if the child's object choice or label matched the object that was initially photographed. Non-intentional codes were assigned if children's object choice or label matched the object that was not photographed (e.g. choosing the pink duck when the experimenter had intended to photograph the blue duck). Appearance codes were not utilised here as selecting the non-intended object (e.g. pink duck) did not match the greyscale appearance of the picture. 'Other' responses included the distractor object, since this was the only additional response ever provided. The same coding scheme was used for the photograph and line drawing tasks.

2.1.2 Results and Discussion

To provide an initial view of any patterns in the data, the percentage of question responses falling into each of the three coding categories was calculated. The majority of responses given by participants fell into the 'Appearance/Non-intentional' and 'Intentional' categories. Children's responses were coded as 'Other' on a total of 6.2% of trials, indicating that they chose the distractor object from the array. Due to the infrequency of these responses they were removed from subsequent analyses, which focused on comparing appearance/non-intentional and intentional question responses.

Children each had 12 data points, having answered three questions per trial across four trials. Since different stimuli were used on each trial it was important to check that children's question responses did not differ as a function of the stimuli used. Prior to formal statistical analysis, McNemar tests were conducted to identify possible stimulus effects; no such effects were identified and thus the data was collapsed across trials. The dichotomous nature of the 'appearance'/non-intentional' and 'intentional' response categories necessitated that only one response type act as the dependent variable. Thus, intentional question responses were chosen and summed across all four trials to provide three composite scores, one per question: verbal, behavioural and memory control (see Table 2). The final DV was number of intentional responses out of 4 trials, thus scores ranged from 0-4. A score of 0 indicated that no intentional responses were given to that question, whereas a score of 4 indicated that intentional responses were given to all questions of that type.

These data were analysed using a 2 (Modality: photograph, drawing) x 2 (Condition: colour change, black and white) x 2 (Age Group: 3- and 4-year-olds, 5- and 6-year-olds) x 3 (Question Type: verbal, behavioural, memory control) mixed

ANOVA. Greenhouse-Geisser values are reported due to a violation of Mauchly's sphericity assumption. A main effect of question type, $F(1.48, 211.13) = 8.94$, $MSE = 19.98$, $p = .001$, $\eta_p^2 = .60$, and a Question Type x Condition interaction, $F(1.48, 211.13) = 44.13$, $MSE = 98.63$, $p < .001$, $\eta_p^2 = .24$, were qualified by a Question Type x Condition x Age Group interaction, $F(1.48, 211.13) = 5.93$, $MSE = 13.25$, $p = .007$, $\eta_p^2 = .040$. A Modality x Age Group interaction, $F(1, 143) = 7.38$, $MSE = 18.08$, $p <. 007$, $\eta_p^2 = .049$, was also identified. In order to establish the nature of these interactions and because age group was a common factor across all interactions, additional 2 (Modality) x 2 (Condition) x 3 (Question Type) one-way within subjects ANOVAs were conducted on data from the two age groups separately.

3- and 4-year-olds

A significant main effect of modality, $F(1, 71) = 8.11$, $MSE = 25.67$, $p = .006$, $\eta_p^2 = .10$, revealed that children gave significantly more intentional responses in the line drawing task ($M = 2.49$, $SE = .17$) than the photograph task ($M = 1.81$, $SE = .17$). A significant main effect of condition, $F(1, 71) = 33.78$, $MSE = 106.91$, $p < .001$, $\eta_p^2 = .32$, also showed that children gave significantly more intentional responses in the black and white condition ($M = 2.84$, $SE = .17$) than the colour change condition ($M = 1.46$, $SE = .17$), which suggests that when a picture does not clearly resemble one specific referent children use artist intention as an alternative source of information about the picture.

A significant Question Type x Condition interaction, $F(1.70, 120.68) = 12.53$, $MSE = 17.12$, $p < .001$, $\eta_p^2 = .15$ (see Table 2) was also identified. To establish the nature of this interaction two separate one-way within subjects ANOVAs were conducted for the colour change and black and white conditions. In the colour change

condition children gave significantly ($p < .001$) more intentional responses to the memory control question ($M = 2.16$, $SE = .25$) than the verbal ($M = .97$, $SE = .21$) or behavioural questions ($M = 1.18$, $SE = .24$), $F(1.61, 59.50) = 16.75$, $MSE = 18.86$, $p < .001$, $\eta_p^2 = .31$. No significant effect of question type was found in the black and white condition. Individual univariate ANOVAs were also conducted for each of the three question types. Children in the black and white condition gave significantly more intentional responses to the verbal ($M = 2.89$, $SE = .22$), $F(1, 73) = 40.43$, $MSE = 68.98$, $p < .001$, $\eta_p^2 = .36$ and behavioural questions ($M = 3.11$, $SE = .22$), $F(1, 73) = 39.80$, $MSE = 69.39$, $p < .001$, $\eta_p^2 = .35$, than children in the colour change condition (verbal: $M = .97$, $SE = .21$; behavioural: $M = 1.18$, $SE = .21$).

Chance analyses (chance value = 2) indicated that children in the black and white condition gave significantly more intentional responses to the verbal ($M = 2.89$, $SE = .22$), $t(36) = 4.02$, $p < .001$, behavioural ($M = 3.11$, $SE = .19$), $t(36) = 5.86$, $p < .001$, and memory control questions ($M = 2.54$, $SE = 1.50$), $t(36) = 2.19$, $p = .035$, than would be expected by chance. Contrastingly, children in the colour change condition gave significantly fewer intentional responses to the verbal ($M = .97$, $SE = .20$), $t(37) = -5.01$, $p < .001$, and behavioural questions ($M = 1.18$, $SE = .24$), $t(37) = -3.43$, $p < .001$, than would be expected by chance. Children in this condition performed at chance on the memory control question ($M = .2.16$, $SE = .25$), $t(37) = .62$, $p = .54$.

Table 2

Percentage of Intentional responses given by 3- and 4-year-old children in the Photograph and Line drawing Tasks in Experiment 1

	Photograph		Line drawing	
	Black and white	Colour change	Black and white	Colour change
Verbal	56%	16%	88%	33%
Behavioural	74%	19%	82%	42%
Memory Control	63%	45%	65%	64%

5- and 6-year-olds

A main effect of question type, $F(1.34, 96.58) = 6.07$, $MSE = 19.28$, $p = .009$, $\eta_p^2 = .08$, revealed that children gave significantly more intentional responses to the memory control ($M = 2.72$, $SE = .20$) and behavioural questions ($M = 2.28$, $SE = .14$) than the verbal questions ($M = 1.90$, $SE = .15$). A main effect of condition, $F(1, 72) = 70.95$, $MSE = 124.08$, $p < .001$, $\eta_p^2 = .50$, also showed that children in the black and white condition ($M = 3.04$, $SE = .12$) gave significantly more intentional responses than children in the colour change condition ($M = 1.56$, $SE = .13$).

A Question Type x Condition interaction, $F(1.34, 96.58) = 32.04$, $MSE = 101.83$, $p < .001$, $\eta_p^2 = .31$. was also identified (see Table 3). To establish the nature of this interaction two separate one-way within subjects ANOVAs were conducted for the colour change and black and white conditions. In the colour change condition children gave significantly more intentional responses to the memory control question ($M = 3.08$, $SE = .25$) than the verbal ($M = .64$, $SE = .18$) and behavioural ($M = .94$, SE

= .23) questions, $F(1.16, 40.61) = 29.10$, $MSE = 110.08$, $p < .001$, $\eta_p^2 = .45$. In the black and white condition children gave significantly more intentional responses to the behavioural question ($M = 3.60$, $SE = .16$) than the memory control question ($M = 2.38$, $SE = .29$), $F(1.51, 58.99) = 7.65$, $MSE = 20.31$, $p = .003$, $\eta_p^2 = .16$. Individual univariate ANOVAs were also conducted for each of the three question types. Children in the black and white condition gave significantly more intentional responses to the verbal ($M = 3.15$, $SE = .21$), $F(1, 74) = 69.39$, $MSE = 119.48$, $p < .001$, $\eta_p^2 = .48$, and behavioural questions ($M = 3.60$, $SE = .19$), $F(1, 74) = 97.43$, $MSE = 133.62$, $p < .001$, $\eta_p^2 = .57$, than children in the colour change condition (verbal: $M = .64$, $SE = .22$; behavioural: $M = .94$, $SE = .20$).

Chance analyses (chance value = 2) indicated that children in the black and white condition gave significantly more intentional responses to the verbal ($M = 3.15$, $SE = .23$), $t(39) = 4.92$, $p < .001$, and behavioural questions ($M = 3.60$, $SE = .16$), $t(39) = 10.31$, $p < .001$, than would be expected by chance. They performed at chance on the memory control questions, $t(39) = 1.30$, $p = .200$. Children in the colour change condition gave significantly fewer intentional responses to the verbal ($M = .64$, $SE = .18$), $t(35) = -7.43$, $p < .001$, and behavioural questions ($M = .94$, $SE = .23$), $t(35) = -4.69$, $p < .001$, than would be expected by chance, yet gave significantly more intentional responses to the memory control question ($M = 3.08$, $SE = .25$), $t(35) = 4.33$, $p < .001$, than would be expected by chance.

Table 3

Percentage of Intentional responses given by 5- and 6-year-old children in the Photograph and Line drawing Tasks in Experiment 1

	Photograph		Line drawing	
	Black and white	Colour change	Black and white	Colour change
Verbal	80%	18%	78%	15%
Behavioural	88%	29%	92%	18%
Memory Control	64%	75%	54%	79%

These findings demonstrate that across different modalities, the referential ambiguity of a picture is of fundamental importance in determining children's use of appearance and intentional cues. When an image could represent multiple referents, as in the black and white condition, the picture's identity is ascertained using intentional cues. Contrastingly, when an image is intended to represent one object but strongly resembles another, as in the colour change condition, appearance cues dominate picture interpretation.

The increase in intentional responding for the memory control question in the colour change condition, seen more in the 5- and 6-year-old group than the younger group, suggests that appearance-based responding to the verbal and behavioural questions was not a result of children having forgotten the artist's original intention. However, children in the black and white condition gave fewer intentional responses to the memory control question than the behavioural question. Given the overall dominance of intentional responding in this condition it seems unlikely that children

had forgotten the artist's stated intention. Rather, repeated questioning may have caused this drop in performance. The memory control question was always asked last, and thus children in this condition had already given two intentional responses when they were asked, "what did I mean to take a picture of?" Consequently, they might have thought they were being asked again because their previous answers were incorrect. This claim is supported by previous research, which has shown that repeated questioning fosters inconsistent responding in children (Krahenbuhl, Blades & Eiser, 2009; Siegal, Waters & Dinwiddy, 1988).

Interestingly, only younger children's performance differed across modality. Three- and 4-year-old children in the photograph task gave fewer intentional responses than 3- and 4-year-old children in the line drawing task. One explanation for this finding is simply that the iconic nature of the photographs focused children's attention on the picture-world relationship, resulting in an increase in their use of appearance cues and a corresponding decrease in intentional responding. Alternatively, the introduction of a camera and printer may have weakened children's reliance on intentional cues since the appearance of the final picture is less closely related to the photographer's intentions. For instance, technical malfunctions can have unintentional effects on a picture's appearance, which distort the photographer's intentions. These two explanations are not mutually exclusive. It seems likely that the combination of a stronger picture-world relationship and weaker photographer-picture relationship both contributed to lowering intentional responding. These issues are returned to in the General Discussion (Section 2.4).

Having addressed what underlies intentional responding in the black and white condition, it is also important to consider what motivated appearance-based responding in the colour change condition. One potentially important extraneous

variable in this condition was the artist's knowledge about the picture. It is possible that when instructing the child that the printer was not working properly ("the printer isn't working very well today") in the photograph task, choosing the wrong crayon in the line drawing task, and commenting on the change in the final picture ("it printed like this") children were misled into thinking that her stated intention was no longer relevant, and consequently that the test questions pertained to the referent depicted in the final picture. This is particularly likely if, as Rosset (2008) states, humans initially interpret all actions as deliberate due to an 'intentional bias', and only develop the ability to override this bias as they gain experience of other explanations for behaviour, such as accidental or coincidental events; experience children have relatively little of. Thus, the aim of Experiment 2 was to rule out this explanation as the underlying reason for children's appearance-based responses in the colour change condition of Experiment 1.

2.2 Experiment 2

The aim of Experiment 2 was to clarify the underlying motives for the predominance of appearance responses given to the verbal and behavioural questions by children in the colour change conditions of Experiment 1. It was hypothesised that these responses may have been prompted by the artist's failure to comment on the picture's changing appearance, thereby leading children to believe that her earlier intention was no longer relevant. Previous research has shown that young children are aware that what people see directly affects their knowledge of objects or events (O'Neill, Astington & Flavell, 1992; Patt & Bryant, 1990; Pillow, 1989, 1993; Robinson & Whitcombe, 2003; Wimmer, Hogrefe & Perner, 1988) and can use this information to distinguish between knowledgeable and ignorant observers (Einav &

Robinson, 2011; Koenig & Harris, 2007; Robinson, Butterfill & Nurmsoo, 2011). In order to explore whether the knowledge of the experimenter influenced children's picture choices in Experiment 1 a second experimenter was added. Experimenter 2 knew what the final picture looked like, but did not know anything about experimenter 1's (the artist) intentions. Conversely, while experimenter 1 knew what she intended the picture to represent she never saw the final image. Half the children were asked the test questions by experimenter 1, and the other half were asked by experimenter 2. Children were expected to accept that the knowledge of the two experimenters did not overlap, since previous work has shown that much younger children do not expect knowledge acquired by one person to be known by another (Moll, Richter, Carpenter & Tomasello, 2008; Tomasello & Haberl, 2003).

It was predicted that, if children considered the artist's knowledge when interpreting the picture, then when experimenter 1 (the artist) asked the questions, children should give predominantly intentional responses since experimenter 1 only knew what she intended to depict. When experimenter 2 asked the questions, children were expected to give appearance responses because experimenter 2 only knew what the picture looked like. Contrastingly, if the children were staunch realists they were expected to give appearance responses regardless of which experimenter asked the test questions, since the picture's appearance did not change across conditions. No age group differences were expected.

2.2.1 Method

Participants

Eighty typically developing 3- to 6-year-old children participated. They were split into two age groups: 3- and 4-year-olds (M_{age} = 50m; Range = 40-59m) and 5-

and 6-year-olds (M_{age} = 70m; Range = 60-82m). See Table 4 for condition and age groupings. Children were recruited from four primary schools in North Yorkshire, and the database of the Centre for Research in Human Development and Learning (CRHDL) at Lancaster University. Families were predominantly white and middle class.

Table 4

Number of children in each age group per condition in Experiment 2

	Experimenter 1	Experimenter 2
3- and 4-year-olds	18	15
5- and 6-year-olds	25	22

Apparatus and stimuli

The materials were identical to the colour change condition of Experiment 1, however, due to the nature of the procedure, only two of the original four trials were included. Pilot testing revealed that children would not believe that a second experimenter would interrupt with four 'unexpected' phone calls during the short testing session. Since no stimulus effects were found in Experiment 1 the duck and spoon trials were randomly chosen.

Design

A 2 x 2 x 2 mixed design was used. Condition ('experimenter 1' and 'experimenter 2') and Age group (3- and 4-year-olds and 5- and 6-year-olds) acted as

the between-subject factors. Question type (verbal and behavioural) was the within-subject factor. For consistency with Experiment 1, intentional responses were summed across trial to form two composite scores, one per question type.

Procedure

Children took part in two test trials. As in Experiment 1, on each trial children were introduced to three familiar objects ("oh look a pink duck, a blue duck, and a teddy bear"), a photograph was taken of one of the objects ("I'm going to take a picture of the pink duck") and the photograph was printed. The final pictures always depicted the same object (e.g. duck) but in a different colour to that originally photographed (blue duck if the pink duck was photographed) and thus contrasted intention with appearance.

In the 'experimenter 1' condition, as the picture printed experimenter 2 interrupted telling experimenter 1 there was an urgent phone call for her ("sorry to interrupt but Melissa is on the phone and she says it is important"). Experimenter 1 left the room to take the phone call, telling the child "I will be back in a minute", while experimenter 2 removed the photograph from the printer and showed it to the child ("wow this is a nice picture!"). Critically, experimenter 2 was ignorant of experimenter 1's knowledge state and the events that happened until that point, and from the child's perspective was unaware of which object was actually photographed. Experimenter 1 then ended her phone call, re-entered the room and without seeing the final picture, which was held by experimenter 2, asked the test questions, "what is this a picture of?" (verbal question) and "can you pass me this?" (behavioural question).

A similar scenario took place in the 'experimenter 2' condition, except that after experimenter 1 re-entered the room, experimenter 2 showed the child the

photograph ("wow, this is a nice picture!") and asked the test questions, "what is this a picture of?" and "can you pass me this?" The memory control question, "what did I mean to take a picture of?" was not asked here as it would have been illogical; the first experimenter did not know the picture looked any different to how she intended it to look, and the second experimenter did not know the picture was ever supposed to look any different to how it emerged from the printer. The conflict between these two knowledge states elicited a verbal reaction from several children when the final picture did not resemble the intended object (e.g. informing the second experimenter that, "it was meant to be the pink duck") and this led to the inclusion of an additional protest measure. Verbal protests have previously been used to assess children's feelings about social norm violations (Rakoczy, Warneken & Tomasello, 2008, 2009) and in the current experiment were considered a valuable source of information about how important children considered the artist's intention. Responses of this type were never given in Experiment 1.

Coding

The coding scheme from Experiment 1 was used, with one amendment made. Children's spontaneous comments regarding the colour change in the depicted object were coded as *protests*. For instance, if children said "that's the wrong colour" or "it was supposed to be pink" upon seeing the final picture, this was given a score of 1. Two protest scores were calculated: the number of children who protested was summed, and children were also categorised according to the number of times they protested across the two trials.

2.2.2 Results and Discussion

Only one question response (out of 320) was coded as 'other'. Due to the low frequency usage of this coding category, this response category was removed. As in Experiment 1, intentional responses were used as the dependent variable. McNemar tests revealed no stimulus effects on children's question responses, thus data were collapsed across trials. Intentional responses were summed to give each child two composite scores, one per question type: verbal and behavioural. Scores ranged from 0–2. A score of 0 indicated that no intentional responses were given to that question type, whereas a score of 2 indicated that intentional responses were given to both questions of that type.

Intentional responses were analysed using a 2 (Condition: experimenter 1, experimenter 2) x 2 (Question Type: verbal, behavioural) x 2 (Age Group: 3- and 4-year-olds and 5- and 6-year-olds) mixed ANOVA. No significant main effects or interactions were identified. However, children gave significantly fewer intentional responses than would be expected by chance (chance value = 1) to both the verbal (M = .14, SE = .05), $t(79) = -17.42$, $p < .001$, and behavioural questions (M = .20 SE = .06), $t(79) = -13.95$, $p < .001$, indicating a strong reliance on the realist picture interpretation strategy. This replicates the findings of the colour change condition in Experiment 1; in the colour change condition, when pictures unambiguously resemble a single referent, children rely on appearance cues.

Finally, analysis of the 'protest' data revealed that 31/64 (48%) of children protested, and 19/64 (29%) children protested multiple times, demonstrating that they had noticed that the printed picture did not resemble the intended referent. Protests were made equally across the two conditions. Children were split into protesters and non-protesters and a one-way ANOVA revealed no significant difference in the

number of intentional responses given by the two groups; those who protested did not give more intentional responses than those who did not protest. Thus, whilst the children who protested considered intentional information relevant enough to be noted, they did not consider it to be the 'correct' response to the test questions.

Before subscribing to the view that children's responding reflects a preference for appearance-based picture interpretation, it is important to consider another possibility. Due to the nature of the current task, it is possible that children's lack of *intentional* responding is attributable to poor false belief understanding. In order to acknowledge the experimenter's intention children needed to recognise that, having left the room before the picture printed, experimenter 1 possessed a 'false belief' about its appearance – that it depicted the object she intended. Since children do not reliably pass traditional false belief tasks until around the age of 4 (Perner, 1991; Wellman, Cross & Watson, 2001; Wimmer & Perner, 1983), this possibility is particularly relevant to the youngest children tested in this experiment. However, counterevidence is provided by the lack of age differences evident in performance; if poor false belief understanding inhibited younger children's intentional responding one would have expected a higher level of intentional responses from the older children. Furthermore, 30% of children in the younger group protested at the picture's unexpected appearance, indicating that they had successfully imputed experimenter 1's false belief and thus recognised her intention. Nevertheless, since 70% of the 3- and 4-year-old children did not protest it remains possible that an inability to reason about and track the experimenter's intention did inhibit the performance of some of the 3- and 4-year-olds. Given the interconnectedness of intention and theory of mind, future research should include a measure of false belief understanding in order to

ensure that any apparent insensitivity to creator's intentions is not simply due to immature theory of mind abilities.

Experiment 2 confirmed that realist responding in the colour change condition of Experiment 1 was underpinned by a genuine preference for interpreting pictures according to their appearance, and was not influenced by the experimenter's verbal statements, actions or knowledge about picture production or the final image. The protests made by children demonstrate an awareness of the conflict between intention and appearance, and in the context of Freeman and Sanger's framework (1995) indicate that children are spontaneously trying to incorporate multiple pictorial cues into their picture interpretation. By giving appearance-based responses whilst noting the relevance of intentional cues via verbal protests, children are beginning to demonstrate a sophisticated understanding of the multi-faceted nature of picture interpretation. However, given the overall lack of age effects found in Experiments 1 and 2 this raises the question of whether adults use appearance and intentional cues in the same way as children. Experiment 3 addresses this issue by replicating Experiment 1 with adult participants.

2.3 Experiment 3

Previous research has documented that adults and children respond similarly when asked to name ambiguous line drawings (Browne & Woolley, 2001) or pictures produced intentionally versus accidentally (Gelman & Ebeling, 1998). Experiment 3 investigated whether, using the current paradigm, adults would replicate children's appearance and intentional responding.

2.3.1 Method

Participants

Sixty-four adults (range: 18-52, M_{age} = 20 years) participated in a replication of Experiment 1 (colour change condition: N = 32; black and white condition: N = 32). They were recruited using opportunity sampling in the North Yorkshire area and via the research participation system at Lancaster University.

Apparatus and Stimuli

The stimuli from Experiment 1 were used.

Design

A 2 x 2 x 3 mixed design was used. Condition ('colour change' and 'black and white') and Modality ('photograph' and 'drawing') acted as the between-subject factors and question type (verbal, behavioural and memory control) as the within-subject factor. Intentional responses per question type were summed across trial to form three composite scores (see Coding section of Experiment 1).

Procedure

Prior to the commencement of the experiment, adults were informed that the task had been designed for children and, as such, they should answer based on their intuitions. This was necessary as pilot testing indicated that adults often questioned the nature of the procedure; it is unusual to have someone tell you they intend to draw a particular picture, and then to immediately draw a different one. All other aspects of the procedure followed that of Experiment 1.

Coding

The coding scheme from Experiment 1 was used.

2.3.2 Results and Discussion

An initial exploration of the data revealed that although none of the adults ever chose the distractor object from the array; overall, 7% of their responses were coded as 'other'. These responses were largely confined to the black and white condition of the line drawing task and can be split into two categories. Twenty per cent (38/192) of these responses involved adults naming the greyscale images according to their final appearance (e.g. grey duck) and thus refusing to choose a target object from the array due to the absence of a grey referent. Here adults were focusing on the picture alone and ignoring the picture-referent relationship; since there was no grey duck in the array the picture could not represent a grey duck if one was using this relationship. The most likely explanation for such responding is that adults did not believe the experimenter could draw a grey duck when she intended to draw a pink duck, and thus inferred that she must have intended to draw a grey duck. Browne and Woolley (2001) reported a similar finding; 75% of their adult participants attempted to reconcile conflicting appearance and intention cues by stating that ambiguous pictures (e.g. rabbit-bear) looked like their intended referents (e.g. rabbit) rather than the non-intended referents. Together, these findings support Bloom's (1996) intentional-historical account of artifact concepts, which argues that appearance can be used to infer a picture creator's intention.

The remaining 'other' responses, which accounted for 10% (19/192) of the black and white condition responses, involved adults claiming that the black and white drawings represented both objects (e.g. the pink duck and the blue duck). This

gives rise to two potential explanations. Firstly, adults may have been using appearance and intentional cues as equally viable indicators of what the pictures represented, for instance, 'it was intended to represent the pink duck, but looks equally like the blue duck, therefore it is a representation of both the pink and blue ducks'. A compatible explanation is that adults' knowledge of pictorial conventions, specifically that colourless images are more abstract or generic representations than colour pictures (Gelman, Chesnick & Waxman, 2005), allowed them to treat the greyscale pictures as representations of categories and not specific referents. For instance, a black stick figure represents the category of 'men', not a specific man. In the current experiment, given the absence of a grey duck in the object array adults might have assumed that a black and white picture of a duck represented the two duck shaped objects that were present in the array.

For consistency with Experiment 1 the dependent variable was the number of intentional responses. McNemar tests revealed no stimulus effects on participants' responses, thus data was collapsed across trials to provide three composite scores, one per question type. Scores ranged from 0–4. A score of 0 indicated that no intentional responses were given to that question, whereas a score of 4 indicated that intentional responses were given to all questions of that type.

Intentional responses were analysed using a 2 (Modality: photograph, drawing) x 2 (Condition: colour change, black and white) x 3 (Question Type: verbal, behavioural, memory control) mixed ANOVA. There was no significant effect of modality. A significant main effect of condition, $F(1, 60) = 172.16$, $MSE = 234.08$, $p < .001$, $\eta_p^2 = .74$, revealed that adults in the black and white condition ($M = 3.90$, $SE = .12$) gave significantly more intentional responses than adults in the colour change

condition (M = 1.69, SE = .12), indicating that picture ambiguity facilitated adults' as well as children's intentional responding.

For the remaining effects Greenhouse-Geisser values are reported due to a violation of Mauchly's sphericity assumption. A significant main effect of question type, $F(1.24, 74.55) = 179.72$, $MSE = 107.08$, $p < .001$, $\eta_p^2 = .75$, also revealed that across condition adults gave significantly more intentional responses to the memory control question (M = 3.97, SE = .02) than the verbal (M = 2.19, SE = .13) or behavioural questions (M = 2.22, SE = .12). This also mirrors children's performance, and indicates that adults too remembered what the artist had intended to draw or photograph.

Finally, a significant Question Type x Condition interaction was identified (see Table 5), $F(1.24, 74.55) = 149.33$, $MSE = 88.97$, $p < .001$, $\eta_p^2 = .71$. In order to establish the nature of this interaction, two separate one-way within subjects ANOVAs were conducted for the colour change and black and white conditions. Adults in the colour change condition gave significantly more intentional responses to the memory control question (M = 3.94, SE = .04) than the verbal (M = .56, SE = .24) or behavioural questions (M = .56, SE = .24), $F(1, 31) = 203.60$, $MSE = 243$, $p < .001$, $\eta_p^2 = .87$. No significant effect of question type was found in the black and white condition.

Individual univariate ANOVAs were also conducted for each of the three question types. Adults in the black and white condition gave significantly more intentional responses to the verbal, $F(1, 62) = 161.82$, $MSE = 161.82$, $p < .001$, $\eta_p^2 = .72$, and behavioural questions, $F(1, 62) = 183.32$, $MSE = 175.56$, $p < .001$, $\eta_p^2 = .75$, than adults in the colour change condition. Chance analyses (chance value = 2) further revealed that adults in the black and white condition gave significantly more

intentional responses to the verbal (M = 3.81, SE = .09, $t(31)$ = 19.16, p < .001, behavioural (M = 3.88, SE = .06), $t(31)$ = 31.57, p < .001, and memory control questions (M = 4.00, SE = 0.00) than would be expected by chance, with ceiling performance on the memory control question. Adults in the colour change condition also gave significantly more intentional responses to the memory control question (M = 3.94, SE = .04), $t(31)$ = 44.57, p < .001, than would be expected by chance, however, they gave significantly fewer intentional responses to the verbal (M = .56, SE = .24), $t(31)$ = -6.06, p < .001, and behavioural questions (M = .56, SE = .24), $t(31)$ = -6.06, p < .001, than would be expected by chance, indicating a firm realist response to these questions.

Table 5

Percentage of Intentional responses given by adults in the Photograph and Line drawing Tasks in Experiment 3

	Photograph		Line drawing	
	Black and white	Colour change	Black and white	Colour change
Verbal	95%	14%	42%	14%
Behavioural	97%	14%	59%	20%
Memory Control	100%	98%	94%	100%

The findings of Experiment 3 largely replicate those of Experiment 1. Adults follow an intentional strategy to picture interpretation when they are presented with ambiguous pictures, which could represent multiple referents, but switch to realist responding when shown pictures that unambiguously represent a single real world

referent. Experiment 3 also extends the findings of Experiment 1 to reveal that adults, unlike children, are aware that when a picture is ambiguous both appearance and intentional cues can identify what it represents; a greyscale image can represent its intended referent (e.g. pink duck) but also any object similar in appearance (e.g. blue duck). Overall, children and adults use appearance and intentional cues similarly when interpreting pictures. However, adults demonstrated a more sophisticated notion of how the two cues interact when pictures are ambiguous, which is likely the result of additional experience with pictures.

2.4 General Discussion

Pictures share both a resemblance-based link to their real world referents, and an intentional link to their creator. The current experiments examined under what conditions children and adults use these cues to interpret pictures. It was hypothesised that when the picture-world relationship was transparent, participants would rely on resemblance cues to interpret them, whereas when the picture-world relationship was unclear, they would turn to the artist-picture relationship for intentional cues. In accordance with these hypotheses, the findings show that children and adults gave predominantly appearance-based responses when asked to name or retrieve the referents of non-ambiguous pictures, yet relied on intentional cues when interpreting ambiguous pictures. In theoretical terms, this suggests that the picture-world relationship is attended to before the picture-artist relationship (Freeman & Sanger, 1995).

Experiments 1 and 3 revealed that both children and adults identified unambiguous pictures, which resembled only one object referent (colour change condition), as representing the referent they resembled and not the intended referent.

