

Preschool Children's Drawings of 'Tall and Short'

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The study reported in this paper contributes to the exploration of the development of children's mathematical drawing. 36 preschool children produced drawings of 'something tall and something short'. Open-ended analysis of the forms and structures of the drawings revealed four categories ranging from scribble to the base-line comparison of two objects. The variety in drawing forms and the scattering of ages across the four categories suggests that educators should be more aware of children's drawing development in association with their skills in creating mathematical representations.

In Australia, the Early Years Learning Framework (Australian Government Department of Education and Training [AGDET], 2009) provides guidance for the outcomes of learning experiences for children in preschool and earlier care settings. The Framework specifies measurement experiences as being a necessary component of developing children's numeracy, and further suggests that children should "... create and use representation to organise, record and communicate mathematical ideas and concepts" (AGDET, 2009, p.28). In this statement we see an acknowledgement of the significant role of representations in children's learning of mathematics. However, there is little guidance available to teachers about what representational forms to expect from children and how to support the development of mathematical representation (Bobis & Way, 2018). *Drawing* is a fundamental form of representation in mathematics, and from the commencement of formal schooling there is an expectation that children will increasingly make use of conventional drawing techniques and diagrams. As emphasised by Ginsburg, Lee and Boyd (2008), children need to be supported in 'mathematising' their self-created representations. Yet how much attention do educators give to actually teaching children to make explicit connections between mathematics concepts and drawn representations? A currently under-researched aspect of mathematical development is how young children transition from natural drawing, to drawing as a mathematical representation tool (Way, 2018).

Natural Development of Drawing

From a developmental perspective, it is important to consider the *natural* development of drawing in children, and for this, the substantive work of Antonio Machón (2013) is invaluable. Children between 1 and 3 years of age engage in drawing as a playful exploration of movement and graphic space, without intention to represent external objects. Scribble is therefore a natural part of drawing development, that gradually takes on more controlled forms such as wavy lines, circles and dashes (Machón, 2013). Around 3-4 years, these forms are used as units that are repeated and combined experimentally to create composite figures, such as combining circles and dashes to make a 'sun' or a human ideogram. Typically, children do not begin deliberately representing external objects (symbols and pictures) until 4-5 years, though the act of drawing is still largely whimsical or 'artistic' at the time children begin formal schooling. Gradually the emergence of schemas (pictorial structures) such as baselines, proportionality and the exploration of perspective can be seen in children's drawings in the 4 to 7 years range (Machón, 2013).

Young Children's Conception of Length

As noted by other researchers, young children develop a range of contextualised measurement concepts through their informal experiences, prior to engaging in more formal instruction at the commencement of school (Chigeza & Sorin, 2016; MacDonald, 2013; MacDonald & Lowrie, 2011). In a rare study of young children's representation of mathematical ideas through drawing, MacDonald (2011) examined the drawings of 'something tall and something short', produced by 83 children who had just commenced formal schooling at two Australian schools (around the age of 5 years). The children were also asked to provide a verbal description of the drawings, facilitating richer data and more accurate interpretations. The majority of children (80 to 90%) produced representations that; a) focused on the specific attribute of length, b) made direct comparison of the heights of two objects, and, c) used appropriate measurement language, often including comparative terms such as taller and shorter (MacDonald, 2011). About a third of the children chose to draw more than two objects, sequencing them in order of height. Similarly, Chigeza and Sorin (2016) found that 4/5-year-olds in Australia and Canada were able to focus on a selected attribute of objects, such as length, and demonstrate comparison through drawings and words. The study reported in this paper utilises a 'something tall and something short' task similar to the one used by MacDonald (2011), with the important difference that only the completed drawings were available to the researcher, so there were no accompanying verbal explanations from the children.

Focus of the Study

The purpose of this paper is to reveal the range of drawings produced by preschool children in response to a simple verbal prompt regarding relative height. Although understanding of 'tall and short' can, to some extent, be inferred from the drawings in this study, the emphasis is on the nature of the drawings themselves rather than the assessment of mathematical concepts. Therefore, this paper is focused by the question: What types of drawings do preschool children create to represent 'tall and short'?

Method

The data set for this paper is drawn from a larger ongoing research project, *Emerging Mathematical Drawings* that explores the development of mathematical drawing across preschool and primary years, with particular interest in the transition from naturalistic drawing to mathematical diagrams. The site for the study was a state primary school with an attached preschool in the metropolitan area of a major city in Australia. Data collection took place mid-way through the school year, and at that time the age range of the preschool children was 4 years and 3 months to 5 years and 4 months. All the children attending preschool on the day were invited to complete the drawings, but only the drawings from children whose parents provided written consent were used in the study. The three preschool teachers were provided with instructions and drawing materials for the children, and the researcher was not present at the time.

