The relationship between children’s production and comprehension of realism in drawing

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Two studies compared 2- to 14-year-olds’ production and comprehension of realism in human figure drawings. In the comprehension task, children were asked to choose from an array of children’s drawings the (1) most realistic drawing, (2) one they liked the best, and (3) one most similar to their own human figure drawings. Both studies reported that children of all drawing levels typically selected a more advanced drawing than shown in their own productions for all three questions, except that the most advanced drawers consistently estimated their drawing level appropriately. In Study 2, children were also asked to place the drawings in an age-related developmental sequence. Performance on this task was positively related to the child’s production level, independently of the child’s age. It is concluded that production lags comprehension in drawing development, but that production level may have an influence on children’s knowledge of the developmental sequence in drawing.

Comprehension is often found to be in advance of production within many aspects of a child’s development. This is perhaps most clearly seen in learning symbol systems, such as language (e.g. Jusczyk, 1997), but is also evident in the processing of information, such as in the use of strategies for remembering material (Bjorklund & Douglas, 1997). Explanations for the disparity are likely to include the increased cognitive and motor demands required in production. In language, for instance, to successfully convey an oral message the child has to mentalize what needs to be said, translate this mental conception into words, and pronounce those words in an appropriate order. In contrast, understanding some key words in a heard message may be sufficient for an adequate comprehension of that message.

Given these production demands one might predict that production lags comprehension in children’s developing use of other symbol systems. In respect of picture production, for example, Freeman (1972) has long since alerted the cognitive and graphic demands involved in the drawing process. To complete a representational drawing, a child needs to hold in mind the conceptual and perceptual components of the chosen topic, and translate the perceptual parts into an appropriate set of graphic schema. During the drawing process the child is also required to monitor constantly how the schema is being coordinated spatially on the page, and to plan ahead so that the available space is

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used sensibly. Finally, the Western convention of perspective needs to be learned for a visually realistic depiction to be produced.

These cognitive demands stand in contrast to the ease with which depicted topics are recognized without prior experience of pictures (Hochberg & Brooks, 1962). As Sigel (1978) notes, however, comprehension involves a more complex understanding of a picture than merely identifying its depicted referent. For instance, depicted topics vary in realism to the extent that detail, proportion and perspective are shown in the picture. Awareness of the degrees of realism is a cognitive response, and represents one measure of the child’s comprehension of pictures. Furthermore, affective responses need to be considered in measuring comprehension, such as the child’s preference for a certain level of realism. Thus, comprehension is more than merely recognition and will involve an interplay between cognitive and affective responses (see Goodman, 1968).

Analyses of children’s cognitive and affective responses to paintings and coloured line drawings has revealed a development shift from non-representational interpretations to a focus on subject-matter depicted visually realistically (e.g. Jolley, Zhi, & Thomas, 1998; Machotka, 1966; Parsons, 1987; Rosenstiel, Morison, Silverman, & Gardner, 1978). Similarly, drawing production develops through an ordered sequence in which the child’s graphic marks progress from the earliest scribbles to representational forms of increasing visual realism (Luquet, 1927; Piaget & Inhelder, 1956, 1969). Developments in production and comprehension of pictures are intrinsically linked, therefore, to levels of depicted realism. The aforementioned demands in production predict that drawing increasingly visually realistic representations develops more slowly than comprehension of visual realism.

A number of studies have compared children’s production of drawings with their attitudes towards other drawings. In these studies children’s drawings of a topic are typically rated along a developmental sequence. The child’s production level is then compared to the drawing the child selects from an array of drawings of that same topic. In this selection task, children are usually instructed to pick the ‘best’ drawing but in a few studies a more specific criterion is given, such as to pick the one made by the oldest child or the most realistic version. While some studies have reported that selections are in advance of productions (e.g. Fayol, Barrouillet, & Chevrot, 1995; Golomb, 1992; Hart & Goldin-Meadow, 1984; Kosslyn, Heldmeyer, & Locklear, 1977; Lewis, 1963), others have reported children selecting the same level of drawing as their own (e.g. Brooks, Glenn, & Crozier, 1988; Moore, 1986; Taylor & Bacharach, 1981). The findings from the first set of studies suggest that production lags comprehension, the second set that production and comprehension develop concurrently.

To account for children producing and selecting similar levels of drawings, Brooks et al. (1988) and Moore (1986) cite Luquet’s (1927) notion that a child draws a topic from his or her ‘internal model’ of that topic. That is, the child’s conceptions of the important features of the topic are produced on the page. If the child has such a mental conception of a topic then one might expect it to also dictate the drawing chosen in the selection task.

The conflicting findings in the literature may be explained partly by the ambiguous instruction to choose the ‘best’ drawing in the selection task. This instruction is likely to cue either a cognitive or affective response depending on how the question is interpreted. For example, children may be well aware of the most visually realistic drawing in the set,
but prefer a more diagrammatic or symbolic version that is closer to the style they use in their own drawings. No study in this literature has requested explicitly and independently the child’s understanding (cognitive response) and preference (affective response) of realism in drawing. We also believe that children’s estimate of the version that is most similar to their own human figure drawings provides a useful addition to their realism and preference responses. It would be particularly interesting, for instance, if scribblers overestimated their drawings to a representational level. Such estimations would be consistent with the view that scribblers intend their marks to be representational (Mathews, 1984; Thomas, 1995). Golomb (1992) notes evidence from one of her studies that children do tend to overestimate the level of their own drawings but she provided no data to support this finding. Nevertheless, her comments indicate the importance of assessing children’s notion of their own drawing level.

