The drawing rules of children: Sequence and direction

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This study examined the development of some of the directional rules children use in drawing. A broader age range than in previous studies was used to analyze the following drawing rules: top-to-bottom, left-to-right, threading in a continuous clockwise or counterclockwise direction, and nonthreading. These rules were tested across three different age groups (4- and 5-year-olds, 6- and 7-year-olds, and 8- to 10-year-olds) and three figure types (circular, square, and apex). Age and figure type interacted to significantly influence the percentage of rule use. Two tasks, copying and modeling, were compared to test the robustness of these rules to task variation. Task did not greatly influence the selecton of drawing rules. The implications from this study are that the process of drawing is rule-governed, and that some of the rules children use, robust to task variation, shift in kind with age.

Many constraints operate on a child who is learning to draw (Freeman, 1972, 1980; Goodnow, 1977). Although a child might hold a certain concept of an object in mind, that concept is not always revealed once the drawing is laid out on paper. Certain performance and task variables can mask a child's true drawing abilities. The goal of this study was to examine some of the rules that operate when a child is drawing. *Rule*, as used here, is defined as the tendency to proceed in a structured and predictable manner over repeated trials or across time.

The particular drawing rules dealt with here involve the sequence and direction of lines drawn, and whether these lines are "threaded" by using a continuous clockwise or counterclockwise direction from start to finish (Fenson, 1985; Goodnow, 1977). "Nonthreading" implies that the continuous thread was broken: at least one line in the drawing was copied in a direction opposite to that used for the rest of the figure.

The set of figures used in the current study duplicated some used in past investigations of children's drawing rules (Goodnow, 1977; Goodnow & Levine, 1973; Graham, Berman, & Ernhart, 1960). Some additional relatively complex figures were also included to determine whether the rules in question applied across a variety of figure types that varied in complexity. To determine whether the same rules of direction would be used by children, regardless of task presentation, copying and modeling tasks were presented. In copying, the child merely drew the target figure that was placed above his/her paper. In modeling, the child drew the figure after it had been presented in a specific manner by the researcher.

It was predicted that, after an initial period of using nonthreading directional rules or of using inconsistent drawing strategies, children should gradually come to favor clockwise directional rules, and eventually counterclockwise threading rules. Furthermore, specific figure-differentiated nonthreading rules were expected to eventually replace both clockwise and counterclockwise directional rules as preferred strategies for copying many figures, but not all (e.g., circles). Finally, top-to-bottom and left-to-right rules should both be preferred once schooling starts (6- and 7-year-olds), due partly to the emphasis on reading and writing from left to right and from the top of the page to the bottom.

METHOD

Subjects

The 90 right-handed children who participated represented three age groups: 4- and 5-year-olds (mean age = 5;7), 6- and 7-year-olds (mean age = 6;11), and 8- to 10-year-olds (mean age = 9;5). Fifteen females and 15 males made up each group. All children tested were from three rural Pennsylvania schools.

Procedure

The stimuli that were presented for copying were 4 × 6 in. laminated cards with stamped designs, the components of which are shown in Figure 1. In addition to copying these shapes, the children copied relatively complex aggregates of some of the shapes. All designs were made using a combination of three rubber stamps: a 1-in. straight line, a ½-in. straight line, and a circle ½ in. in diameter. Ten different figures were used for the modeling task. These stimuli consisted of small faint marks that indicated to the experimenter where to stamp or draw lines making up figures for the child to copy.

Each child drew on 4 × 6 in. white unlined pieces of paper, using a #2 pencil. Each stimulus card was presented in a clear plastic viewer, which was mounted flat on the table. The child's paper was clamped vertically under the stimulus drawing.

Copying task. The directions for the copying task, given to each child individually, were as follows: "I'll show you a picture for you to copy. Try to make a drawing that looks just like the one I show you." The copying stimuli were presented in a different scrambled order to each child.

Modeling task: Sequencing. The copying task preceded the modeling task, since information derived from the first task was used by the experimenter in determining the sequence and direction of lines to model in the modeling task. The experimenter always modeled a *different* order and/or sequence from that used by the child in the copying phase. This was done to test the prediction that the graphic rules children use are robust—that they remain in place even if a model is presented in a manner different from that normally used.

The experimenter used rubber stamps and black ink during the sequencing phase of the modeling task. The directions for this task were as follows: "I'll make a picture with these stamps. When I'm all done, you try to draw the picture with your pencil the same way I did it with these rubber stamps." The order of presentation of stimuli within the modeling task was random.

Modeling task: Direction. In the modeling subtask, direction, the experimenter actually drew the lines to indicate direction. The instructions to the child were as follows: "I'll draw a picture with my pencil. When I'm done, you draw it just the same way I did it with your pencil. Okay?" The stimulus figure was slid into the viewer, where it stayed while the child drew. Five figures were modeled in the sequencing manner; five were modeled to indicate direction.

