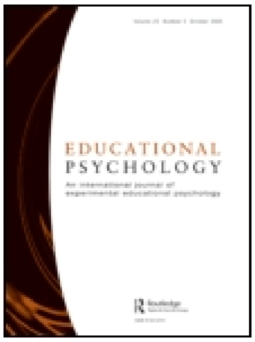

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Children's Drawings: A mirror to their minds

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Children's drawings are thought to be a mirror of a child's representational development. Research suggests that with age children develop more complex and symbolic representational strategies and reference points become more differentiated by gender. We collected two drawings from 109 5–13-year-old children (three age groups). Each child drew their family and their school and participated in an independent recall task. The results indicated significant gender and age differences in the number of details depicted in the family drawings. There were also significant differences between boys' and girls' stereotyped drawings, usage of proportionality, and clothing. With age, children tended to draw more aerial views of their school. The results are discussed in terms of the contribution children's drawings can make to the study of cognitive development and vice versa, as well as their importance for education.

Understanding children's cognitive development has implications for many fields, and in particular for education. While there are many possible approaches to the study of cognitive development, assessing a child's drawings can provide a window into their representational world. For example, the ability of children to depict spatial elements from their environment through an understanding of where an object is located in comparison to others is an important aspect of child development as well as an important aspect of geography, geometry, and graphic design. The purpose of the present study is to contribute to our understanding of representational development by studying two different types of children's drawings – a family drawing and a school drawing – and how these representations may correlate with the children's (working) memory capacity. Children's drawings are often used for cognitive, personality, and diagnostic assessment (Knoff & Prout, 1985; Naglieri,

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1988), and it is therefore important to establish a reliable baseline of their abilities, particularly with regard to gender- and age-related differences.

Research into children's drawings has focused on three main areas: (a) the internal structure and visual realism of children's depictions (e.g., Cox, 1985, 1992); (b) the perceptual, cognitive, and motor processes involved in producing a drawing (e.g., Freeman, 1980); and (c) the reliability and validity of the interpretation of children's drawings (e.g., Hammer, 1997). Very young children produce simple scribbles, and later demonstrate representational intentions. With maturation and increased dexterity, children draw things as they are known rather than as they are actually perceived. Finally, they develop visual realism that includes consideration of perspective (Tallandini & Valentini, 1991). The present study was designed to examine possible relationships between the visual realism of children's graphical depictions and their underlying cognitive processes. More specifically, we examined the relationship between children's representation of spatial and familial relationships and their independent recall.

How objects, thoughts, and events in the world are represented is one of the fundamental questions in cognitive development. There is more than one way to represent a thing or information, and children of different ages seem to use different ways to represent their world. How they represent knowledge and encode events in their world changes developmentally. The question is whether there is a different representation for different kinds of information, or whether all kinds of information are represented in some common format.

A picture of an object is a stand-in for the real thing – it is a concrete yet symbolic representation of an object that is not physically present. A challenge to children in developing competence with symbols stems from the dual nature of symbols; every symbolic artifact is an object in and of itself, and at the same time it also stands for something other than itself. To understand and use a symbol, a child must mentally represent its concrete characteristics and its abstract relation to what it stands for (DeLoache, Pierroutsakos, & Troseth, 1996). This dual representation can be achieved if the child can keep in mind both the object and its referent. DeLoache (1987) has demonstrated that basic understanding of the analogical space–object–symbol relation emerges by about 3 years. That is, 3-year-olds can understand that a little Snoopy hidden under the little couch in a scale model of a room stands for big Snoopy being hidden under the big couch in the real room. With age, children develop the (memory) capacity and the motor skills necessary to represent and re-create an aspect of their everyday experiences. The ability to create images meaningfully is an important human capacity that has been exploited in a number of methods for improving children's comprehension and memory (Pressley, 1977).

Case (1985) argued that the development of working memory controls the growth of cognitive structures. Working memory is therefore a useful construct with which to measure developmental changes in the information-processing capacity which drawing requires. Because individuals can accurately perceive, remember, and manipulate the environment, they clearly have the ability to represent it. Recall can be facilitated by a more richly represented image, which in turn can presumably serve as a mirror into a child's mental representation of that image. Thus, exploring children's mental representations through drawings may provide researchers with a better understanding of their developing knowledge structures.