Moore (1986) noted other important objections to previous studies, but we believe that there are further methodological issues yet to be adequately addressed. For example, it is important to ensure that the depicted topic under investigation is not only commonly found in children’s drawings, but also one in which the depictions change developmentally in a known pattern. Thus, the choice of spaceships, spheres, cubes, prisms, etc. is problematic (e.g. Hart & Goldin-Meadow, 1984; Kosslyn et al., 1977; Lewis, 1963). Lange-Kuttner & Edelstein (1995) commented that individual differences are more likely to occur in drawings of the human figure than in objects. Indeed, the human figure is the optimum choice of topic as it is one of the earliest representations children draw, remains a consistent topic throughout a child’s drawing experience, and develops fairly reliably in most children (for review, see Cox, 1993). A related point is that although children’s drawing experience normally covers the period from at least 2 to 9 years of age, none of the previous research in this area tested children over the whole of this age range.

The stimuli presented in many of the selection tasks have often been stereotyped versions produced by the authors to reflect the forms normally drawn by children (e.g. Brooks et al., 1988; Kosslyn et al., 1977; Lewis, 1963; Moore, 1986; Taylor & Bacharach, 1981). This approach is appropriate if the aim of the investigation is to establish which properties (e.g. colour, detail, proportion, perspective, etc.) of drawings children focus on (for findings see Golomb, 1992). Where the aim, however, is to compare production and comprehension in drawing then it is desirable to use the same stimuli in both tasks (i.e. actual children’s drawings). In any event it is unclear whether children’s responses to stereotyped versions are the same as those to children’s drawings.

The theoretical framework adopted for classifying the drawings in the present study was that outlined by Luquet’s (1927) theory (later discussed by Piaget & Inhelder, 1956, 1969). Luquet described children’s drawings developing through a sequence of various forms of realism (scribbling, failed realism, intellectual realism and visual realism), and thus his theory suited this study’s aim of comparing production and comprehension on that dimension. Furthermore, each phase of realism is conceptually distinct (see Freeman, 1972) and can be applied easily to drawings of the human figure. All children in the present study were asked to draw a man. Drawings of men are often portrayed in pictures made by both girls and boys, and gender differences in the children’s drawings literature are not commonly reported (Cox, 1992). Nevertheless, the classification and selection of drawings by gender was analysed to check for any gender bias.
Study 1

Method

Production task

Participants. In all, 120 children were chosen to represent 20 children in each of 6 age groups: 2-year-olds ($M = 2;7$, range = 2;0–2;11); 3-year-olds ($M = 3;10$, range = 3;0–3;11); 4-year-olds ($M = 4;3$, range = 4;0–4;9); 5-year-olds ($M = 5;2$, range = 5;0–5;3); 7-year-olds ($M = 7;4$, range = 7;0–7;10); and 9-year-olds ($M = 9;4$, range = 9;0–9;11). All participants attended either a private day-care nursery, or an infant or junior school in South Cheshire, England and consisted of 67 boys and 53 girls.

Materials and procedure. Children aged 2–7 years used 9cm pencils, whereas 18cm pencils were given to the 9-year-olds. All children were tested within their classes by their respective teachers who had been given written guidelines for the procedure. Children aged 4 years and above were tested in groups: either the whole class was tested (and the teacher randomly chose 20 of the drawings), or only 20 children from the class were tested while the remaining children completed another task. The 2- and 3-year-olds were tested either individually or in small groups (between two and five children). All children were given one A4-sized white page and were asked to ‘draw a picture of a man’. The teachers were instructed to tell the children not to copy from another child and sufficient distance was placed between each child to emphasize this request. Any questions regarding the topic of the drawing were answered by clarifying that the drawing could be of any man.

Assessment of drawings.

Construction of ratings booklet. The descriptions of each category based on Luquet’s (1927) theory can be found in Appendix 1, together with some of the drawings provided to the raters for clarification of the descriptors.

According to Luquet, after a period of producing non-representational forms (see Appendix 1: (i) Scribbling), a child’s earliest representational marks are characterized by failed realism. At this level of drawing only a selection of the constituent parts of a topic are represented, and in a style in which the drawn parts are uncoordinated. A common example of this style in children’s human figure drawings is the ‘tadpole’ figure in which the arms and legs appear to be drawn from the head, with no body depicted. For the purposes of this study these drawings were classified as (ii) Pre-conventional, as they do not show the conventional style of depicting a body. Luquet described the next phase of drawing development as intellectual realism in which all the main features of a topic are included and coordinated appropriately (e.g. a separate head and body with the arms and legs placed from the body). Although the drawing may now be regarded as conventional in the sense that the main criterial features of the human figure are included, these features are drawn schematically and not as an accurate representation of reality (e.g. parts are not portrayed in proportion to each other). Hence, such human figure drawings were classified as (iii) Simple conventional. The final level of drawing that Luquet described, that of visual realism, is characterized by drawings that have a sense of perspective, depth and proportion. Thus, examples of these human figure drawings were classified as (iv) Advanced conventional.

The general instructions in the ratings booklet emphasized that (1) the rater should use the descriptions and example drawings characterizing four levels of drawing development to categorize each of the drawings made in the production task; (2) the sub-categories of each level were not to be regarded as separate categories but merely a means by which a particular characteristic of the level could be emphasized; (3) some drawings to be rated may not fulfil all the criteria of any particular level, but each drawing should be categorized to the level that best fits the criteria; and (4) decisions should be influenced by the descriptions and example drawings only, and not by any previously acquired knowledge or attempts to estimate the artist’s age. In addition, it was stressed to the raters that very few children are able to produce visually accurate depictions, and thus drawings showing a greater sense of proportion and perspective than in the simple conventional category should be classified as advanced conventional. The ‘man on a horse’ drawing was presented to best exemplify partial occlusion, but the raters understood that
the drawings to be rated consisted of only human figure drawings, and also how partial occlusion might be shown in this topic. The raters were two female third-year psychology undergraduates who had been taught Luquet’s (1927) theory in a second-year module.