In line with the hypotheses, this indicates that when the picture-world relationship is transparent, resemblance cues are prioritised over intentional cues, which suggests that both children and adults have a predisposition to judge pictures based on the extent to which they resemble their real world referents (Browne & Woolley, 2001; Richert & Lillard, 2002). It seems unlikely that realist responding is a result of participants forgetting the artist's stated intention since overall intentional responding was high for the memory control question ("what did I mean to take/draw a picture of?"). However, there were some individual differences that warrant discussion.

A subset of children in all conditions did not give intentional responses to this question (see Tables 2 & 3). The drop in 5- and 6-year-olds intentional responses may be attributable to their disbelief that the experimenter wanted to draw a pink duck, but instead drew a blue duck, for example. The high level of conflict between intention and appearance in this condition, combined with the artist's seemingly deliberate incorrect crayon choice, may have led older children to reject her stated intention. Instead they may have assumed that she intended to depict the referent she actually drew (e.g. 'she must have intended to draw the blue duck because that is what her picture looks like'), which would lead to fewer intentional and more appearance-based responses. However, since the 3- and 4-year-olds gave far fewer intentional responses (photograph task: 45%; line drawing task: 64%), than the 5- and 6-year-olds (photograph task: 75%; line drawing task: 79%), this suggests that perhaps they were more susceptible to forgetting the artist's intention.

In the black and white condition children's performance could be explained by repeated questioning. The memory control question was always asked last, and thus children in this condition had already given two intentional responses when they were asked this question. If children thought their previous answers were wrong this may

have discouraged them from giving another intentional response (Krahenbuhl, Blades & Eiser, 2009; Siegal, Waters & Dinwiddy, 1988). The drop in intentional responding in this condition was more pronounced for the 5- and 6-year-old children, indicating that they might have been more sensitive to question repetition than the 3- and 4-year-old children. It is important to note that these findings cannot entirely rule out the possibility that some children had forgotten the picture creator's intention, and gave non-intentional responses simply because they were looking at the final picture. Nonetheless, with the exception of the adults in the colour change condition of the line drawing task, the majority of participants did remember the artist's stated intention.

Experiment 2 ruled out the possibility that children's realist responses in the colour change condition were a reaction to the artist ignoring that the picture's appearance had changed. They gave realist responses regardless of whether the experimenter knew what the picture was intended to represent or not, apparently confirming that they were genuinely focusing on the picture's appearance. However, despite giving overwhelmingly realist responses to the test questions, 48% of children spontaneously acknowledged the importance of the artist's intention by making one or more attempts to inform the experimenter that the picture's appearance was 'wrong' or unexpected in relation to the original intention (e.g. "she took a picture of the blue one, and now it is pink"). This suggests that children were processing appearance and intention cues in parallel. While appearance responses were dominant, children were aware of intentional information and made a conscious effort to ensure it was not ignored. However, there is another potential explanation for children's protests, which is that they simply did not like the discordant knowledge of the two experimenters and were attempting to resolve the conflict. Whilst this is plausible, the work of Rakoczy

and colleagues supports the initial claim; they report that children protest when a new player violates the rules of a game, precisely because they know that the rules are important (Rakoczy, Warneken & Tomasello, 2008, 2009). Previous research has shown that children are aware that an artist's intention is important when interpreting pictures (Gelman & Ebeling, 1998; Preissler & Bloom, 2008; Richert & Lillard, 2002), and thus in the current experiment, when children realised that the experimenter's intention had been violated without her knowledge they protested to ensure that, at the very least, the experimenter knew that he or she understood the relevance of the intentional information for interpreting the picture.

The general realist bias found in the present experiments can be explained with reference to the pictorial experience of children and adults. Children's picture books are typically made up of pictures that clearly resemble their real world referents, and adults talk to children about the link between these pictures and the world by labeling them (Fletcher & Reese, 2005), and pointing out their relevance to the child's own world using statements such as, "jelly, you had jelly on your toast this morning" (DeLoache & DeMendoza, 1987, p. 114). Thus, children learn that pictures represent the world by virtue of resemblance, and from the age of 15 months iconicity facilitates their ability to map information from pictures to their real world referents (Callaghan, 2000; Chiong & DeLoache, 2013; Ganea, Pickard & DeLoache, 2008; Tare, Chiong, Ganea & DeLoache, 2010). Perceptual similarity enhances the transparency of the picture-referent relationship and therefore makes it easier for children to understand that one refers to the other. Children are also encouraged to make their own pictures recognisable. Adults often ask young children to name their scribbles and these label requests reinforce resemblance as a defining characteristic of pictures. Callaghan (1999) also found that 3- and 4-year-old children make their

drawings more recognisable after they are told that an adult cannot match their picture to its referent. Intense focus on what a picture looks like persists until the age of around 11 or 12, with children typically referring to the appearance or content of a picture when asked their opinion (Parsons, 1987), and using subject matter to evaluate aesthetic beauty (Freeman & Sanger, 1995). Thus, the majority of children's early pictorial experiences revolve around transparent picture-world relationships that can be understood via resemblance. Consequently, when faced with unambiguous pictures in the colour change condition of the present experiments, children relied on resemblance cues because that is how they are familiar with interpreting pictures.

Experience may also be implicated in adults' realist responding, however, there is another explanation that might account more adequately for their performance. As previously discussed in relation to the memory control question, it is possible that adults might not have believed that the experimenter could reasonably intend to draw or photograph one object and instead produce a picture of a different object. Previously it has been found that adults have strong expectations about the correspondence between pictures and their referents, namely that they should look like one another (Browne & Woolley, 2001). This expectation may have encouraged adults to try and resolve the cue conflict by inferring intention from appearance (Bloom, 1996; Bloom & Markson, 1998), for instance, 'she must have intended to draw the blue duck because that is what her picture looks like'. Alternatively, they may have tried to decipher the pragmatics of the situation and ultimately, decided that appearance was a more stable cue given the inconsistent nature of the intentional cues.

Despite the staunch realism found in the colour change conditions of the current experiments, it was also found that children and adults appreciate that what an artist intends to depict is an important determinant of what a picture represents

(Wollheim, 1987). In line with the hypotheses, visually ambiguous pictures, those that equally resembled two object referents (black and white condition), were identified as representing their intended referent. This finding supports the claim that children are sensitive to the intentional cues provided by a picture creator from an early age (Gelman & Ebeling, 1998), but also confirms that intention is only prioritised when the picture's appearance is insufficient to determine its referent (Bloom & Markson 1998; Browne and Woolley, 2001; Preissler & Bloom, 2008).

Children and adults' ability to disambiguate pictures using an artist's intention fits into a wider body of literature concerning how attuned humans are to intentionality. Between 14 and 18 months old, children begin to infer intentionality from failed actions (Meltzoff, 1995), eye gaze and pointing (Behne, Carpenter & Tomasello, 2005; Liebal, Behne, Carpenter & Tomasello, 2009), and by 2.5-years children can infer an artist's intention from his or her eye gaze (Preissler & Bloom, 2008). Together, this suggests a natural proclivity for intentional information, which is further supported by studies showing that adults are unconsciously biased towards intentional explanations for behaviour (Rosset, 2008). This raises the question of why artist intention seems to function as a secondary cue to picture interpretation, when philosophers argue that it is a defining feature of what a picture represents (Barthes, 1977; Gombrich, 1972; Goodman, 1976; Scruton, 1981; Wollheim, 1987) and psychologists consider it to play a crucial role in the communicative efficacy of pictures (DeLoache, 2004).

One of the reasons children may not immediately use intentional cues to interpret pictures, is that they lack experience of doing so. It is uncommon for children to receive explicit instruction regarding how artists relate to their pictures. Picture book interactions typically consist of adults asking children to identify

pictures (e.g. “what is it?”) or report something about the depicted content, such as the sound a snake makes, (DeLoache & DeMendoza, 1987; Gelman, Chesnick & Waxman, 2005) rather than, “who do you think made this picture?” or “what do you think the person was trying to draw?” This lack of experience coincides with the fact that in everyday life people are not required to use intentional information to interpret pictures since they typically resemble what their artists intend them to (Bloom, 1996), meaning appearance-based responses are often sufficient. Although children are reluctant to spontaneously refer to an artist’s role in picture production (Gardner, Winner & Kircher, 1975), when it is explicitly demonstrated or intentions are stated, as in most research paradigms (Browne & Woolley, 2001; Callaghan & Rochat, 2003; Preissler & Bloom, 2008; Richert & Lillard, 2002), children can and do utilise intentional cues as they did in the black and white condition of Experiment 1.

Overall, there was no significant difference in the performance patterns of children and adults, however, adults’ responses to the black and white condition do provide room for conjecture regarding how their approach to the task may have differed from that of children. Adults in the line drawing task displayed a tendency to name the greyscale picture according to its final appearance (e.g. grey duck) or to state that the picture represented both target objects (e.g. pink and blue duck). The latter response type suggests that adults were either combining appearance and intentional cues (e.g. it was meant to be a pink duck but looks equally like both ducks) or assuming that the colourless image served as a representation of a category, ‘ducks’, rather than of a specific exemplar. Together, these responses suggest that the considerable experience adults have of using pictures as symbols allowed them to approach the current task with greater representational flexibility than children. This experience also imbues them with the knowledge that picture interpretation is one

domain in which beholders have the power to construct their own subjective interpretations without being 'wrong' (Freeman & Sanger, 1995; Gombrich, 1961; James, 1890/1950; Wollheim, 1987). This manifested itself in adults combining cues that were presented individually, as well as going beyond the provided cues to apply their broader knowledge of how pictorial conventions function in the real world, for instance, approaching black and white pictures as generic representations. The knowledge that we can interpret the world in multiple ways, and that people can perceive the same picture differently (Lagattuta, Sayfan & Blattman, 2010) is referred to as an interpretive theory of mind (iToM). The onset of iToM is around the age of 7 (Carpendale & Chandler, 1996; Chandler & Helm, 1984; Taylor, 1988), and since the current sample of children were aged between 3 and 6 this explains why adults felt confident in manipulating the responses explicitly provided by the task, while children never did this. Future research could explore whether older children who have acquired an iToM might manipulate their responses as adults did, thereby demonstrating a developing insight into the subjective nature of pictorial representations.

The dual representation hypothesis was also explored by asking two different questions to tap into children's perception of pictures as symbols or as concrete objects. Contrary to the hypotheses, intentional responding did not increase when children were asked the behavioural question ("can you pass me this?") compared to the verbal question ("what is this a picture of?"). Thus, it would appear that children's responses were solely reliant on cues from the picture and the artist rather than question format. Consequently, responses to the behavioural question served only as a check that children's knowledge was not being underestimated by the verbal demands

of the question, “what is this a picture of” (Bloom, 2004; Jolley, Zhi & Thomas, 1998).

Modality was the final manipulation used in Experiments 1 and 3. In support of the hypotheses, 3- and 4-year-old children in the photograph task gave fewer intentional responses, across both conditions, than 3- and 4-year-old children in the line drawing task. Contrastingly, 5- and 6-year-old children and adults gave a similar number of intentional responses in the photograph and drawing tasks. What could explain this age-related performance difference? Children begin to use verbal and non-verbal cues, such as eye gaze, to infer an artist’s intentions and decode drawings between the ages of 2.5- and 3-years (Bloom & Markson, 1998; Gelman & Ebeling, 1998; Preissler & Bloom, 2008). Associative cues are not sufficient for this mapping to occur (Preissler & Bloom), thus indicating that young children are knowledgeable about the criteria for using intentional cues to interpret drawings. The link between intention and photography is less visible; although the photographer also gazes at a referent or scene, the presence of the camera and reliance on a printer (in the present experiment) in order to produce the final output could disrupt younger children’s developing ability to map a photographer’s intentions directly onto their pictures. On the other hand, increasing iPad and smartphone usage among school-aged children (Rideout et al, 2013; Ofcom, 2013) is resulting in greater direct experience with photographs and the photographic process, which may bolster their understanding of how photographers’ intentions shape their pictures (Kose, 1985). Furthermore, improvements in theory of mind (Callaghan et al., 2005; Wellman, Cross & Watson, 2001; Keysar, Lin & Barr, 2003) likely facilitate a mature understanding of intention, allowing children to make the more complex and indirect photographer-picture mapping.

The present studies focused on colour iconicity, however, colour is only one of the ways in which symbols resemble their referents. Future work should therefore investigate the importance of appearance and intentional cues for other types of iconicity, such as shape and size (see Sloutsky, 2003 for a discussion of the relative importance of different similarity relations). For instance, if the printer had produced a crocodile instead of a duck appearance-based responding would likely have increased, since shape is a powerful cue in defining an object's identity (Bloom & Markson, 1998; Gelman & Ebeling, 1998; Landau, Smith & Jones, 1988; Landau, Smith & Jones, 1998), and thus may override the importance of a creator's intention to a greater extent than was seen in the current experiments. By contrast, size might have had a weaker impact on intentional responding. A picture of a pink duck, which depicts the duck as larger or smaller than it is in reality does not contradict the artist's intention (to depict a pink duck) as strongly as a differing shape might; it remains a representation of a pink duck. Since the present results are specific to colour iconicity it is important for future research to build upon these findings by addressing how powerful other resemblance-relations are in terms of overriding intentional cues when interpreting pictures.

Taken together, the results of these three experiments have theoretical implications for Freeman and Sanger's (1995) intentional net. The relationships within the net appear to be processed hierarchically. The picture-world relationship is attended to first, and if it is insufficient to provide a clear picture interpretation participants utilise the artist-picture relationship as an additional source of information. Furthermore, children's understanding of picture creators' intentions matures with age until they understand both the direct and indirect creator-picture relationships that exist in different modalities. This extends previous work by showing

that children and adults are not realists *or* intentional picture interpreters; rather they adapt their cue use to fit the specific picture they are viewing. This and the similar performance of adults and children supports the notion that picture interpretation is dependent upon pictorial experience (Lin & Thomas, 2002; Parsons, 1987) as well as age.

Chapter Three: **Comparing children's reliance on artists' versus photographers' intentions during picture interpretation**

One approach to deciphering artwork is to focus on its source: the creator. According to Dutton (1979), "the work of art has a human origin, and must be understood as such" (p. 305). When we talk about artwork, we often refer to creations as a 'Monet' or a 'Picasso', prioritising the creator over the content. One important aspect of an artist's input is intention (Bloom, 1996, 2004; Freeman & Sanger, 1995; Perner, 1991). Artists create pictures with the intention to represent their referents, and it is these intentions that motivate the picture-referent relationship (Bloom, 1996, 2004; DeLoache, 2004; Freeman, 2000; Freeman & Sanger, 1995): "nothing is inherently a symbol; only as a result of someone using it with the goal of denoting or referring does it take on a symbolic role" (DeLoache, 2004, p. 67).

Theoretical accounts of pictorial understanding have posited that intention underlies our intuitions about pictures (Bloom, 1996, 2004; Freeman & Sanger, 1995), in particular, how we name and categorise them. Bloom's (1996, 2004) intentional-historical theory of art suggests that while it might appear that we name pictures according to what they resemble, for instance, a picture that looks like a dog represents a dog, in reality resemblance serves as a cue to intention. A picture looks like a dog because it was created with the intention to represent a dog. Empirical evidence confirms that even very young children rely on intentional cues when decoding drawings, however it is an open question whether such cues hold when children evaluate photographs. The current experiment examines whether the method of creation affects how children name drawings and photographs, and also assesses how they value such creations.

From the age of 2-years children name ambiguous drawings according to what the experimenter was looking at while drawing (Bloom & Markson, 1997; Preissler & Bloom, 2008), thus demonstrating an early sensitivity to the importance of referential intentions, as well as the ability to track these intentions via subtle behavioural cues such as eye gaze. Furthermore, as explained in Section 1.3, Gelman and Ebeling (1998) report that when pictures are not created intentionally 2- and 3-year-old children are less likely to name them according to shape (e.g. a man), and more likely to name them according to the material used to create them (e.g. paint), which suggests that intention is an important factor for determining the representational status of a picture.

It has also been posited that intention might contribute to the value of a picture since, "artwork is a product of thoughtful human activity" (Bloom, 2004, p. 92). Thus, it is plausible that when compared to accidental creations, intentionally created pictures will be preferred based on the human investment they represent, even if the pictures are identical. However, while the human element of drawing or painting is undeniable, photography presents an interesting comparison since the role of the photographer is mediated by the influence of an insentient camera.

Unlike drawings or paintings (hereafter referred to as handmade pictures), photographs do not share a direct or transparent relationship with their creator's intentions; they are both causally and intentionally related to their referents (Bloom, 2004; Gooskens, 2012; Perner, 1991; Ross, 1982; Scruton, 1981). Although photographers set out to create pictures with intentions that are just as valid as those possessed by artists (Bloom, 2004), cameras capture any referent that is in their field of vision, irrespective of the photographer's intentions (Bloom, 1996; Costello & Phillips, 2009; Currie, 1999; Sontag, 1977). For instance, while a photographer might

intend to take a picture of a bleak and empty field, if a rabbit runs in front of the camera the subsequent photograph will depict the rabbit. This distinction between the representing relations that characterise handmade pictures and photographs has led to a debate about the relevance of intention for interpreting photographs. Some theorists argue that the influence of causality devalues the role of intention in photography (Bazin & Gray, 1960; Black, 1979; Bloom, 1996; Browne & Woolley, 2001; Costello & Phillips, 2009; Schier, 1986), while others contend that photographs remain a medium for expression, and thus should still be understood in light of their creators' intentions (Alward, 2012; Mitcheson, 2010; Newhall, 1978; Scharf, 1974; Wilson, 2012). To date, which of these positions children and adults adopt when interpreting photographs remains an open question, as research has not yet empirically addressed the role intention plays in the interpretation of photographs.

The suggestion that intention is devalued in photography receives some support from reports that children rarely refer to the photographer when discussing their own or others' photographs. When Sharples, Davison, Thomas and Rudman (2003) asked 7-, 11- and 15-year-old children why they had taken particular photographs, their responses provided little indication of whether they were created with clear intentions in mind or were simply "lucky accidents" (p. 12). Furthermore, Liben and Szechter (2002) found that 7- and 8-year-old children chose their favourite photographs on the basis that they liked the depicted content, rather than because they appreciated the photographer's style or use of technique. Nonetheless, Liben (2003) showed that in a simplified task some 5-year-old children, and most 7-year-olds could attribute differences between pairs of photographs to 'something the photographer did'.

In contrast, children demonstrate substantial knowledge of the role cameras play in the photographic medium (Kose, 1985; Wellman & Hickling, 1994). Kose (1985) asked 7- to 11-year-old children several open-ended questions, such as "are there things you can't take photographs of?" and "what makes a photograph good?" The majority of responses described how the referential content, or cameras, impose restrictions on what can be photographed, and how it looks in the final picture. For instance, one child commented that "sometimes cameras make things dark and fuzzy and you can't see them" (p. 376). Likewise, Wellman and Hickling (1994) reported that when 6-, 8- and 10-year-old children were asked to explain how instant photographs are made they described the role of the camera, rather than the photographer. Collectively, these studies indicate that children's sensitivity to the role of the photographer may be overshadowed by a focus on the mechanical nature of photograph creation.

One other factor that may affect how children view photography is the iconicity of a picture. Photographs are typically highly realistic representations of their referents, in contrast to handmade pictures, which can vary in how closely they resemble the real world. When considering young children's creations, it is not atypical for a 4-year-old to draw an ambiguous picture of a monkey (Bloom & Markson, 1998; Callaghan, 1999; Jolley, Knox & Foster, 2000; Louis, 2013), but take a perfectly realistic and canonical photograph of one (Liben & Szechter, 2002). Using ambiguous photographs would provide an inaccurate representation of the role intention plays in this medium, and so in order to remain faithful to the two picture formats under investigation, and the outputs children are likely to see, in the current experiment realistic photographs and ambiguous handmade pictures were purposefully used.

Overall, the aim of the current experiment was to investigate whether 4- and 6-year-old children consider intention to be of equal importance for interpreting drawings and photographs, or whether a photographer's intention is devalued due to the less agentive and more mechanical nature of photography. In order to answer this question the importance of intention was assessed on two dimensions: naming and judging the value of pictures. Adapting the methodology used by Gelman and Ebeling (1998), participants were presented with pairs of intentionally and accidentally created pictures and were asked to name them ("what is this?"), to select the picture they wanted to take home (preference question) and to select the one they thought their Mum would like best (beholder question). Based on reports that children do not possess a good grasp of the role of cameras or photographers until age 6 (Wellman & Hickling, 1994), yet are sensitive to the intentions of artists from the age of 3 (Gelman & Ebeling) the current sample consisted of 4- and 6-year-olds, to ensure children had sufficient experience with both mediums to engage with the task. A group of adults were included as a control sample.

Given children's early sensitivity to artists' intentions (Gelman & Ebeling, 1998; Preissler & Bloom, 2008) it was hypothesised that 4- and 6-year-old children in the handmade condition would name pictures differently depending on how they were created, with more shape names being given to intentionally created pictures. Furthermore, if intention does contribute to the value of a picture all participants in this condition were expected to show a preference for intentional over accidental pictures. In the photograph condition it was not possible to assign 'material' names since the pictures were not composed of identifiable materials. Thus it was hypothesised that if intention is important in the photographic medium, participants might give the intentional photographs a 'scene-based' name, for instance, 'beach',

while only naming individual components of the accidental photographs, for example, 'bucket and spade'. This is based on the intuition that children may expect intentional but not accidental photographs to be aimed at a coherent scene; aiming a camera is something children experience in their own attempts at photography, and thus should be able to take into account when viewing others photographs (Liben, 2003; Liben & Szechter, 2002). Nonetheless, it was hypothesised that due to increased experience of taking photographs 6-year-old children might assign different names to the intentional and accidental photographs more often than 4-year-olds. Furthermore, if intention contributes to the value of a photograph participants were expected to show a preference for, and therefore more highly value, intentional over accidental photographs (Gelman & Ebeling, 1998; Preissler & Bloom, 2008).

If intention is devalued in photography, it was anticipated that participants would assign the *same* resemblance-based names to both pictures, since photographs represent their depicted referents via causation regardless of how they are created. Furthermore, participants were expected to choose an equal number of intentional and accidental photographs in response to the preference questions. No age-related differences were expected in the appreciation of intention, since even 7- and 8-year-old children show little regard for the photographer when appraising photographs (Liben & Szechter, 2002; Sharples, Davison, Thomas & Rudman, 2003). Finally, in both conditions it was anticipated that any preferences exhibited by participants would be extended to an independent beholder, if they were based on a stable belief that one of the pictures is more valuable than the other. Alternatively, if preferences were based on idiosyncratic inclinations a different preference pattern was expected for participants and an independent beholder.

The findings of this experiment will clarify how children and adults perceive the picture-referent and picture-creator relationships across different picture modalities, and what impact this has on how they name and evaluate photographs compared to handmade pictures. If causality is shown to undermine the importance of intention in photography this will confirm that children weight the intentional relationship between creators and their pictures (Bloom, 1996; Freeman & Sanger, 1995; Freeman, 2000) differently based on whether the pictures are created by hand or not. These results will have important implications for how we think about children's developing understanding of the 'human' component of art.

3.1 Experiment 4

3.1.1 Method

Participants

Ninety-eight typically developing children aged 4 and 6 participated in the photograph condition ($N = 48$) or the drawing condition ($N = 50$); 32 adults were also included. See Table 6 for condition groupings, and age-related descriptive statistics. Children were recruited from six primary schools, three nurseries, one holiday play scheme, and the database of the Centre for Research in Human Development and Learning (CRHDL) at Lancaster University. Families were predominantly white and middle class.

Table 6

Children's Age and Condition groupings in Experiment 4

	Condition					
	Photograph			Handmade		
	N	M_{age} (months)	*Range*	*N*	M_{age} (months)	*Range*
Age group						
4	16	52m	48-59m	17	55m	50-59m
6	16	77m	72-81m	17	79m	74-83m
Adults	16	18y	18-20y	16	18y	18-19y

Design

A 2 (Condition: photograph, handmade) x 2 (Picture Type: intentional, accidental) x 3 (Question Type: naming, preference, beholder) mixed design was used. Condition acted as the between-subject factor, while picture type and question type acted as within-subject factors. Each participant gave eight naming responses, and received four preference scores and four beholder scores. Preference and beholder scores were summed across trials to provide one composite score per question type.

Materials

Four 6 x 4 inch handmade pictures (see Figure 4) based on stimuli used by Gelman and Ebeling (1998), and four 6 x 4 inch photographs were used as pictorial stimuli (see Figure 5). Two short vignettes accompanied each picture; one vignette described the picture as intentionally produced and the other described it as

accidentally produced. For instance, in the handmade condition one vignette read: "When David was painting in art class, he used some paint to make a picture" (intentional) and "When Chris was painting the house he accidentally spilled some paint on the floor (accidental). While, in the photograph condition one of the vignettes read: "Tom went to the beach on holiday, and he decided to take a picture to remember his day out" (intentional) and "Kane went to the beach on holiday. While he was there he tripped over his camera and it took a picture" (accidental). See Appendices A and B for a full list of vignettes. The handmade pictures were reproduced from Gelman and Ebeling (1998) and the photographs were gathered from the Internet.

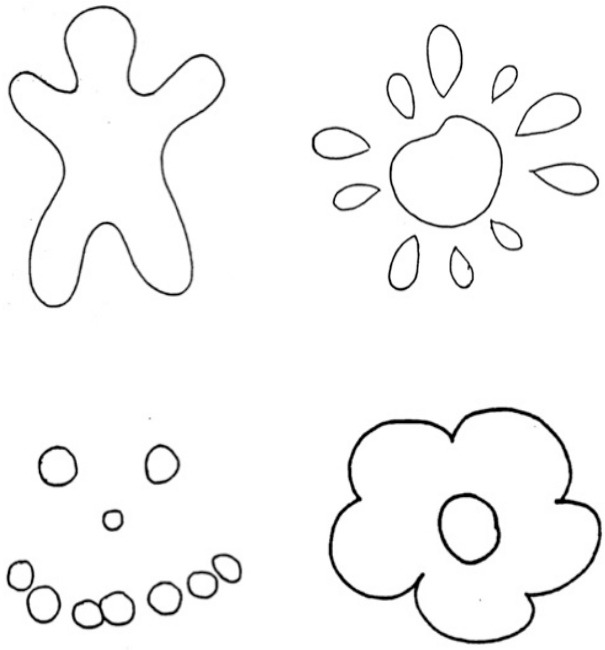

Figure 4. Pictorial stimuli used in the handmade condition of Experiment 4

Figure 5. Pictorial stimuli used in the photograph condition of Experiment 4

Procedure

Participants each took part in four trials of either the photograph or the handmade condition. Within each trial participants viewed two identical pictures and were told one had been created intentionally while the other had been created accidentally. After the first vignette was read participants were shown the associated picture and asked 'What is this?' (naming question). The second vignette and picture were then introduced and the naming question was asked again. The two pictures were then placed next to one and other and participants were asked a further two questions: 'Which picture would you choose to take home?' (preference question) and 'Which picture would your Mum like best?' (beholder question). The vignette and questions were repeated for any participants who did not respond or said they did not know. The order in which participants were read the intentional and accidental vignettes was counterbalanced, as was the order of the preference and beholder questions.

Coding

Responses to the naming questions were coded differently for the handmade and photograph conditions. In the handmade condition, a four-category coding system was used. If participants labelled the picture according to shape this was coded as ‘shape’, whereas if they labelled the picture according to material this was coded as ‘literal’. Remaining responses were coded as 'other' and null responses as 'don't know'. In the photograph condition, since the majority of participants named both the intentional and accidental photographs according to referential content, it was only necessary to code responses as ‘same’ or ‘different’. Contrary to the hypotheses, those assigned to the ‘different’ category did not fall into ‘scene’ and ‘component’ subcategories. In both conditions, responses to the preference and beholder questions were coded as 'intentional', 'accidental' or ‘both’ according to which of the two pictures participants selected.

3.1.2 Results

Due to the different manner in which participants were expected to assign names to the photographs and handmade pictures, the naming data from these two conditions are considered separately. However, data from the preference and beholder questions are compared across condition.

Naming responses

Photograph Condition. In line with the resemblance hypothesis, the majority of participants named both pictures in each pair on the basis of referential content. Several children (13/32) and a handful of adults (3/16) did assign different names to the intentional and accidental pictures, typically by naming an extra or different

referent for the second picture. For instance, naming the first picture ‘a beach’ and the second picture ‘a beach and a bucket’. Contrary to the hypotheses, there was no evidence that participants had attempted to give ‘scene-based’ names to intentional pictures, or tried to name individual components of accidental pictures. Notably, eleven participants, five 4-year-olds and six 6-year-olds explicitly stated, on at least one trial, that both pictures in a pair were “the same”. Due to the largely homogeneous nature of picture naming in this condition statistical analyses were unnecessary.

Handmade Condition. Only 2 children used a name that did not conform to the ‘shape’ or ‘literal’ categories. Due to the scarcity of such responses, they were removed prior to further analysis. Preliminary analyses did not find any picture or vignette order effects, and McNemar chi square tests revealed no stimulus effects on naming responses. Consequently, ‘shape’ and ‘literal’ names were collapsed across trials to allow parametric analysis. Due to the dichotomous nature of these responses (shape or literal), shape names were used as the dependent variable in the subsequent analysis.

A 3 (Age Group: 4, 6, adults) x 2 (Name: intentional, accidental) mixed ANOVA revealed a significant main effect of naming, $F(1, 47) = 20.37$. $p < .001$, $\eta_p^2 = .30$. Pairwise comparisons subjected to Bonferroni adjustment indicated that participants named intentional pictures ($M = 2.88$, $SE = .21$) according to shape significantly ($p < .001$) more often than accidental pictures ($M = 2.34$, $SE = .23$). Chance analyses (chance value = 2) showed that intentional pictures were named according to shape significantly more often than would be expected by chance, $t(49) = 4.17$, $p < .001$ (See Figure 6). By contrast, participants named accidental pictures

according to shape at a level equal with chance, $t(4) = 1.48$, $p = .15$. There was no significant effect of age group. Thus, these findings replicate those of Gelman and Ebeling (1998), by showing that both children and adults take into account how a picture is produced when naming it. Intentional pictures were named according to shape, whereas accidental pictures were equally likely to be named according to the material used to create them or via shape.