RESULTS

Overview

The following rules were examined: clockwise threading, top-to-bottom, and left-to-right. The dependent measure was the percentage of use of a particular rule when that rule could apply. For example, a score of 40 indicates that the child used a particular rule in 40% of the instances in which it could apply.

Separate repeated measures analyses of variance (ANOVAs) were performed on the percentage of rule use. Age (4- and 5-year-olds, 6- and 7-year-olds, and 8- to 10-year-olds) and sex were between-subject variables, and figure type (circular, square, and apex) was a within-subject variable. The data from the copying task were analyzed first alone. Later analyses on a subset of figure types compared tasks, copying and modeling, to determine the effect on rule use of modeling stimuli in a certain way.

Copying task: Clockwise threading. An analysis of the percentage of use of clockwise threading rules in the copying task showed a strong age × figure type interaction, indicating that certain age groups drew particular figure types differently [$F(4,168) = 8.00, p < .001$]. Age and figure type were both main effects [for age, $F(2,84) = 3.32, p < .05$; for figure type, $F(2,84) = 6.49, p < .01$]. For circular figure types, as subjects' ages increased, the tendency to copy in a clockwise direction steadily decreased (as shown in Table 1). There were U-shaped curves for both square and apex figure types, with more 6- and 7-year-olds using clockwise threading than either the younger or older age groups.

Copying task: Nonthreading. A second analysis of variance was conducted on the percentage of rule use for nonthreading. There was a significant main effect for age [$F(2,84) = 3.37, p < .05$]. The 4- and 5-year-olds (mean

Table 1
Mean Percentages of Rules Used for Copying and Modeling Tasks

	Drawing Rule Used				
	Clockwise Threading				
	Circle	Square	Apex	Top-Bottom	Left-Right
4- and 5-Year-Olds ($n=30$)					
Copying	50	41	34	84	98
Modeling	46	45	30	85	93
6- and 7-Year-Olds ($n=30$)					
Copying	16	52	39	97	99
Modeling	13	53	36	93	100
8- to 10-Year-Olds ($n=30$)					
Copying	10	47	33	94	96
Modeling	9	38	43	94	100

percentage of nonthreading rule use = 33%) scored significantly higher than the 6- and 7-year-olds (mean percentage rule use = 21%). The 8- to 10-year-olds (mean = 27%) also scored significantly higher than the middle group, as determined by post hoc Tukey tests.

Copying task: Top-to-bottom rule. The three figures to which the top-to-bottom rule could apply can be seen in Figure 1. A repeated measures ANOVA, using age and sex as between-subject variables, was conducted on the percentage of top-to-bottom rule use. The mean percentages of top-to-bottom rule use were high across all age groups; neither age nor sex significantly contributed to these differences in rule use (both Fs < 1).

Copying task: Left-to-right rule. In a repeated measures ANOVA examining the percentages of use of the rule "draw horizontal lines from left to right," age and sex were again used as between-subject variables. No significant interactions or main effects were found, indicating that neither age nor sex greatly affected the use of this rule [for age, $F(2,84) = 1.53, p < .22$; for sex, $F(1,84) = 1.49, p < .23$]. Table 1 shows markedly high percentages (all above 90%) of left-to-right rule use for all age groups.

Task comparisons. Neither sequence nor direction modeling had a large effect on the drawing rules examined for right-handed children. As Table 1 shows, the percentages of rule use in drawing circular figure types in a clockwise direction were similar for each age group across tasks. Correlations of each child's copying and modeling scores were calculated to help determine the effect of task on the percentage of rule use. A significant positive correlation [$r(88) = .98, p < .0001$] indicates that most children maintained the threading clockwise rule used in copying circular figure types in the parallel modeling task. Likewise, the percentages of clockwise threading of square [$r(88) = .41, p < .001$] and apex [$r(88) = .71, p < .001$] figure types were correlated positively and significantly across tasks.