Teacher script:

Say: *Think about things that are **tall** (raise your hand over head height) and things that are **short** (lower your hand below waist level).*

Draw something tall and something short.

The analysis procedure described here was applied to the entire set of 104 drawings from the larger study involving Preschool, Kindergarten and Year 1. The 36 preschool drawings

used for this paper where extracted *after* the categorisation process was completed, and happen to include all of the groupings found in the larger sample. An open-ended inductive approach was used to gradually sort the 104 drawings into groups as obvious similarities began to emerge, such as the number of figures, recognisable objects, scribble etc. These tentative groupings were then examined more closely with mathematical characteristics in mind, such as clear depiction of tall/short, or the use of a baseline for comparison, which resulted in the refinement and consolidation of groupings. The groups were then given descriptive names, compared, and drawn together into clusters that revealed four main categories with distinct characteristics. These characteristics formed the basis of definitions for each category and sub-group.

Findings

The four categories and their sub-groups are listed in Table 1, followed by detailed descriptions and examples. The categories have been deliberately sequenced. There is a marked developmental difference between the drawings in *Category 1: Scribble* and the drawings in *Category 4: Two Figures*. As children do not suddenly change from scribble to picture-drawing, *Categories 2: Multiple Figures* and *Categories 3: Single Figure* are possibly transitional phases. As indicated by the children's ages (noted on the examples of drawings below), there was a tendency for an increase in age from Categories 1 through 4, though age was not a definite predictor of the type of drawing produced. (The ages are expressed in years using decimal fractions rather than months).

Table 1
List of Drawing Categories

Category	Sub-groups	Number of children	Total
1. Scribble	1a. Uncontrolled scribble	4	11
	1b Controlled scribble	4	
	1c Controlled scribble complex	3	
2. Multiple Figures	2a Lines	6	8
	2b Humps & rectangles	2	
3. Single figure		3	3
4. Two Figures	4a Simple shapes	3	14
	4b Similar size	1	
	4c No baseline	3	
	4d With baseline	7	
Total			36

Category 1: Scribble

The 11 drawings in the Scribble category do not appear to represent specific objects, suggesting the children have not yet reached this stage of drawing development. The children's understanding of the concepts of tall and short cannot be inferred from these drawings. The category can be further divided into three subgroups according to the degree of control and structure in the scribble.

a) *Uncontrolled Scribble* (Figures 1 & 2). The children made flowing, freeform, mostly circular marks.

b) *Controlled Scribble* (Figure 3): The mark-marking of the children suggests that their drawing development is in the phase of experimenting with forms such as lines and closed shapes. It is possible that these drawings had some link to imaginings of tall and short objects, but there is insufficient form and structure to derive meaning from the drawings themselves.



Figure 1: Category 1a - Uncontrolled Scribble (4.42 years)

Figure 2: Category 1a – Uncontrolled Scribble (4.42 years)

Figure 3: Category 1b – Controlled Scribble, emerging structure (4.75 years)

c) *Complex Controlled Scribble* (Figures 4, 5, 6 below): Other drawings consisted of a repetition of units, such as lines and rectangles, to create complex composite figures. Again, it is possible that there was representational intention in these drawings, but the intended representation was simply not apparent to the researcher.

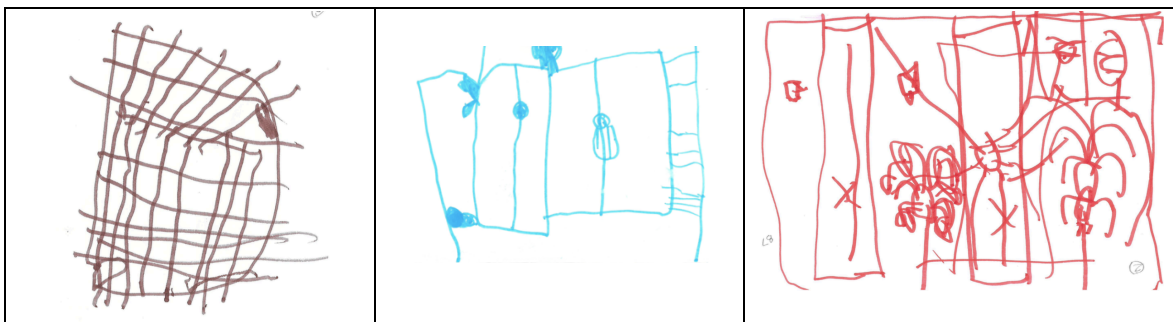


Figure 4: Category 1c – Complex Controlled Scribble, repetition of forms. (5.25 years)

Figure 5: Category 1c – Complex Controlled Scribble, repetition of forms. (4.66 years)

Figure 6: Category 1c – Complex Controlled Scribble, emerging figures. (5.33 years)