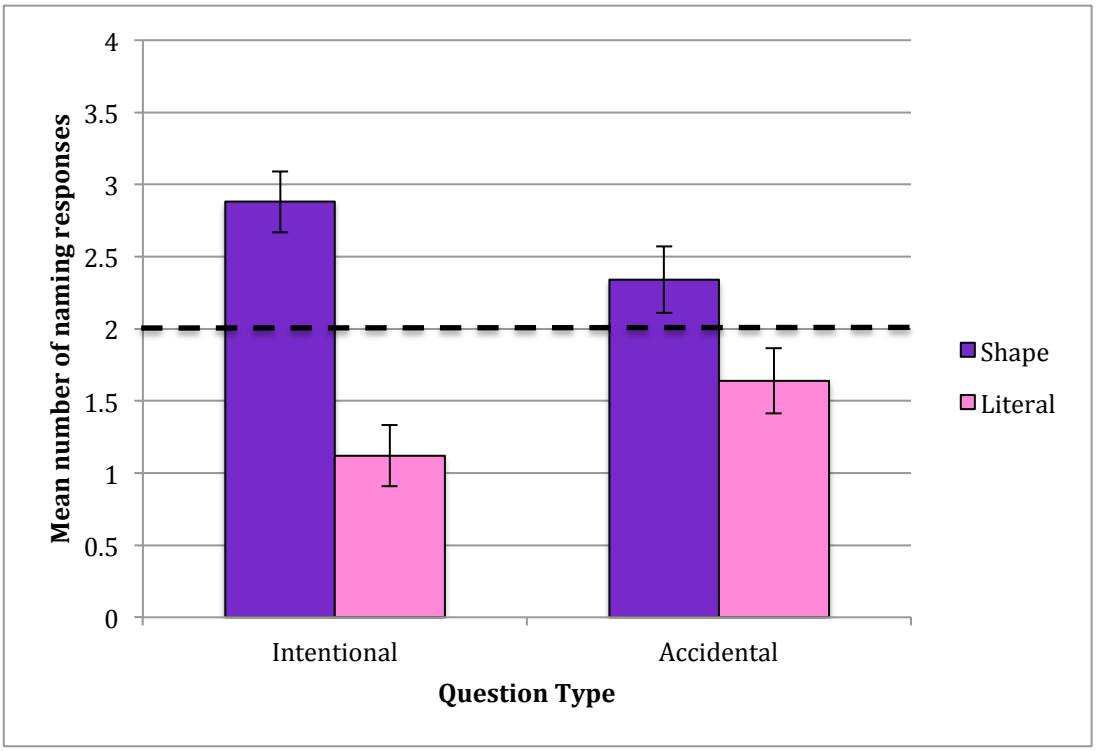

Figure 6. Mean number of shape and literal names assigned to the intentional and accidental pictures in Experiment 4. Error bars represent standard error.

Preference and Beholder questions

Across four trials responses to the preference and beholder questions were coded as 'intentional', 'accidental' or 'both'. Since preliminary analyses did not find any picture or vignette order effects, and McNemar chi square tests revealed only one stimulus effect, between the smile and sun trials for the preference question in the

handmade condition, responses were collapsed across trial for the preference and beholder questions. Thus, for every participant, the number of responses (out of 4) per category was calculated for each question type.

In order to identify whether the choice of intentional, accidental or both pictures was related to experimental condition (photograph, handmade), question type (preference, beholder) or age group (4-years, 6-years, adults), the data was entered into a hierarchical loglinear analysis (HLA), and backward elimination was used to determine which combination of interactions among the variables provided the model that best fit the data. This is a commonly used method for analysing categorical data that has more than two factors (Field, 2013); it works by sequentially removing factors and interactions to examine the effect on the likelihood ratio chi-square (G^2), which is the test statistic associated with HLA. If the removal of any given factor (or interaction) significantly changes the likelihood ratio, then removing the factor(s) has a significant effect on the fit of the model and it is retained, whereas if there is no change to the likelihood ratio then the factor(s) is removed. This iterative process continues until only the factors and interactions that have a significant effect on the model remain, thus resulting in a model that provides the closest fit to the data.

A 4-way (Age Group x Condition x Question x Picture Choice) hierarchical loglinear analysis was conducted. Table 7 shows that one first order effect (Response Type), and three higher order effects (Condition x Response Type, Age group x Response Type and Age group x Condition x Response Type) were significant. The final model is displayed in Table 8. This was the least complex model that did not differ significantly from the saturated model (which includes all effects and interactions). In loglinear analysis a non-significant effect indicates that the expected

values of the saturated model does not differ significantly from the values observed in the dataset. As such, higher p values indicate a better-fitting model.

Table 7

Partial Associations for all terms in loglinear analysis (Experiment 4)

Effect	df	Partial χ^2	Probability
AG x C x QT	2	.121	.941
AG x C x PC	4	49.28	< .001*
AG x QT x PC	4	2.669	.615
C x QT x PC	2	1.870	.393
AG x C	2	.036	.982
AG x QT	2	.020	.990
C x QT	1	.071	.790
AG x PC	4	27.298	< .001*
C x PC	2	71.461	<. 001*
QT x PC	2	.408	.816
AG	2	203	.903
C	1	.217	.641
QT	1	.032	.858
PC	2	185.143	< .001*

Note: AG: Age Group (4-years, 6-years and Adults); C: Condition (Photograph, Handmade); QT: Question Type (Preference, Beholder); PC: Picture Choice (Intentional, Accidental, Both). Statistical significance denoted by *

Table 8

Final model: Difference estimation from saturated model (Experiment 4)

Model	df	Likelihood ratio G^2	Probability
AG x C x PC	18	6.57	.99

Note: AG: Age Group (4-years, 6-years and Adults); C: Condition (Photograph, Handmade); PC: Picture Choice (Intentional, Accidental, Both).

In order to establish the nature of the Age Group x Condition x Picture Choice interaction separate chi square tests on condition and picture choice were performed for the three age groups. For 4-year-olds, there was no significant effect of condition on picture choice, χ^2 (2) = 1.53, p = .47, V = .08 (see Table 9). For 6-year-olds, there was a significant effect of condition on picture choice, χ^2 (2) = 35.94, p < .001, V = .37. Finally, for adults there was also a significant effect of condition on picture choice, χ^2 (2) = 58.52, p < .001, V = .48. Six-year-olds and adults chose more intentional pictures in the handmade than the photograph condition (see Tables 10 and 11). There was no difference in the number of accidental pictures selected in the two conditions. Lastly, they chose both pictures more often in the photograph than the handmade condition.

Table 9

Number of picture choices per condition for 4-year-olds in Experiment 4

	Condition	
	Photograph (%)	Handmade (%)
Picture Choice		
Intentional	67 (52%)	72 (53%)
Accidental	51 (40%)	48 (35%)
Both	10 (8%)	16 (12%)

Table 10

Number of picture choices per condition for 6-year-olds in Experiment 4

	Condition	
	Photograph (%)	Handmade (%)
Picture Choice		
Intentional	53 (41%)	83 (61%)
Accidental	41 (32%)	51 (38%)
Both	34 (27%)	2 (1%)

Table 11

Number of picture choices per condition for adults in Experiment 4

	Condition	
	Photograph (%)	Handmade (%)
Picture Choice		
Intentional	59 (46%)	97 (77%)
Accidental	21 (16%)	29 (23%)
Both	48 (38%)	0

Response pattern analysis

Since participants always named the pictures before being asked the preference and beholder questions, it was important to investigate whether 6-year-old children and adults' preference for intentionally created handmade pictures was based on how they were created (intentional vs. accidental) or how they were named (shape vs. literal). In order to do so, the handmade picture data were recoded into four categories per trial: shape-intentional, shape-accidental, literal-intentional and literal-accidental. Where participants had assigned different names to the two pictures, I identified the name they had assigned (shape or literal) to the one they preferred (intentional or accidental). For instance, if the intentional picture was selected and had previously been named according to shape, this response was included in the 'shape-intentional' category. 'Both' picture choices were omitted since there was no preference to match to a name. Preference and beholder responses were collapsed since question type did not emerge as a significant effect in the loglinear analysis.

Overall, 6-year-olds and adults who gave shape names (e.g. man) to both pictures preferred the intentional to the accidental pictures. However, generally this was also true of 6-year-old and adults who gave literal names (e.g. paint) to both pictures (see Tables 12 and 13). Chi square tests of independence confirmed that there were no significant associations between naming and picture choice[2], which suggests that intentionally created handmade picture selections were motivated by how the pictures were created, rather than how participants named them.

Table 12

Number of intentional, accidental and both picture choices per name category, given by 6-year-old participants in Experiment 4

	Trial			
	Man (%)	Flower (%)	Smile (%)	Sun (%)
Response category				
Shape – Intentional	18 (69%)	12 (50%)	18 (69%)	13 (72%)
Shape – Accidental	8 (31%)	12 (50%)	8 (31%)	5 (28%)
Literal – Intentional	1 (14%)	6 (60%)	5 (63%)	10 (77%)
Literal – Accidental	6 (86%)	4 (40%)	3 (37%)	3 (23%)

[2] With the exception of the 'man' trial for 6-year-olds, χ^2 (1) = 6.82, p = .039, Φ = .45

Table 13

Number of intentional, accidental and both picture choices per name category, given by adults in Experiment 4

	Trial			
	Man (%)	Flower (%)	Smile (%)	Sun (%)
Response category				
Shape – Intentional	17 (65%)	22 (84%)	13 (54%)	22 (92%)
Shape – Accidental	9 (35%)	4 (16%)	11 (46%)	2 (8%)
Literal – Intentional	6 (100%)	6 (100%)	6 (75%)	7 (88%)
Literal – Accidental	0	0	2 (25%)	1 (12%)

3.1.3 Discussion

The purpose of the current experiment was to determine whether 4- and 6-year-old children, and adults, consider intention to be equally important when naming and judging the value of photographs and handmade pictures, or if intention is devalued in photography due to the additional influence of causality. These findings indicate that artists' intentions enjoy a privileged status, which does not extend to the intentions of photographers. The presence of intention influenced the naming, and increased the value, of handmade picture, yet did not affect how photographs were named or valued.

In the handmade condition, all participants named intentionally created pictures according to shape significantly more often than accidental pictures. While shape naming did not fall below chance for the accidental pictures, intentional creation did increase shape-based naming. Correspondingly, there was an increase in

the assignment of non-representational material names to accidentally created pictures. Thus, in line with the hypotheses and the findings of Gelman and Ebeling (1998), the representational status of a handmade picture is at least partly determined by the intentions of its creator.

Extending previous work the results also showed that intention contributes to the value of a handmade picture. Six-year-old children and adults chose to take home intentional over accidental pictures, a preference that was driven by how the pictures were created, rather than the names they were assigned: even those participants who named both pictures literally (e.g. paint) preferred the intentional pictures. The possibility that participants chose the intentional pictures based on their own idiosyncratic preferences was negated by the assertion that their Mother would also prefer the intentional pictures. Thus, it can be inferred that participants' intentional picture preference was based on a stable belief that the intentional picture was more valuable or somehow 'better' than the accidental picture.

One interpretation of these findings is that intention acts as an index of effort. It is plausible that 6-year-olds and adults would perceive a handmade picture in which an artist has invested time and effort as more valuable than one that was created in the absence of such human investment. Recent work has shown that young children use creative effort to assign ownership of an object or artwork. Three-year-olds consider the creator of a new artwork to be its owner (Kanngiesser & Hood, 2014), while 3- and 4-year-olds are more likely to transfer ownership of modelling clay from one person to another, if the second person has transformed the clay into something new (Kanngiesser, Gjersoe & Hood, 2010). Crucially, 4-year-olds justify this change in ownership by referring to how it was created: it is mine because 'I made it!' or yours because 'you made it'.

Four-year-olds in the current study did not show a preference for the intentional handmade pictures when asked which picture they would like to take home, which suggests that if intention was used to infer effort, 4-year-olds did not value it in the same way as older children and adults. It may be that children this young are only capable of appreciating artistic effort that they have observed, as in the work of Kanngiesser and colleagues, whereas in the present task the identical appearance of the two handmade pictures might have led 4-year-olds to appraise the pictures on surface features alone: they look the same and therefore are of equal worth. By contrast, the older children and adults looked beyond appearance to judge the handmade pictures on a less tangible attribute, be that intention or perceived effort, which suggests a developing appreciation of the human element of artwork and in particular, the notion that an artist's input does not have to be seen to be appreciated. While the current data cannot confirm the association between intention and effort, or accidents with a corresponding lack of effort, future work should explore this possibility by asking children to justify their picture preferences.

Collectively, data from the handmade condition demonstrates that from a young age children value the human investment in hand-created pictures. Not only does an artist's intention elevate the representational status of a picture, it also contributes to its value. Correspondingly, a lack of intention lessens the extent to which a handmade picture is viewed as a representation, and makes it a less desirable picture to take home. Taken together these findings support intentionalist theories, which assert that intention provides a coveted route to understanding pictures (Bloom, 2004; Freeman & Sanger, 1995; Wollheim, 1987). Interestingly, and as predicted, intention carried less weight in the photograph condition.

The vast majority of children and adults in the photograph condition named both intentional and accidental pictures on the basis of resemblance and showed no preference for either picture. Moreover, when asked which picture they wanted to take home, both pictures were chosen more often by 6-year-old children and adults in the photograph than the handmade condition. Choosing both photographs indicates that these participants viewed them as equal, rather than simply having no preference, which provides particularly clear evidence of the lack of regard they had for the photographer's role in creating the images.

There are two possible explanations for the lack of consideration awarded to the photographer's intentions. Firstly, it might be that the causal connection between photographs and their referents is prioritised over intentional information. Photographs represent their referents via causation, regardless of whether the photographer created them intentionally or accidentally. Thus, unlike accidental handmade pictures, accidental photographs retain their representational status and can be named according to the referents they resemble. Prior research with children supports the causal argument. When Browne and Woolley (2001) introduced children to a puppet named George who wanted to draw a picture of a cow, yet 'accidentally' traced a picture of a horse, without seeing the final picture, 7-year-olds and adults named the drawing a horse, the referent it was causally linked to, ignoring George's intention to draw a cow. Reports that 7- and 8-year-old children focus on the camera's role (Kose, 1985; Wellman & Hickling, 1998) to the exclusion of the photographer (Sharples, Davison, Thomas & Rudman, 2003) also support the notion that in the current task participants may have focused on the relationship between cameras and photographs, and thus the causal nature of picture production, rather than the photographer's intention or lack thereof. If so, these findings indicate that children

considerably younger than 7 years old appreciate the causal nature of photography, which is consistent with the argument that, "because photographs are often thought to show the world as it "is"…the role of the artist may be less apparent" (Szechter & Liben, 2007, p. 880), and in this case less important.

Can this also explain why intention did not contribute to the value of a photograph? Research with adults suggests that the value of photographs lies in the direct and causal relationship they share with their referential content, for instance, a loved one or a favourite place (Gooskens, 2012; Hood, Donnelly, Leonards & Bloom, 2010). When adult participants were asked to cut up photographs of sentimental objects and control objects, significantly more electrodermal activity was elicited by the former activity. A control condition verified that this could not be explained by the visual resemblance shared by the photograph and the object, suggesting that adults were genuinely responding to these photographs as if they contained something of their referents (Hood, Donnelly, Leonards & Bloom). Since the photographs in the current task did not depict objects that were in any way special to the participants, and as preference was not related to naming in the handmade condition, these findings cannot adequately explain why the photographer's intentions did not contribute to the value of photographs. Alternatively, in light of the suggestion that an artist's intention may serve as an index of effort, perhaps the photographer's contribution was not perceived as effortful in the same way as the artist's contribution. Despite the wide array of skills required to become an accomplished photographer, the everyday assumption may be that at its most basic photography requires little more than the push of a button (Gullers, 1990; Liben, 2003). However, again, additional research is needed to confirm the link between intention and effort before such claims can be verified.

A second plausible explanation for these findings is that participants' responses to the photographs were motivated by resemblance cues, since they were not ambiguous. Previous work has reported that appearance is more important than intention when interpreting unambiguous pictures (Browne & Woolley, 2001). However, naming on the basis of appearance does not necessarily indicate a disregard for the role of intention. Bloom's (1996, 2004) account holds that under normal circumstances appearance is assumed to be the result of intentional action: a picture of a dog resembles a dog because it was intended to represent a dog. Furthermore, appearance was also a salient cue in the handmade condition, so much so that shape naming did not fall below chance even for the accidental pictures, yet in this condition mode of creation was taken into account. Thus, appearance should not have precluded a consideration of how the photographs, specifically, were created, particularly given how much emphasis was placed on creation in the vignettes. Accordingly, it seems likely that that there is something other than iconicity diminishing the importance of intention in photography, the most likely candidate being causality. Future work should focus upon disentangling the influence of iconicity and causality on the interpretation of photographs.

Collectively, the findings from this experiment confirm that intention is devalued in the photographic medium, thereby indicating that the human component of art is appreciated to a greater extent for handmade pictures than photographs. Although additional research is necessary, it remains a distinct possibility that this is attributable to the different representing relations that characterise the photograph-referent and handmade picture-referent relationships. Nonetheless, the results are consistent with the traditional argument that when viewing drawings or paintings "we are invited to make sense of the artist's thoughts about the subject" (Phillips, 2009, p.

4), whereas a photograph's "appearance is not interesting as the realization of an intention but rather as a record of how an actual object looked" (p. 579).

Chapter Four: **Exploring children's knowledge of the distinct roles played by artists and photographers in picture creation**[3]

People have been creating pictures for thousands of years (Aubert et al, 2014; Halverson, 1992; Jolley, 2010; Spivey, 2005) using pencils and paint, as well as mechanical devices such as cameras. How pictures are created has important implications for how they are perceived and this is particularly true when comparing drawings and photographs, given the disparate tools involved (Barrett, 1986; Bazin & Gray, 1960; Beilin, 1983, 1999; Cavedon-Taylor, 2014a; Pettersson, 2011). While many studies have assessed how children appraise the role of the artist (Bloom & Markson, 1998; Callaghan & Rochat, 2003; Preissler & Bloom, 2008), and an understanding of the artist-picture relationship lies at the heart of theoretical frameworks of pictorial development (Freeman & Sanger, 1995), comparatively little research has compared children's understanding of picture creation across modality (O'Connor, Beilin & Kose, 1981; Seidman & Beilin, 1984). Consequently, the aim of the current experiment is to investigate whether children understand the unique roles that artists and photographers play in picture creation, with a view to expanding our understanding of how children characterise the relationship between picture creators and their pictures in different mediums.

It has been suggested that knowledge of picture production (Beilin, 1983, 1999; Liben, 1999) is integral to children's developing understanding of different picture modalities. More specifically, Liben (1999) argues that children must learn how, "to reflect upon the mechanisms by which…graphic representations are created,

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[3] Based on Armitage, E., & Allen, M. L. (under review). Exploring children's knowledge of the distinct roles played by artists and photographers in picture creation. *Psychology of Aesthetics, Creativity and the Arts*

including understanding that different correspondence rules and conventions are used in different media" (p. 308), in order to achieve what she terms 'meta-representation'. When applied to drawing and photography, such an approach would predict that in order to fully comprehend photography children must acquire knowledge of the roles of the photographer and the camera (Arnheim, 1974; Beilin, 1983), whereas an understanding of artistry demands knowledge of how an artist's mind and actions influence their pictures (Wollheim, 1987). While Liben posited that children do not acquire 'meta-representation' until adolescence, when it is broken down in this way it becomes possible to explore how even younger children might begin to distinguish picture modalities, at least in terms of how they are created.

Existing research has explored children's understanding of a range of factors pertaining to the artist's role in picture creation, including effort (Kanngiesser, Gjersoe & Hood, 2010), the importance of intentionality (Gelman & Ebeling, 1998; Preissler & Bloom, 2008), and the influence of characteristics such as age and mood (Callaghan & Rochat, 2003). In a recent study, Kanngiesser, Gjersoe and Hood (2010) reported that 3- and 4-year-old children assigned ownership of a newly created clay object to the person who created it over the person who owned the raw materials, suggesting that they value the physical effort invested by the creator. Relatedly, between the ages of 4 and 6 children begin to place value on the ideas that underlie artistic creations (Li, Shaw & Olson, 2013). In this study 4- and 6-year-old children were asked whether they wanted to take home a picture they physically created or one that contained their idea. The 6-year-olds chose the picture containing their idea, while the 4-year-olds only did so when the picture also contained their idiosyncratic preferences.

Even before the age of 4 children grasp the importance of the artist-picture relationship for decoding pictures. For instance, 2.5-year-olds can use an artist's eye gaze to map ambiguous pictures to their intended referents (Preissler & Bloom, 2008) and by 3 years old children can use intention as a cue for naming pictures; intentionally created drawings are more likely to be assigned a shape-based name, denoting them as symbolic, than identical drawings that are accidentally created (Gelman & Ebeling, 1998). Older children also recognise that an artist's characteristics can influence the appearance of their pictures. Callaghan and Rochat (2003) presented 2- to 5-year-old children with pairs of pictures produced by artists of different ages (e.g. little brother and Dad), and found that only the 4- and 5-year-olds could use a picture's appearance to deduce who had produced it. Five-year-olds could also use the artist's mood – a less predictable influence than age – to identify his or her drawings, which indicates that from an early age children are aware of how the characteristics and actions of artists impact their pictures.

In the realm of photography there have been fewer attempts to investigate the role of the picture creator, with more emphasis placed on the role played by cameras, as well as how children conceptualise the relationship between photographs and their real world referents. In one such study, O'Connor, Beilin and Kose (1981) showed 5- to 7-year-old children photographs and drawings that contradicted a real world scene and found that the 6-year-olds treated the photographs as the "correct" representation of the scene, indicating that they consider the photograph-world relationship to be transparent. This occurred significantly less for drawings, which suggests that children consider photographs to depict reality in a *more* faithful manner than drawings (for additional evidence regarding photographs see Donnelly, Gjersoe & Hood, 2013; Robinson, Nye & Thomas 1994).

From the age of 7 children also demonstrate an awareness of the camera's role in photograph production (Liben, 2003; Kose, 1985). When Kose asked 7- and 11-year-old children questions such as "what makes a photograph good (or bad)?" 7-year-olds spontaneously referred to the camera's role in production with statements such as, "sometimes cameras make things dark and fuzzy and you can't see them" (p. 376). Yet, it is not until the age of 8 that children can accurately describe how instant photographs are made. Wellman and Hickling (1994) found that 6-year-olds described the process as agentive, for instance, "the camera gets the idea of it and draws the picture" (p. 1572), whereas 8- and 10-year-old children described the physical or mechanical stages of production. Since many of the characteristics of photography, particularly those that distinguish it from drawing, are defined by its mechanical nature, these conflicting findings raise questions about when children acquire sufficient knowledge of the interaction between cameras and photographers to distinguish photographers from artists.

Finally, when Seidman and Beilin (1984) asked 4- to 10-year-old children to talk aloud as they were drawing pictures and taking photographs, they found that all age groups described what they intended to draw and how they were going about it. Contrastingly, when taking photographs only the 6- to 10-year-old children made similar verbalisations. Such findings again indicate that at least until the age of 6, children may view photographers as possessing less control over their pictures relative to artists.

The separate literature on artists and photographers has yielded a wealth of information regarding children's understanding of picture creation. However, given the argument that knowledge of picture creation can illuminate ones interpretation of the final image (Beilin, 1999; Liben, 1999), it is also important to directly compare

children's understanding of how artists and photographers produce pictures (Beilin, 1983, 1999; Liben, 2003; Seidman & Beilin, 1984). There are intuitive distinctions that can be made between the two. For instance, when viewing a photograph of Niagara Falls it would be reasonable to assume that the photographer was onsite when he or she took the picture. This assumption is not necessarily applicable to a drawing: artists can draw from their imagination as well as using a real world referent as a model. There are also putative differences in the time it takes artists and photographers to complete a picture (Barrett, 1986; Currie, 1999; Davey, 2000), the different skill sets they require (Gullers, 1990; Liben, 2003; Ross, 1982; Seidman & Beilin, 1984; Wilson, 2012), and as a result of the different tools they use, typically, the level of realism in their pictures also differs (Beilin, 1991; DeLoache & Burns, 1994; Mitcheson, 2010; Walton, 1984).

On this basis four main distinctions between photographers and artists were identified for the purposes of the current experiment: faithfulness to reality, realism, physical presence, and skill. Due to the limitations imposed on them by cameras, photographers typically depict referents that are real, whereas artists can also depict fantasy referents (faithfulness to reality). Furthermore, photographers can only capture referents that are physically present at the moment of capture, whereas artists can use their memory and imagination to depict absent referents (physical presence). However, photographs are typically more realistic representations than drawings (realism). Finally, the skill required by photographers and artists is considered. Of course, a good photographer and a good artist can both show considerable amounts of expertise and proficiency, but these may be evident in different skill sets. It is arguable that much of the skill involved in photography concerns the use of angle and lighting (Liben, 2003; Liben & Szechter, 2002), which is less readily perceptible than

the motoric skill required to draw. Children learn to draw gradually (Jolley, Knox & Foster, 2000; Jolley & Rose, 2008), yet produce canonical photographs with relative ease (DeMarie, 2001; Liben & Szechter, 2002; Liben, 2003), which suggests that initially they might expect a younger child to produce a better photograph than drawing, for example. Accordingly, in the current experiment a broad distinction is drawn between the time taken and skill needed to press a button compared to using a paintbrush or pencil in order to produce a recognisable drawing (skill set).

Young children may differentially weight these domains, and it is thus important to probe for understanding of a range of distinctions across picture modality. The focus of the current experiment is first and foremost the picture creator, rather than the final picture. While it is true that *photographs* can depict fantasy creatures using editing software (Atencia-Linares, 2012), *photographers* cannot capture these referents in the moment. Furthermore, these distinctions are not absolute; they are intended as a starting point to explore children's conceptions of artists and photographers. Asking simple questions is a useful method for tapping into underlying understanding in this domain, as has been demonstrated previously by Parsons (1987) and Freeman and Sanger (1995), who both constructed theories of pictorial understanding using this methodology.

In summary, there are two specific discrepancies in the previous literature that the current experiment intends to address. Firstly, drawing research has consistently explored the understanding of younger age groups than photograph research, and this age disparity prevents a clear comparison of the emergence and progression of children's pictorial understanding across different modalities. Secondly, there has been no direct assessment of what children know about the differences between how photographs and drawings are produced. Such a comparison would provide empirical

evidence regarding whether or not knowledge of picture production contributes to children's understanding of different modalities and thus their representational development (Liben, 1999). Consequently, the aim of the present experiment was to explore 4- to 8-year-old children's ability to distinguish the roles of artists and photographers' in picture creation. This age range was chosen based on prior research, which has shown that children understand some of the ways in which an artist influences drawing production from 4 years old (Callaghan & Rochat, 2003; Preissler & Bloom, 2008), yet suggests that the photographers' influence may not be fully understood even at the age of 7 or 8 (Kose, 1985; Liben, 2003; Wellman & Hickling, 1994). Since the artist-photographer distinctions under investigation are not absolute, an adult group was included to provide a baseline against which to compare children's responses.

All participants were introduced to two puppets (one an 'artist' and one a 'photographer'), and were asked 10 forced-choice questions about which puppet should make a series of pictures. The questions were intended to address the faithfulness to reality, realism, physical presence and skill distinctions outlined above. On the basis of previous studies it was hypothesised that children would demonstrate an earlier understanding of artistry (Callaghan & Rochat, 2003; Preissler & Bloom, 2008) than photography (Liben, 2003; Kose, 1985; Wellman & Hickling, 1994). Alternatively, it was anticipated that children's increasing exposure to, and use of, cameras as a result of the rapid expansion of digital technology (Ofcom, 2012, 2013, 2014; Rideout et al, 2013), might facilitate their acquisition of photographic knowledge, making it plausible that they may understand the photographer's role in picture creation before the artist's role.

It was also anticipated that age would differentially influence children's performance on the four question topics. Children were expected to respond successfully to the skill set and realism questions from age 4, since children of this age understand how age impacts drawing skill (Callaghan & Rochat, 2003) and an early preference for realistic pictures (Coffey, 1968) suggests an awareness of pictorial surface features. Success on the faithfulness to reality and physical presence questions was expected to emerge later, since the former requires an understanding of the fantasy-reality distinction, which develops gradually between the ages of 4 and 8 (Sharon & Woolley, 2004; Martarelli & Mast, 2013; Morison & Gardner, 1978), and both topics require some awareness of the causal nature of photography, the age of acquisition of which is unclear (O'Connor, Beilin & Kose, 1981; Wellman & Hickling, 1994). Finally, it was anticipated that the adult sample would show a good understanding of the roles of both types of picture creator.

This experiment will provide the first comparison of 4- to 8-year-old children's understanding of the roles played by artists and photographers in picture creation. The findings will contribute empirical evidence regarding how knowledge of the creator-picture relationship changes with age, and if it differs across modality. Ultimately, this will inform a developing theory of pictures about when and how children incorporate modality into their understanding of pictures.

4.1 Experiment 5

4.1.1 Method

Participants

One hundred and fifty nine children aged between 4- and 8-years (Range = 4;2–8;10) were recruited from nine primary schools and one nursery in North

Yorkshire and Lancashire. To probe for developmental differences, children were initially assigned to five different age groups (see Table 14). Sixteen adults (Range = 18-20, M_{age} = 18.5 years) also participated. They were recruited using the research participation system at Lancaster University.

Table 14

Age groupings for children in Experiment 5

	N	M_{age}	*Range*
Age Group			
4	33	55	4;2–4;11
5	30	64	5;0–5;11
6	33	79	6;0–6;11
7	33	91	7;0–7;11
8	30	97	8;0–8;10

Materials

Two puppets, a Sony digital camera, a selection of colouring pencils, and an easel were positioned as shown in Figure 7. Five objects, corresponding to five of the ten forced choice questions were also used (see Appendix C). Objects were used to support question understanding. For instance, in order to assess children's understanding of how reality can be manipulated in pictures it was necessary to present children with a physical object (pink cupcake) and ask them who could portray it differently in a picture (as a blue cupcake).