Children must acquire fine motor skills and develop eye–hand coordination to carry out the motor functions necessary for drawing. Toddlers' scribbles appear unintentional and largely determined by the mechanical structure of the arm, wrist, and hand. Although initially awareness and planning may be absent, through their scribbles, children have created a record of their actions. However, researchers suggest that drawing skills may not be required to create a mental representation on paper (e.g., Golomb, 2004). Young children with no prior drawing experience tend to draw human figures spontaneously when given a pencil and paper. Golomb (2004) identifies children's drawings of the human figure as the most informative in terms of cognitive development. This is studied more frequently than other representations and allows researchers to assess the development of children's use of figural differentiation and representation. Children typically progress from scribbles to first representational shapes and forms, to complex representations of the human figure (Golomb, 2004; Harris, 1963). In other words, as children mature and develop cognitively, their representations move from simple pictures to differentiated, complex ones. A young child will often draw a "tadpole" figure with a circle as the body/head and sticks as appendages (Golomb, 2004). This representation is a generic creature shaped to symbolise a person. As children develop, they experiment with their representation of the human figure and eventually arrive at a differentiated form that is specific and includes their personal drawing style.

Children's drawings are greatly influenced by the art of their society and by schooling. Children in cultures with little interest in art produce simpler forms (Wales, 1990). Schooling provides opportunities to draw and write, see pictures, and to understand that artistic forms have meanings that are shared by others (Cox, 1993). Children's cognitive development as represented in drawings of the human figure can also reflect a child's social world. La Voy et al. (2001) explored the idea that, because cultural differences permeate children's representations of people, children from different cultural backgrounds may represent these differences in their drawings. Cultural differences were examined by looking at differences in social factors such as smiling, and at details and perception of societal worth expressed by the height of the figures. Results indicated that American children drew more smiles and Japanese children drew more details as well as larger figures (La Voy et al., 2001). Similarly, Case and Okamoto (1996) showed that there are cultural differences between Chinese and Canadian children's drawings. These findings suggest that children's drawings not only reflect representational development but a child's understanding of self and culture as well.

Children's human figure drawings and in particular family drawings are also used by psychologists to assess personality (Knoff & Prout, 1985; Naglieri, 1988). The assumption is that children's drawings reveal their inner world as reflected in their representation of experiences with their own family. The advantage of using drawings is that they represent a means of gathering children's self-report data without some of the limitations of questionnaires or interviews (Pianta, Longmaid, & Ferguson, 1999). However, individual differences in fine motor skills can confound both the drawing variables and outcomes of the personality assessments which they are believed to predict (Pianta & McCoy, 1997). Because of gender differences in fine motor skills (Halpern, 2000), females may be at an advantage if interpretations are based on criteria that may be confounded with motor skills. For example, Koppitz (1968) found that girls tended to include more body parts and clothing in their figures than boys. Because drawings are often determined and interpreted, in part, on the basis of realism (Pianta et al., 1999), which is identified through completeness of the human figure(s), the additional details drawn by the girls could be misinterpreted as manifesting superior intelligence (Goodnow, 1977; Naglieri, 1988). If drawings are used for school placement purposes, boys may be at a disadvantage. In addition, sex differences in children's free drawings may indicate that boys and girls have different feelings and ways of perceiving objects when they draw pictures. It is therefore important to examine gender differences further and to establish a baseline for the various types of drawings that are frequently used for diagnostic purposes. In addition, fine motor skills develop rapidly in children between 5 and 9 years old. Therefore, chronological age is an important factor to consider in drawing performance.

Children's drawings show dramatic gains in organisation, detail, and representation of depth during middle childhood, when some depth cues such as making distant objects smaller than near ones begin to appear (Braine, Schauble, Kugelmass, & Winter, 1993). Compositional development, the arrangement of the different parts of the picture, is evident in children's drawings of their families. Golomb (2004) suggests that most children across age groups align family members side by side facing forward although, with increasing age, composition becomes more relevant to a child's drawing; 3–4 year olds do not completely align family figures and do not randomly place the figures on the page, but in older children, alignment improves and they display an increased awareness of the coordinates of the paper. Attending to a page's quadrants allows children to experiment with the placement of the figures. Thus framing, alignment, and compositional tasks are strategies children use to group their figures together.