Category 2 – Multiple Figures

The eight drawings in this category have a common key characteristic of repeated units of differing heights that suggest an awareness of the attribute of length or height, but do not clearly depict a comparison of ‘tall’ and ‘short’. Unlike the multiple figures in MacDonald’s (2011) study, these figures were not arranged in order of height. There are two subgroups.

a) *Multiple Lines* (Figures 7 & 8). These drawings consisted of a row of ‘lines’ of various lengths. All but one of the drawings presented vertical lines. Technically these drawings may

indicate the drawing development phase of Controlled Scribble, but unlike the other Scribble drawings, the intent to represent length or height seems deliberate, so they have been interpreted as conceptual representations.

b) Multiple humps or rectangles (Figure 9). These drawings are distinct from the multiple lines in that the repeated units are arranged along a baseline, and are accompanied by other marks that suggest the representation of physical objects. For example, the sun in Figure 9 suggests an outdoor scene, with the humps representing hills of various heights.

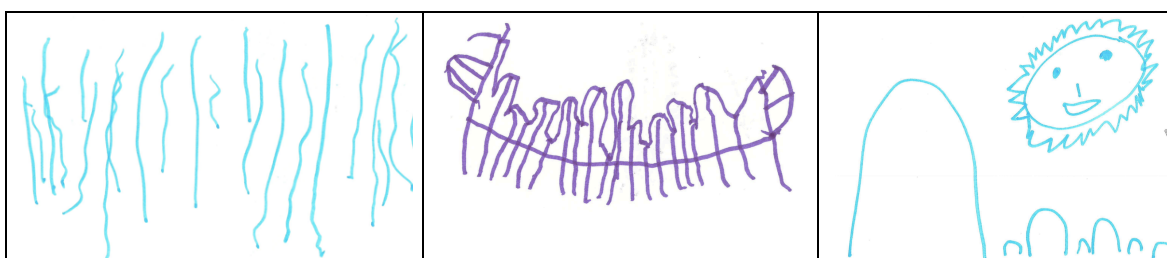


Figure 7: Multiple lines
(4.58 years)

Figure 8: Multiple lines
(4.66 years)

Figure 9: Multiple humps
(4.75 years)

Category 3 – Single Figure

Three drawings were of a single recognisable object that would generally be considered as being tall, such as a dinosaur or a tree (Figures 10, 11, 12 below). It seems likely that the children have represented something that they perceive as being tall in comparison to themselves, and did not think it necessary to also draw a person.

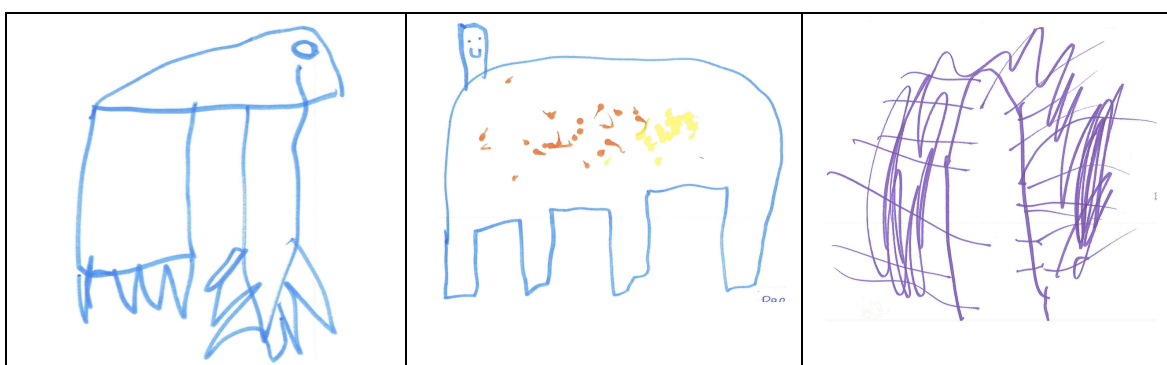


Figure 10: Single tall object
(4.66 years)

Figure 11: Single tall object
(5.08 years)

Figure 12: Single tall object
(5.0 years)

Category 4 – Two Figures

Fourteen children drew two distinct figures, as implied by the instruction to draw ‘something tall and something short’. However, there are several subgroups of drawings that reveal interesting differences in the children’s representation techniques. With the exception of the group of geometric shapes, all the figures clearly represent a real-world object in a vertical orientation.

a) Two Simple Shapes. Some children chose to draw simple shapes to show a length comparison – either with a baseline (Figure 13) or without a baseline (Figure 14). It cannot

be determined from the drawings if the shapes were intended to represent a real-world object, or if the intent was to depict geometric shapes.

b) Two Similar Size Objects. Four children drew a pair of figures on a baseline that were of similar height, so the differentiation between ‘tall’ and ‘short’ is ambiguous (Figure 15).