With top-to-bottom rules, scores on the copying task again correlated with scores on the parallel modeling task.
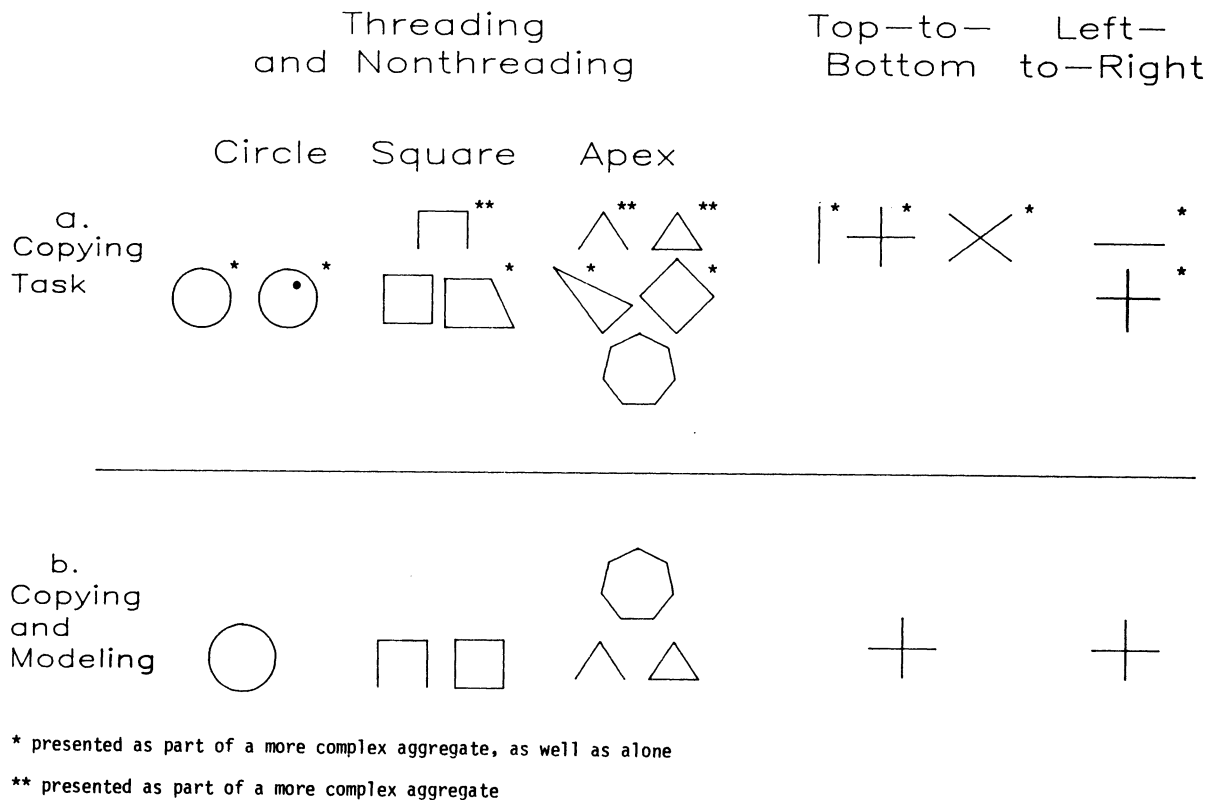
Figure 1. Figure types used to assess various copying rules: threading and nonthreading, top-to-bottom, and left-to-right in (a) a copying task and (b) both copying and modeling tasks.

The positive correlation [$r(88) = .90$, $p < .0001$], in conjunction with the similar percentages across tasks, shows that task had little effect on the rules used.

Finally, scores on the left-to-right rule from the copying and modeling tasks were compared. Because almost all of the 90 children tested used the left-to-right rule in the parallel copying and modeling tasks, no correlation was necessary to show the close relationship between scores. Only 4 of the 4- and 5-year-olds switched rules after modeling.

DISCUSSION

The two general predictions that the drawing rules of 4- to 10-year-olds would be consistent across tasks and that certain rules would shift in kind with age were both supported. The results also bolster several of the more specific original predictions.

The most strongly established rules were the left-to-right and top-to-bottom directional rules. Contrary to the original predictions, that the 6- and 7-year-olds would show a marked increase in the use of left-to-right and top-to-bottom strategies, both these rules were adhered to strongly by all three age groups. Schooling, with its emphasis on reading from left to right and top to bottom, cannot be offered as the sole reason for the strength of these rules, since, as shown by these results and others (Goodnow, 1977; Lehman & Goodnow, 1975; Pigram, 1984), even preschoolers firmly adhere to them.

The use of threading and nonthreading strategies varied, depending on the direction of threading (clockwise or counterclockwise) and the

figure types threaded (circular, square, or apex). Of these combinations, threading circular figure types in a counterclockwise direction was adhered to most often, replacing clockwise threading as a preferred rule.

The results were not so clear concerning the threading and nonthreading of noncircular figure types. Square and apex figure types differed from the circular forms in that they all contained apexes or corners. Children who did not thread often drew these figures from the apex (or corner) down, with two or more separate strokes.

To summarize, the children followed consistent rules (i.e., repeated manners of drawing objects) across similar figure types and across tasks. Some of these rules shifted in kind with age. The rules chosen held across the two tasks presented, copying and modeling, suggesting that the children's drawing techniques were robust to task variation. The implication from this study is that drawing reflects a stable, rule-governed thought process. It is not a random activity engaged in merely for fun. Drawings could be carefully examined as reflections of children's rule-governed thought processes, and possibly as indications of disorders in thought processes.

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