The most frequently used strategy is that of alignment. It reveals which figures are grouped together (Golomb, 2004). Gender grouping is also a strategy used by many children. For example, children will draw all girls similarly and yet differently from the boys. Symmetrical ordering of family members is another grouping device used by children that increases with age. Symmetrical ordering refers to how children arrange the figures. For example, grouping older and younger children separately, or placing parental figures in the middle of the family with children on either side, can be seen increasingly with age. In using the symmetrical ordering strategy, children reveal information about their familial relationships. In addition, information about who the figures are is evident from the size relations, with parents being taller than the children. Thus, children's family drawings hold promise as a method for interpreting representations of this important emotional relationship.

Another important aspect of a child's development is the ability to depict spatial elements from his or her environment through an understanding of where an object is located in comparison to him- or herself. Liben and Downs (1993, 2001) found that children as young as three could recognise maps as symbolising referent spaces but that their understanding was limited due to their developing symbolic and spatial concepts. They also showed that by the age of five or six, children can identify spatial relations on a map, but have difficulties with its geometry. Moreover, boys tended to perform better than girls in correctly identifying the direction of an object when the map was turned 180° in comparison to how the real room was laid out (Liben & Downs, 1993). This finding is consistent with other studies that have shown males outperforming females on tasks necessitating visual–spatial and mental rotation abilities (e.g., Cherney & Collaer, 2005; Cherney & Neff, 2004; Halpern, 2000).

A child's understanding of spatial tasks can also be explored through his/her drawings. Very young children fail to comprehend a picture's reference point of view and are unable to understand individual references despite understanding that the picture or map represents another object (Liben & Downs, 1993). In addition, young children have difficulty understanding a picture's viewing angle. For example, Liben and Downs (2001) found that when shown an aerial photograph of Chicago and asked to identify grass, young children tended to identify the bottom of the page as grass. Similarly, many young children reported that representational roads could not be roads because two cars would not be able to fit on them.

Young children tend to perform better on topological mapping tasks whereas older children (8–12-year-olds) tend to perform better on projective and Euclidean relations, thus demonstrating a better understanding of reference points (Golomb, 2004; Liben & Downs, 2001). Golomb notes that 7- and 8-year-olds begin to portray near–far relations using the vertical axis of the page. Moreover, an important aspect of spatial development is the ability to view the world aerially. Iijima, Arisaka, Minamoto, and Arai (2001) found that row or frontal arrangements were most commonly used by girls, whereas the incidence of aerial composition was significantly higher in boys' drawings. Boys also tended to draw dynamic objects (e.g., cars, machines, robots) in bold colours whereas girls tended to draw nature and life-oriented objects (e.g., humans, flowers, butterflies) using warm colours. These sex differences in drawings mirror some of the sex differences found in toy preferences and leisure activities (e.g., Cherney & London, submitted).

Representational development is also evident when examining children's drawings of schools. Tallandini and Valentini (1991) found that children's representations of schools were expressed in three different pictorial components: (a) the building structure (a global component); (b) the building access; and (c) the windows. Using these components, Tallandini and Valentini observed children's drawings of school buildings and found a progression in representational strategy, with a clear association between age and strategy for all these pictorial components. Children's most rudimentary strategy, labelled failed symbolism, either did not have these pictorial components or they were unrecognisable. The second strategy, generic symbolism, had pictorial components similar to a house, with no evidence of it being a school building. Specific symbolism, the third strategy, had components belonging to any school building. Finally, realism included pictorial components that made unequivocal reference to a specific, real school, usually the school attended by the child (Tallandini & Valentini, 1991). Children aged 5–7 draw schools like a simple house without any particular indications that it represents a school. As children conceptually differentiate categories of buildings, they modify the picture into a more specific prototype.

In addition to understanding space locations, a child's cognitive development is also revealed by the complexity of his or her drawings. Bensur, Elliot, and Hedge (1997) found age differences in the developmental complexity of children's drawings. These differences were related to their recognition and memory of various objects found in their environment. Although it was implied that a more developed working memory was responsible for more complex drawings, it is also evident that increased spatial ability also influences complexity. Bensur et al.'s study concluded that increased drawing complexity reveals advanced working memory and spatial abilities. In addition, Case and Okamoto (1996) demonstrated that training or additional drawing experiences contribute to the complexity of the drawings (e.g., Chinese schools provide specific instruction on how to render certain objects, such as the human figure). The present study explored these assumptions by examining the relationship between children's recall and the complexity of their family and school drawings. It was hypothesised that children who portrayed more details in their drawings would also recall more stimuli (toy pictures) and have more drawing experience.