Figure 7. Puppet and tool stimuli used in Experiment 5

Design

The aim of this experiment was to assess 4- to 8-year-old children and adults' knowledge of artists and photographers using two sets of questions. This yielded a 5 (Age Group: 4-, 5-, 6-, 7-, 8-years) x 2 (Question Type: photographer, artist) mixed design. Age group was the between-subject factor, and question type was the within-subject factor. Correct responses per question type were summed and used as the dependent variable. To ensure that my intuitions about the 'correct' answers to the test questions were accurate 16 adults also participated in the forced choice task.

Procedure

Children were introduced to two puppets (see Figure 7) as follows: "This is Jack, he draws pictures with colouring pencils. This is Luke, he takes pictures with his camera. This is one of Jack's pictures (drawing of an ice lolly) and this is one of Luke's pictures (photograph of an ice lolly). Children were then shown four more pictures (two photographs and two drawings, which were matched on content) and asked to pair the picture with the puppet who made it. By presenting children with images of the same objects in drawing and photograph form I hoped to draw attention

to picture type (Liben, 2003) as the most relevant distinction to make between the puppets. If children made incorrect pairings they were given corrective feedback; they had to pair all pictures with the correct puppet before proceeding to the experimental task. Following successful completion of the pre-test, children were asked each of the ten test questions. These questions were intended to address children's understanding of four broad topics: 1) the ability of artists (and inability of photographers) to depict absent or non-existent entities, 2) the enhanced realism and level of detail achievable by photographers compared to artists, 3) the physical presence constraints on photographers (which do not typically apply to artists), and 4) the skill set required by artists and photographers to produce good quality pictures. An example of one of the 'faithfulness to reality' questions is: "This is a pink cupcake. I want a picture of this cupcake in blue. Who should I ask to make me a picture of this cupcake in blue, Jack or Luke?" The correct answer in this case being whichever puppet is the artist (see Appendix C for full set of questions and 'correct' answers).

The order of questions was counterbalanced using seven different question orders. The puppets' roles were also counterbalanced: for half the participants the yellow puppet acted as photographer and for the other half the purple puppet acted as the photographer. In every case participants were asked whether Jack or Luke could 'make' the requested picture. The words 'take' or 'draw' were not used so as not to bias participants towards the photographer or the artist.

Coding

All participants received two scores: one for the artist questions (out of 5), and one for the photographer questions (out of 5). The question scores were also grouped

according to topic. Correct scores were summed and converted into proportions to permit parametric analysis and equate number of questions per topic.

Faithfulness to reality: The ‘cupcake’, ‘fairy’ and ‘toy’ questions were grouped as tapping children’s understanding of an artist’s ability to manipulate the world in his or her pictures.

Physical presence: The ‘recorder’ and ‘Disneyland’ questions were grouped as they assessed children’s understanding that artists but not photographers can capture referents that are not present in time and space.

Skill set: The ‘doll’, ‘broken arm’ and ‘sisters’ questions were grouped as relating to children’s understanding of the skills and actions required by photographers and artists to create pictures.

Realism: The ‘car’ and ‘school’ questions were grouped as exploring children’s perception of whether photographers or artists can produce the most detailed or realistic pictures.

4.1.2 Results

Adults

As anticipated adults performed at ceiling on all questions. One distinction, which can be drawn between children and adults, is that in response to, “I need a picture of this building to show my friend so she can find it later. Who should I ask to make me a picture of this building for my friend, Jack or Luke?” three adults claimed that photographers and artists were equally well equipped to produce this picture. However, the significant majority chose the picture creator they considered ‘most likely’ to produce the requested picture, in this case, the photographer. Thus, the test

questions served their intended purpose: highlighting four basic distinctions that can be made between the roles of artists and photographers.

Children

No children failed the pre-test, although seven children (one 4-year-old, four 5-year-olds, one 6-year-old and one 7-year-old) made errors and thus were given corrective feedback. Preliminary analyses revealed no effect of question order on children's performance. Separate photographer and artist scores (each out of 5) were entered into a 2 (Question Type: photographer, artist) x 5 (Age Group: 4-, 5-, 6-, 7-, 8-years) mixed ANOVA. A significant main effect of question type, $F(1, 154) = 22.64$, $MSE = 34.56$, $p < .001$, $\eta_p^2 = 456.13$, indicated that overall children performed significantly better on the photographer questions (M = 3.55, SE = .09) than the artist questions (M = 2.89, SE = .10). A significant Question Type x Age Group interaction was also identified, $F(1, 154) = 2.53$, $MSE = 3.87$, $p = .04$, $\eta_p^2 = .06$ (see Figure 8). Further pairwise comparisons subjected to the Bonferroni correction revealed that 4-year-olds gave significantly more correct responses to the photographer questions ($M = 3.33$, $SE = .21$) than the artist questions ($M = 1.88$, $SE = .21$), $F(1, 32) = 15.94$, $p < .001$, $\eta_p^2 = .33$, as did the 6-year-olds (photographer: $M = 3.76$, $SE = .10$; artist: $M = 3.00$, $SE = .24$), $F(1, 32) = 5.82$, $p = .022$, $\eta_p^2 = .15$, and 7-year-olds (photographer: $M = 3.79$, $SE = .17$; artist: $M = 3.33$, $SE = .18$), $F(1, 32) = 5.43$, $p = .03$, $\eta_p^2 = .15$. Five-year-olds (photographer: $M = 3.13$, $SE = .12$; artist: $M = 2.67$, $SE = .26$) and 8-year-olds (photographer: $M = 3.73$, $SE = .22$; artist: $M = 3.57$, $SE = .16$) gave an equal number of correct responses to the two sets of questions.

There was also a significant effect of age group on artist question scores, $F(1, 154) = 9.82$, $MSE = 13.96$, $p < .001$, $\eta_p^2 = .20$. Six-year-old, ($M = 3.00$, $SE = .24$), 7-

year-old (M = 3.33, SE = .18), and 8-year-old children (M = 3.57, SE = .16) outperformed 4-year-olds (M = 1.88, SE = .21), p < .001, and 8-year-olds outperformed 5-year-olds (M = 2.67, SE = .26), p = .04. There was no significant effect of Age Group on photographer question scores. One-sample t-tests (chance value = 2.5) confirmed that all age groups performed significantly above chance on the photographer questions; all p < .001 with the exception of 5-year-olds, p = .013. Contrastingly, only the 6-year-olds, $t(32) = 2.06$, p = .047, 7-year-olds, $t(32) = 4.69$, p < .001, and 8-year-olds, $t(29) = 6.81$, p < .001, performed significantly above chance on the artist questions. The 4-year-olds performed significantly below chance, $t(32)$ = -2.99, p < .001 and the 5-year-olds performed at chance.

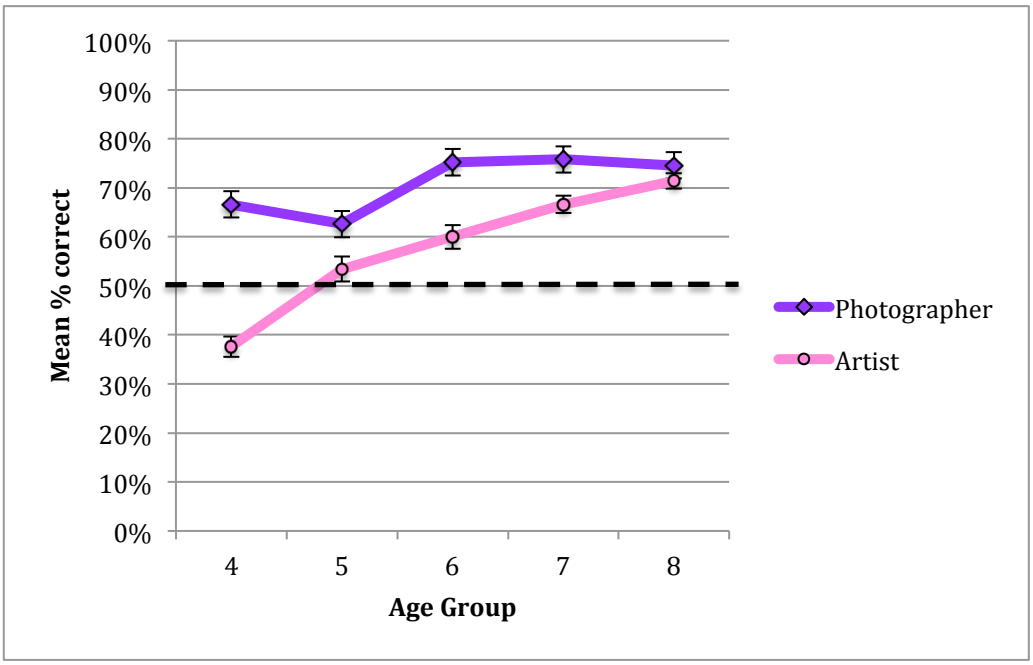

Figure 8. Mean percentage of correct responses given to the photographer and artist questions per age group in Experiment 5. Error bars represent standard error.

Contrary to what one might draw from previous work, children demonstrated an earlier understanding of the photographer's role in picture production, compared to

the artist's role. From the age of 4 children performed well on the photographer questions, whereas it was not until age 6 that children succeeded on the artist questions. Furthermore, only 8-year-old children understood the roles of the artist and photographer equally well.

Question Topic Analysis. Children's responses were also grouped by question topic and converted into proportions. A 4 (Question Topic: faithfulness to reality, realism, skill set, physical presence) x 5 (Age Group: 4-, 5-, 6-, 7-, 8-years) mixed ANOVA was conducted on these proportional scores. Greenhouse-Geisser values are reported due to a violation of Mauchly's sphericity assumption. Significant main effects of Question Topic, $F(2.80, 431.15) = 30.74$, $MSE = 3.32$, $p < .001$, $\eta_p^2 = .17$, and Age Group, $F(1, 154) = 3.66$, $MSE = .92$, $p < .001$, $\eta_p^2 = .18$, were identified, as was a Question Topic x Age Group interaction, $F(11.20, 431.15) = 2.32$, $MSE = .25$, $p = .008$, $\eta_p^2 = .06$. Pairwise comparisons subjected to the Bonferroni correction revealed a significant main effect of Question Topic for all age groups: 4-year-olds: $F(3, 96) = 11.03$, $MSE = 1.41$, $p < .001$, $\eta_p^2 = .26$; 5-year-olds: $F(3, 87) = 3.75$, $MSE = .47$, $p = .014$, $\eta_p^2 = .14$; 6-year-olds: $F(3, 96) = 5.61$, $MSE = .59$, $p = .001$, $\eta_p^2 = .15$; 7-year-olds: $F(3, 96) = 5.78$, $MSE = .41$, $p = .001$, $\eta_p^2 = .15$; 8-year-olds: $F(3, 87) = 15.41$, $MSE = 1.16$, $p < .001$, $\eta_p^2 = .35$.

Four-year-olds gave significantly more correct responses to the realism questions ($M = .79$, $SE = .05$) than the other three question topics: faithfulness to reality ($M = .41$, $SE = .06$) $p = .002$, physical presence ($M = .32$, $SE = .07$) $p < .001$, and skill set ($M = .59$, $SE = .06$) $p = .035$. Five-year-olds gave significantly more correct responses to faithfulness to reality ($M = .64$, $SE = .06$) than physical presence questions, ($M = .38$, $SE = .07$), $p = .017$. Six-year-olds gave more correct responses to

the faithfulness to reality (M = .69, SE = .06) p = .028, and skill set questions (M = .77, SE = .05) p = .011, than the physical presence questions (M = .47, SE = .07). Seven-year-olds gave more correct responses to the realism (M = .80, SE = .05) than the physical presence questions (M = .55, SE = .06) p = .007. Finally, 8-year-olds gave more correct responses to the faithfulness to reality (M = .89, SE = .03), p < .001, realism (M = .83, SE = .06), p < .001, and skill set questions (M = .69, SE = .06), p = .026, than the physical presence questions (M = .45, SE = .07). They also gave more correct responses to the faithfulness to reality than skill set questions, p = .012.

One sample t-tests (chance value = 0.5) revealed that performance was above chance on all question topics, with three main exceptions (see Figure 9). Firstly, 4-year-olds performed below chance on the physical presence questions, showing a bias for incorrectly selecting the photographer, $t(32) = -2.81$, p = .008, while 5-year-olds, $t(29) = -1.65$, p = .11, 6-year-olds, $t(32) = -.47$, p = .65, 7-year-olds, $t(32) = .72$, p = .48, and 8-year-olds, $t(29) = -.77$, p = .45, performed at chance. Secondly, 4-year-olds performed at chance on the skill set, $t(32) = 1.57$, p = .13, and faithfulness to reality questions, $t(32) = -1.53$, p = .14. Thirdly, 5-year-olds performed at chance on the realism questions, $t(29) = 1.44$, p = .16.

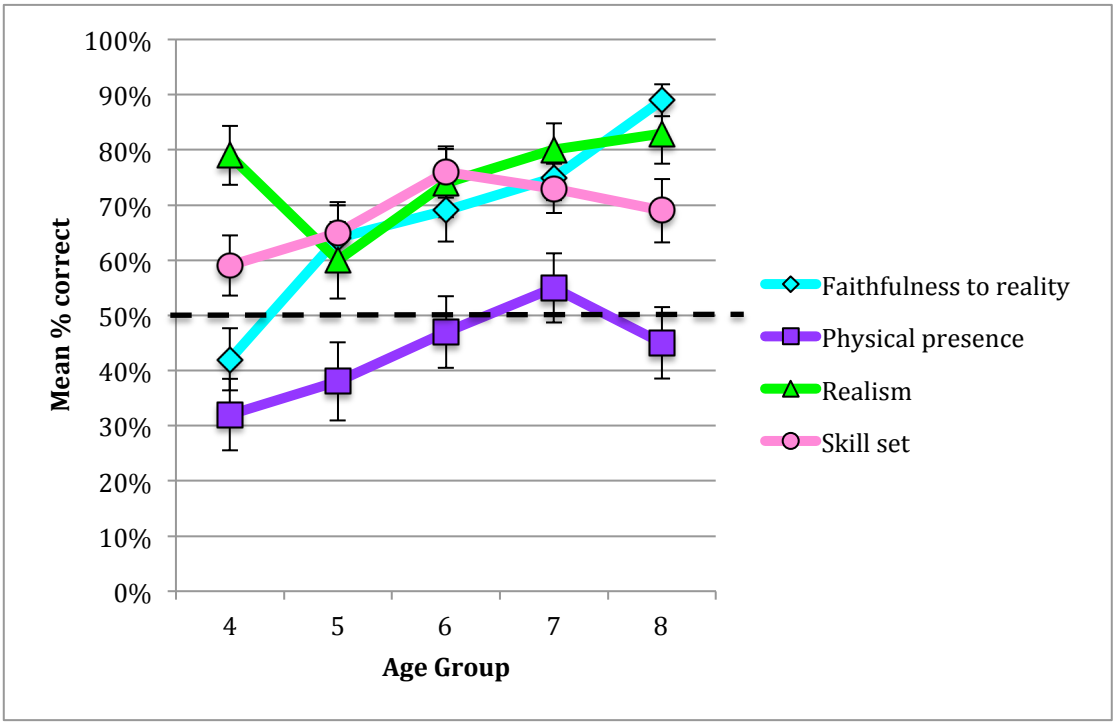

Figure 9. Mean percentage of correct responses per age group and question topic in Experiment 5. Error bars represent standard error.

Further pairwise comparisons subjected to the Bonferroni adjustment also identified a significant effect of Age Group for the faithfulness to reality questions, $F(1, 154) = 12.05$, $MSE = .96$, $p < .001$, $\eta_p^2 = .24$. All age groups (5-year-olds: $M = .64$, $SE = .05$; 6-year-olds: $M = .69$, $SE = .05$; 7-year-olds: $M = .75$, $SE = .05$; 8-year-olds: $M = .89$, $SE = .05$) performed significantly better than the 4-year-olds ($M = .41$, $SE = .05$), and the 8-year-olds performed significantly ($p = .010$) better than the 5-year-olds. As previously described, one sample t-tests (chance value = 0.5) confirmed that 4-year-old children performed at chance on this question topic, while all other age groups performed above chance. Thus, from the age of 5 children understand that artists can change the surface features of their referents (e.g. by changing blue to pink or a smile to a frown) as well as depict things that do not exist in the real world, such

as fairies. There were no significant age effects for the remaining three question topics.

Overall, the most striking finding is that, contrary to the hypotheses, even the oldest children were unsuccessful on the physical presence questions, which suggests a lack of understanding that photographers cannot depict things that no longer exist or are not physically present, while artists can use their imagination to depict such referents. Performance on the remaining three question topics, however, shows that other cross-modal distinctions are understood earlier. In line with the hypotheses, from the age of 4 onwards children demonstrated knowledge that photographers produce more realistic and detailed pictures than artists. Furthermore, success on the faithfulness to reality questions was achieved earlier than expected. From the age of 5 children understood that only artists can manipulate the appearance of the world in their pictures, and this understanding improved significantly with age. Lastly, and later than hypothesised, 5-year-olds also reasoned that it was faster to create a photograph than a drawing, and easier for a young child or someone with a broken arm to produce a photograph than a drawing.

4.1.3 Discussion

The current experiment investigated what 4- to 8-year-old children and adults know about the divergent roles of artists and photographers in picture creation. It was anticipated that children's understanding of these two picture creators might come online at different points in development due to the unique manner in which they create pictures. In particular, it was hypothesised that an understanding of artistry would precede photography if children lacked an appropriate grasp of how cameras work. Alternatively, it was posited that an understanding of photography might come

online first if children's increasingly early exposure to cameras facilitates their knowledge of the photographer's role in picture creation.

These findings confirm that between the ages of 4 and 8 children are capable of distinguishing artists and photographers on a number of dimensions. Children understood the photographer-picture relationship before the artist-picture relationship. Success was achieved on the questions tapping knowledge about photographers from age 4, yet it was not until age 6 that children performed above chance on the questions probing artist knowledge. Furthermore, the range of artist-photographer distinctions children were capable of making increased with age, which suggests that an awareness of how modality impacts pictorial representation develops gradually. Together, these findings are consistent with the notion that knowledge of picture creation contributes to children's pictorial development (Beilin, 1999; Liben, 1999), and they also suggest that children possess an earlier understanding of the differences that exist between picture modalities than has previously been suggested (Beilin, 1999; DeLoache & Burns, 1994; Liben, 1999).

Children's increasing familiarity with photography may explain their superior performance on the photographer questions. A recent cross-cultural comparison assessed the mobile phone use of 4,500 children aged between 8 and 18 (GSM Association & NTT DOCOMO, 2013), and found that cameras are the most used function (89%). Younger children also enjoy taking and sharing photographs (Cook & Hess, 2007; Ofcom, 2012, 2013, 2014; Plowman & McPake, 2013), and receive tuition in these activities from family members (Plowman, McPake & Stephen, 2008). Thus, exposure to cameras, particularly on mobile devices, and experience of taking their own photographs likely contribute to children's early understanding of the photographer's role in picture production. Similarly, this might explain why the

current findings contradict previous reports that children do not understand photography until the age of 7 (Kose; 1985; Liben, 2003; Wellman & Hickling, 1994). Prior work has shown that experience with pictures facilitates young children's ability to use them as sources of information (Callaghan, 1999; Troseth, Casey, Lawver, Walker & Cole, 2007), and it is likely that children in 1985, 1994 and 2003 had less experience of photography than the current sample, who have grown up in a society where cameras are used on a day-to-day basis, and by children as young as 2 (Rideout et al, 2013).

Four main distinctions between photographers and artists were also investigated. The first to be understood was realism, followed by faithfulness to reality and finally, skill set. All children performed poorly on the physical presence questions. On the realism questions all age groups performed above chance, with the exception of 5-year-olds, who seemingly considered photographs and drawings to be equally realistic representations. Thus, in line with the hypotheses, from the age of 4 children are aware that there are surface differences between the pictures created by photographers and artists. This finding builds on previous work by showing that not only can children use resemblance cues to map pictures on to their real world referents (Browne & Woolley, 2001; Callaghan, 2000; Ganea, Pickard & DeLoache, 2008; Richert & Lillard, 2002; Tare, Chiong, Ganea & DeLoache, 2010), they also know that these cues differ across modality, with the most realistic pictures being created by photographers.

The faithfulness to reality questions were answered successfully by all but the 4-year-old children, which shows that from age 5 children understand that artists can distort the real world in their pictures, while photographers cannot. This suggests early insight into the importance of an artist's mind for drawing, which can be linked

to a developing theory of mind (Gopnik & Wellman, 1992; Keysar, Lin & Barr, 2003; Perner, 1991). Knowing that people can imagine things that do not exist and think about things in a way that differs from reality allows children to understand how artists can depict fairies and change the appearance of real world referents in their pictures (e.g. depicting a smiling toy frowning). The importance of fantasy-reality understanding for the fairy question may offer a partial explanation for the chance level performance of 4-year-olds. Children of this age are inconsistent in their ability to categorise fantasy entities as 'real' or 'not real' (Morison & Gardner, 1978; Sharon & Woolley, 2004; Taylor & Howell, 1973), and if they did not identify the fairy in the present questions as 'not real' then it is reasonable to expect that an artist or a photographer could create a picture of one. Nonetheless, 5- to 8-year-old children's responses demonstrate understanding of a crucial difference between the artist-picture and photographer-picture relationships; what happens in an artist's mind determines the appearance of their picture, whereas photographers' pictures are ultimately governed by the causal workings of their cameras.

On the skill set questions, contrary to expectations, while 5-, 6-, 7- and 8-year-old children performed above chance, the 4-year-olds performed at chance. Only the older children knew that photographers could produce pictures more easily, at a younger age or with a broken arm, than artists. This challenges previous research, which has found that 4-year-olds know how age affects drawing ability (Callaghan & Rochat, 2003). It is possible that children in the current experiment decided, based on their own experience, that young children are equally capable of producing good photographs and drawings. This is consistent with reports that children tend to overestimate the quality of their own pictures until they can produce advanced conventional drawings (Jolley, Knox & Foster, 2000), and that 4- to 7-year-olds have

little knowledge of the skill required for painting, and thus think anyone can produce artwork (Gardner, Winner & Kircher, 1975).

Finally, children in all age groups performed poorly on the physical presence questions. Four-year-old children performed below chance, incorrectly selecting the photographer more often than the artist, while 5- to 8-year-old children performed at chance. Five- to 8-year-old children's performance on the faithfulness to reality questions indicates that they know artists are governed by their intentions, which suggests that the difficulty lies in understanding that a photographer's ability to depict absent referents is constrained by the causal-mechanical functioning of cameras. This is somewhat surprising given that between the ages of 6 and 8 children respond to photographs as if they are faithful representations of the world (Donnelly, Gjersoe & Hood, 2013; O'Connor, Beilin & Kose, 1981) and begin to describe photography as a mechanical rather than an agentive process (Wellman & Hickling, 1994).

An alternative explanation is that the phrasing of the physical presence questions did not make it clear that the requested pictures had to be made 'in the moment'. For instance, in the Disneyland question more emphasis perhaps needed to be placed on the fact that the question was asking which puppet could make the picture *right now*, since in general, a photograph might be considered a 'better' visual representation of such a varied and complex location. Similarly, an intact recorder can be depicted in a photograph, but the photographer could not capture the specific recorder the experimenter requested a picture of, since it was broken. Ultimately, confusion regarding whether they had to think about whether a 'photograph' or a 'photographer' could depict the desired referent might explain why most children performed at chance on these questions. The nine 6- to 8-year-old children who correctly selected the artist in response to the Disneyland question did deduce that the

picture needed to be created ‘now’. All nine of these children pointed out that the photographer “would have to go all the way to Disneyland” to take a picture of it. However, the fact that so few children made this link suggests that it was not explicit within the context of the question. In future, questions addressing the physical presence aspect of photography should contain more specific information about where and when the requested pictures are to be made in order to ensure that children reason about the picture creator and not the picture itself.

Overall, there are limitations to the methodology used here. Simple forced choice questions can only provide preliminary insights into children’s understanding of the divergent processes artists and photographers engage in to create pictures, particularly as the number of questions asked was limited in order to retain the interest of the younger children. However, given the lack of prior research in this area, this methodology allowed us to investigate a broad range of potential differences between the two types of picture creator, which future research can use to identify topics worthy of additional investigation. Although attempts were made to equate the level of difficulty of the individual questions, it is possible that the difficulty level across questions and amongst topic areas contributed to the pattern of responding obtained. Nevertheless, this experiment is the first to demonstrate that children younger than 7 are knowledgeable about photographers, and that there may be differences in when and how children understand photographers compared to artists.

Theoretically, these findings conflict with Liben’s (1999) claim that modality is not integrated into representational understanding until adolescence. The current results show that by the age of 4 children possess a limited awareness of how modality mediates the picture-creator relationship, which increases considerably between the ages of 5 and 8. Thus, it would seem that pre-adolescent children are able

to "reflect upon the mechanisms by which graphic representations are created" (Liben 1999, p. 308), in order to identify whether an artist or a photographer is the most appropriate person to create any given picture, and therefore do not necessarily generalise information learnt about one modality to another. For instance, while the 5-year-olds in the present task knew that artists could draw imaginary referents, they did not presuppose that photographers could do the same. In this sense, modality may be more relevant to early pictorial development than has previously been assumed. Hence, the artist-picture relationship that exists in current frameworks of pictorial development (Freeman & Sanger, 1995) should be joined by a photographer-picture relationship to account for children's burgeoning ability to draw distinctions between how artists and photographers relate to their pictures.

Finally, although I did not directly test whether children's knowledge of picture production guides the inferences they make about photographs and drawings, the findings indicate that this might be the case. For example, when asked which puppet could create the better picture with which to locate a school building, children in all age groups correctly selected the photographer, which suggests that from a young age they expect pictures created by hand to be less realistic, and therefore less useful navigation aids, than those produced by cameras. If additional studies confirm that children's knowledge of the different ways in which photographs and drawings are created shapes their perception of the pictures themselves, this will further cement the role of picture modality in a developing theory of pictures. Although further research is required to establish whether modality affects all or only select aspects of children's developing pictorial understanding, the current experiment has successfully demonstrated its impact on their comprehension of the relationship between picture creators and their pictures.

Chapter Five: **Children's sensitivity to how a picture creator's visual access and referent knowledge impact pictorial content**

Upon viewing a picture it is intuitive to assume that the person who created it did so, at least partly, on the basis of his or her knowledge of the referent; if we were unsure what a picture depicted we would expect the artist to be able to tell us (Bloom, 1996). However, the picture may be created based purely on the artist's immediate visual experience of the referent, which minimises the need to use their knowledge or imagination. While artists can draw from knowledge *or* visual access, photographers are reliant on visual access to their referents, which makes referent knowledge neither necessary nor sufficient for the creation of photographs (Cavedon-Taylor, 2014a; Currie, 1991).

These distinctions can be mapped broadly onto Freeman & Sanger's (1995) notions of both the picture-creator and picture-world relationships, outlined in their intentional net framework. A theory of pictures that prioritises the role of knowledge would focus more heavily upon the picture-creator link, whereas a focus upon visual access prioritises the picture-world relation. It is possible that whereas artistry follows the first route, a strict interpretation of photography minimises the role of the photographer's knowledge in picture creation, and focuses instead upon the link between the picture and the world. The aim of the current experiment is to investigate how 6- and 8-year-old children weight the picture-creator (as measured by referent knowledge) and picture-world (as measured by visual access to referent) relationships when identifying which of a series of objects can be photographed or drawn. Do children think the content of drawings and photographs is determined by the minds of their picture creators, or are they aware that photographs are causally related to their real world referents, which limits the influence of a photographer's knowledge? These

questions are especially important given that children must acquire a flexible understanding of how different picture types relate to the world and their creators in order to acquire complete pictorial competence (Freeman & Sanger, 1995; Liben, 1999).

On the basis of their own experience, one might expect even young children to be familiar with the notion that pictures can be created via the creator's visual access to the referent. For instance, in school children draw from models (Anning, 2002; Rose, Jolley & Burkitt, 2006; Winner, 1989), and in everyday life they take photographs of things that they encounter in their environment (DeMarie, 2001; Sharples, Davison, Thomas & Rudman, 2003). Studies in which children have taken their own photographs (DeMarie, 2001; Liben, 2003; Liben & Szechter, 2002; Seidman & Beilin, 1984) provide anecdotal evidence that young children are aware that photographs capture what is directly in front of the camera. For instance, when asked to take photographs during a trip to the zoo, DeMarie (2001) reports that 3- to 5-year-old children used the camera as a way to get a closer look at the animals, while one 7-year-old said he photographed a snake because, "the snake looked so long. And I thought [my mother] wouldn't believe it" (p. 7). In both instances, children recognised that the photographs would reflect and even enhance what they could see. However, whether they recognise the unique importance of visual access in photography remains an open question.

The underlying reason that photographs require the physical presence of their referents is because they share a causal link to the real world. Thus, it may be that understanding the photographer's need for visual access requires some knowledge of the causal nature of photography. Prior research suggests this does not emerge until the age of 7 or 8. When Kose (1985) questioned 7- and 11-year-old children about

their understanding of photography with questions such as, “are there things you can’t take photographs of?” (p. 376), he reported that 7-year-olds commented on both the technical aspects of photography, “if you stand too far away with the camera you won’t be able to see what’s in the picture” (p. 377) and the necessary qualities of referents, “cars have to be standing still or the picture will turn out bad” (p. 377). Furthermore, when Liben (2003) asked 7- to 8-year-old children to take a picture of a lion statue showing only one of its paws, one child described how he waited until someone walked by, blocking one paw from view, to take the photograph. Together, these findings suggest that by 7-years children understand that the content and quality of photographs is contingent on the mechanical ability of a camera to capture a physically present referent. However, a more stringent test involving questions about the possibility of photographing absent referents is necessary to confirm this understanding and clarify the age at which it emerges. In addition, to date research has not investigated whether children appreciate that photography’s dependence on the physical presence of its referents, makes the photographer’s referent knowledge, or lack thereof, redundant.