Analysis of ratings. In order to validate the developmental sequence used in the rating criteria, the numbers of children categorized by the four drawing levels across the six age groups were calculated for each rater. The modal age group for each drawing level was identical for both raters: scribblers (2-year-olds); pre-conventional drawers (3-year-olds); simple conventional drawers (7-year-olds); and advanced conventional drawers (9-year-olds). With the exception of one child, all 4- and 5-year-olds were classified as either pre-conventional or simple conventional drawers by both raters. Thus, both raters categorized the drawings in the same ordered age-related sequence as indicated by the ratings criteria. Furthermore, a Spearman rank correlation coefficient (corrected for ties) showed a high level of agreed classification of drawings between the two raters (\(r = .84, p < 0.001\) (75% of the drawings were rated similarly)).

Despite the high inter-rater reliability, drawings from 30 children were not classified similarly and hence their artists did not proceed to the comprehension task. The main cause of the disagreements was between the pre-conventional and simple conventional categories. Specifically, the raters disagreed on whether some drawings were a transitional figure (see Appendix 1, (ii)(c)) or a simple conventional figure. Such interpretations are intrinsically difficult. For instance, underneath the head a child might draw two stretched out vertical lines that appear too long to represent legs but do not particularly look like a body either (i.e. too narrow and not joined at the bottom). Unfortunately, the criterion provided in the ratings booklet for a transitional figure was not sufficiently clear (this was rectified in the amended booklet used in Study 2). As a precaution, a third rater examined the drawings that had been agreed as either pre-conventional or simple conventional in Study 1 and confirmed the classification in every case.

A further 12 pre-conventional and 17 simple conventional drawers were randomly withdrawn to avoid potential statistical problems concerning the disparity in the numbers of children rated consistently between the four drawing levels. Despite the slippage in numbers of children between the two tasks (this issue was re-examined in the design of Study 2), the modal age group of each of the four drawing levels in the final sample was identical to that found for the initial sample (see above). Hence, the initial and final samples represented the same age-related developmental sequence.

Comprehension task

Participants. Of the children who had participated in the production task, 61 proceeded to the comprehension task: scribblers (\(N = 13, M = 2;7\), range = 2;0–3;3); pre-conventional drawers (\(N = 18, M = 3;11\), range = 2;9–5;3); simple conventional drawers (\(N = 17, M = 7;3\), range = 5;1–9;6); and advanced conventional drawers (\(N = 13, M = 9;3\), range = 6;8–9;11). There were 31 boys and 30 girls.

Materials and procedure. Eighteen sets of four drawings (collected in the production task) were photo-copied and pasted onto blue cards (52cm \(\times\) 78cm). Only drawings given the same categorization by the raters were used and some drawings appeared on two cards. Each card displayed one example from each of the four levels of drawing development. The drawings were always presented on the cards in the same order (see Fig. 1).

The comprehension task was administered individually to each child in a quiet area within the school by the second author within one month of the production task. Each child was presented with one of the sets of four drawings (no child saw his or her own drawing) and was instructed, ‘Here are four pictures drawn by other children. They were all asked to draw a picture of a man and this is what they each drew. I will now ask you three questions about the drawings . . . ’ The three questions were as follows:

- Realism: ‘Which picture looks most like a real man?’
- Preference: ‘Which picture do you like the best?’
- Estimation of own skill: ‘Which picture looks most like how you draw a man?’

The order of the realism and preference questions was counterbalanced. The estimation question was always asked last. It was important to ensure that a drawing was not selected simply because it was the
nearest to the child. Hence, for the youngest children the card was placed either on a table or on the floor and the children walked around the drawings. The older children were seated and the experimenter held the card vertically in front of them. The drawing to which each child pointed in response to each question was noted down in terms of the number reflecting the level of drawing (1 for scribble, 2 for pre-conventional, etc.).

Results and discussion

Children’s production performance was measured by the raters’ agreed classification of their drawing (1—4). Note that although example drawing (ii)(a) of the pre-conventional category (see Appendix 1) appears to be distinct from the other two examples in that category, no child in Study 1 (nor Study 2) produced a drawing similar to that shown by (ii)(a) of randomly distributed human figure parts. Hence, the children categorized as pre-
Table 1. Numbers of children selecting four levels of human figure drawing in response to realism, preference and estimation questions by category of children’s own human figure drawing (Study 1)

<table>
<thead>
<tr>
<th>Comprehension performance</th>
<th>Production performance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Scribblers</td>
</tr>
<tr>
<td>Realism</td>
<td></td>
</tr>
<tr>
<td>Scribble</td>
<td>–</td>
</tr>
<tr>
<td>Pre-conventional</td>
<td>–</td>
</tr>
<tr>
<td>Simple conventional</td>
<td>5</td>
</tr>
<tr>
<td>Advanced conventional</td>
<td>8</td>
</tr>
<tr>
<td>Total</td>
<td>13</td>
</tr>
<tr>
<td>Preference</td>
<td></td>
</tr>
<tr>
<td>Scribble</td>
<td>2</td>
</tr>
<tr>
<td>Pre-conventional</td>
<td>2</td>
</tr>
<tr>
<td>Simple conventional</td>
<td>7</td>
</tr>
<tr>
<td>Advanced conventional</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>13</td>
</tr>
<tr>
<td>Estimation of own drawing level</td>
<td></td>
</tr>
<tr>
<td>Scribble</td>
<td>1</td>
</tr>
<tr>
<td>Pre-conventional</td>
<td>7</td>
</tr>
<tr>
<td>Simple conventional</td>
<td>1</td>
</tr>
<tr>
<td>Advanced conventional</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>13</td>
</tr>
</tbody>
</table>
conventional may be regarded as a coherent group of human figure drawers, as was the case for the other groups of drawers. Three comprehension measures were obtained according to the level of drawing (1–4) selected in response to the realism, preference and estimation questions. Table 1 describes the children’s responses to these questions by their own drawing level. An alpha level of .05 was used for the statistical tests unless otherwise stated. Chi-square analyses comparing the performances of children across the production and comprehension tasks by gender revealed no significant gender differences (all \( p > .05 \)). Hence the tasks were not gender biased.