Taken together, these studies suggest that children's drawings illustrate an array of mental representations and cognitive abilities. In the present study we attempted to juxtapose two types of drawings that are used to index children's feelings and understanding concerning the objects depicted: (a) one that depicts an important emotional relationship, i.e., the family; and (b) one that depicts a familiar spatial object/location, i.e., the school. We examined whether children's representations would differ between these two types of relationships and how age and gender would influence the 5–13 year-olds' representations of the pictures. Because females tend to be more attentive to and have more experience with familial relationships (Matlin, 2004) and males tend to be more attentive to and have more experience with spatial tasks (e.g., Cherney & London, submitted), we reasoned that, similar to La Voy et al.'s (2001) cultural differences in children's drawings, we would find gender differences between children's family and school drawings. In particular, we hypothesised that girls would draw more essential and inessential details than boys in their family drawings and that boys would draw more essential and inessential details than girls in their school drawings. We also hypothesised that boys would be more likely use an aerial perspective than girls (e.g., Iijima et al., 2001). Based on the findings that with age children's drawings become more complex and more realistic, we hypothesised that older children would draw more aerial views of their school buildings than younger children and that the latter would be more likely than older children to use stick figures. In general, with age, we expected children's drawings to contain more details.

Method

Participants

A total of 109 (54 boys and 55 girls) 5–13-year-old children's drawings were analysed. Each of the three age groups comprised a similar number of boys and girls (38 5–7-year-olds: M = 76.65, SD = 11.62; 34 8–10-year-olds: M = 115.90, SD = 10.28; 37 11–13-year-olds: M = 147.98, SD = 8.52). Of these, 87% were European-Americans, 7% were Asian Americans, 3% African Americans, and 1% Hispanics. Participants were recruited from local childcare centres and a small private school in the Midwest. Children received a small prize for their participation in the study.

Procedure

Each child was tested individually. The drawing tasks were used as distracter tasks in a study on the development of incidental memory (Cherney, 2005). Each child was exposed to two sets of 18 toy pictures that were presented on a computer screen and was asked to label each toy. After the first set of pictures, the participant received a pencil and a piece of white, standard size paper. The child was given five minutes to draw a picture following the instructions: "Please draw your family." Then, s/he was shown the second set of 18 toy pictures and asked to label them. Following this encoding task, the participant was asked to draw his/her school on the reverse side of the sheet of paper. After each drawing session, the participant was asked to recall the pictures s/he had seen previously.

Coding

The family drawings were coded by three trained coders who were blind as to the hypotheses of this study. Inter-rater reliability was 92%. They used 16 criteria that illustrated key concepts in the drawings (e.g., Bensur et al., 1997; Golomb, 2004; Harris, 1963; La Voy et al., 2001). All of the items, except four, were coded dichotomously. The dichotomous categories included whether or not the child used stick figures, whether any figure was shown smiling, whether all figures were smiling, proportionality (appendages vs. the trunk of figure), whether or not any pets were included in the family picture, whether the figures were represented with clothing, whether the clothing was stereotypic (e.g., included skirts or triangles for female figures), whether the picture included a particular setting/composition, whether the child wrote any words or letters to accompany the picture, whether members of the extended family were included, whether some members were holding hands, and the placement of figures on the page (immediate centre/whole page, top, bottom, left, right, top and left, top and right, bottom and left, bottom and right). Categories that were not coded dichotomously included the number of essential and inessential details, and the average heights of male and female figures. Essential details were defined as the hair, nose, mouth, eyes, hands, feet, arms, and legs; each item was attributed a point for inclusion, to a maximum of eight points. Inessential details were defined as any additional detail that was not previously categorized (e.g., accessories, fingernails, etc.). The heights of all male and all female figures were averaged to create an average male height and average female height.

The school drawings were coded using 10 criteria. Six of these criteria were coded dichotomously. The dichotomous categories included the point of reference chosen by the child (i.e., frontal or aerial views), whether the child chose to draw the interior or exterior of the school, the proportionality (doors and window proportionate to the building and each other), whether or not the name of the school was written on the drawing, whether there were any other words included in the picture, and the placement. Non-dichotomous categories included essential and inessential details, the number of windows or desks (depending on view), and the number of people included in the picture. Essential details, defined for the exterior view as a door and windows and for the interior view as desks and chairs, were counted individually (range 0–2). There was no range limit for inessential details. The placements of the figures on the page were coded using the same scheme as with the family drawings.