Existing research shows that 6- to 8-year-old children have a general lack of regard for the photographer’s role in picture creation relative to the input of the camera (Kose, 1985; Wellman & Hickling, 1994). They do not discuss photographs in terms of what the photographer intended to show (Kose, 1985), nor do they reference the photographer’s actions when asked to explain how photographs are made (Wellman & Hickling, 1994). Such findings suggest that children are unlikely to consider the photographer’s referent knowledge an important determinant of the subject matter they can depict, however this has not been directly tested. Accordingly, one of the aims of the current experiment is to further investigate how children reason

about the relationship between photographs, the world and the photographer by asking children if photographers can create pictures of absent referents, both when they do and do not possess knowledge of the referent.

In direct contrast to photographers, artists can draw from knowledge as well as visual access. For instance, an artist could draw an elephant while sat in her living room if she had sufficient prior knowledge of elephants. Between the ages of 3 and 6 children develop an understanding of how knowledge is constructed (Pillow, 1989; Sodian, Thoermer & Dietrich, 2006) and they become increasingly familiar with various sources of knowledge, including visual access (Patt & Bryant, 1990; Robinson & Whitcombe, 2003; Wimmer, Hogrefe & Perner, 1988). Yet it is not until the age of 6 that children can use this understanding to predict the influence of knowledge on subsequent beliefs about pictures. Four-year-old children in Taylor, Cartwright and Bowden's (1991) study could identify that in general, adults had a higher level of knowledge than older children, and that both of these populations were more knowledgeable than babies. However, they went on to assert that all of these age groups would produce the same interpretation of an ambiguous picture. Contrastingly, the 6-year-old children understood that the greater knowledge possessed by older children and adults could allow them to construct different picture interpretations to each other, and babies.

The link between knowledge and picture *creation* also proves difficult for children younger than 6-years to master. As reviewed in Section 1.3.2, Richert and Lillard (2002) found that the majority of 6-, 7- and 8-year-olds recognised that a doll who had no prior experience of animals could not think she was drawing a fish, thereby demonstrating an understanding that, in the absence of an example, a person cannot draw something he or she is not knowledgeable about. Similarly, Browne and

Woolley (2001) found that 7-year-olds and adults were less likely to name ambiguous pictures (e.g. resembling both a bear and a rabbit) according to what the artist intended to depict (e.g. a bear) when they were told the artist did not know the difference between rabbits and bears. Contrastingly, artist knowledge had no effect on 4-year-old children's responding; they gave intentional responses more often than would be expected by chance.

Since it remains unclear how children construe the relationship between what an artist knows and what he or she can depict, and as research has yet to address this same relationship in photography, the aim of the present experiment is to investigate whether 6- and 8-year-old children recognise the differential influence that visual access and referent knowledge have on the pictorial content that can be depicted by artists and photographers. These age groups were selected as it is between 6- and 8-years that children show some awareness that photographs are closely related to their referents (DeMarie, 2001; Kose, 1985; Liben, 2003) as well as an understanding of how knowledge impacts the creation of drawings (Browne & Woolley, 2001; Richert & Lillard, 2002). An adult group was included for comparison purposes.

Participants took part in either a photograph or a drawing condition. In both conditions they were introduced to an alien from a planet named Glob, who was knowledgeable about aliens and spaceships (since they exist on his planet), but had no knowledge of cars or trees (since they do not exist on his planet). The alien's visual access was also manipulated using location; Gooba was either on Earth (with visual access to cars and trees) or on Glob (with visual access to aliens and spaceships). In two trials, one in which Gooba was on Earth and one in which he was on Glob, participants were shown individual pictures (photographs or drawings) of four referents and asked for each one, "Could Gooba have taken/made this picture?"

It was hypothesised that both 6- and 8-year-old children would correctly state that Gooba could draw *and* photograph referents to which he had visual access, based on their own experience of drawing and photographing things they can see (Anning, 2002; Plowman & McPake, 2013; Rose, Jolley & Burkitt, 2006; Sharples, Davison, Thomas & Rudman, 2003; Winner, 1989). However, if knowledge of causality is required to understand that photographs are dependent on the physical presence of their referents then only the oldest children (Kose, 1985; Wellman & Hickling, 1994) were expected to recognise that Gooba's knowledge has no bearing on the referents he can photograph, and therefore he cannot photograph absent referents. Finally, since prior research has suggested that there is a developmental increase in children's ability to map the link between an artist's knowledge and what he or she can draw (Richert & Lillard, 2002), it was anticipated that 8-year-olds would be more successful than 6-year-olds at recognising that the artist-picture relationship is such that Gooba can draw an absent referent on the basis of knowledge alone. The findings of this experiment will contribute to a deeper understanding of how children acquire a theory of pictures. Should they recognise that knowledge is more important for artists than photographers this would provide evidence that pictorial development involves the acquisition of modality-specific rules concerning the picture-creator and picture-world relationships.

5.1 Experiment 6

5.1.1 Method

Participants

Thirty-seven 6-year-old children and thirty-six 8-year-old children were recruited from three primary schools and one nursery in North Yorkshire and

Lancashire. Thirty-five adults aged between 18 and 21 also participated. They were recruited using the research participation system at Lancaster University. All participants were assigned to either the Photograph or Drawing condition (see Table 15).

Table 15

Age and condition groupings of all participants in Experiment 6

	Condition					
	Photograph			Drawing		
	N	M_{age}	*Range*	*N*	M_{age}	*Range*
Age group						
6	17	78m	72-83m	20	78m	73-83m
8	18	100m	96-106m	18	100m	96-107m
Adults	15	19y	18-20y	16	19y	18-20y

Materials

A soft toy alien and two 7 x 5 inch photographs, of Earth and 'Glob', were used in all tasks and conditions (see Figure 10). Four 6 x 4 inch photographs and four 6 x 4 inch drawings (depicting a car, a tree, an alien and a spaceship) served as test stimuli (see Figures 11 and 12).

Figure 10. Gooba soft toy, Glob and Earth photographs

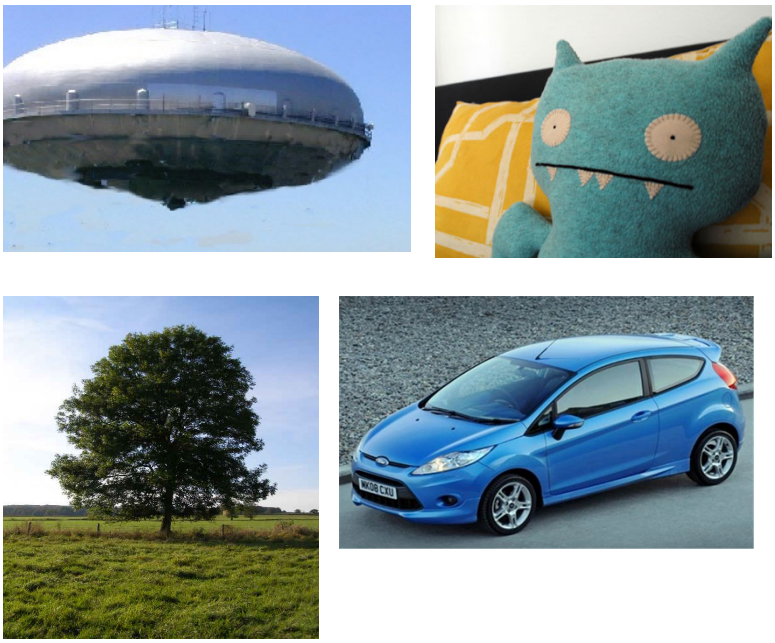

Figure 11. Photograph condition stimuli used in Experiment 6

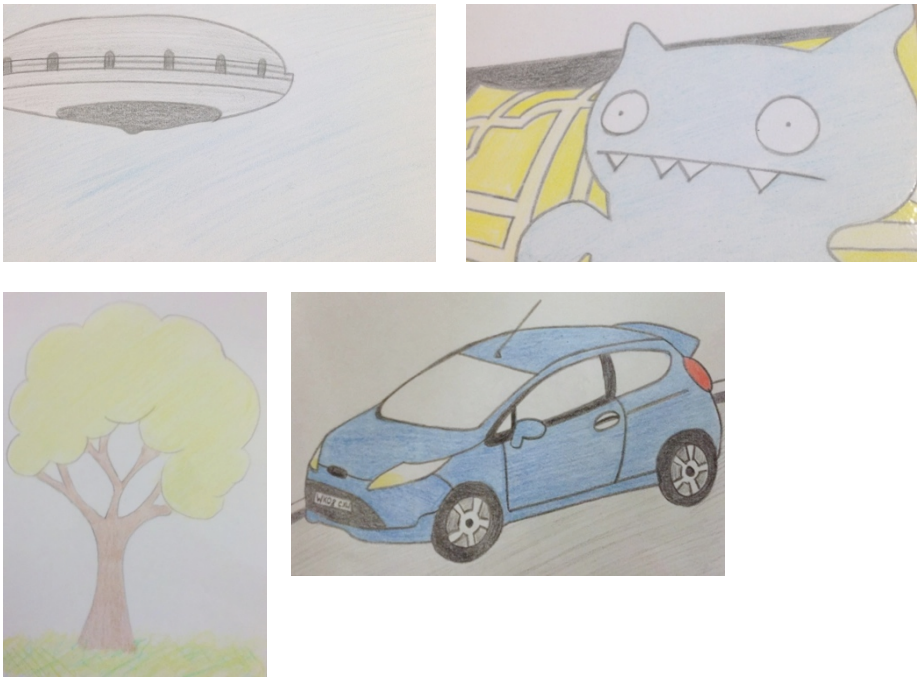

Figure 12. Drawing condition stimuli used in Experiment 6

Design

A 2 (Condition: Photograph, Drawing) x 2 (Location: Earth, Glob) x 3 (Age Group: 6-years, 8-years, Adults) mixed design was used. Condition and Age Group acted as the between-subject factors, and Location acted as the within-subject factor. Participants took part in two trials (Glob and Earth) of either the Photograph or Drawing condition. They were asked four forced choice questions in each trial of the format "did Gooba take/make this picture?"

Procedure

Participants were introduced to 'Gooba', an alien from a faraway planet named Glob (see Figure 10). They were then read a vignette about Gooba's knowledge state, as follows: "This is Gooba. Gooba is from a faraway planet called Glob. This is Glob (shown a picture of Glob, see Figure 10). On Glob there are no

cars or trees, so Gooba has never seen a car or a tree and he doesn't know what they are. But, there are lots of aliens and spaceships on Glob, so Gooba has seen aliens and spaceships and he knows what they are." Following this children were asked four memory questions to ensure they had understood the story and knew which objects were familiar to Gooba and which were not. For example, "does Gooba know what cars are?" Correct answers received positive feedback, while incorrect answers were corrected. Children who failed these questions were excluded. Those who passed went on to complete the test trials. Adults were not asked these questions on the assumption that they would retain the information over the short duration of the task.

In both conditions the test phase consisted of two trials. During one trial Gooba remained on Glob whilst making his pictures, and in the other he visited Earth. By manipulating Gooba's location and his referent knowledge concurrently it was possible to explore what participants understand about the picture creator's role in different modalities: whilst photographic content is entirely dependent on the picture creator being in the presence of the intended referent, the content of drawings is also partly dependent upon the picture creator's knowledge of the intended referent. Thus, four scenarios were created in which children had to take into account one or both of these factors in order to correctly identify Gooba's pictures. The main variable of interest for photographs was location, and for drawings was knowledge. Task instructions differed according to Gooba's location. The following is an example of the procedure for a child who participated in an Earth trial followed by a Glob trial.

In the photograph-Earth trial participants were told, "Gooba came to visit Earth, he walked around and looked at all the things we have on Earth. When Gooba got tired of looking around he decided to take some pictures. I am going to show you some pictures and I want you to tell me which ones Gooba took." The experimenter

then showed participants four photographs (car, tree, alien and spaceship) individually and for each one asked, “Could Gooba have taken this picture?” Picture order was counterbalanced. In the photograph-Glob trial participants were told, “Gooba spent all day playing on Glob, when he got tired he decided to take some pictures. I am going to show you some pictures and I want you to tell me which ones Gooba took.” The photographs and questions remained the same as in the photograph-Earth trial.

The instructions used in the drawing trials were the same as in the photograph trials, except Gooba drew pictures and participants were asked, “Could Gooba have drawn this picture?” After the test trials were completed children were asked to identify each of the four pictures as 'real' or 'not real' to ensure they understood the reality status of aliens and spaceships outside of the Glob task scenario. Participants had to answer all four control questions correctly in order to be included in the final dataset.

Coding

All children had to pass the four memory control questions to proceed to the experimental task. Responses to the second set of control questions, completed after the experimental task, were scored as correct or incorrect and children had to get all four questions correct in order for their data to be included in the analysis. Responses to the test question, “could Gooba have drawn/taken this picture?” were scored as ‘yes’ or ‘no’. Since participants answered this question eight times across two trial types (Earth and Glob) this yielded sixteen data points per participant. The correct pattern of responding for all conditions and trial types is summarised in Table 16.

Table 16

Possible and Impossible pictures according to Trial type and Condition (Experiment 6)

Trial	Picture	
	Spaceship and Alien	Car and Tree
Photograph-Glob	✓	✗
Photograph-Earth	✗	✓
Drawing-Glob	✓	✗
Drawing-Earth	✓	✓

5.1.2 Results

After hearing the vignettes describing Gooba's referent knowledge, children were asked four memory questions to ensure that they had remembered which objects Gooba was knowledgeable about and which he was not. All children successfully passed this preliminary control, allowing the entire sample to progress to the experimental task. A second control trask followed the completion of the experimental task, the intention of which was to confirm that children knew which of pictured referents were 'real' (e.g. car) and which were 'not real' (e.g. spaceship). In the drawing condition, four 6-year-old and two 8-year-old children failed the 'real-not real' control questions by stating that either aliens or spaceships are real. In the photograph condition, one 6-year-old and one 8-year-old said aliens and spaceships were real, while an additional 8-year-old said the spaceship was real. Consequently, these participants' responses to the spaceship and/or alien pictures were not included in the following analyses since it was not clear whether their responses accurately reflected their knowledge of how photographers and artists create pictures. For

instance, if a child thinks spaceships are real it follows that they would also think they could be seen and photographed on Earth, as well as Glob, which violates the design of the task. Data from the two conditions were analysed separately. For each condition, individual binomial tests were conducted on the percentage of yes and no responses given to each of the four pictures on both the Earth and Glob trials. The results are summarised in Tables 16 to 27.

Photograph Condition

Glob. When Gooba was taking photographs on Glob, over 80% of 6-year-olds, 8-year-olds and adults (see Tables 17, 18 & 19) correctly stated that he could photograph spaceships and aliens. Furthermore, the vast majority of participants in all age groups also said he could not take photographs of cars and trees (see Tables 17, 18 & 19). Thus, from the age of 6-years children assert that Gooba can take photographs of familiar referents he can see, but cannot take photographs of absent referents that are unfamiliar. It is necessary to refer to responses on the Earth trial to identify how participants reasoned about the individual contributions of visual access and referent knowledge to picture creation. Chi square tests of independence revealed no significant age group effects.

Table 17

Percentage of 6-year-olds in the photograph condition giving yes and no responses on the Glob trials of Experiment 6. Level of significance determined by binomial tests.

	Response		Binomial significance
	Yes	No	*p*
Spaceship	81%	19%	= .021
Alien	81%	19%	= .021
Tree	18%	82%	= .013
Car	18%	82%	= .013

Table 18

Percentage of 8-year-olds in the photograph condition giving yes and no responses on the Glob trials of Experiment 6. Level of significance determined by binomial tests.

	Response		Binomial significance
	Yes	No	*p*
Spaceship	94%	6%	< .001
Alien	82%	18%	= .013
Tree	0%	100%	< .001
Car	0%	100%	< .001

Table 19

Percentage of adults in the photograph condition giving yes and no responses on the Glob trials of Experiment 6. Level of significance determined by binomial tests.

	Response		Binomial significance
	Yes	No	*p*
Spaceship	100%	0%	< .001
Alien	93%	7%	< .001
Tree	7%	93%	< .001
Car	0%	100%	< .001

Earth. When Gooba was taking photographs on Earth, 6-year-old children performed at chance on all pictures (see Table 20), indicating a lack of understanding that photographers can only depict physically present referents, regardless of whether they are familiar or unfamiliar. Contrastingly, 89% of 8-year-olds and 87% of adults (see Tables 21 and 22) said that Gooba could photograph trees and cars, thereby showing an understanding that referent knowledge is irrelevant to photography. Additionally, 88% of 8-year-olds said Gooba would be unable to take a photograph of a spaceship, yet did not know if he could photograph an alien. Interestingly, adults performed at chance when asked if he could photograph an alien or a spaceship (see Table 22). However, anecdotal evidence suggests that 8-year-olds and adults did not respond to the alien and the spaceship pictures as intended. The adults who stated the spaceship could be photographed identified the referent as a satellite, which exists and could be photographed from Earth, while several of the the 8-year-olds and adults

referred to the alien as a ‘soft toy’, ignoring its identity as a ‘non-existent’ lifeform. Chi square tests of independence revealed no significant age group effects.

Table 20

Percentage of 6-year-olds in the photograph condition giving yes and no responses on the Earth trials of Experiment 6. Level of significance determined by binomial tests.

	Response		Binomial significance
	Yes	No	*p*
Spaceship	44%	56%	= .80
Alien	44%	56%	= .80
Tree	71%	29%	= .143
Car	65%	35%	=.332

Table 21

Percentage of 8-year-olds in the photograph condition giving yes and no responses on the Earth trials of Experiment 6. Level of significance determined by binomial tests.

	Response		Binomial significance
	Yes	No	*p*
Spaceship	12%	88%	= .004
Alien	71%	29%	= .14
Tree	89%	11%	= .001
Car	89%	11%	= .001

Table 22

Percentage of adults in the photograph condition giving yes and no responses on the Earth trials. Level of significance determined by binomial tests.

	Response		Binomial significance
	Yes	No	*p*
Spaceship	27%	73%	= .118
Alien	53%	47%	= 1.00
Tree	87%	13%	= .007
Car	87%	13%	= .007

Across both the Earth and Glob trials, only the oldest children and adults consistently demonstrated knowledge that photographers rely on visual access to their referents, and that referent knowledge is unecessary. By contrast, the 6-year-olds did not perform in accordance with this understanding of the photographic medium. Although they said Gooba could photograph aliens and spaceships on Glob, they were less confident in asserting that he could photograph cars (65%) and trees (71%) on Earth, the only difference being that Gooba was familiar with aliens and spaceships, but not cars and trees. This suggests that at least some of the children in this age group thought referent knowledge was necessary for photography.

Drawing condition

Glob. When Gooba was drawing pictures on Glob, over 90% of 6-year-olds, 8-year-olds and adults stated that he could draw spaceships and aliens (see Tables 23, 24 and 25), demonstrating knowledge that artists can draw referents that are present

and familiar. Likewise, all age groups also stated that Gooba could not draw cars and trees on Glob (see Tables 23, 24 and 25), indicating that they know artists cannot draw referents that are absent and unfamiliar. As in the photograph condition, from this data visual access and knowledge cannot be disentangled, and thus it is necessary to refer to responses on the Earth trial to identify how these two factors individually contribute to participants' reasoning about picture creation. Chi square tests of independence revealed no significant age group effects.

Table 23

Percentage of 6-year-olds in the drawing condition giving yes and no responses on the Glob trials. Level of significance determined by binomial tests.

	Response		Binomial significance
	Yes	No	*p*
Spaceship	94%	6%	< .001
Alien	90%	10%	< .001
Tree	20%	80%	= .012
Car	20%	80%	= .012

Table 24

Percentage of 8-year-olds in the drawing condition giving yes and no responses on the Glob trials. Level of significance determined by binomial tests.

	Response		Binomial significance
	Yes	No	*p*
Spaceship	100%	0%	< .001
Alien	94%	6%	< .001
Tree	11%	89%	= .001
Car	11%	89%	= .001

Table 25

Percentage of adults in the drawing condition giving yes and no responses on the Glob trials. Level of significance determined by binomial tests.

	Response		Binomial significance
	Yes	No	*p*
Spaceship	94%	6%	= .001
Alien	100%	0%	< .001
Tree	25%	75%	= .077
Car	12%	88%	= .004

Earth. When Gooba was drawing on Earth, 6-year-olds again performed at chance for all pictures, showing a lack of understanding that artists can draw absent but familiar referents (spaceship and alien), or physically present but unfamiliar

referents (car and tree). However, 70% of children did state that Gooba could draw the car and tree, which suggests that the majority did know that artists can draw what they can see, although this did not reach statistical significance (see Table 26). Eight-year-olds and adults performed almost identically (see Tables 27 and 28). When asked whether Gooba could draw absent but familiar referents (alien and spaceship) both age groups performed at chance, suggesting a lack of understanding that artists can draw on the basis of referent knowledge alone. Furthermore, the majority of 8-year-olds and adults performed above chance when asked if Gooba could draw trees, but performance at chance when asked about cars. The picture of Earth that was used to remind participants which planet Gooba was on depicted a field, in which a tree is more likely to be found than a car, and this may account for the difference in performance between these referents, as participants may have used the picture as a cue that Gooba would only see a tree on his visit to Earth. Chi square tests of independence revealed no significant age group effects.

Table 26

Percentage of 6-year-olds in the drawing condition giving yes and no responses on the Earth trials. Level of significance determined by binomial tests.

	Response		Binomial significance
	Yes	No	*p*
Spaceship	53%	47%	= 1.00
Alien	55%	45%	= .82
Tree	70%	30%	= .12
Car	70%	30%	= .12

Table 27

Percentage of 8-year-olds in the drawing condition giving yes and no responses on the Earth trials. Level of significance determined by binomial tests.

	Response		Binomial significance
	Yes	No	*p*
Spaceship	50%	50%	= 1.00
Alien	50%	50%	= 1.00
Tree	78%	22%	= .03
Car	67%	33%	= .24

Table 28

Percentage of adults in the drawing condition giving yes and no responses on the Earth trials. Level of significance determined by binomial tests.

	Response		Binomial significance
	Yes	No	*p*
Spaceship	44%	56%	= .80
Alien	50%	50%	= 1.00
Tree	88%	12%	= .004
Car	75%	25%	= .077

Combined, the results from the Glob and Earth trials show that even adults did not consider referent knowledge sufficient to allow an artist to depict absent referents. By contrast, 8-year-olds and adults were aware that, like photographers, artists can depict physically present referents. Seventy percent of 6-year-olds also recognised

that Gooba could draw referents he had visual access too, although this did not reach statistical significance.

5.1.3 Discussion

This study investigated if 6- and 8-year-old children and adults recognise the differential impact visual access and referent knowledge have on the content that artists and photographers can depict. The results indicate that from the age of 8 children recognise that a photographer's visual access to their intended referent is the crucial determinant of photographic content. In line with expectations, they adhered to a strict interpretation of photography, minimising the importance of the photographer's mind and instead focusing on the picture-world relationship when deciding which referents could be photographed. Contrastingly, both children and adults demonstrated considerably less understanding of the unique role that referent knowledge plays in the creation of drawings by artists. Contrary to the hypotheses, they did not prioritise the picture-creator relationship over the picture-world relationship when determining which referents could be drawn.

The findings from the photograph condition support the hypotheses by showing that only the oldest children and adults possess an understanding that photographic content hinges on visual access to the intended referent, while the photographer's referent knowledge is unimportant. These participants knew that Gooba could photograph physically present yet unfamiliar referents (e.g. the car and tree on Earth), and with the exception of the alien (see Section 5.1.2 for explanation), that Gooba could not photograph absent referents (e.g. spaceship on Earth). However, the pattern of responding for the 6-year-olds revealed that a minority of children (approximately 30%) did not think Gooba could photograph present but *unfamiliar*

referents (e.g. car and tree on Earth), indicating that they failed to rule out the possibility that referent knowledge impacts photography. Finally, only half of the 6-year-olds knew that Gooba was incapable of photographing absent referents, such as the spaceship on Earth. This cannot be attributed to a lack of understanding that spaceships and aliens are not real, since all children included in the dataset passed the fantasy-reality control task. Together, these findings suggest that there is a developmental progression in the acquisition of photograph-specific rules, in particular, making the transition from recognising that photographs tend to depict what is in front of them, to realising that they are *dependent* on their real world referents, and therefore that the photographer's referent knowledge does not impact photographic content. Ultimately, over time children adhere to an increasingly strict interpretation of photography, which minimises the importance of the photographer's mind in favour of focusing on the link between the picture and the world.

One potential explanation for the performance differences between 6- and 8-year-old children is their knowledge of causality. The causal relationship between photographs and their referents is what dictates that photographers must be able to see their intended referents, however, children do not demonstrate an awareness of this aspect of photography until around the age of 7 or 8 (Kose, 1985; Liben, 2003; Wellman & Hickling, 1994). While 8- and 10-year-old children know that cameras are mechanical devices, 6-year-old children think that to create a photograph, "the camera gets the idea of it and draws the picture" (Wellman & Hickling, 1994, p. 1572). If 6-year-olds in the current experiment thought cameras could come up with their own ideas, this would explain why they thought absent referents could be photographed, and failed to rule out knowledge as a potentially influential factor.

In the drawing condition, as hypothesised, 8-year-old children and adults recognised that Gooba could draw referents that were physically present, even if they were unfamiliar to him, showing an understanding that artists, like photographers, can draw anything they can see, irrespective of whether they know what it is. This falls in line with the expectation that children's own experience of drawing (Anning, 2002; Rose, Jolley & Burkitt, 2006; Winner, 1989) would imbue them with the knowledge that drawings can be created on the basis of visual access alone. By contrast, although the majority of the 6-year-olds also correctly asserted that Gooba could draw present but unfamiliar referents, approximately 30% did not. It is plausible, and not unreasonable, that this subsection of children did not think Gooba would have any interest in drawing unfamiliar referents, such as cars and trees. Supporting this assertion is DeMarie's (2001) finding that younger children prefer to take pictures of familiar animals at the zoo, while older children would rather capture animals they have not encountered before.

Despite their success on the drawing-Glob trials, contrary to expectations, only half the participants in all age groups acknowledged that on Earth Gooba could draw absent referents on the basis of prior knowledge, for instance, he could draw the spaceship on Earth. There are two possible explanations for the lack of regard participants showed for referent knowledge. Firstly, children and adults are unaware that artists can draw from prior experience, and thus do not need to see their referent. Secondly, participants did not pay sufficient attention to the referent knowledge manipulation.

It is highly implausible that adults think artists can only draw referents they can see, given the frequency with which they think and talk about absent referents in everyday life (Liszkowski, Schafer, Carpenter & Tomasello, 2009; Osina, Saylor &

Ganea, 2013; Tomasello, 2001). Furthermore, by adulthood we have been exposed to a wide variety of artwork, including pictures of fantasy worlds and abstract images, which cannot be created via visual access to specific referents. It is possible that the children were unaware that artists can draw from referent knowledge, although this contradicts previous research, which has shown that even 6-year-old children recognise that an artist's ability to draw, a fish, for example, is hindered by her lack of knowledge about animals (Richert & Lillard, 2002). In which case, it may be that the referent knowledge manipulation in the current experiment was not as strong as in previous work.

In Richert and Lillard's (2002) task children were asked to decide whether a troll could draw a fish if she did not know anything about animals. Thus, participants only had one cue, knowledge, on which to base their response. By contrast, in the current task referent knowledge and visual access were both manipulated, and it is possible that visual access was highlighted to a greater extent than knowledge. During the procedure, immediately prior to answering the test questions the experimenter placed a picture of Earth or Glob in front of the participants, which was intended to act as a reminder of Gooba's current location. After the first trial the picture was changed to reinforce Gooba's movement from Earth to Glob or Glob to Earth. Thus, although participants were informed about Gooba's knowledge state and asked control questions to verify that they remembered which referents he was knowledgeable about, the importance of this information might have been overshadowed by the salience of the location manipulation. After the procedure adult participants who had failed to account for referent knowledge were asked why they did not think Gooba could draw the alien and spaceship when he was on Earth. They all made statements to the effect that they 'just had not thought about it' or 'assumed

he was making pictures of the places he was in', seemingly confirming that the importance of referent knowledge was not made clear enough in the procedure. Accordingly, it will be important for future work to try and place more emphasis on knowledge to ensure it is given due consideration. For example, rather than referent knowledge being an all or nothing state, perhaps allowing Gooba to see the referent and then removing it would be one way to highlight that having seen it previously he can use that experience to draw it, despite its absence.

Future studies should also expand on the repertoire of stimuli used here. Using a stuffed toy alien proved problematic in the current experiment, even among adult participants. In some cases, their responses indicated that while the toy was intended to represent a non-real entity that cannot be photographed on Earth, participants thought of it as a 'real toy', which of course can be photographed on Earth. Another, perhaps less abstract way, to tap the same underlying knowledge that was of interest here would be to ask children to create the pictures themselves. By asking children to take a photograph of 'a car' and then 'an alien', for example, it would be possible to analyse their photographs (they may go find a toy alien to photograph) and equally, to record their reasons for not taking fantasy photographs. This would provide deeper insight into children's knowledge of photography and its associated limitations. Similarly, asking children to draw an alien might elicit remarks about exactly how it is that artists can depict absent or non-existent entities, namely by using their imagination. Imagination, as well as knowledge, allows artists to draw without the need for a physically present referent. As such, this is another factor that could be manipulated to explore differences in how children construe the role of the artists mind in picture creation.