Production and comprehension of the most realistic drawing

A Kruskal–Wallis (corrected for ties) just failed to report a significant difference in selections for the ‘most real man’ between the children’s production levels (\( \chi^2(3) = 7.59, p = .06 \)). The selections were collapsed across the production levels. A one-group chi-square test revealed a significant difference between the levels of drawing selected (\( \chi^2(3) = 99.59, p < .0001 \)). Inspection of Table 1 indicates that with only one exception all children selected a conventional figure as the most real man, the advanced form being the predominant choice.

Production and comprehension of the most preferred drawing

A Kruskal–Wallis (corrected for ties) reported a significant difference in the most preferred drawing between the children’s production levels (\( \chi^2(3) = 29.01, p < .0001 \)). Mann–Whitney \( U \) tests (adjusted \( \alpha = .0083 \)) revealed significant differences between levels 1 and 3, levels 1 and 4, levels 2 and 3, and levels 2 and 4. Hence, an important change in preference occurred between those children who did not draw a conventional figure (scribblers and pre-conventional drawers) and those who did (simple and advanced conventional drawers). Inspection of Table 1 shows that the modal response of scribblers and pre-conventional drawers was a simple conventional figure, whereas most conventional drawers preferred the advanced conventional form.

The realism and preference data showed, therefore, that scribblers, pre-conventional drawers and simple conventional drawers typically preferred and considered the most realistic a more advanced form of the human figure than they produced in their own drawing. Thus, production lagged comprehension for these drawers. Although the advanced conventional drawers chose the same standard as their own drawing, these drawers were not provided with a more advanced alternative in the comprehension task. Hence, it would be premature to conclude that production and comprehension were at the same level for these advanced drawers.

Production and estimation of own production level

To examine whether children estimated correctly their own level of human figure drawing, the responses to the estimation question were coded as either the same or different to the child’s own production. Of the children, 22 estimated correctly, while 39 did not (of which 35 selected a drawing in advance of their own production). A Kruskal–
Wallis (corrected for ties) confirmed a significant difference in proportion of same and different responders between the four production levels ($\chi^2(3) = 17.49, p < .001$). Inspection of Table 1 reveals that most scribblers and pre-conventional drawers over-estimated the level of their human figure drawing. Simplified conventional drawers showed some improvement in estimation with approximately 50% selecting their own standard of drawing. The majority of the advanced conventional drawers estimated correctly, but of course overestimation was impossible for these drawers because of the lack of a more advanced version in the selection set. Explanations for the tendency to overestimate among the less-experienced drawers are given in the general discussion.

Comparison of comprehension responses

Of the children, 22 selected the same drawing for each of their three comprehension responses. A one-way chi-square showed that this was a significantly higher number than predicted by chance ($\chi^2(1) = 92.63, p < 0.001$). The consistent responders were distributed among scribblers (2), pre-conventional drawers (3), simple conventional drawers (7) and advanced conventional drawers (10). In addition, 19 of the 22 consistent responders selected the advanced conventional figure. Hence, consistency in overall comprehension of the drawings tended to (1) develop with improvements in drawing level, and (2) be more commonly directed towards the most advanced drawing.

Study 2

The purpose of Study 2 was twofold: first, to incorporate further methodological improvements to test the reliability that production lags comprehension of realism in drawing; and second, to examine whether comprehension of the developmental sequence in drawing is related to the level of the child’s own productions along that sequence.

A production – comprehension comparison is only meaningful if the measure of both elements is reliable. In respect of production, for example, not all children draw consistent forms of a topic at any one time (see Cox & Parkin, 1986). In order to indicate the consistent drawers more reliably, each child in Study 2 produced two drawings of the human figure, one in each of two sessions. The reliability of the comprehension measures (realism, preference and estimation) was improved by asking each comprehension question for three arrays of drawings.

Further methodological changes to Study 1 included testing a sample of older children to test an even wider age range of children, and to increase the likelihood of obtaining advanced conventional drawers. In addition, the advanced conventional drawers were presented with an artist’s drawing of the human figure in one selection set so that they saw a more advanced version than typically produced by themselves. Finally, to test whether production also lagged comprehension of stereotyped drawings, a set of drawings was constructed by the third author to represent the main criteria of each of the four levels of human figure drawing described in the ratings booklet. Although these drawings were similar to the stereotyped human figure drawings used in previous studies, the present set represented a wider range of abilities than previously presented in a single study. All children were asked the realism and preference questions to these stereotyped drawings.
An additional task was administered in Study 2 to assess children’s knowledge of the developmental sequence in children’s drawing. Tryphon and Montenegro (1992) asked 6- to 12-year-olds to produce as many human figure drawings as necessary to reflect how their drawings had changed over the years. While the younger children simply varied their productions in size, older children made more qualitative distinctions. However, such a task relies on children’s ability to remember their earlier representations and to draw them. Even the older children sometimes omitted both a scribble and a tadpole figure, forms that are characteristic of early drawing. The methodology used in the present study was one adopted from Dye and Dowker (1996) who asked children to match human figure drawings to photographs of differently aged children. This recognition form of the task reduces memory demands and also does not require the child to actually produce the different versions.

Two hypotheses were entertained for the developmental sequence task. As the majority of children at all drawing levels in Study 1 knew the most realistic version in the set, they then might also be expected to know the whole developmental pattern and not just its end-point. The first prediction, therefore, was that comprehension of the developmental sequence in drawing is unrelated to drawing performance. Alternatively, it is possible that children are relatively unaware of developmental changes, and the order in which they occur, until they have actually produced those changes themselves. Hence, this hypothesis predicted that comprehension of the developmental sequence task is related to the level of the children’s productions.

**Method**

*Production task*

*Participants, materials and procedure.* In all, 138 children aged from 3 years 2 months to 14 years 4 months (57 boys and 81 girls) were chosen from three schools in Staffordshire, England: two primary schools with nursery classes and a secondary school. All children were tested in small groups in two sessions within one week of each other. In each session they were given a white A4-sized sheet of paper and a pencil, and asked by the third author to draw a picture of a man.