The number of correctly identified toy pictures was summed across the two recall tasks.

Results

The drawings were coded by three trained experimenters. Interrater reliability was 89%. Drawings were analysed separately. A total of 109 family drawings and 110 school drawings were analysed (see Figure 1 for examples – one for each age group, for each type of drawing). Separate 2 (sex) × 3 (age group) analyses of variance (ANOVA) on the continuous variables were performed. For the number of essential details in the family drawings, there was a significant main effect of age ($F[2,103] = 4.37$, $p = .015$, $\eta^2 = .11$). Post-hoc tests (Tukey's HSD; $p < .05$) showed that the youngest children ($M = 6.11$, $SD = 1.54$) drew significantly fewer essential details than the 8–10-year-olds ($M = 6.82$, $SD = 1.58$) and the oldest children ($M = 7.05$, $SD = 1.20$). The two older age groups did not differ significantly in their drawing of essential details. A 2 (sex) × 3 (age) ANOVA on the inessential details showed significant main effects of sex ($F[1,103] = 8.25$, $p = .005$, $\eta^2 = .07$) and age ($F[2,103] = 11.95$, $p = .001$, $\eta^2 = .18$). As hypothesised, girls ($M = 3.37$, $SD = 2.94$) drew significantly more inessential details than boys ($M = 2.07$, $SD = 2.21$) and the youngest children drew significantly fewer inessential details ($M = 1.25$, $SD = 1.81$) than the middle ($M = 3.05$, $SD = 2.52$) and oldest children ($M = 3.87$, $SD = 2.89$; Tukey's HSD, $p < .05$). In addition, there was a marginal sex difference in the average female height drawn ($F[1,103] = 3.84$, p = .05, $\eta^2 = .04$). On average, girls ($M = 7.37$, $SD = 3.80$) tended to draw the female characters taller than did the boys (M