Finally, future research may also wish to treat location as a between rather than a within subjects variable. In the current study each child received two trials, one in which Gooba was on Earth and one in which he was on Glob, which were counterbalanced to avoid order effects. As such, half of the children experienced the Earth trial before the Glob trial. This is potentially problematic, since this may have led these children to think that during his visit to Earth Gooba would acquire knowledge of the previously unfamiliar car and tree categories, and thus be capable of drawing these objects on his return to Glob. Such reasoning directly violates the knowledge manipulation, which was devised such that Gooba's lack of knowledge about cars and trees should inhibit his ability to draw them on Glob. A comparison of correct responses across the two trial orders indicates that 6-year-olds who received the Earth-Glob trial order were no more likely to claim that Gooba could draw cars and trees on Glob than children who received the Glob-Earth trial order. However, the 8-year-olds and adults who received the Earth-Glob trial order were slightly more likely to state that Gooba could draw cars and trees on Glob than participants who received the Glob-Earth trial order. For 8-year-olds there was a 12% increase in yes responses, and for adults there was a 25% increase in yes responses for the car and a 37% increase in yes responses for the tree. Given the likelihood of at least some order effects it would be advantageous for future research to expose participants to either the Glob *or* Earth trials, rather than both.

Collectively, these findings indicate that between the ages of 6 and 8 children are in the process of acquiring knowledge specific to the photographic medium, in particular, that the photograph-world relationship is a stronger predictor of photographic content than the photographer's knowledge. At least within the comparison of visual access and referent knowledge, 8-year-old children treat

photographs as ‘belief-independent’ (Cavedon-Taylor, 2014a; Currie, 1991). However, I did not find the anticipated evidence that children understand how knowledge influences an artist’s ability to draw. Given the inconclusive nature of the drawing data future research will need to modify the current task in order to further assess how children acquire knowledge of the ‘mind-dependent’ nature of drawing. One potentially fruitful avenue is exploring children’s understanding of the role an artist’s imagination plays in drawing. Endeavours such as these will continue to further our understanding of how media-specific factors shape children’s pictorial development.

Chapter Six: **Fantasy and reality in the pictorial domain: Do children think non-existent entities can be photographed?**[4]

One of the fundamental building blocks of symbolic understanding is learning how symbols, such as pictures, relate to their real world referents (DeLoache, 2004). Pictures are a key source of information about the world (Allen, Bloom & Hodgson, 2010; DeLoache, 1991, 2004; Ganea, Ma & DeLoache, 2011; Keates, Graham & Ganea, 2014), and therefore it is important to know how accurately they represent reality. One factor that can influence how pictures relate to the real world is modality - the type of picture - such as a photograph or a drawing.

Photographs share a direct and transparent relationship with the world, and thus in most instances are faithful representations of the world. They can only depict fantasy referents with the aid of post-production editing or the use of models rather than real entities; a 'real' unicorn cannot stand in front of a camera to be photographed. By contrast, handmade pictures, such as drawings, frequently depict both real and fantasy referents. Decoding the picture-world relationship is crucial for developing a mature conception of pictures (Freeman & Sanger, 1995), and therefore it is important to investigate the mediating influence of picture modality. The aim of the current experiment is to investigate how readily 5- to 8-year-old children use picture modality and referential content to identify which of two pictures a confederate is most likely to have created. Do children expect photographs to depict only real referents, or does increasingly easy access to digital technology mean they understand how fantasy photographs can be created?

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[4] Based on Armitage, E., & Allen, M. L. (under review). Fantasy and reality in the pictorial domain: Do children think non-existent entities can be photographed? *Child Development*

Between the ages of 18 months and 3 years children learn to match photographs and drawings to their real world referents (Pierroutsakos & DeLoache, 2003; Preissler & Carey, 2004; Simcock & DeLoache, 2006), using cues such as iconicity (Ganea, Pickard & DeLoache, 2008), verbal labels (Callaghan, 2000) and artist intention (Preissler & Bloom, 2008). Furthermore, by the age of 2.5 years old children are capable of using pictures to guide their actions, for instance, to locate hidden objects (DeLoache & Burns, 1994; Suddendorf, 2003) and to identify which toys to place in a box (Callaghan, 2000). Thus, by 3 years old children have a strong grasp of how pictures refer to their real world referents. However, an as yet unanswered question concerns pictures of non-real referents, specifically fantasy pictures. It is here that picture modality mediates the picture-world relationship (Freeman & Sanger, 1995) most strongly, yet little research has directly compared children's understanding of the content that can be depicted by photographs and drawings. Nonetheless, a review of the individual literature on these picture types can inform our expectations of how children's responses to the two might differ.

From a young age children are immersed in fantasy worlds that are inhabited by make-believe characters, hence, it is crucial that they learn how to distinguish these from real people and objects (Woolley & Van Reet, 2006). Prior to the age of 4 children have considerable difficulty separating real and fantasy animals, and scenarios, into ‘real’ and ‘not real’ categories (Morison & Gardner, 1978; Sharon & Woolley, 2004; Taylor & Howell, 1973). Contrastingly, 4- and 5-year-olds understand that real and fantasy figures possess different properties (Wellman & Gelman, 1998), for instance, sleep is a physical need attributed to humans more often than fantasy creatures, such as fairies (Sharon & Woolley, 2004). At age 5, children can also categorise real and generic fantasy entities appropriately (Martarelli & Mast, 2013;

Morison & Gardner, 1978; Sharon & Woolley, 2004), although their accuracy improves until at least the age of 7 or 8, when they can use narrative cues to correctly classify unfamiliar real and fantasy figures (Corriveau, Kim, Schwalen, & Harris, 2009; Martarelli & Mast, 2013).

Much of children's early exposure to fantasy occurs via picture books, which are populated with drawings of imaginary creatures and characters (Marriott, 2002; Troseth, 2003; Woolley & Cox, 2007). Despite the somewhat protracted development of the fantasy-reality distinction, recent research has shown that even 3-year-old children are less likely to generalise information learnt from fantasy pictures books than realistic picture books (Richert, Shawber, Hoffman & Taylor, 2009; Richert & Smith, 2011; Walker, Ganea & Gopnik, 2014; Waxman, Herrmann, Woodring & Medin, 2014). For instance, Ganea, Canfield, Ghafari and Chou (2014) showed 3- and 5-year-old children storybooks containing realistic or anthropomorphised pictures of novel animals (e.g. a bird emerging from a tree versus lying in bed). Children learned factual information from both books, yet did not map the unrealistic characteristics seen in the anthropomorphic pictures onto the real world animal. Only when the pictures were accompanied by anthropomorphic descriptions did children attribute more human-like characteristics to the real animal. Thus, despite the frequency with which fantasy drawings appear in picture books, evidence shows that while children are accustomed to them, they do not rely on them as valid sources of information about the world. Is this also the case for fantasy photographs?

In parallel with the drawing literature, empirical investigations of how children understand photographs have been dominated by a focus on production and comprehension of real, rather than fantasy, pictures. One such study reports a tendency for children to overestimate the correspondence between photographs and

the world. Donnelly, Gjersoe and Hood (2013) found that 3- and 4-year-old children expect changes made to a photograph to affect its referent; they behave as if wetting a photograph causes the referent object itself to become wet. This demonstrates a desire for photographs not only to share a veridical relationship with their referents, but also to maintain it over time. Older children place similarly high expectations on photographs. In one of the only cross-modal studies to date, O'Connor, Beilin and Kose (1981) presented 5- to 7-year-old children with photographs and drawings that contradicted the scene in front of them, and found that 6-year-olds treated the photographs as the "correct" representation of the world, over and above the real world scene. Again this suggests that children expect photographs to act as faithful representations of the world. On the basis of this pattern of results it would be reasonable to expect children to select real over fantasy photographs due to the lack of a discernible link between fantasy photographs and the real world. For instance, unicorns cannot be seen in the real world and, therefore should not be seen in photographs. However, a related branch of photograph research has identified a potential obstacle that might inhibit children's sensitivity to picture modality, and thus their ability to use it as a cue for making judgments about the content that different picture types can and cannot depict.

When older children are asked to produce and describe their own photographs (Liben & Szechter, 2002; Sharples, Davison, Thomas & Rudman, 2003), or to describe and sort professional photographs (Szechter & Liben, 2007), they display a strong focus on referential content. Justifications such as, "because it's a fountain and usually fountains have a lot of water to throw pennies in" (Liben & Szechter, 2002, p. 392), were common among 7-8-year-old children when they were asked to explain their photograph preferences. Intriguingly, Liben (2003) has shown that when content

is held constant children display more sensitivity to the representational surface features of an image. When she presented 3-, 5- and 7-year-old children with photographs of the same referent taken from a different angle, some 5-year-old children and most 7-year-olds correctly attributed the difference in the pictures to the photographer's actions. When referential content varied between pictures, even 7-year-olds claimed a change had been made to the referent itself. Liben argues that the perceptual transparency of photographs draws attention to the depicted referent, at the expense of the photograph's surface. Since modality information is derived from the surface features of a picture, this raises the possibility that when viewing fantasy photographs children will fail to consider the influence of picture modality on the depiction of fantasy referents, unless content is held constant.

An alternative perspective on fantasy photographs can be gained by considering the rise of digital technology. The advent of websites such as Instagram, which are dedicated to filtering and sharing photographs, alongside the increasing use of cameras and photograph-editing apps on smartphones and tablets, may mark a turning point in how children experience the photographic medium (Cavedon-Taylor, 2014b; Gooskens, 2012). Recent surveys suggest that many children now have access to and have used a digital camera by the age of 2, while 45% of 2- to 4-year-old children and 43% of 5- to 8-year-old children have 'sometimes or often' used creative apps, such as those used for drawing or editing photographs (Rideout et al, 2013). This being the case, it is plausible that children are aware from a very young age that although photographs typically share a direct and transparent relationship with reality, this can be manipulated later. Using this information children might accept fantasy photographs, not because they lack knowledge of how photographs relate to reality, but like adults, they understand that photographs can be edited.

The theoretical importance of studying picture modality cannot be underestimated. If children's understanding of the picture-world relationship differs for photographs and drawings this could have implications for a developing theory of pictures. According to Liben (1999), modality is not integrated into children's symbolic understanding until the latter stages of their representational development, when they become aware that different types of representation are underpinned by unique symbol-referent relationships (DeLoache & Burns, 1994; Troseth, 2010) and associated with distinctive rules (Beilin, 1999). The current experiments will comprise one of the first attempts to systematically investigate when and how picture modality affects children's picture interpretation. A lower age limit of 5 was chosen since the ability to categorise real and fantasy entities is stable by this age (Harris, Brown, Marriott, Whittall, & Harmer, 1991; Sharon & Woolley, 2004; Taylor & Howell, 1973), and an upper age limit of 8, to ensure sufficient knowledge of both drawings and photographs for making cross-modal comparisons (Liben, 2003; Wellman & Hickling, 1994). An adult group was also included; their performance was intended to act as a baseline against which to compare children's responses.

Here two experiments, which vary how photographs and drawings are paired, investigate how 5- to 8-year-old children and adults use picture modality and referential content to identify which of two pictures a confederate is most likely to have created, for instance, a fantasy photograph or a fantasy drawing. It is important to manipulate both of these factors since previous research indicates that children respond differently to pictorial surface features, which include modality, depending on whether referential content is held constant or allowed to vary (Liben, 2003; Steinberg & DeLoache, 1986). In Experiment 7 picture modality was manipulated. Participants were presented with pairs of photographs and drawings: half of the pairs

depicted real referents (e.g. a photograph of a horse alongside a drawing of a horse), and half depicted fantasy referents (e.g. a photograph of a unicorn alongside a drawing of a unicorn). Referential content was held constant in an attempt to facilitate children's sensitivity to the picture's surface features (Liben, 2003; Steinberg & DeLoache, 1986), and thus, the contrast in picture modality. Participants were then asked to identify which picture from each pair they thought a girl named Sarah, who had access to both a camera and crayons, had created. Since there was no right or wrong answer to this question: Sarah *could* have made both pictures, two possible patterns of performance were hypothesised for fantasy pictures.

When shown real pictures children and adults were expected to choose an equal number of photographs and drawings, since real referents can be depicted in any modality. When shown fantasy pictures it was hypothesised that frequent experience of fantasy drawings, combined with knowledge that photography is a reality-bound medium, would result in a higher selection of drawings than photographs. Alternatively, it was posited that increasing familiarity with how photographs can be manipulated might result in a higher selection of fantasy photographs than drawings. Furthermore, fantasy photograph selections might increase with age as children gain more exposure to photograph-editing software on mobile media platforms (Rideout et al, 2013). By contrast, it was anticipated that experiences such as viewing photographs on digital camera screens immediately after they are taken, might reinforce the veridical relationship between photographs and the world. It has previously been reported that showing children how a Polaroid camera works improves their ability to understand that a photograph of a room represents a real room (DeLoache & Burns, 1994). If this is the case, fantasy photograph selections should decrease with age.

In Experiment 8, referential content was varied while picture modality remained constant. A between-subjects design was used to present participants with real-fantasy pairs of photographs *or* drawings. It was hypothesised that here children's focus on referential content might facilitate performance by allowing them to use the contrast between real and fantasy referents as a basis for reasoning about picture modality. For instance, children could identify a horse as 'real' and a unicorn as 'not real' and then use this information to decide which referent can be photographed. Together, these experiments will contribute to the emerging literature on children's appraisal of fantastical representations, as well as provide empirical evidence about when and how children incorporate modality into their repertoire of useful pictorial cues, thereby informing a developing theory of pictures.

6.1 Experiment 7

6.1.1 Method

Participants

Seventy-three children (47 female and 26 male) from four age groups (5-, 6-, 7-, and 8-years) participated (see Table 29). Children were recruited from six primary schools in North Yorkshire and three primary schools in Lancashire. Sixteen adults (14 female and 2 male, range: 18-21, M_{age} = 18.4) also participated, and were recruited using the research participation system at Lancaster University. Participants were predominantly white and middle class.

Table 29

Children's age groupings in Experiment 7

Age Group	N	M_{age} (months)	Range
5	22	65	60-71
6	16	78	75-83
7	17	90	84-95
8	16	100	96-103

Materials

Thirty-four colour photographs (6 x 4 inches) and 34 coloured sketches (A5) were used in the experimental task and the control task. The photographs were gathered via the Internet, and a professional artist drew the sketches using the photographs as a reference point. The pictures were paired according to referential content to form 17 real pairs and 17 fantasy pairs, which were presented in a randomised order. Each pair consisted of one photograph and one drawing of the same referent (see Figures 13 and 14). See Appendices D and E for full stimuli set. An additional eight pictures were used in a set of control task pre-trials, four depicted real referents and four depicted fantasy referents. They too were sourced from the Internet.

Procedure

Experimental Task. Children were read a vignette (adults read the vignette themselves) about a little girl named Sarah and her pictures. The vignette read, *"*My

friend Sarah got a new camera and some colouring crayons for her birthday, so she took lots of photographs and drew lots of pictures, but they got mixed up with someone else's. Do you think you can help me find Sarah's pictures?" Participants were then presented with 17 pairs of real pictures and 17 pairs of fantasy pictures (see Figures 13 and 14) and for each pair were asked, "Which one did Sarah make?" Picture order was counterbalanced. Children also completed a control task that was intended to provide a measure of their ability to distinguish fantasy from reality within the specifics of this study. This was a necessary ability if the experimental task was to assess their understanding of the differences between photographs and

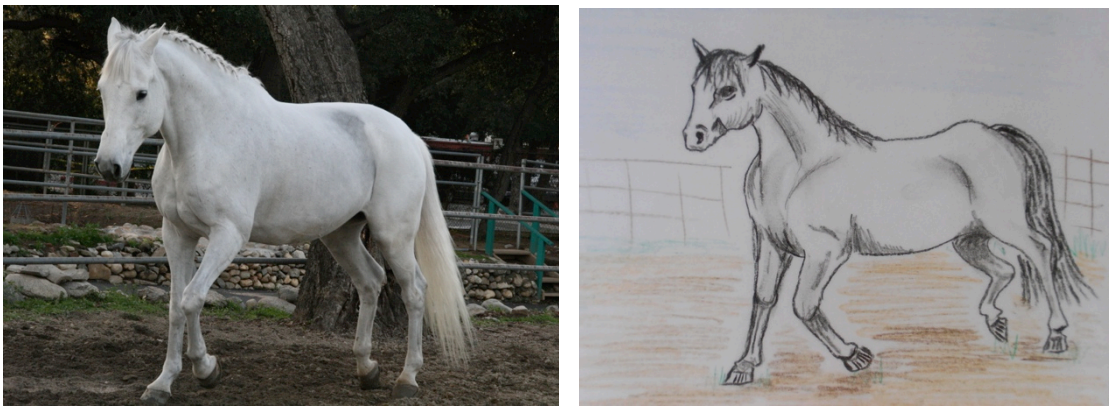


Figure 13. Example of a real picture pair used in Experiment 7

Figure 14. Example of a fantasy picture pair used in Experiment 7

drawings, and not to reflect their fantasy-reality understanding.

Control task. After the experimental task children completed eight pre-trials, followed by the control task. The pre-trials were used to ensure children understood the terms ‘real’ and ‘not real’ as relating to the existence of particular entities. In each pre-trial they were shown a picture, for instance, a rhino-panda hybrid, and were asked, “Is this real or not real?” Four of the pictures depicted fantasy creatures or events, and the remaining four depicted real animals or events. Feedback was given to correct any incorrect responses and children had to pass 6 out of 8 pre-trials (75%) to proceed to the control task. Those who passed then completed the control task.

In the control task children were shown all 34 pictures from the experimental task individually and asked to identify each one as real or not real. Using the experimental stimuli allowed the measurement of children’s ability to make the fantasy-reality distinction within the specific confines of the current task, rather than more generally. Since children saw both photographs and drawings in the experimental task, in the control task half of the sample were shown photographs and the other half were shown drawings. This ensured that their judgments about the reality status of the depicted referents were not influenced by picture modality, i.e. stating that all the photographs were 'real' simply because photographs have a realistic appearance.

Coding

The experimental task yielded four scores: a photograph score and a drawing score for real picture pairs and a photograph score and a drawing score for fantasy picture pairs (each out of 17). Due to the reciprocal nature of these scores (i.e. photograph and drawing choices are mutually exclusive and children choose either one or the other for each trial), photograph scores were used as the dependent

variable. Scores ranged from 0–17. A score of 0 indicated that no photographs were chosen, and a score of 17 indicated that all photographs were chosen. Children received an additional score for the control task. The control task score was the total number of pictures (out of 34) correctly identified as real or not real.

6.1.2 Results and Discussion

Adults

The adult data was analysed first to provide a baseline for ideal performance. To identify whether content influenced picture choices, a paired t-test was conducted on the number of photographs selected for real and fantasy picture pairs. Adults chose significantly more real photographs (M = 6.13, SE = 1.16) than fantasy photographs (M = 2.31, SE = 1.02), $t(15) = 2.60$, $p = .02$. Real photographs were chosen at a level equal with chance, $t(15) = -4.84$, $p = .06$, while fantasy photographs were chosen at a level significantly below chance, $t(15) = -8.36$, $p < .001$. These findings support the hypotheses by confirming that adults choose real over fantasy photographs, yet readily accept both photographs and drawings of real referents (indicated by chance performance).

Children

Control Task. Control data is reported first since participants who did not demonstrate sufficient fantasy-reality understanding were removed. Preliminary analyses indicated that 8 children scored less than 75% (25/34) on the control task: seven 5-year-olds, and one 6-year-old. These children were not included in subsequent analyses, which did not change any of the reported effects or effect sizes. The remaining sample (N = 65) comprised only children who passed the control task.

A 4 (Age group: 5-, 6-, 7-, and 8-years) x 2 (Picture Modality: Photograph, Drawing) univariate ANOVA revealed no effect of age group or picture modality on control task score. Children were equally proficient at identifying the depicted entities as real or not real regardless of whether the pictures were photographs or drawings. This demonstrates that the stimuli did not confound children's performance; seeing realistic photographs of fantasy referents did not increase the likelihood of children identifying them as real.

Experimental Task. Preliminary analyses revealed no significant effect of presentation order. To identify whether picture content influenced children's picture choices, a 2 (Picture Content: real, fantasy) x 4 (Age Group: 5-, 6-, 7-, and 8-years) repeated measures ANOVA was conducted on the number of photograph selections. A significant main effect of picture content, $F(1, 61) = 18.99$, $MSE = 215.56$, $p < .001$, $\eta_p^2 = .24$, revealed that overall children chose significantly more real photographs ($M = 8.00$, $SE = .68$) than fantasy photographs ($M = 5.43$, $SE = .63$). Real photographs were chosen at a level equal with chance, $t(64) = -.75$, $p = .46$, while fantasy photographs were chosen at a level significantly below chance, $t(64) = -4.86$, $p < .001$.

A Picture Content x Age Group interaction, $F(3, 61) = 2.95$, $MSE = 33.48$, $p = .040$, $\eta_p^2 = .13$ (see Table 30) was also identified. Further pairwise comparisons subjected to the Bonferroni adjustment identified a significant main effect of picture content for the 7-year-old, $F(1, 16) = 14.79$, $MSE = 144.12$, $p = .001$, $\eta_p^2 = .48$, and 8-year-old children, $F(1, 15) = 12.86$, $MSE = 162.00$, $p = .003$, $\eta_p^2 = .46$. Children in these age groups chose significantly more real photographs (7 year olds: $M = 7.94$, SE

= 1.31; 8 year olds: *M* = 8.88, *SE* = 1.15) than fantasy photographs (7 year olds: *M* = 3.82, *SE* = 1.20; 8 year olds: *M* = 4.38, *SE* = .92).

Chance analyses (chance value = 8.5) indicated that 5- and 6-year-old children chose real photographs (5-year-olds: *M* = 7.5, *SE* = 1.34; 6-year-olds: *M* = 7.69, *SE* = 1.62) and fantasy photographs (5-year-olds: *M* = 7.06, *SE* = 1.31; 6-year-olds: *M* = 6.44, *SE* = 1.53) at a level equal with chance. Seven- and 8-year-old children also chose real photographs (7-year-olds: *M* = 7.94, *SE* = 1.31; 8-year-olds: *M* = 8.88, *SE* = 1.15) at a level equal with chance. However, they chose fantasy photographs at a below chance level: 7-year-olds: $t(16) = -3.91$, $p = .001$ and 8-year-olds: $t(15) = -4.48$, $p < .001$.

To compare the performance of the eldest children with that of adults, an additional 3 (Age Group: 7-years, 8-years, adults) x 2 (Picture Content: real, fantasy) mixed ANOVA was conducted. This revealed that there was no difference in the performance of the three age groups, who all chose more real than fantasy photographs, $F(1, 46) = 32.06$, $MSE = 420.26$, $p < .001$, $\eta_p^2 = .41$.

Table 30

Percentage of Photograph and Drawing Choices according to Referential Content and Age Group in Experiment 7

	Real		Fantasy	
	Photograph	Drawing	Photograph	Drawing
Age Group				
5	44%	56%	42%	58%
6	45%	55%	38%	62%
7	47%	53%	23%	77%
8	52%	48%	26%	74%

As anticipated, children selected an equal number of photographs and drawings when the referential content was real, indicating that by age 5 they recognise that real referents can be depicted in both picture modalities. This supports previous research, which reports that even younger children will accept drawings of imaginary events (Harris, Kavanaugh & Dowson, 1997). However, only 7- and 8-year-old children, and adults, chose real over fantasy photographs. It seems unlikely that younger children know more about photograph-editing than the older age groups, which leaves open two other possible explanations for this age difference. It could be that younger children are simply less knowledgeable about fantasy than older children, although a control task screened out children who failed to identify a sufficiently high number of the fantasy stimuli as ‘not real’, and the remaining participants’ control task scores did not correlate with performance in the

experimental task. Children who scored highly on the control task did not select more real photographs than children who obtained a lower score on the control task.

An alternative explanation is that 5- and 6-year-olds possess insufficient knowledge of how photographs are created, specifically, they may be unaware that the use of cameras limits photographers to taking pictures of referents that are both real and physically present. This is particularly plausible given that the commentaries provided by older children indicate that this formed the basis for their picture selections. Five children aged 7 or 8 and one 5-year-old, produced a total of 26 comments about their picture choices. The most common justifications for choosing fantasy drawings over fantasy photographs centred on referential content (n = 18), although 4 comments also referred to picture modality. Examples include, "definitely not the photograph, unicorns aren't real" (age 7), and "dragons aren't real so I knew it was going to be a drawing" (age 8). Together, these findings suggest that despite increased accessibility to digital cameras and other photograph-related media, 7- and 8-year-old children still choose real over fantasy photographs, and that this is attributable to knowledge that photographs share a direct and transparent relationship with the world, and therefore can only depict real referents.

Interestingly, despite the attempt to facilitate awareness of picture modality by holding referential content constant (Liben, 2003), 5- and 6-year-old children failed to distinguish real and fantasy photographs, and older children made more explicit references to content than modality when justifying their picture selections. This raises the possibility that children's preoccupation with the referential content of pictures (DeLoache, 2002; Liben & Szechter, 2002; Parsons, 1987; Sharples, Davison, Thomas & Rudman, 2003) is advantageous to their performance in the present task. Consequently, Experiment 8 highlights the fantasy-reality distinction

(e.g. horses versus unicorns), rather than the photograph-drawing distinction, to investigate whether this facilitates 5- and 6-year-old children's discrimination of real and fantasy photographs. This manipulation also provides another opportunity to rule out insufficient fantasy knowledge as the reason younger children did not make this distinction in Experiment 1.

6.2 Experiment 8

The aim of Experiment 8 was to investigate whether 5- to 8-year-old children could use differences in referential content, rather than picture modality, as the basis for judging which picture 'Sarah' was most likely to have created. Here two conditions were included in a between-subjects design: a photograph condition and a drawing condition. In both conditions children were shown 17 picture pairs, each consisting of a real picture and a fantasy picture, for instance, a horse and a unicorn (see Figures 15 and 16). The pairs were made up of photographs *or* drawings, depending on condition. Thus, in contrast to Experiment 7, in Experiment 8 children saw only one picture modality (photographs or drawings) but were presented with real and fantasy content simultaneously. It was hoped that drawing children's attention to the differences between real and fantasy referents would facilitate their consideration of the content that is most likely to be depicted in photographs or drawings.

It was hypothesised that 5- and 6-year-old children would be more sensitive to differing content than they were to the modality contrast in Experiment 7. Thus, 5- and 6-year-old children in the photograph condition were expected to select significantly more real than fantasy pictures, while children in the drawing condition were expected to choose an equal number of real and fantasy pictures. Older

children's performance was also expected to follow this pattern, as it did in Experiment 7.

6.2.1 Method

Participants

One hundred and fifty-eight children (78 female and 80 male) from four age groups (5-, 6-, 7-, and 8-years) were assigned to two conditions: 77 children participated in the photograph condition and 81 in the drawing condition (see Table 31). Children were recruited from six primary schools in North Yorkshire and three primary schools in Lancashire. Thirty-two adults (22 female and 10 male, range: 18-20, M_{age} = 18.6) also participated (Photograph condition: N = 16; Drawing condition: N = 16). They were recruited using the research participation system at Lancaster University. Participants were predominantly white and middle class.

Table 31

Children's age and condition groupings in Experiment 8

	Condition					
	Photograph			Drawing		
	N	M_{age} (months)	Range	*N*	M_{age} (months)	Range
Age Group						
5	21	64	60-71	19	61	60-68
6	22	78	72-83	25	78	73-83
7	16	90	83-95	21	90	84-95
8	18	99	96-103	16	99	96-106

Materials

The stimuli from Experiment 7 were used. Each pair consisted of one picture of a real entity and one picture of a fantasy entity (e.g. a horse and a unicorn). The pictures were either photographs or drawings (see Figures 15 and 16), depending on condition. Fantasy and real pictures were matched using appearance and natural category. For instance, a white horse (real) and white unicorn (fantasy) were matched, as were pigs grazing in a field (real) and pigs flying (fantasy).

Figure 15. Example of a photograph pair used in Experiment 8

Figure 16. Example of a drawing pair used in Experiment 8

Procedure

Experimental task. Participants were randomly assigned to the drawing or photograph condition. Children were read one of two vignettes about a little girl named Sarah and her creative activities; adults read the vignette themselves. In the photograph condition the vignette read, "My friend Sarah got a new camera for her birthday and she took lots of photographs but they got mixed up with someone else's. Do you think you can help me find Sarah's pictures?" In the drawing condition, Sarah got colouring crayons for her birthday, and drew lots of pictures. Picture order was counterbalanced. In each trial they were shown either two photographs or two drawings, one of a real creature/character and one of a mythical creature/character, and asked, "which one did Sarah make?" There were 17 trials overall.

Control task. As in Experiment 7 pre-trials were used to ensure children understood the terms 'real' and 'not real' as relating to the existence of particular entities. Corrective feedback was given and children had to pass 6 out of 8 pre-trials (75%) to proceed to the control task. Those who passed the pre-trials were then shown the 34 pictures from the experimental task individually and asked to identify each one as real or not real. Children in the photograph condition were shown photographs; those in the drawing condition were shown drawings. Adults did not complete the control task.

Coding

Children received three scores: a control task score, a real picture score and a fantasy picture score. Adults received only the real and fantasy picture scores. The control task score was the total number of pictures (out of 34) correctly identified as real or not real. Two experimental task scores (out of 17) were individually calculated for real picture choices and fantasy picture choices. The reciprocal nature of these scores (i.e. real and fantasy choices are mutually exclusive and children chose either one or the other on every trial) meant that only one response type was used as the dependent variable. Fantasy scores were chosen. Scores ranged from 0–17. A score of 0 indicated that no fantasy pictures were chosen, and a score of 17 indicated that all fantasy pictures were chosen.

6.2.2 Results and Discussion

Adults

Preliminary analyses revealed no significant effect of picture order. An independent samples t-test revealed that adults in the drawing condition ($M = 6.75$, *SE*

= .94) chose significantly more fantasy pictures than adults in the photograph condition (M = 0.69, SE = .94), $t(30) = -4.58$, $p < .001$. One-sample t-tests (chance value = 8.5) indicated that adults in the photograph condition chose fantasy pictures at a level significantly below chance, $t(15) = -39.40$, $p < .001$, while adults in the drawing condition chose fantasy pictures at a level equal with chance, $t(15) = -1.34$, $p = .20$. These findings mirror those found in Experiment 1: adults accept both real photographs and real drawings yet expect fantasy referents to be depicted in drawings rather than photographs.