*Assessment of drawings.* The drawings from both production sessions were presented in a random order to two independent raters (different from those used in Study 1) together with an instruction booklet. The instructions and example drawings in the booklet were essentially the same as used in Study 1. The main amendment concerned clarification of the distinction between transitional and simple conventional figures, which had represented the main cause of disagreement between the raters in Study 1. The amendment stated that lines drawn down from the head that are joined to form a separate enclosed area should be considered to represent a body, and hence such drawings are of a conventional figure not a transitional figure. A Spearman rank correlation coefficient (corrected for ties) showed that a high agreement was obtained for the children’s first drawing ($r = .98, p < .0001$ (95% of drawings rated similarly)) and second drawing ($r = .97, p < .0001$ (91%)).

If three of the child’s four ratings (2 drawings $\times$ 2 raters) were identical, then that child proceeded to the comprehension task. A criterion of 4/4 would have run the risk of excluding a high number of consistent drawers. A level of 2/4 was equally undesirable as it could be attained through only one rater categorizing the drawings similarly, and was likely to include children who were not drawing consistent human figures at the time of testing.

Only five children did not meet the criterion for proceeding to the comprehension task. Although the raters had agreed on each drawing these five children had produced, the children drew a different level of human figure drawing between the two sessions. Of the remaining 133 children there were 32 scribblers.
(M = 4;0, range 3;6–4;11), 30 pre-conventional drawers (M = 4;4, range = 3;2–6;8), 47 simple conventional drawers (M = 8;4, range = 4;9–14;0) and 24 advanced conventional drawers (M = 13;1, range = 9;7–14;4). A further 13 children were excluded as their drawings were presented in the selection sets used in the comprehension and developmental sequence tasks (it was considered inappropriate for any child to see their own drawing in these tasks). The distribution of the remaining children was as follows: scribblers (30), pre-conventional drawers (27), simple conventional drawers (43) and advanced conventional drawers (20). Seventeen simple conventional drawers were randomly excluded to obtain similar numbers of participants across the four drawing levels (for the same statistical reasons as noted in Study 1). The mean age and range of the remaining 103 children in the four drawing levels (see below) was compared to the initial sample used in the production task and found to be very similar.

**Comprehension and developmental sequence tasks**

**Participants.** In all, 103 children participated in the comprehension task: scribblers (N = 30, M = 4;2, range = 3;6–4;11); pre-conventional drawers (N = 27, M = 4;5, range = 3;7–6;8); simple conventional drawers (N = 26, M = 8;3, range = 4;9–14;0) and advanced conventional drawers (N = 20, M = 12;11, range = 9;7–14;4). There were 41 boys and 62 girls. Of these children, 16 (10 scribblers, 6 pre-conventional drawers) failed the warm-up trial to the developmental sequence task (for details see Appendix 2). Thus, the participants (31 boys and 56 girls) of the developmental sequence task were 20 scribblers (M = 4;2, range = 3;8–4;11) and 21 pre-conventional drawers (M = 4;4, range = 3;7–4;11), plus the 26 simple conventional drawers and 20 advanced conventional drawers described above.

**Materials.** Sixteen drawings were selected from the production sessions to compile four sets for the comprehension task (i.e. realism, preference and estimation questions). Three of the sets consisted of four drawings—one drawing representing an example from each of the four levels of human figure drawings. The fourth set was compiled on the same basis but also consisted of an artist’s drawing of a man (see Fig. 2). There were six artists’ drawings in total and one was selected in rotation to be added to the children’s drawings. A fifth set of stereotyped drawings of a man representing each of the four drawing levels was constructed and presented as the final set in the comprehension task (see Fig. 3).

The materials in the developmental sequence task included the aforementioned three sets of children’s drawings used in the comprehension task (i.e. not the set that included the artist’s drawing) and three sets of four colour portrait-style photographs of children aged 2, 4, 6 and 10 years (two boy sets and one girl set). All drawings and photographs used in the tasks were mounted on a card.

**Procedure.**

**Comprehension task (realism, preference and estimation questions).** These tasks were administered individually to each child in a quiet area within the school by the third author within 2–3 weeks of the production sessions. Each child was presented with the three sets of four children’s drawings, one set at a time. Within each set the drawings were always placed horizontally, but the order of the drawings varied between the children. On being shown the first set the child was asked either the realism, preference or estimation question (same phrasing as in Study 1). The drawings were then removed and the same question given in the first instance was repeated for the second and third sets. This procedure was then repeated for the remaining two questions. The order of the questions was counterbalanced (i.e. one third of the children had the realism question first, one third the preference question first and one third the estimation question first). The order of the three sets of drawings was also counterbalanced. Children categorized as advanced conventional drawers were then presented with the set of children’s drawings that included an artist’s drawing. Each advanced conventional drawer was asked the realism, preference and estimation questions, counterbalanced for order. All drawings were then removed from each child.

**Developmental sequence task.** The developmental sequence task immediately followed the comprehension task. All children were presented with one set of four portrait photographs (presented horizontally in chronological order of age). Each child was told the name and age of each person in the picture (labels were
also written below each photograph). Scribblers and pre-conventional drawers had to pass a warm-up trial (see Appendix 2) while the other children proceeded directly to the developmental sequence task (a pilot study had revealed that no conventional human figure drawer failed a similar warm-up trial).

In the main task, one set of children’s drawings was placed horizontally in a randomized order beneath the portrait photographs. Each child was told, ‘Each one of these children has drawn a picture. Can you tell me which has drawn which picture?’ The procedure was repeated twice for the other two sets of portrait photographs and children’s drawings. All pairings of drawings to photographs were recorded.

Comprehension of stereotyped drawings task. Finally, all drawings and photographs were removed and replaced with the set of stereotyped versions of a man, presented in a random order. Each child was asked the realism and preference questions (order counterbalanced). This version of the comprehension task was presented last to avoid any influence of the stereotyped drawings on the two preceding tasks using children’s drawings.