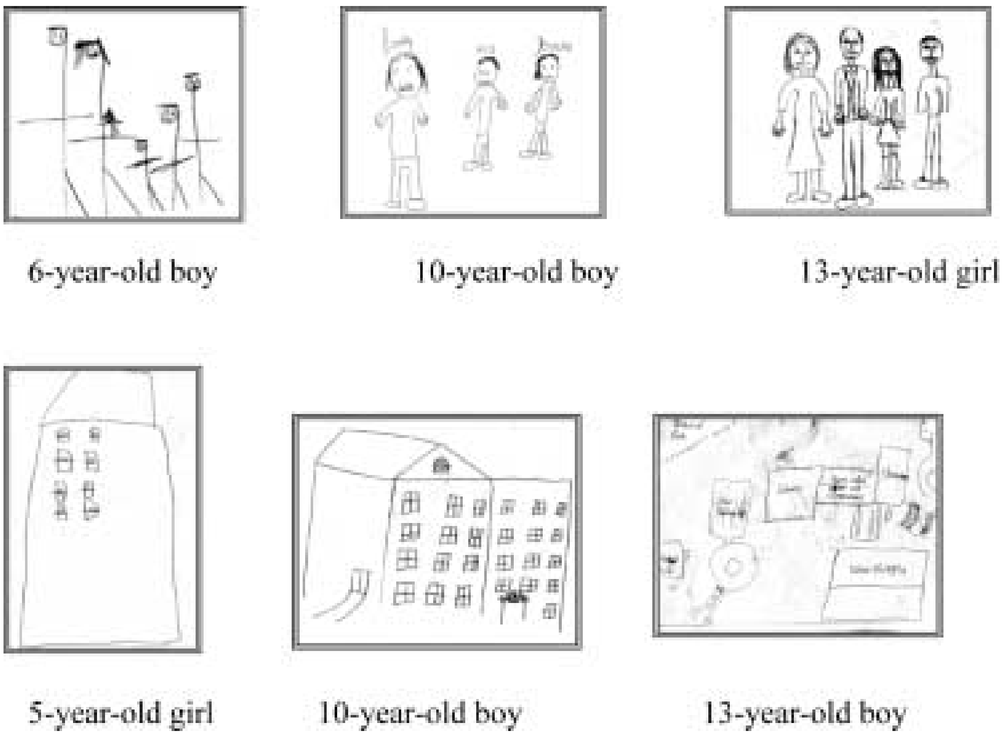

Figure 1. An example of family and school drawings for each age group

= 5.87, *SD* = 4.25). For the school drawings, the only significant main effect was a sex difference in the number of desks or windows drawn ($F[1,103] = 3.96$, $p = .049$, $\eta^2 = .04$). On average, males drew 7.59 (*SD* = 17.29) windows/desks and females 13.32 (*SD* = 12.82).

Separate chi square tests on the dichotomous variables by sex and age were computed. For the family drawings, results indicated significant sex differences for clothing ($\chi^2[1, n = 109] = 6.31$, $p = .012$), the use of stereotyping ($\chi^2[1, n = 109] = 13.16$, $p = .001$) and proportionality ($\chi^2[1, n = 109] = 4.81$, $p = .028$; see Table 1). Girls were more likely than boys to use clothing and stereotyped features in their

Table 1. Gender differences (*n*) in family drawings

	Boys	Girls	Total
With clothing	30	43	73
Without clothing	24	12	36
Stereotypic	6	23	29
Not stereotypic	48	32	80
Proportional	2	9	11
Not proportional	52	46	98

Table 2. Age differences in family drawings

Age	Number of children in different age groups			
	5–7 years	8–10 years	11–13 years	Total
Stick figures	19	8	9	36
No stick figures	19	28	28	75
With clothes	18	25	30	73
No clothes	20	9	7	36

drawings and they were more likely to draw proportionate figures. In terms of age, there were significant differences in the use of stick figures ($\chi^2[2, n = 109] = 7.60$, $p = .022$) and in the use of clothing ($\chi^2[2, n = 109] = 10.59$, $p = .005$; see Table 2). Not surprisingly, the youngest children were more likely to draw stick figures and less likely to use clothing in their depictions. The only significant difference between the school drawings was that of the reference point children of different ages chose ($\chi^2[2, n = 109] = 8.69$, $p = .013$); 38% of the older children used an aerial view, as did 18% of the 8–10-year-olds and 10% of the youngest age group. There were no sex differences for the school drawings.

Finally, to test whether drawing complexity increased with independent memory recall, correlational analyses of the essential and inessential details in both drawings and the total recall scores revealed a significant correlation between essential details and memory scores ($r[109] = .24$, $p = .012$) as well as between the inessential details and memory scores ($r[109] = .34$, $p = .001$) for the family drawings only. No correlations were found between the details of the school drawings and memory scores. To explore further the relationship between detailed drawings and recall, the essential and inessential details for both drawings were summed to form a "detail index". The simple regression with recall scores as the dependent variable and the index as the predictor was significant ($F[1,107] = 7.89$, $p = .006$; $R^2 = .069$; $b = .25$). The index accounted for only 7% of the variance in memory.

Discussion

Understanding children's representational development is an essential component for constructing a more complete picture of cognitive development. The representation of knowledge in long-term memory has been portrayed as an important explanatory component of memory performance and cognitive development (Schneider & Pressley, 1985). One key issue that all theories of cognitive development must address concerns age differences in how children represent experience. A critical issue is the ability to understand, use, and produce symbols. They allow us to communicate; to abstract, simplify, and generalise; to hold information far from the referent; to manipulate and transform information, etc. (e.g., Liben & Downs, 1993). The purpose of the present study was not only to examine and establish a baseline for 5–13-year-old children's family and school drawings, but also to investigate how memory performance would be correlated with the children's graphical representations. Because children's drawings are often used for diagnostic and referral purposes (e.g., Pianta et al., 1999), it is crucial to assess children's drawing skills in a non-clinical sample. We chose to examine two types of drawings that are used with clinical samples. The results for each type of drawing are described in turn.