Children

Control Task. As in Experiment 7 children completed 8 pre-trials before proceeding to the control task. Thirty-three children (twelve 5-year-olds, six 6-year-olds, ten 7-year-olds and five 8-year-olds) required corrective feedback on the pre-trials. After feedback all children passed at least 6 out of 8 pre-trials and proceeded to the control task. A one-way between subjects ANOVA was conducted to compare the effect of age group on control task score. A significant main effect of Age Group was identified, $F(3, 152) = 5.40$, $MSE = 59.17$, $p < .001$, $\eta^2 = .09$. Pairwise comparisons indicated that the 5-year-old children (M = 28.85) gave significantly fewer correct responses than the 6- (M = 30.93), 7- (M = 31.33) and 8-year-old (M = 31.50) children. Furthermore, a total of 15 children scored less than 75% (25/34) on the control task: seven 5-year-olds, four 6-year-olds, and four 7-year-olds. These children were deemed to have insufficient fantasy-reality understanding for the purposes of the experimental task and their data was not included in the analysis; there was no statistical difference in reported effects or effect sizes when these participants were

included. The remaining sample (N = 141) comprised only children who passed the control task.

Experimental Task. Preliminary analyses revealed no significant effect of picture order. A 2 (Condition: photograph, drawing) x 4 (Age Group: 5-, 6-, 7-, 8-years) univariate ANOVA was conducted on the number of fantasy picture choices. Children in the drawing condition (M = 5.94, SE = .49), chose significantly more fantasy pictures than children in the photograph condition (M = 4.06, SE = .48), F(1, 133) = 7.54, MSE = 123.83, p = .007, η_p^2 = .05. However, one sample t-tests (chance value = 8.5) revealed that children in both the photograph, t(71) = -8.61, p < .001, and drawing conditions, t(68) = -5.94, p < .001, chose fantasy pictures at a level significantly below chance (see Table 32). There was no significant effect of age group. Thus, children showed an overall bias towards real pictures, which fits with previous research documenting children's reality bias (Martarelli & Mast 2013; Weisberg, Sobel, Goodstein & Bloom, 2013). Nonetheless, there was a higher selection of real over fantasy pictures in the photograph condition than the drawing condition, indicating that children expect photographs to depict real rather than fantasy referents. Again, children's comments during picture selection highlight referential content as the primary basis on which these decisions were made.

Table 32

Percentage of Real and Fantasy Picture Choices per Picture Modality in Experiment 8

Condition	Real	Fantasy
Photograph	76%	24%
Drawing	65%	35%

In the photograph condition 7 children, covering the whole age range tested, produced a total of 11 comments. As in Experiment 7, the majority of remarks (n = 8) justified choosing real photographs by referring to the 'non-real' status of the other picture. Examples include, "those ones [elephant-koala hybrid] are not real" (age 5), "we can't see dinosaurs anymore" (age 7), and one that explicitly mentioned modality, "It can't be a blue strawberry unless you painted it, you don't get those" (age 8). As in Experiment 7, children used the reality status of the depicted referents in order to decide if they can be photographed. This extends the earlier findings, by showing that when referential content is a more salient cue, 5- and 6-year-old children can use it to reason about picture modality. Under these experimental conditions they exhibit similar intuitions to 7- and 8-year-old children and adults, expecting photographs to depict more real than fantasy referents. These findings suggests that in Experiment 7 younger children did not differentiate real and fantasy photographs because they failed to note the relevance of referential content for comparing photographs and drawings, rather than because they lack a sufficient understanding of

fantasy, or possess inadequate knowledge of the relationship between photographs and reality.

6.3 General Discussion

The current experiments investigated 5- to 8-year-old children and adults' ability to make picture judgments based on the interaction between referential content and picture modality. Of particular interest was whether participants would expect photographs to depict only real referents, or if they would expect 'Sarah' to be able to create fantasy photographs as well. These results indicate that from the age of 5 children choose real over fantasy photographs, yet choose an equal number of real and fantasy drawings. Together, these findings demonstrate an earlier appreciation of picture modality than has previously been suggested (Liben, 1999).

In Experiment 7, participants viewed photograph-drawing pairs in which referential content was held constant. When asked to identify the pictures they thought Sarah had made, children and adults chose an equal number of real photographs and real drawings. This supports the hypothesis that from the age of 5 children recognise that real referents can be depicted in both drawings and photographs. Responses to the fantasy pictures were more interesting. Only 7- and 8-year-old children and adults chose more real than fantasy photographs, indicating that only the oldest children thought photographs were more likely to depict real than fantasy referents. There are two possible explanations for this age-related difference in performance. Firstly, there might be a developmental shift in children's understanding of fantasy, or photography. Evidence indicates that children younger than 7 or 8 have a somewhat fragile understanding of fantasy (Morison & Gardner, 1978), particularly when it is tested using a categorisation task, where children are asked to identify various characters as 'real' or 'not real', rather than a property

attribution task, in which they assign characteristics to real and fantasy characters (Sharon & Woolley, 2004; Woolley, 1997). However, in the present experiments a stringent control task confirmed that even 5-year-old children could successfully categorise the specific fantasy referents used as 'not real'. Furthermore, performance on the control task did not correlate with the number of fantasy photographs chosen in the experimental task.

Perhaps then 5- and 6-year-old children know less about the photographic medium than 7- and 8-year-olds, in particular, they may not know that photographs are dependent on the physical presence of their referents. Since the majority of photograph research has been conducted with children aged 7 and older (Liben & Szechter, 2002; Sharples, Davison, Thomas, & Rudman, 2003; Szechter & Liben, 2007), it is difficult to draw firm conclusions about what younger children should be expected to know about this picture format. Nevertheless, it has been shown that 6-year-old children expect photographs to depict the world in a faithful manner (O'Connor, Beilin & Kose, 1981), which would suggest that the 5- and 6-year-olds in the current experiments should also recognise that there is a close correspondence between photographs and the real world.

A second, alternative, explanation is that younger children did not pay sufficient attention to the referential content of the pictures in the experimental task. In previous studies that have held referential content constant, children were required to completely disregard content in order to focus on pictorial surface features (Liben, 2003; Steinberg & DeLoache, 1986). However, in the present task it was necessary for children to identify whether the depicted content was real or fantasy, since this was important for comparing photographs and drawings. Thus, it was suspected that holding referential content constant in Experiment 7 led younger children to disregard

content as a relevant cue for making picture judgments. Experiment 2 tested this possibility.

In Experiment 8, participants viewed real-fantasy pairs, of either drawings or photographs. Adults in the photograph condition chose more real pictures than adults in the drawing condition, while children showed a bias for real over fantasy pictures in both conditions. As in Experiment 7, this supports the hypothesis that children are aware that both photographs and drawings can depict real referents. In a departure from Experiment 7, age did not influence the number of fantasy picture selections. Participants in the photograph condition chose more real and fewer fantasy pictures than participants in the drawing condition. Thus, when referential content was varied 5- and 6-year-olds thought it more likely that Sarah had created a real photograph than a fantasy photograph. This supports the argument that the reason they did not differentiate real and fantasy photographs in Experiment 7 stemmed from a failure to use the reality status of the depicted referents to judge the pictures, rather than from any developmental shifts in sensitivity to modality, or the understanding of fantasy.

Taken together, the findings of Experiments 7 and 8 are inconsistent with the hypothesis that possible knowledge of photograph editing might facilitate fantasy photograph selections. Although I did not directly measure such knowledge, the low incidence of fantasy photograph selections indicates that either, children were not aware that photographs can be edited, or that this knowledge did not override their intuition that real photographs are still more likely than fantasy photographs. Instead, the current results support the expectation that children would treat real and fantasy photographs differently. I argue that children's selection of real over fantasy photographs can be attributed to knowledge that photographs are reality-bound in a way that drawings are not. Anecdotal evidence from both experiments supports this

claim. In Experiment 7, children chose fantasy drawings over fantasy photographs, justifying their selections by referring to the 'non-real' status of the referential content. For instance, children explained that they chose the drawing, rather than the photograph, of a unicorn because unicorns are not real. In Experiment 8, children chose real photographs over fantasy photographs using similar justifications. Thus, in both cases children were actively reasoning about the relationship between fantasy referents and modality, ultimately deciding that fantasy referents can be depicted in drawings but not photographs. This is consistent with the interpretation that children's picture selections were underpinned by knowledge of pictorial conventions, specifically that photographs are dependent on the physical presence of their real world referents.

An alternative explanation for the current findings is that children are merely more accustomed, even in the age of computer generated imagery, to seeing real things depicted in photographs and fantasy referents depicted in drawings. However, if this were the case a real picture bias should have emerged in the photograph condition and a fantasy picture bias in the drawing condition, neither of which were evident in the data. In fact, in Experiment 8 children chose more real than fantasy pictures in the drawing as well as the photograph condition. Furthermore, the reviewed anecdotal evidence shows that when children selected real over fantasy photographs they did so on the basis that, for instance, unicorns are not real, rather than because horses are real. In other words, they ruled out fantasy photographs before selecting real photographs. Nonetheless, this account cannot be entirely discredited and thus the role experience plays in shaping children's picture choices remains an open empirical question.

Placing the current experiments in a broader context, the finding that children choose real over fantasy photographs is consistent with previous work showing that young children overestimate the correspondence between photographs and the real world (Donnelly, Gjersoe & Hood, 2013; O'Connor, Beilin & Kose, 1981). Although it is incorrect to expect changes made to a photograph to affect its referent (Donnelly, Gjersoe & Hood, 2013), and to treat photographs as infallible representations of the world (O'Connor, Beilin & Kose, 1981), collectively, these findings highlight the fact that children treat them differently to drawings: photographs are expected to represent the world in a faithful manner.

The results also speak to the suggestion that increasingly realistic depictions of fantasy referents, as a result of more advanced technology, mean it is becoming more difficult to distinguish fantasy and reality on a purely perceptual basis (Troseth et al, 2007; Troseth, 2010). The findings show that even 5-year-old children can separate content from realism in order to evaluate a picture's plausibility: they select fantasy drawings over photographs despite a well-documented preference for realistic images (Brookshire, Scharff & Moses, 2002; Coffey, 1968). Thus, despite the technological advances in photography and the widespread availability of cameras and photograph editing software, children still consider photography to be reality-bound. From this it can be inferred that the reported increase in children's exposure to cameras and photography is reinforcing, not diminishing, their perception of photography as a veridical picture format (Cavedon-Taylor, 2014b; Gooskens, 2012). It might be that early use of digital cameras, particularly viewing pictures on the screen immediately after they are taken, facilitates this perception of photographs. However, additional research is needed to empirically assess whether exposure to photography is correlated with children's understanding of the medium.

Further research is also necessary to investigate whether children's reluctance to select fantasy photographs affects how they evaluate these pictures as sources of information about the world. Recent evidence suggests this might be the case. Children quarantine the information presented in fantasy drawings, for instance, they do not think real animals wear pyjamas and sleep in a bed after viewing a drawing of a bird who does just that (Ganea, Canfield, Ghafari & Chou, 2014). Accordingly, fantasy photographs should not be considered a valid information source, when teaching an alien about our planet, for example. Three- and 4-year-old children are adept at using content to evaluate which of two drawings would be most useful to a viewer (Allen, Bloom & Hodgson, 2010), hence it would be interesting to use a similar task to see if children are as successful with real and fantasy photographs.

Together, the experiments reported here show that from the age of 5 picture modality influences how children evaluate the picture-world relationship. This is one of the first relationships children learn to decode, and thus these findings suggest that picture modality plays an integral role in children's developing understanding of pictures, rather than emerging after they have already amassed significant knowledge of representation (Liben, 1999). Specifically, I found that children expected photographs to share a more veridical relationship with the world than drawings, which indicates a fledgling appreciation of the different rules that underpin these two mediums, and raises the possibility that children acquire individual concepts for different picture types, rather than a global 'picture' concept. Accordingly, I propose that existing theoretical frameworks need to be more specific in how they conceptualise children's pictorial development. In particular, the picture-world relationship (Freeman & Sanger, 1995) should be divided into photograph-world and drawing-world subsidiaries.

Going forward it will be important to assess whether the artist-picture relationship should undergo a similar division. It has been suggested that knowledge of picture production facilitates an understanding of different representational formats (Beilin, 1999; Liben, 1999), and thus investigating children's knowledge of artists and photographers will be an important next step in this program of research. For instance, knowing that artists can use their imagination to draw might underlie children's recognition that drawings can depict fantasy referents. Similarly, an understanding of cameras might drive children's choice of real over fantasy photographs. Ultimately, conducting further cross-modal studies will be vital for identifying whether children's pictorial development progresses in a unitary manner, or pursues multiple modality-specific routes.

Chapter Seven: **General Discussion**

This thesis has examined the relative importance of appearance and intentional cues for children's ability to make picture-referent mappings, and more broadly, how picture modality mediates children's developing understanding of pictures. Throughout, a particular emphasis was placed on elucidating differences in how children perceive the picture-world and picture-creator relationships for drawings and photographs. In this way, Liben's (1999) suggestion that children must acquire an understanding of the unique nature of different picture formats was empirically tested within the context of two of the relationships thought to underpin a complete theory of pictures (Freeman & Sanger, 1995).

Chapters Two, Three, Four, and Five investigated children's knowledge of the roles played by artists and photographers in picture creation (Chapter Four) and interpretation (Chapters Two, Three and Five), while Chapter Six focused on children's understanding of how the picture-world relationship differs for drawings and photographs. More specifically, Chapter Two investigated how children use appearance and intentional cues to identify which of two referents a picture represents, while Chapter Three assessed whether there are any differences in the extent to which children rely on artists' versus photographers' intentions when naming and judging the value of pictures. Chapter Four examined children's knowledge of how artists and photographers create pictures, including their understanding of the different skill sets required, and how the medium constrains the referential content that can be depicted. Building on this, Chapter Five assessed when children understand that artists and photographers rely to a different extent on visual access to, and prior knowledge of, their intended referents. Finally, Chapter Six

explored children's sensitivity to the differences in how photographs and drawings relate to the world, using both real and fantasy referents.

7.1 Intention versus Appearance

In Chapter Two (pp. 54 - 96), children tailored their use of appearance and intentional cues to the particular picture being decoded, rather than adhering strictly to the realist (Plato, 1987) or intentional route (Wollheim, 1987) to picture interpretation. In Experiments 1 and 3, children aged 3- to 6-years and adults watched as the experimenter stated her intention to draw or photograph a particular referent (e.g. a blue duck) from a choice of three (e.g. a blue duck, a pink duck and a teddy bear). In the colour change condition the final picture clearly resembled a differently coloured object to the one the experimenter intended to depict (e.g. a pink duck), thus creating a transparent picture-world relationship that conflicted with the picture creator's intention. By contrast, in the black and white condition the final picture was ambiguous (e.g. a grey duck), creating a much less transparent relationship between the picture and the world, which could be disambiguated using the artist's stated intention. When participants were asked to identify the picture's depicted referent they relied on the picture's appearance in the colour change condition, only deferring to intentional cues in the black and white condition, when the pictures were ambiguous. Furthermore, picture modality mediated the cue use of the younger, 3- and 4-year-old children; they were less likely to use intentional cues in the photograph than the drawing condition. By contrast, there was no modality difference for the older children or the adults.

Using a modified version of the task, Experiment 2 confirmed that children's appearance-based responding in the colour change condition reflected a genuine focus

on what a picture looks like, rather than a disregard for the experimenter's intention. It had been posited that in Experiment 1, because the experimenter failed to comment on the fact that the final picture (e.g. a pink duck) did not look like the one she intended to create (e.g. a blue duck), children may have thought her intention was not relevant. However, in Experiment 2, children relied on appearance cues regardless of whether the experimenter knew what the picture was intended to represent or not, and therefore was not contingent on whether children trusted her stated intention. Together, these findings show that from the age of 3 children appreciate both the resemblance-based link pictures share with their referents, *and* the intentional relationship they have to their creator. Thus, in contrast to the realist and intentional accounts, which argue that appearance *or* intention should dominate picture interpretation, these findings support a more flexible account of children's picture interpretation. Critically, they show that children are selective in their use of these two cues when decoding picture-referent relations, the route they follow being dependent on the ambiguity of the picture's appearance and, for younger children, picture modality.

Chapter Three (pp. 97 - 122) revisited the role of intention by asking 4- and 6-year-old children, and adults, to name and judge the value of photographs and drawings. In Experiment 4, participants were shown pairs of identical drawings or photographs, and were told that one picture in each pair had been created intentionally (e.g. someone painted a picture for their teacher) and that the other had been created accidentally (e.g. by someone spilling paint). When asked to name the drawings children and adults named intentional drawings according to shape (e.g. man), yet showed a tendency to give material-based names (e.g. mud) to accidental drawings. Moreover, when asked to select which one of the drawings they would like to take

home, 6-year-old children and adults showed a preference for the intentionally created drawings. In marked contrast, children and adults assigned photographs the same name irrespective of how they were created, and showed no preference when asked to select one to take home. In fact, the 6-year-old children and adults most often selected both pictures. This pattern of results shows that from the age of 6 children place less value on the intentions of photographers than artists. Whether this is attributable to children's knowledge that photographs are causally, as well as intentionally, related to their referents (e.g. a photograph of a beach represents a beach, regardless of whether it was intended to or not), or is a result of children focusing on the identical, and highly salient, appearance of the photographs to the detriment of information about how they were created, remains an open question.

Collectively, the experiments reported in Chapters Two and Three contribute to the existing literature concerning the importance of picture creator's intentions for decoding pictures, and how they are mediated by other factors, such as a picture's appearance and picture modality. In Chapter Two, when appearance and intention were placed in direct conflict participants only deferred to intentional cues when the picture's appearance was ambiguous, and thus did not provide a transparent link to its referent. However, that is not to say that children do not recognise the inherent link between appearance and intention. In Chapter Three, children interpreted the appearance of a drawing differently depending on whether it was intentionally or accidentally created: intentional drawings were assigned shape-based names more often than accidental drawings. This indicates an understanding that, ordinarily, intention motivates the resemblance-based link between pictures and their referents, and therefore underpins the representational status of a picture (Bloom, 1996), that is, pictures resemble their referents because they were created with the intention to

represent that particular referent. This expectation of congruence between appearance and intention is also evident in the findings of Experiment 3, where some adults tried to reconcile the two conflicting cues. Twenty per cent of adults' responses involved ignoring the artist's intention to draw, for example, a pink duck, and naming the resulting greyscale image a 'grey duck', apparently inferring that the experimenter must have intended to draw a grey duck.

Experiment 4 also revealed that children can derive more from an artist's intention than information about the particular referent a picture represents. Six-year-old children preferred intentionally over accidentally created drawings, despite their *identical* appearance. One possibility is that in this task intention served as a proxy measure of the effort expended by the artist in creating the picture, based on the assumption that if someone was 'painting a picture for a teacher' he would be investing more time and effort in it, making it more valuable, than if he 'spilled paint'. Although additional research is necessary to identify the specific basis on which children were selecting one drawing over the other, it is evident that by age 6 children are capable of using information about an artist's intention to move beyond an appearance-based interpretation of drawings, and incorporate a consideration of their creative origins.

Lastly, Chapters Two and Three provide evidence that children prioritise intentional cues to a lesser extent in the photographic medium compared to drawing. In Experiment 1 (Chapter Two) the youngest, 3- and 4-year-old, children relied less on intentional cues to decode ambiguous photographs than drawings, while there was no modality difference in 5- and 6-year-old children's use of intentional cues. This difference may be an artefact of the task procedure, in which the link between the experimenter's stated intention and the final photograph is indirect, due to the use of a

camera and a printer, and thus might be harder for younger children, who have less experience of using intentional cues, to track. Nonetheless, in Experiment 4 (Chapter Three) children actively disregarded intention when it provided the only means of distinguishing two identical photographs, whereas it exerted a strong effect on how they named and judged the value of drawings. This finding provides more robust evidence that although children view the picture creator, and their intentions, as a central component of the drawing modality, this does not extend to photographs, whose interpretation is governed to a greater extent by their appearance, causal connection to their referents, or perhaps a combination of the two.

7.2 Picture Modality

Chapter Four (pp. 123 - 146) revealed that children could distinguish the roles played by artists and photographers in picture creation. In Experiment 5, 4- to 8-year-old children were introduced to two puppets, an artist (Jack) and a photographer (Luke), and were asked forced choice questions such as, "Who should I ask to make me a picture of a fairy, Jack or Luke?" and "Who should I ask to make me a picture of your school so my friend can find it later, Jack or Luke?" The findings showed that overall children possess an earlier understanding of the photographer's role than the artist's role in picture creation, which is in line with evidence that children are being exposed to cameras and photography from an increasingly early age (Ofcom, 2013; Rideout et al, 2011, 2013). Critically, children began making cross-modal distinctions from the age of 4, when they asserted that photographers could create pictures faster, and include more detail than artists. Between the ages of 5 and 8 the number of distinctions children could make increased to include knowledge that artists, but not photographers, can depict fantasy referents, such as fairies, indicating an

understanding of the role imagination plays in artistry, yet it is easier to create a photograph than a drawing. However, even 8-year-old children did not realise that photographers cannot capture absent referents, such as Disneyland, thus indicating a lack of knowledge that photographers are reliant on the physical presence of their referents. Nonetheless, these findings show that from the age of 4 children begin to construct unique profiles of artists and photographers, which become increasingly detailed with age, and thus allow them to accurately predict which of the two picture creators is most capable of making specific pictures. Hence, this provides important evidence that from a young age modality mediates children's understanding of the relationship between picture creators and their pictures.

Chapter Five (pp. 147 - 174), reported a more direct test of whether 6- and 8-year-old children and adults know that photographers rely on visual access to physically present referents, while artists can draw using only their prior knowledge of the intended referent. In Experiment 6, participants were introduced to an alien named Gooba, who lived on a planet where there were aliens and spaceships, but no cars or trees, hence he did not know anything about the latter two objects. Across two trials, one in which Gooba was on Glob and the other in which he was on Earth, participants were told that Gooba had drawn some pictures, or taken some photographs (depending on condition). Participants were then shown four photographs or drawings: an alien, a spaceship, a car and a tree and were asked, "Could Gooba have made this picture?" The results showed that 8-year-old children and adults are aware that a photographer's visual access to their intended referent is the crucial determinant of photographic content; they cannot photograph objects based solely on prior knowledge or experience of a referent. Prioritising visual access over the photographer's knowledge suggests that 8-year-old children are aware of the role

causality plays in photography. Somewhat surprisingly, children and adults failed to demonstrate an understanding that artists can draw from knowledge alone. For instance, they did not assert that Gooba could draw a spaceship when he was on Earth. However, it was posited that this was at least partly attributable to the task procedure, in which the visual access manipulation was made more salient, by changing Gooba's location, than his knowledge state, which was only described in the vignette. This would also explain why in Chapter Four children could map the relationship between imagination and drawing, claiming that an artist could draw a fairy or depict a pink cupcake in blue, yet in Chapter Five failed to do the same for knowledge, which also involves understanding how an artist's mind exerts influence over the content of his or her drawings.

There is one other discrepancy in the findings of Chapters Four and Five, which must be addressed. In Chapter Four, 8-year-old children failed to realise that photographers cannot capture absent referents, such as Disneyland, yet in Chapter Five, children of the same age correctly stated that Gooba could not photograph absent or unfamiliar referents. This can also be explained with reference to the tasks used. In Chapter Four, the questions about absent referents were somewhat unclear in that they did not specify that the photographer was not in, and could not go to Disneyland, for instance. This was rectified in Chapter Five, where Gooba's location was systematically manipulated in relation to specific referents, and a picture of Glob or Earth was used to denote his current location in every trial. Thus, when it is clear that the photographer is not in the physical presence of particular referents, 8-year-old children correctly assert that he cannot take photographs of them.

Lastly, Chapter Six (pp. 175 - 205) explored children's sensitivity to the interaction between referential content and picture modality. In Experiment 7, 5- to 8-

year-old children and adults were told that a confederate (Sarah), who had a camera and crayons, had drawn some pictures and taken some photographs. They were then shown a series of photograph-drawing pairs, half of which depicted real creatures (e.g. a horse) and half of which depicted fantasy creatures (e.g. a unicorn). For every pair, participants were asked to select the one they thought Sarah had created. The results showed that 7- and 8-year-old children chose real over fantasy photographs, yet selected an equal number of real and fantasy drawings. In Experiment 8, a revised version of the task, in which participants saw real-fantasy pairs of photographs *or* drawings (e.g. a horse and a unicorn), saw the age of success fall to 5-years. Children in the photograph condition chose more real than fantasy photographs, while children in the drawing condition chose an equal number of real and fantasy drawings. That is, when referential content was varied children were able to use the reality status of the referent (e.g. unicorns are not real) to decide whether they could be photographed or not. Overall, these findings indicate that children pay sufficient attention to the representational surface of pictures, and possess enough modality-specific knowledge, to recognise that while photographs are reality bound, and thus typically represent real referents that exist somewhere in the world, drawings are not, and can therefore depict both real and fantasy referents.

Collectively, Chapters Four, Five and Six provide converging evidence that children recognise the differential influence that 'the mind' and 'the world' have on what artists and photographers can capture, and thus what is typically depicted in drawings compared to photographs. The findings of Chapters Four and Six speak to children's understanding of the role artist's minds, specifically imagination, plays in the creation of drawings. In Chapter Four, 5- to 8-year-old children asserted that artists can draw fantasy referents, such as fairies, as well as manipulate the

appearance of real world referents, for example, depicting a pink cupcake in blue. Furthermore, in Chapter Six, children of the same age range chose an equal number of real and fantasy drawings, indicating that they are aware that drawings are not constrained to depicting real referents. The claim that these responses are underpinned by knowledge of how artists' imaginations influence their pictures is supported by children's contrasting responses to photographers, whom far fewer children thought had the power to change the colour of their referents, and photographs, which they expect to depict real over fantasy referents. Nevertheless, more explicit verbal evidence is needed to verify that children understand imagination, and that this is what motivated their behavioural responses in the current experiments (see Section 7.4).

Regarding photography, the findings reported in Chapter Five suggest that it is not until the age of 8, and only under specific task conditions, that children recognise that photographs are dependent on the real world, by explicitly asserting that a photographer can photograph physically present referents, while rejecting the possibility that he or she could photograph an absent but familiar referent. However, the findings of Chapter Six suggest this is an underestimation of children's knowledge. In Experiment 8, even 5-year-old children selected real over fantasy photographs justifying their selection with reference to the fact that fantasy creatures, such as dragons, are not real and therefore cannot be photographed: "dragons aren't real so I knew it was going to be a drawing". Thus, it may be that children realise that photographs are limited by their relationship with the world before they become aware that this diminishes the extent to which photographers' minds, in particular their knowledge state, can influence the referential content of their pictures.

In summary, the findings reported in this thesis show that between the ages of 4 and 8 children become increasingly cognisant of the differences in how photographs and drawings relate to their referents, and their creators. Specifically, during this period children develop an understanding that while drawings rely to a large extent on the mind of their artist, whose intentions underpin the representational status of drawings, and whose imagination allows them to depict fantasy referents or change the appearance of real referents, photography is governed by the causal relationship that cameras forge between photographs and their real world referents, which lessens the importance of the photographer's intentions in determining the representational status or value of a photograph, as well as constraining the referents that photographers can depict to those which are physically present at the time of capture.

7.3 Refining a theoretical framework of pictorial understanding

The findings of this thesis provide evidence to support the philosophical and theoretical argument (Beilin, 1991, 1999; Kose, 1985; Liben, 1999) that children's understanding of pictorial representation is modality-specific. In turn, this allows the refinement of Freeman and Sanger's (1995) intentional net framework (see Figure 17). Specifically, it warrants dividing the picture-world and picture-creator relationships into two routes, one for photographs and one for drawings (see Figure 18).

In its original form, the picture-world relationship (Freeman & Sanger, 1995) can be thought of as encompassing the development of children's early understanding of the referential nature of pictures, which is neatly summarised by the first four levels of Liben's (1999) theory of representational understanding (see Section 1.2 for a full description). Briefly, this includes: children's early emerging ability to note both

the similarities (Hochberg & Brooks, 1962; DeLoache, Strauss & Maynard, 1979) and differences (DeLoache et al, 1998; Polak, Emde & Spitz, 1964; Slater, Morison & Rose, 1984) between pictures and their real world referents, the subsequent onset of representational insight (DeLoache, 1995, 2002), whereby children realise pictures refer to their referents (Preissler & Carey, 2004), and finally an understanding that pictures and their referents are independent, and thus do not share all of their respective features (Donnelly, Gjersoe & Hood, 2013; Jolley, 2008, 2010; Thomas et al, 1999; Zaitchik, 1990).

In light of the current findings, these abilities can be characterised as levels of *modality-general* pictorial development, since they apply to all picture formats and thus provide the foundation on which modality-specific knowledge of pictures can be built. For instance, children need to understand that as members of the 'picture' category, 'drawings' and 'photographs' share a common referential function, before they can begin to acquire knowledge of the unique picture-world relationships that characterise different picture modalities. This latter understanding is described by Liben (1999) as correspondence mastery, and constitutes the fifth level of her sequence theory.

In line with Liben's (1999) theory, the current experiments consistently report that children as young as 5-years recognise the unique representing relations (Perner, 1991) that exist between photographs and drawings, and the world. In accordance with the fact that photographs capture what can be 'seen' by a camera, in Chapter Six children expected photographs to depict real over fantasy referents. Further showing their appreciation of the direct relationship between photographs and the world, children associated them with a high level of realism and detail, which is especially useful for guiding ones actions in the real world, for instance, locating a school

(Chapter Four). Moreover, in line with an understanding that drawings are not constrained to depicting reality, children did not discriminate real from fantasy drawings (Chapter Six). Thus, it is clear that children's general understanding that pictures refer to their referents is supplemented by the acquisition of knowledge that while photographs are bound to reality, drawings are not. Consequently, this permits the addition of two distinct photograph-world and drawing-world routes to Freeman and Sanger's (1995) original framework (see Figure 18).