Figure 2. Example of an artist’s drawing of the human figure presented to advanced conventional drawers in Study 2.
Results and discussion

Children's production performance was measured by the raters' agreed classification of their two human figure drawings (1–4). Children were given three comprehension scores (1–4 for each of the realism, preference and estimation questions) according to the level of drawing selected most consistently from the sets of children's drawings. That is, children who selected a particular level of the human figure for at least two out of the three responses were allocated the number pertaining to that drawing level. Children who selected a different drawing form for all three responses were allocated 0 (inconsistent responders). Table 2 describes the number of children selecting each standard of drawing (including inconsistent responders) for their realism, preference and estimation responses. As the inconsistent responders represented a very small minority of the sample tested they were excluded from the analyses on the realism and preference data. The realism and preference responses to the stereotyped drawings are presented in Table 3.

Figure 3. The stereotyped set of human figure drawings presented in Study 2.
Table 2. Numbers of children selecting four levels of human figure drawing in response to realism, preference and estimation questions by category of children's own human figure drawings (Study 2)

<table>
<thead>
<tr>
<th>Comprehension performance</th>
<th>Production performance</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Scribblers</td>
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<tr>
<td>Realism</td>
<td></td>
</tr>
<tr>
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<tr>
<td>Pre-conventional</td>
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<tr>
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<tr>
<td>Estimation of own drawing level</td>
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Table 3. Numbers of children selecting four levels of stereotyped human figure drawings in response to realism and preference questions by category of children’s own human figure drawings (Study 2)

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<th>Production performance</th>
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<tbody>
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</tr>
<tr>
<td>Total</td>
<td>20</td>
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</table>

Production and comprehension in drawing
Production and comprehension of most realistic drawings

A Kruskal–Wallis (corrected for ties) revealed a significant difference in realism selections between the children’s production levels ($\chi^2(3) = 34.35, p < .001$). Mann–Whitney U tests were conducted between the production levels (adjusted $\alpha = .0083$). Responses significantly differed between levels 1 and 3, levels 1 and 4, levels 2 and 3, and levels 2 and 4. Thus, scribblers and pre-conventional drawers responded similarly, but differently to simple and advanced conventional drawers. Inspection of Table 2 reveals that whereas scribblers and pre-conventional drawers typically selected either the simple or advanced conventional human figure, all but one of the simple and advanced conventional drawers chose the advanced conventional form. The responses to the four stereotyped drawings shows a similar pattern (see Table 3). Thus, children’s comprehension of realism depicted in children’s drawings and stereotyped drawings was in advance of their productions.

Production and comprehension of most preferred drawings

A Kruskal–Wallis (corrected for ties) revealed a significant difference in preference selections between the children’s production levels ($\chi^2(3) = 26.21, p < 0.001$). Mann–Whitney U tests revealed significant differences between levels 1 and 3, and between levels 1 and 4. Inspection of Table 2 indicates that whereas the modal response of scribblers was the simplified conventional figure, the representational drawers tended to prefer the advanced conventional form. Although a slightly different pattern is observed for their responses to the stereotyped set, children still tended to prefer a more advanced version than shown by their own production classification. Thus, children’s preferred drawing (either from the children’s drawing sets or stereotyped versions) was in advance of their productions.

The finding that production lagged comprehension also applied to the advanced conventional drawers. When presented with the set of drawings that included an artist’s drawing, all 20 children selected the artist’s drawing as the most realistic and 19 selected it also as their most preferred.

Production and estimation of own production level

Each child’s consistent response to the estimation question was coded as either the same or different to the child’s own production category. Of the children, 43 estimated correctly while 60 did not. All of the different responders selected a figure representing an advanced form compared to their own drawing standard (this included the five inconsistent responders who all selected a more advanced drawing on at least two out of the three trials). A Kruskal–Wallis (corrected for ties) revealed that selecting either the same or a different standard of drawing varied significantly in respect of the child’s production level ($\chi^2(3) = 67.29, p < .001$). Table 2 indicates that whereas scribblers and pre-conventional drawers predominantly overestimated their production ability, approximately 73% of simple conventional drawers and all of the advanced conventional drawers estimated correctly. In the additional trial consisting of the artist’s drawing, all the advanced conventional drawers still selected the figure representing the same level as their own drawing. These responses confirmed strongly that advanced conventional drawers are aware of their own standard of drawing.
Production and comprehension of developmental sequence

Each child was given a point for each drawing matched appropriately to the photograph. For each trial a maximum score of three was possible as three correct placements necessarily led to a correct match of the fourth drawing. As there were three trials the range of possible scores was 0–9. The respective mean scores and standard deviations were as follows; scribblers ($M = 5.65$, $SD = 1.42$); pre-conventional drawers ($M = 6.05$, $SD = 1.36$); simple conventional drawers ($M = 8.73$, $SD = .60$); and advanced conventional drawers ($M = 9.00$, $SD = .00$). A one-way between-participants ANOVA revealed a
significant difference on the task between the four groups ($F(3,83) = 64.34, p < .001, MSE = 1.02$). Post hoc Tukey tests revealed a significant shift in performance between the pre-conventional and simple conventional drawers. That is, both types of conventional drawer were significantly better at matching the drawings to the photographs than the scribblers and pre-conventional drawers. Furthermore, there was no significant difference between the scribblers and pre-conventional drawers, nor between the two types of conventional drawer. These findings indicated strongly, therefore, that those children who produce a conventional figure have a significantly advanced understanding of the developmental sequence of drawing compared to children who produce simpler forms.

The performance of matching appropriately each level of drawing for each of the four groups of children was examined. Children were categorized as knowing the developmental position of a particular form of drawing if it had been matched successfully to the portrait photograph on at least two of the three trials. The percentages of children who correctly responded for each drawing form by drawing group are shown in Fig. 4. Only the conventional drawers (simple and advanced) showed a high level of matching all the drawings appropriately.