In general, the results of the current study support the hypothesis that with age children's ability to create more complex drawings increases and, in particular, that the difference in representational complexity is linked, at least in part, to an increased working memory capacity as measured by an independent memory recall task (Bensur et al., 1997; Scott, 1981). The family drawings showed that, consistent with other studies and our hypothesis, older children included significantly more essential and inessential details than younger children (e.g., Bensur et al., 1997; Case, 1985; Golomb, 2004; La Voy et al., 2001); they were more likely to draw figures with clothes and were less likely than younger children to use stick figures. In other words, with age, children's drawings included more distinctive features, making the pictures appear more realistic. They frequently wrote the names of the family members, indicating that they were drawing an experienced relationship. Younger children made comments suggesting that they were also drawing from experience. The fact that they included pets also suggests that they were aware that they were drawing themselves. When drawing their family, the children first used symbolic strategies and later a realism strategy (Tallandini & Valentini, 1991). In comparison, children in the youngest age group produced more stick figures.

These findings may illustrate the development of differentiation abilities (Golomb, 2004). With increased cognitive (working memory) capacity, children are more easily able to differentiate between representations (Case, 1985), moving from simple (e.g., stick figures) to complex representations (clothed individuals with detailed facial features). This increased differentiation is also manifested in the finding that the number of details in the children's family drawings was significantly correlated with their recall of toy pictures. It is possible that asking children to recall aspects of their own drawings rather than using an independent recall measure would have yielded higher recall scores. The complexity of children's drawings is probably influenced by children's ability to recall figural configurations and to hold them in working memory. The results may also simply reflect children's maturation and development of motor skills. However, it is interesting to note that there was no association between chronological age and details depicted in the children's school drawing, suggesting that these two types of drawings may tap differential cognitive resources. Similarly, children's placement of family figures was the same across the age groups, suggesting that children as young as 5 years old have developed a schema or mental framework about the alignment of family members.

The current findings also showed significant sex differences among the family drawings. Girls were more likely than boys to draw clothes, add stereotyped details (e.g., fingernails, hairstyles, jewellery) to their figures, and draw proportionate human figures. These findings are related to the fact that, on average, girls drew significantly more inessential details than boys, and they are consistent with previous studies (e.g., Koppitz, 1968) showing that girls tend to depict more details in their family drawings. Together, these results suggest that the girls' drawings may represent their experiences with family relationships. In general, girls tend to value relationships more than boys and they tend to pay more attention to what other same-sex friends wear (Matlin, 2004). Thus, the depictions may not necessarily reflect a different stage of intellectual development. Furthermore, there were no age-related differences in the number of children who used stereotyped items in their drawing, suggesting that girls may develop a prototype or schema for what it means to be female. This schema remains rather invariant over time. This prototype may reflect their attempt to draw things as they are known rather than as they are actually perceived. It may be a means for differentiating females from males. The finding that girls were more likely than boys to draw proportionate human figures may be due to their expertise in drawing and family relationships. Girls tend to spend more time drawing than boys (Cherney & London, submitted).

Interestingly, girls also tended to draw the female figures taller than did the boys. Golomb (2004) suggests that a child's composition of a drawing may be reflective of the relationships in his or her life. For example, the hierarchy of the family may be made explicit by children drawing parents first followed by the children (Golomb, 2004). The tendency for girls to draw larger female figures may indicate the children's high self-esteem. The current sample was composed of children with a middle to high SES background. The children reported spending several hours each day in extra-curricular activities. It is therefore reasonable to assume that these girls were likely to have high self-esteem. However, it is also likely that the boys had equally high self-esteem. Another possible reason for the taller female figures may be that girls adopt more sophisticated and controlled drawing techniques in relation to emotional characters than boys. Hammer (1997) suggests that girls draw in a more controlled manner than boys at most ages. However, if boys were drawing in a less controlled manner than girls, this may have resulted in larger figures, in part because of the reduced level of production control involved. La Voy and her colleagues (2001) suggest that the size of figures may reflect a child's view of his or her worth within a culture. Burkitt, Barrett, and Davis (2003) found that children drew human figures taller than the baseline following a positive characterisation, and shorter following a negative characterisation. In particular, boys tended to draw larger positive drawings than girls, but there were no gender differences between the negative drawings. Overall, Burkitt et al.'s results suggest that the size of children's drawings may reflect an affective component of their representation. That study also found that the oldest group drew taller and larger drawings than the youngest group, running counter to previous findings that children's drawings become smaller with age (Cox, 1992, 1993). Our current findings did not show any age-related size differences. Lack of power may be one reason why there were no age differences, although absolute numbers showed a trend toward drawing larger figures with age.

Future studies should continue to examine the effects of affective characterisations on the size of children's drawings.