Figure 13: Two simple shapes on baseline (5.42 years)

Figure 14: Two simple shapes – without baseline (4.58 years)

Figure 15: Two objects similar height (5.08 years)

c) Two Figures, No Baseline. These three drawings contained two figures with a clear size difference, though the height comparison was not accentuated with a common baseline (Figures 12, 13, 14). The style of human figures suggests these children are in the developmental phase for drawing that is common around 4 years of age, in which ideograms are produced by combining units such as circles and strokes.



Figure 12: Two Figures without baseline (4.75 years)

Figure 13: Two figures without baseline (5.58 years)

Figure 14: Two figures without baseline (5.0 years)

d) Two Objects on Baseline. (Figures 15, 16, 17 below). The drawings in this group all showed just two figures arranged on a common baseline, often the bottom of the page. The height difference was quite clear, with most objects being recognisable items from the child’s environment such a tree or a person. Five of the seven drawings included a person, mostly as the short thing, so possibly representing the child him/herself.

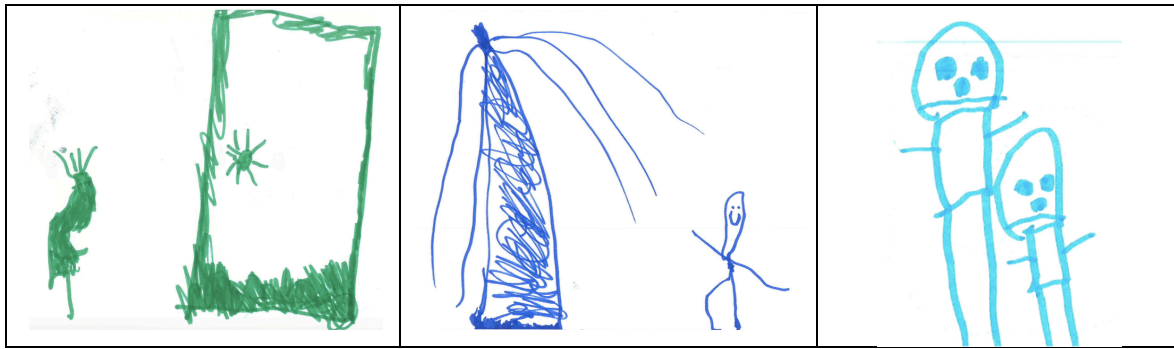


Figure 15: Two figures on baseline (4.83)

Figure 16: Two figures on baseline – tree (5.33 years)

Figure 17: Two figures on baseline – people (4.33 years)

Discussion and Conclusion

Previous research (Chigeza & Sorin, 2016; MacDonald, 2013; MacDonald & Lowrie, 2011) suggested that most 4/5-year-olds have some understanding of the meaning of ‘tall and short’, and this study showed that at least half of the children were able to communicate such an understanding through their drawing. It seems likely that more of the children would have revealed an understanding if they’d had the opportunity to talk about their imaginings and drawings. However, the main interest of this study was in exploring the particular ways in which the children reacted to the request to ‘draw something tall and something short’, and depicted their thinking in their drawings.

The Category 4 drawings that depicted two figures of different heights along on a baseline provided a clear representation of the comparison technique of ‘something tall and something short’, using the spatial organisation (or drawing convention) of arranging the figures on a baseline. Such comparison drawings were anticipated by the researcher, as were the Scribble drawings. However, the drawings of Categories 2 and 3 (Multiple Figures and Single Figure) were somewhat of a surprise, and warrant further investigation through other methods such as interviews with the children, and with larger samples. The nature of Category 2 and 3 drawings suggest they may be ‘transitional’ in representing the particular concepts of tall and short, which may mean that some carefully considered intervention by a teacher could support the children in developing drawing techniques to more clearly represent their thinking. The fact that about a third of the children produced Scribble drawings raises some concerns about their commencement of formal schooling in another six months, as they may not be ready to cope with the growing expectation of adults that they should be able to communicate mathematical ideas through drawing. Children need considerable time and effort to gradually develop both the mark making and the associated conceptualisations before they can use drawing as a representation of real objects (Machón, 2013). The ‘danger’ for the Scribble children is that they may experience a sense of failure when they do not meet the expectations for ‘drawing mathematics’ during the first year of formal schooling.

The age span of the sample of preschool children was about one year, and although there was a tendency for older children to produce the more sophisticated comparison drawings, there was a scattering of ages across *all* categories. This spread highlights the developmental nature of drawing, yet reminds us of the variation in children’s developmental progress. The findings of this study suggest that it is advisable for teachers to be aware of children’s drawing development around school entry and take it into consideration when planning learning experiences that will support drawing development. It would also be wise for

teachers in the first few years of schools to consider assessment practices that will not disadvantage children whose phase of drawing development may disguise their mathematical understandings.

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