Finally, the relationship between the children’s performance on the developmental sequence task and their production level was examined with age partialed out. Pearson’s partial correlation revealed an effect size between medium and large using Cohen’s (1988) criteria and was significant ($r(84) = .42, p < 0.001$, two-tailed). Even taking age into consideration, therefore, children’s level of awareness of the drawing sequence was positively related to the position of their own ability within that sequence.

**General discussion**

The present studies show reliably that a more advanced depiction of the human figure was preferred and considered more realistic by children than the version they typically produced. Furthermore, this relationship was found for all levels of drawer, from preschool non-representational scribblers, through to adolescents producing representational drawings of increasing visual realism. The weaker production performance by all levels of drawer can be explained by the increased cognitive, motor and graphic demands in production. Production of representations requires overcoming two major tasks. First, the child has the cognitive task of holding in mind the conceptual and perceptual properties of the topic(s) during the drawing process. Second, the graphic problem of representing three-dimensional topics on a two-dimensional page needs to be mastered and learned. Hence, there is a developmental process in producing representational drawings. In contrast, recognizing a representation is a relatively simple task of comparing the pictorial devices to the child’s perceptual knowledge of the topic. Indeed, recognizing the pictorial equivalents of topics requires little or no training in pictures (DeLoache, Strauss, & Maynard, 1979; Hochberg & Brooks, 1962), and can be carried out by young infants who produce scribbles in their own drawings. Thus, understanding of levels of realism has a distinct advantage even at this early experience with pictures.

The contrast of children’s comprehension of the pictures (particularly their preferences) to their productions is problematic for the claim that drawings are printouts of the child’s conception of the important components of a topic (Luquet, 1927; Piaget & Inhelder, 1956). Indeed, research in the last 25 years showing that children’s drawings can vary
because of the contextual demands of experimental tasks has questioned the validity of the internal model as the sole influence on production (see Cox, 1993; Thomas & Silk, 1990). It is likely that children use different conceptual models in production and comprehension tasks. For instance, the difficulties involved in the drawing process may encourage children to develop a graphic form that is within their capabilities and satisfactorily represents the topic (see Arnheim, 1974). However, the present finding that children preferred more advanced versions indicates that their ideal production is superior to their actual one.

Despite comprehension being in advance of production at all levels of drawing ability, the present studies reveal that comprehension of the ideal figure may vary between two different types of comprehender: the first represented by the scribblers and pre-conventional drawers, the second by the conventional drawers. The choices made by the scribblers and pre-conventional drawers cut across all three forms of representational drawing, but with a high proportion of simple conventional figures selected. In contrast, almost without exception both types of conventional drawer chose the advanced conventional figure as the most realistic and preferred. This pattern was also evident in the children’s responses to the stereotyped drawings. The near-perfect performance on the developmental sequence task by the conventional drawers suggests strongly that they chose the advanced conventional figure as the most realistic (and possibly the most preferred) because they considered it the end-point of the developmental sequence. It is unlikely that the same explanation applies to the selections of the scribblers and pre-conventional drawers in the comprehension task. For example, those children who chose the simple conventional figure as the most realistic matched that figure against the picture of the oldest child in the developmental sequence task on only 19 out of 59 trials. One tentative explanation is that scribblers and pre-conventional drawers comprehend the basic conventional figure as a good form of the human figure. Inspection of the advanced and simple conventional drawings revealed that level of detail was an important distinguishing feature. Golomb (1992) has shown that younger children are not particularly interested in detailed pictures. Hence, a simple conventional human figure may represent the ideal figure of children drawing below that level.

Children’s performance on the developmental sequence task revealed the same two groups of responders. Both types of conventional drawer performed significantly better than the scribblers and pre-conventional drawers, with no difference in performance between the two levels of drawer within each group. This shift in performance cannot be explained simply by differences in age, as comprehension and production were related even with age partialled out. Furthermore, all the participating scribblers and pre-conventional drawers understood the task, as shown by their success on the warm-up trial. The difficulty experienced by the scribblers and pre-conventional drawers in ordering the drawings is consistent with Gardner, Winner, and Kircher’s (1975) finding that young children have a poor knowledge of the process and evaluation of paintings. Many 4- to 7-year-olds in their study had little awareness of any cognitive or graphic skill required in the act of painting, and believed that works of art could be made by anyone. Such misconceptions do not facilitate an understanding of developmental change. We do not believe, however, that shifts in understanding developmental change in drawing would necessarily stimulate higher levels of realism in production. The consistent finding from the present studies suggests that comprehension (understanding and preferring) a
conventional human figure is not sufficient to being able to produce one, and other developments in comprehension may similarly unafford production.

One interesting possibility, therefore, is that children may not be fully aware of the changes typically found in drawing development unless they have progressed through those shifts themselves. But how can this explain why simple conventional drawers were so much better at ordering the drawings than scribblers and pre-conventional drawers? We argue that developing from the tadpole drawing (a typical feature in children’s pre-conventional drawings of the human figure) to the conventional form may be regarded as the last major qualitative shift in children’s human figure drawings. Producing a conventional figure presents a significant graphic problem for tadpole drawers, as was illustrated by the less than successful attempts to encourage these drawers to produce a conventional figure through copying and dictating its components (see Cox, 1992). Once the child has learned to produce a conventional human figure, further changes may be merely quantitative (e.g. inclusion of more details to make the drawing look more personal). There are few examples in the literature of children’s (or indeed adults’) visually realistic depictions that portray an accurate sense of proportion and perspective, and this was confirmed by the drawings collected by the older children in the present studies. It is tentatively suggested, therefore, that an important shift in the child’s understanding of the developmental pattern in human figure drawing may result from the child learning to produce a conventional human figure.