With regard to the school drawings, we hypothesised that older children would be more likely than younger children to draw an aerial view of their school building, indicating a better understanding of spatial relations. The findings were consistent with our hypothesis and Liben and Downs (2001) findings that as children mature, they develop more complex spatial abilities, allowing them to view the world from different points of view. As Piaget and Inhelder (1956) theorised, children first develop a sense of topological concepts, including relations such as proximity, order, and separation. Next, children develop projective and Euclidean concepts – that is, they are able to represent spatial relations such as left or right, front or behind, front or side, and they develop a reference system that allows them conservation of distance and angle. Similarly, researchers suggest that young children rely upon local landmarks or local configurations before becoming increasingly more flexible in using alternative frames of reference and finally mastering precise metrics of space (e.g., Liben & Downs, 2001; Newcombe, Huttenlocher, Drummey, & Wiley, 1998). It is therefore not surprising that older children are more likely to draw their school building(s) from a different vantage point. However, it is worthy to note that the participants in the current study, although they drew their school, have never seen or experienced their school from a bird's-eye view. No aerial picture of the school exists. Thus, the children had to create a mental image/concept of the school grounds, use symbols to convey that image, transform this large, irregular, three-dimensional surface to a small, regular, two-dimensional surface, and translate the symbols into fine motor movements. Presumably, these skills improve with a higher working memory capacity. Children may have used symbolism and realism strategies simultaneously (Tallandini & Valentini, 1991). This significant age difference may also be due, in part, to exposure to alternative reference points during geography, algebra, and/or art classes. As Case and Okamoto (1996) showed, additional training and exposure is often translated into increased realism.

There were no gender-related differences in the way in which the school was portrayed, with the exception of the difference in desks/windows production. Girls drew significantly more desks/windows than boys. This finding was contrary to our hypothesis, but was consistent with other findings (e.g., Koppitz, 1968) showing that girls tend to depict more details in their pictures. These results suggest that girls may have a more developed schema for school buildings than boys and/or that sex differences in motor skills may confound the findings. Remarkably, there were no correlations between essential and inessential details and the children's recall. In general, the school drawings were very similar in that the children used few details and tended to use a general pictorial prototype of a house. The private school's main architectural site is a large, red-bricked colonial house. In addition, many children chose to draw their classroom rather than the school building. A lack of variance may therefore be the cause of this finding; the range of scores was more restricted than that of the family drawing. Alternatively, the drawings may reflect the fact that the school building is an inanimate object that does not change over time whereas family sizes (and heights) change.

In conclusion, the present findings demonstrate that the relationship between children's depictions of families and school buildings is complex. Understanding how a child sees him- or herself within the context of the family can expand our knowledge about the development of identity and relationships. The sex differences in family drawings suggest that girls and boys represent families differently. Although there were many age-related differences in the family drawings, with children's drawings becoming more realistic with age (as measured by an increase in the number of details), there was only one age-related difference in the school drawings. With age, children's representations of their school changed from a frontal perspective to an aerial one, suggesting a change from relying upon landmarks and local configurations to alternative frames of references (Newcombe et al., 1982). Similar to Bensur (1997), the present findings show an increasing complexity in children's drawings requiring manipulation of spatial components. These could be influenced by three developmental variables: (a) the children's capacity to attend to the appearance of objects regardless of the internal representation a child may possess; (b) their ability to recall figural configurations and to hold them in working memory; and (c) the effects of fine motor skills (Bensur & Eliot, 1993). One third of the older children chose to use this new spatial perspective. However, it is difficult to offer an uncontroversial interpretation of the correlational data.

As Liben and Downs (2001) note, the process of spatial thinking is important not only to acquire the skills to read maps, but also for the graphic representations of places and space. Map skills and spatial thinking play a crucial role in geography, but they are also related to other educational subjects such as geometry, physical education, art, etc. Computer graphics rely on spatial and graphic representational skills. These graphics are increasingly used for the visualisation of data. Scientific visualisation is central to contemporary work in fields as diverse as biology, chemistry, physics, anthropology, history, demography, geology, meteorology, psychology, and astronomy to name a few (Liben & Downs, 2001). It is therefore crucial to provide children with the spatial training that will enable them to represent space from a different perspective. Children's drawings may be a particularly useful tool for assessing their development in these spatial and familial representations.

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