Moving on to consider the relationship between pictures and their creators, Freeman and Sanger's (1995) original model posited only an artist-picture relationship since their analysis focused on drawings and paintings. By contrast, in her sixth level, 'meta-representation', Liben asserts that children must be able "to reflect upon the mechanisms by which…graphic representations are created, including understanding that different correspondence rules and conventions are used in different media" (p. 308), thereby highlighting the importance of understanding picture creation more generally. Supporting Liben's argument, the findings reported in this thesis have shown that children do indeed have differing conceptions of the roles played by artists and photographers.

In line with Freeman and Sanger's (1995) original claims, the current findings suggest that children consider drawings "intentional manifestations of mind", and thus construct an intentional theory of *drawings*, which recognises the pivotal role the artist plays in picture creation and interpretation. However, they do not construct an analogous theory of photographs. In Chapters Two and Three, photographers' intentions were devalued relative to those of artists, both when identifying what a picture represents, as well as judging their value. Beyond intention, Chapter Four revealed that while children appreciate that artists can use their imagination to draw

fantasy referents, such as fairies, or alter aspects of real world referents in their pictures, they only consider photographers capable of capturing referents in a realistic and detailed manner. Moreover, in Chapter Five children, correctly, asserted that photographers depend on the physical presence of their referents, not their own knowledge of the object. As a result, it is necessary to divide the picture-artist relationship (Freeman & Sanger, 1995) into separate artist-drawing and photographer-photograph streams, which more accurately capture children's understanding of the differing relationships that exist between pictures and their creators across modality.

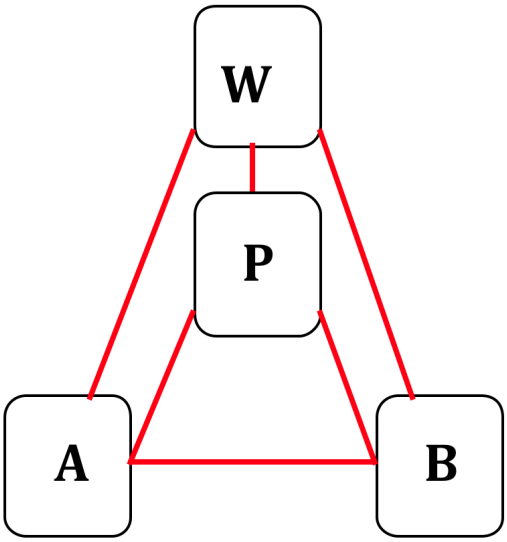


Figure 17. Freeman and Sanger's (1995) intentional net framework comprising four factors: Picture, Artist, World and Beholder.

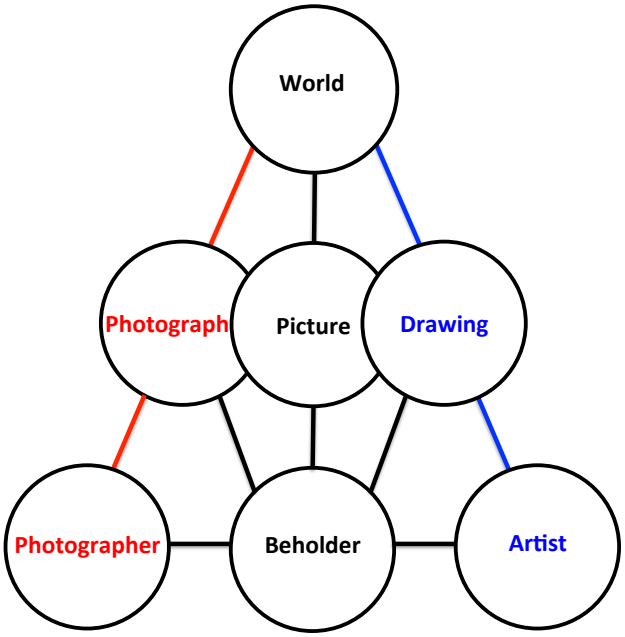


Figure 18. Modified version of Freeman and Sanger's (1995) intentional net framework comprising four factors: Picture Modality, Artist, World and Beholder.

Contrary to Liben's (1999) assertion that children only become aware of the unique rules and conventions that govern different picture formats during adolescence, the empirical work of this thesis has provided evidence of an age-related

progression in modality-specific knowledge and understanding, which begins at age 4 and continues until at least 8-years. Since children in the current experiments did not display a *complete* understanding of photography prior to drawing (or vice versa), it does not appear to be the case that they acquire knowledge of different modalities in a stepwise manner. Rather the ability to discriminate photographs and drawings is built on a more general understanding of the picture-world relationship, as described by the first four of Liben's levels (see Section 1.2 - Chapter One). More specifically, it follows representational insight (level 3) but slightly precedes attribute differentiation (level 4), which is achieved around the age of 5. The current findings show that 4-year-olds can make simplistic distinctions between artists and photographers regarding the realism of the pictures they can create, and consider photographers' intentions less useful than those of artists for decoding pictures. Thus, children's initial awareness that there are differences between picture modalities overlaps somewhat with their developing ability to distinguish which of their respective features pictures and their referents share. This makes intuitive sense when one considers that modality is relevant to attribute differentiation: photographs typically share more visual features with their referents than drawings. This still leaves open the question of *how* children acquire knowledge of the differences that exist across picture modality.

In addition to her age-related predictions, Liben (1999, 2003) posits that exposure to a variety of picture types, as well as experience creating their own photographs and drawings, should bolster children's understanding of cross-modal differences in pictorial representation. Indeed, prior work has shown that experience is one of the driving forces underpinning children's early pictorial development (Callaghan & Rankin, 2002; Simcock & DeLoache, 2008; Walker, Walker & Ganea,

2013). For instance, Callaghan (1999) found that 3- and 4-year-old children improved their drawings following feedback from the experimenter about how well their pictures communicated which object to put down a slide. In addition, Liben and Szechter (1999) reported that 8-year-old children who received photography lessons went on to perform better on spatial representational tasks than children who received no such training. It is entirely plausible that the benefits of such experience also contribute to children's ability to distinguish photography from drawing. Indirect support for this claim can be found in the current finding that 4- and 5-year-old children display a competent understanding of the photographic medium, compared to previous claims that it is not until the age of 7 that children understand the mechanical nature of cameras (Wellman & Hickling, 1994), or the role of the photographer in creating photographs (Kose, 1985; Liben, 2003).

When combined with recent reports that children are exposed to a variety of camera-enabled devices from as young as 2-years (Rideout et al, 2013), it seems likely that one of the reasons younger children succeeded on the current tests of photographic-understanding is that they had significantly more experience of photography than those tested in 1985 or even 2003. Nonetheless, improvements in children's cross-modal understanding were also reported in the current experiments. For instance, it was not until the age of 8 that children displayed explicit knowledge that photographers rely on the physical presence of their referents, rather than their knowledge state (Chapter Five). Hence, although early experience with photography may initiate modality-specific knowledge from a young age, it is inevitable that experience will accumulate with age, allowing older children to acquire a more in-depth understanding of photography and drawing, thereby improving their ability to draw distinctions between the two. It will be important for future work to explore the

relationship between experience and cross-modal understanding more thoroughly (see Section 7.5).

7.4 Limitations

The contributions this thesis makes to the empirical and theoretical literature are moderated by its limitations. Firstly, although it has been argued that experience viewing and creating a variety of picture types might facilitate children's understanding of cross-modal differences, this cannot be confirmed since data was not collected on how often, and in what context, children view and create pictures. As a result it is not possible to examine whether children who, for instance, show a better or earlier understanding of photography are also those children who engage with cameras and photography frequently. As such, this remains an important question for future research to address (see Section 7.5).

Secondly, the experiments reported relied on behavioural tasks, which typically asked children to select an object, a picture, or a picture creator, from an array. This was intentional, since it allowed the inclusion of younger participants, who may otherwise have been unable to participate due to reticence, or an inability to verbalise their reasoning. However, the lack of verbal responding required resulted in little explicit evidence of *how* even the older children made their selections. Thus, while it has been suggested that knowledge of imagination and causality, underpin the distinctions children make between what artists and photographers, drawings and photographs, can depict, the lack of explicit verbal comments to this effect are detrimental to such claims. Reinforcing the importance of verbal responses, in Chapter Six children's spontaneous comments about their real and fantasy picture selections provided an invaluable insight into their decision-making. For example, the

most common reason for rejecting fantasy photographs was related to the non-existent status of their referents, for example, "definitely not the photograph, unicorns aren't real", and "dragons aren't real so I knew it was going to be a drawing." Such anecdotal evidence allowed the inference that children understood that photographs cannot depict things that do not exist in the real world, which in turn suggests some awareness that photographs are dependent on their referents. While this data is compelling, more robust confirmation is needed that children are explicitly considering the relationship between an artist's mental state and their picture in making such judgments. One way to address this issue would be to ask children to justify their responses, for instance, "Why can't Luke make a picture a blue cupcake?" or "Why can't Gooba take a photograph of a spaceship (when on Earth)?" This has proven a simple but effective way to extract rich information from children, particularly about their perceptions of artistic creation (Kanngiesser, Gjersoe & Hood, 2010). A second possibility is to use simple questionnaires (e.g. Freeman & Sanger, 1995; Parsons, 1987) to gather more in-depth information about the thought processes that children engage in when reasoning about the differences between photographs and drawings.

A third limitation of this thesis is that the experiments focused on investigating whether children recognise that photographs depend more on their real world referents and thus, less on their photographer's minds, than drawings. However, it is not the case that causality governs photography to the exclusion of any influence from the photographer's mind. For example, while artists' intentions play a central role in defining the representational status of their drawings, photographers' intentions are more clearly evident in how they *position* or *light* their chosen referents to create a specific scene (Chapter Three). Exposing children to this element of photography

would have allowed investigations of whether children recognise that photographers' minds and ideas *can* influence their pictures, but do so in a different way to artists. Similarly, the current findings cannot speak to whether children understand how, for instance, photographer's can exploit their reliance on causality to capture transient moments that artists simply would not have the time to depict, or how the realistic nature of photographs means that they are a highly valuable source of information about the world. Interestingly, in Chapter Four, 5-year-old children did select the photographer as the puppet that could create the best picture with which to locate their school, which suggests an appreciation of the utility realism affords photographs. This provides a starting point for future research into the strengths of photography, and how children develop an understanding of the advantages, as well as limitations, of this medium. Together, these studies would provide a more complete picture of how children conceptualise photography.

Finally, although the findings of this thesis indicated that children draw distinctions between different picture modalities, which in turn facilitated the refinement of Freeman and Sanger's (1995) intentional net framework, the reported work did not attempt to explore the cognitive developments that underpin the relationships in the intentional net. This is symptomatic of the wider literature, which has largely focused on how symbolic development progresses rather than *why* (Rochat & Callaghan, 2005), and serves to highlight the importance of including such measures in future research. Several of the cognitive developments experienced in early childhood, particularly the acquisition of theory of mind, are highly relevant to children's ability to draw distinctions between the picture-world and picture-creator relationships within different picture modalities, and representational development more broadly (Rochat & Callaghan, 2005). Furthermore, it has also been reported that

the social context in which children experience and converse about pictures plays an important role in their representational development (Callaghan, 2000; Callaghan & Rankin, 2002; Callaghan et al, 2004; Peralta de Mendoza & Salsa, 2003). Thus, in order to integrate the current findings with those of the broader literature it will be critical for future work to include measures of relevant cognitive skills and social-communicative understanding in order to explore how these developments are related to children's ability to distinguish photographs from drawings and artists from photographers. See section 7.5 for a more in-depth discussion of how this should be approached.

7.5 Future Directions

Building on one of the limitations of the current thesis, one avenue for future work to explore is quantifying the relationship between children's early experience of cameras and photography and the emergence of modality-specific knowledge. Based on prior research, which shows that experience is an important factor in children's developing pictorial understanding (see Section 7.3), it is plausible that experience using smartphones and tablets to take, and later edit, their own photographs facilitates children's developing understanding that cameras and therefore photographs are dependent on the real world; if the referent moves out of view the camera will not capture it. Thus, it will be important for future research to gather information from parents about children's experience of cameras and photographs, as well as to directly assess children's ability to use a camera, prior to administering tasks aimed at testing their understanding of the photographic medium. If Liben is correct, children who have had a high level of exposure to photographs and are proficient in photography, should also be those children who assert that a photographer cannot take pictures of

absent referents, such as Disneyland (Experiment 5) or spaceships (Experiment 6), and should select real over fantasy over photographs. Alternatively, a longitudinal training study could be used to assess whether teaching children about drawing or photography facilitates their understanding of just the medium in which they were given training, or whether enhancing their knowledge of one medium also facilitates their ability to make cross-modal distinctions. For instance, if children learn that photographs are causally dependent on their referents does this increase the salience of the photograph-drawing distinction?

In light of the findings of this thesis another clear gap for future research to investigate is how children comprehend the role of the beholder. Continuing the theme of comparing picture modalities, it would be interesting for future work to explore whether children think photographs, like drawings, can be assigned multiple unique interpretations. From previous work we know that children recognise that beholders can hold different interpretations of the same drawing from around the age of 5 (Barquero, Robinson & Thomas, 2003). However, given the wealth of evidence showing that children's default position when viewing photographs is to focus on their content (Liben, 2003), and prioritise their relationship with the world over the photographer (Kose, 1985; Wellman & Hickling, 1994), it might be that children perceive photographs as having one fixed interpretation: a picture of a rabbit is a picture of a rabbit regardless of how it is lit, the angle from which it is captured, or an individual beholder's prior experience of rabbits. Empirical investigations of this notion would first require a task similar to that used by Liben (2003), in which children are presented with two photographs of the same referent, one of which is brightly lit and thus appears 'happy' and the other which is dimly lit, and thus appears 'sad'. If children recognise the difference in lighting, and can provide a description of

why the two conjure a different perception of the referent, this would provide evidence that children understand how representational qualities of a photograph affect how a beholder perceives it.

A second task would then be needed to assess whether children think the same photograph can be interpreted differently by different people, here children would be presented with a single photograph of a rabbit, and asked how a happy or a sad puppet would perceive it (e.g. 'do you think puppet X thinks the rabbit looks happy/sad?). If they assign two different interpretations to the puppets based on emotion (e.g. sad puppet would think the rabbit looked sad) this would provide evidence that children can look past the realistically depicted referent, to recognise the subjectivity of photographs, as well as drawings. Clearly, this is more complex than making simple mappings between a beholder's emotion and their response to a picture, be it a photograph or a drawing. However, an initial indication that children are aware of how a beholder's characteristics or mood influence their interpretation of photographs is important for confirming that they do not think the meaning of a photograph is found entirely within the picture itself.

A further avenue for future research to explore is children's understanding of the conventions and functions associated with different media. Although this thesis addressed children's awareness of the unique correspondence rules that characterise the picture-world and picture-creator relationship in drawing and photography, it did not explore whether this knowledge feeds into, or benefits from, an understanding of how these pictures are typically used in the real world. This ability falls under level 6 of Liben's (1999) sequence theory, in which she states that meta-representation involves the ability to "select among [representations] appropriately for particular purposes" (p. 308). In other words, can children's knowledge of media-specific

qualities aid them in identifying whether a drawing, a map or a photograph is most useful for navigating a new city versus proving that an event occurred? Chapter Four provided preliminary evidence that even 5-year-old children can do this to some extent: they knew that a photograph was more useful than a drawing for finding a particular location, but more robust evidence is needed to support this claim. It would be possible to investigate this using a task similar to that used in Chapter Four, where children are presented with two pictures, rather than picture creators, and asked which one is most appropriate for completing a particular task. For instance, "should we use this photograph or this drawing to show your friends where you went on holiday?" or "should we use this photograph or this drawing to decorate your bedroom?" These questions would allow inferences to be made about the conventions children associate with photographs and drawings, alongside other visual representations such as maps and cartoons. In turn, one could investigate where children learn these conventions. Parental engagement with drawings and photographs being one potential candidate: do parents talk about photographs differently, with more emphasis on the real events they represent, than drawings, which may elicit more discussion of fantasy worlds or events since in children's books they often depict non-real referents?

Finally, future work should continue to explore the role of intention in pictorial understanding. One question that has not been addressed in this thesis is how children initially become aware that intention is a cue to what a picture represents. One possibility is that this occurs when children have to defend the identity of their pictures to adults who have misinterpreted them, typically because they do not clearly resemble their referents (Winner, 2006). For instance, it is not unusual to hear a child protesting that their scribble is a picture of a house when an adult has mistaken it for something else because it lacks any resemblance to its supposed referent. By defining

their own picture according to what they intended to draw children may facilitate an early understanding of the nature of the artist-picture relationship, which is presumably strengthened each time the child uses his or her intention as a defining feature of their pictures. Adding a pre-task to Experiment 1 could provide evidence for or against this theory. In this pre-task children could be asked to draw two pictures (of different stimuli to that used in the experimental task), which would then be misinterpreted by the experimenter (e.g. "oh that's a nice picture of a plate in response to a picture of a yellow ball). If Winner (2006) is correct one would expect that children who defend their own intentions in this pre-task would then rely more strongly on intentional cues in the experimental task. For instance, when the experimenter draws a pink duck after stating her intention to draw a blue duck they would be more likely to identify the picture as a pink duck. Furthermore, pre-task experience would be expected to increase intentional responding in the drawing task more than the photograph task as children would likely have less experience of adults misinterpreting their photographs.

A second intention-related issue is why photographers' intentions are devalued. Do children assign intentional and accidental photographs the same name, and view them as equally valuable (Chapter Three) because their highly realistic appearance focused attention on their surface features, which were identical, and away from how they were created? Or alternatively, is it because children are aware of the causal relationship photographs share with the world, and causality is prioritised over intention? The simplest way to disentangle the influence of iconicity and causality would be to present children with intentional and accidental *ambiguous* photographs. If children's value judgments are contingent on iconicity then ambiguous photographs should be named and evaluated on the basis of intention, as is

the case for ambiguous drawings. Conversely, if responding is based on an understanding of the causal relationship between photographs and their referents then children should respond as they did in Experiment 4, by assigning intentional and accidental images the same name and showing no preference for either picture.

Finally, as outlined in section 7.5, it is important that future research explores the cognitive and social-communicative correlates of children's developing understanding of different picture modalities. One of the most relevant cognitive developments that occurs between the ages of 3 and 8 (the age range focused upon in this thesis) is the acquisition of a theory of mind. Broadly speaking, this refers to the ability to recognise that people have mental states, such as desires, emotions, intentions and beliefs, which govern their behaviour (Astington, 1993; Flavell, 1999; Frye & Moore, 1991; Perner, 1991; Premack & Woodruff, 1978). Such mental state reasoning is fundamental to appreciating that pictures are the intentional products of artists' minds.

Since Chapters Two and Three explored the role of intention in children's picture interpretation, they would have benefitted from the inclusion of a theory of mind measure. Traditionally, the false belief task has served as one of the core tests of theory of mind understanding. Recently, Callaghan and colleagues (2011) devised a pictorial version of this task in order to measure theory of mind in direct relation to pictorial representation. In the new version, a child watches an experimenter place two sets of toys into different boxes and draw a picture to represent the toys that are in each box. Experimenter one then leaves and a second experimenter switches the pictures over. Children are then asked to predict where experimenter one will look for her favourite toys when she returns. Success on this task demands that children must understand that pictures can be used as representations and that as such, experimenter

one will mistakenly believe that the box labeled with the picture of her favourite toys is where her favourite toys are located.

In Chapter Two, including the false picture task would have allowed me to examine whether a more robust theory of mind drives children's ability to a) recognise and map the picture-referent relationship using an artist or photographer's intention, and b) whether this predicted reliance on intentional cues after controlling for the influence of age, condition and modality. Similarly, in Chapter 3 a more advanced theory of mind might explain why a) 6- but not 4-year-old children used intention as a measure of the *value* of a picture, rather than merely an indicator of what a picture represents, and b) why intention is perceived as less relevant for the interpretation of photographs than drawings.

A second cognitive measure which would be useful in future work is the The Test of Pretend Play (Lewis & Boucher, 1997), which assesses three types of symbolic play, including the attribution of an imagined property to an object or person and reference to an absent object, person or substance, and can therefore be used as an indicator of a child's imaginative ability and creativity. Imagination, as well as intention, links artists to their pictures, and the findings of Chapters Four and Six led to speculation that a more developed understanding of imagination might underpin the knowledge that artists can draw imaginary referents such as fairies, and drawings can depict unicorns, whereas photographers and photographs cannot. Consequently, correlations between TOPP and such reasoning would provide more robust evidence for this claim.

While cognitive skills undoubtedly contribute a great deal to children's pictorial development, there is also evidence that the social-communicative exchanges within which children learn about pictures and their symbolic function affect the rate

of pictorial development (Callaghan et al, 2012). In a cross-cultural comparison of the pictorial development of children from Canada, Peru and India, Callaghan et al (2012) found that while children from all three countries acquired social-cognitive skills such as intention reading, imitation, gaze following, communicative pointing and joint attention, at approximately the same age, Peruvian and Indian children's picture comprehension and production was delayed relative to Canadian children. This was attributed to differences in the number and frequency of picture-based interactions with experienced symbol-users, which were highest for Canadian children. In light of these findings, future work should consider the possibility that an understanding of cross-modal pictorial understanding originate in, or are fostered by, the exchanges children have about photographs and drawings with parents and other experienced symbol users. As described in section 1.5.3 in society photographs are commonly thought of and used as veridical representations of reality. As a result, it is likely that when talking to their children parents place more emphasis on discussion of the events depicted in photographs rather than how they are created. By contrast, it may be the case that drawings are discussed both in terms of their content and creation, since children engage in drawing at home and at school from a young age. Comparing the context in which children experience these two types of media with parents and other experienced symbol users would be useful in examining children's emerging understanding that photographs and drawings are unique forms of pictorial representation.

In general, measuring children's cognitive development and the level and content of their picture-based interactions with others would further develop Freeman and Sanger's intentional net framework. For example, it might allow intention reading and a well-developed understanding of imagination to be pinpointed as skills that are

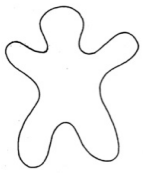
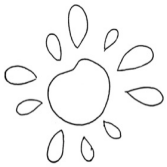
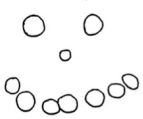
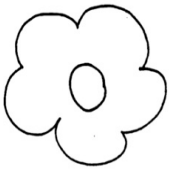
fundamental to reasoning about the artist-picture relationship. Moreover, a developing understanding of others minds may be found to parallel increasingly sophisticated inferences about the artist-picture and photographer-picture relationships. It is in this way that the work on pictorial development should be anchored to the wider literature on children's cognition, particularly in light of the claim that "symbolization is a hallmark of human cognition" (DeLoache, 1987, p. 1556).

7.6 Conclusions

The amassed findings of this thesis show that in addition to the general symbolic capacities, such as representational insight, which motivate an early understanding of the referential and thus symbolic nature of pictorial representation (DeLoache, 1995, 2002; Liben, 1999; Seidman & Beilin, 1984), children's developing pictorial understanding is supplemented by knowledge of differences across picture modalities. Beginning at the age of 4 children display an increasing understanding that there are fundamental differences in how artists and photographers create pictures, and consequently in how photographs and drawings relate to the world. Specifically, they are aware that photographs are more dependent on their real world referents and the causal-mechanical functioning of cameras, than drawings, which rely to a greater extent on the *minds* of their artists, in particular, their intentions and imagination. These findings converge on the notion that picture modality is an important mediating factor in children's developing theory of pictures. Consequently, Freeman and Sanger's (1995) framework of pictorial understanding was refined. The more general picture-world relationship, which captures the early referential understanding upon which modality-specific knowledge is built, was joined by two separate drawing and photography streams, which represent children's understanding

of the unique relationships that exist between artists, drawings and the world, relative to photographers, photographs and the world.

APPENDIX A: INTENTIONAL AND ACCIDENTAL VIGNETTES USED IN THE DRAWING CONDITION OF EXPERIMENT 4

Picture	Intentional	Accidental
	When David was painting in art class, he used some paint to make a picture.	When Chris was painting the house he accidentally spilled some paint on the floor.
	One day, while she was in art class, Anne got to use mud to make an art project. Anne carefully put the mud on the paper until she was done.	One day, while she was playing, Alison saw a big mud puddle. Alison jumped in the puddle and the mud splashed on her t-shirt.
	Matt had peas with his dinner one night. He didn't like the way they tasted, so he pushed them around on his plate to make a picture.	James had peas with his dinner one night. He tried to eat them with a fork, but some of them rolled off his fork onto the floor.
	Hannah decided to make something out of playdoh. Her dog sat next to her chair while she worked. When Hannah was done, this is what it looked like.	Evie opened a new jar of playdoh. While she was getting it out, some playdoh fell on the floor. Then her dog stepped on it.

APPENDIX B: INTENTIONAL AND ACCIDENTAL VIGNETTES USED IN THE PHOTOGRAPH CONDITION OF EXPERIMENT 4

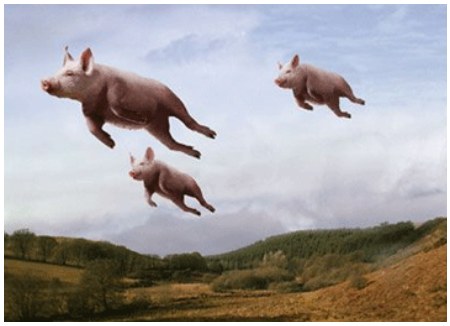
Picture	Intentional	Accidental
	When John was in his art class, he used his camera to take a picture.	When Alex was cleaning his camera he accidentally dropped his camera and it took a picture.
	One day, Alice was playing in the park and she decided to take a picture to put on her wall.	One day, Sophie was running around in the park when her camera fell out of her bag and took a picture.
	Tom went to the beach on holiday, and he decided to take a picture to remember his day out.	Kane went to the beach on holiday. While he was there he tripped over his camera and it took a picture.
	Lucy was tidying her room when she found her camera and used it to take a picture.	Kayleigh left her camera on the table while she was tidying her room. Her cat ran into the camera and it took a picture.

APPENDIX C: FORCED CHOICE QUESTIONS USED IN EXPERIMENT 5

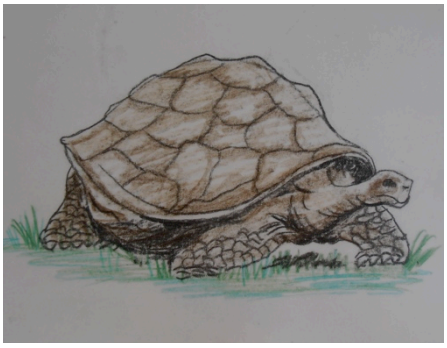
Question	Stimuli
"This is a pink cupcake. I want a picture of this cupcake in blue. Who should I ask to make me a picture of this cupcake in blue, Jack or Luke?" Artist *Faithfulness to reality*	
"I want a picture of a fairy. Who should I ask to make me a picture of a fairy, Jack or Luke?" Artist *Faithfulness to reality*	No object shown.
"This is my toy, he is very happy today. I want a picture of him looking sad. Who should I ask to make me a picture of him looking sad, Jack or Luke?" Artist *Faithfulness to reality*	
"This is my recorder, but it is broken and can't be fixed (demonstrated by experimenter). I want a picture of my recorder before it was broken. Who should I ask to make me a picture of my recorder before it was broken, Jack or Luke?" Artist *Physical presence*	
"I want a picture of Disneyland in America. Who should I ask to make me a picture of Disneyland in America, Jack or Luke?" Artist *Physical presence*	No object shown.

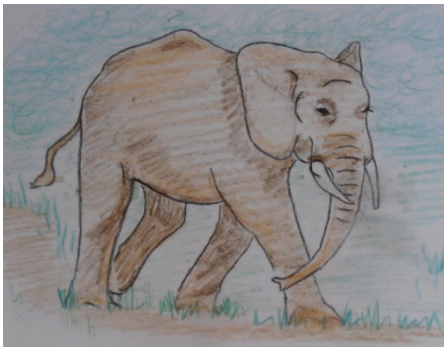
"This is my doll. I'm very impatient and I want a picture of my doll right now. Who should I ask to make me a picture of my doll right now, Jack or Luke?" Photographer *Skill set*	
"Jack and Luke both have little sisters. Jack's sister draws pictures like him, and Luke's sister takes pictures with the camera like him. Because they are younger they are not as good as their big brothers. Who would make the better picture, Jack's sister or Luke's sister?" Photographer *Skill set*	
"If Jack and Luke both broke their arm, then who would make the better picture, Jack or Luke?" Photographer *Skill set*	No object shown.
"I need a picture of your school to show my friend so she can find it later. Who should I ask to make me a picture of your school for my friend, Jack or Luke?" Photographer *Realism*	No object shown.
"This is my car. Look at all these stickers. I want a picture of this car looking just like this with all these stickers on. Who should I ask to make me a picture of this car, Jack or Luke?" Photographer *Realism*	

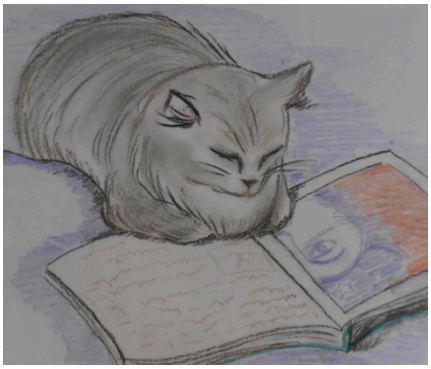
APPENDIX D: REAL AND FANTASY PHOTOGRAPHS USED IN EXPERIMENTS 7 AND 8

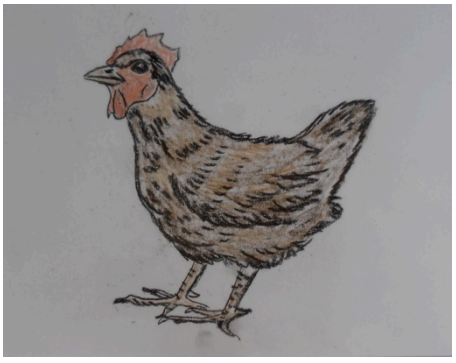


APPENDIX E: REAL AND FANTASY DRAWINGS USED IN EXPERIMENTS 7 AND 8









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