The subject of awareness of developmental change is derived from Piaget’s discussion on diachronic thinking (Piaget, 1969), that is, children’s knowledge that phenomena develop over time. As Montangero (e.g., 1996; Tryphon & Montangero, 1992) has noted, however, diachronic thinking also incorporates an ability to explain a present situation from past events, and to predict future events from the present. Although Montangero (1996) explains the development of diachronic thinking by age, future research needs to examine independently the role of one’s own position within a developmental sequence on one’s awareness of the causes of change in that sequence.

Both of the present studies reported that most scribblers and pre-conventional drawers overestimated their drawing ability, selecting a more advanced human figure drawing than shown by their own productions. This finding is consistent with young children’s general tendency to overestimate their own abilities, known as the ‘positivity bias’. The mechanism of ‘wishful thinking’ has been suggested to account for the positivity bias found in young children’s estimations of their own ability (Stipek, 1984). If children’s understanding and preference for visual realism is an indication of a desire to produce more visually realistic drawings, then the child’s conception of the intended drawing may hinder judgments of the drawings they actually produce. In contrast, all of the advanced conventional drawers selected a similar human figure drawing to their own, resisting any temptation to choose the superior (artist’s) drawing. The shift to accurate self-evaluation is consistent with the findings reported by Schuster, Ruble, and Weinert (1998) that the decline in overestimations with age is not owing to children becoming more negative, as claimed in the previous literature, but more realistic. Schuster et al. argue that with increasing cognitive processing competence, children do no longer ignore evidence that contradicts their inclination towards overestimation. This shift to appropriate self-evaluation is likely to be facilitated if the evidence itself contrasts starkly with their own ability. For instance, it is possible that the artist’s drawing was so obviously different to
their own human figure drawings that the contrast was overriding any inclination to overestimate.

The gap between production and comprehension of realism has particularly important implications for the beginning and end-points of children’s drawing experience. There has been a debate in the literature about whether scribblers attribute representational meaning to their marks (Arnheim, 1956; Kellogg, 1970; Mathews, 1984; Piaget & Inhelder, 1969; Thomas, 1995). As the majority of scribblers in the present studies selected a conventional figure then they clearly conceive pictures as representational. Indeed, 30-month-old infants can use a picture of a household item to search for a toy that is hidden behind a real version of that item in a room (Deloache, 1987). It is possible that scribblers’ understanding of drawings as representations may influence their interpretations of their own drawings. Indeed, Adi-Japha, Levin, and Solomon (1998) recently reported that scribblers do attribute representational meaning to certain parts of their drawings. An attribution of representation to their own drawings may also explain in part why the scribblers overestimated their drawing level in the present studies. At the other end of the drawing experience, Fayol et al. (1995) reported that although production lagged judgment of drawings, this difference decreased with age. Unlike Study 2 reported here, however, their oldest children (10-year-olds) were not shown examples of more advanced drawings typically made by older drawers. The present findings indicate that comprehension of realism in pictures is still likely to be superior to production of realism at the end-point of most children’s drawing experience. It is believed that most children stop drawing on a regular basis because they lack the necessary skill to reproduce the visually representational forms they desire (see also Cox, 1989).

The two studies reported here present valid and reliable findings that children’s cognitive and affective understanding of realism in human figure drawings is in advance of their own productions. It remains to be tested whether these findings extend to production and comprehension of drawing in general. The cognitive, motor and graphic demands involved in production, however, predict that this would indeed be the case.

Acknowledgements

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References


Production and comprehension in drawing


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Appendix 1

Categorization descriptions with example drawings given to raters in Study 1

(i) Scribbling

- Scribbles, marks, swirls, loops, spirals, circles, etc., of randomly appearing distribution.
- Apparently non-representational distinct forms.

(ii) Pre-conventional drawings

(a) Representational distinct forms (recognisable as body parts) but little obvious relationship between forms (features distributed randomly, not arranged in the conventional sequence).
(b) Representational distinct forms, but with a relationship between features, usually within and around a central 'head' form. No attempt at representing a torso or tummy.
(c) As in (b), but with some attempt at separating head and body.
(iii) Simple conventional drawings

(a) Distinct separation of the head and body.
(b) Additional details such as fingers, clothing and hair are included.
(c) Increasing realistic body formation, although body parts are drawn out of proportion to each other, such as an oversized head or oversized hands.
(d) Figure may be drawn from more than one viewpoint giving a transparency effect. This may be due to including items not seen in the real world, such as the body outline underneath clothing, or due to the absence of occlusion, such as a rider’s leg shown through a horse.

(iv) Advanced conventional drawings

(a) Drawing from one viewpoint, such as showing partial occlusion.
(b) Proportions of body feature are more accurate. Greater elaboration of details in, for example, clothing and facial expression. Less variation in body form per se, but greater individuality in personal identification of depicted men.

Copyright permission has been kindly granted by the following authors to reprint drawings (ia), (iia), (iib), (iva) and (ivb) (Thomas & Silk, 1990), drawings (iia) and (iic) (Cox, 1992) and drawings (iib) and (iic) (Goodnow, 1977). See References for full details.
Appendix 2

Warm-up trial to the developmental sequence task (Study 2)

In addition to the portrait photographs of the children used in the developmental sequence task, photographs of four different styles of bicycle were used in the warm-up trial. The bicycles were chosen on the basis that each one represented the style of bicycle that is typically ridden by one of the age groups represented in the portrait photographs.

The experimenter presented the four bicycle pictures horizontally in a randomized order below the portrait photographs and said, ‘Here are some pictures of bikes. Can you tell me which of these children would ride which bike?’ The experimenter further assisted some of the youngest children by saying, ‘Well, which bike do you think (e.g. Daniel aged two) would ride?’ If the child pointed to the correct bike the experimenter said, ‘What about the other children?’ On completion of the warm-up trial the bicycle photographs were removed.

Of the children, 16 did not make all the appropriate matches (10 scribblers, 6 pre-conventional drawers) and therefore did not proceed to the developmental sequence task (see ‘Participants’ in Study 2).