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Sources of Variability in Children's Drawings

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An experiment involving 90 students in the 1st, 3rd, and 5th grades investigated how visual examples and grade (our surrogate for age) affected variability in a drawing task. The task involved using circles as the main element in a set of drawings. There were two examples: One was simple and single (a smiley face inside a circle); the other, complex and dual (a fishbowl extending outside a circle and a bicycle using two circles). There were significant effects of both example and grade on variability. Between-grades, 3rd and 5th graders were more variable than 1st graders with the complex (but not the simple) set of examples. Within-grades, 3rd and 5th graders were more variable with the complex (compared to the simple) set of examples. First graders' variability levels did not change with examples. The discussion focuses on how examples have and should be used to increase variability in drawings of both younger and older children.

There are two reasons for examining variability, rather than creativity, in children's drawings. First, creativity in children is difficult to define. For example, consider how the criteria for creativity in children's art changes with stylistic shifts in adult art. In the 1960s, ambiguous markings made by 5- to 7-year-olds were cited for their Abstract Expressionist qualities; in the '70 s and '80 s, attention shifted to slightly older children, 9- to 12-year-olds whose cartoon-like drawings resembled Pop Art (Korzenik, 1995). Second, creativity, in general, is difficult to quantify. Variability is not. Indeed, as the next section shows, aspects of creative behavior that are quantifiable are themselves kinds of variability (Stokes, 2001a, 2010, 2012).

VARIABILITY AND DIVERGENT THINKING

Variability is a measure of how differently something is done. In Figure 1, it is shown as a continuum with high and low levels at its extremes (Stokes, 1999, 2009). Unsurprising, already successful—and thus repeated—responses lie closer to the low end. Surprising, uncommon, novel ones are nearer to the high end. This is because everyone, children included, tend to reproduce familiar responses before they produce new ones (Christensen, Guilford & Wilson, 1957; Maltzman, 1960; Runco, 1986; Ward, 1994).

Four aspects of divergent thinking (Baer, 1994; Runco, 1991, 1999) that have been widely studied—fluency, flexibility, originality, elaboration—are ways of being variable (Cropley, 1999; Stokes, 2001b). This is apparent in the ways they are quantified: fluency, by the number of different responses made; flexibility, by the number of different response categories used; originality, by the number of uncommon or rare responses; and elaboration, by the number of detailed responses (Guilford, 1968; Torrance, 1990). Doing something in many different ways would produce scores closer to the high, rather than the low, end of the variability continuum.

What then, this article asks, are the sources of variability—high or low—in children's drawings? Summaries of well-studied sources precede discussion of yet another, suggested by, and studied in, this paper.

VARIABILITY AND CHILDREN'S DRAWINGS

Well-studied sources include instructions (Runco, 1986; Runco & Okuda, 1991; Runco, Jilles, & Reiter-Palmon, 2005), developmental stage (Gardner, 1980; Milbrath,

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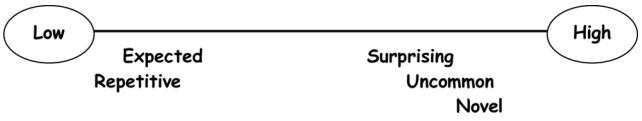


FIGURE 1 Variability continuum.

1998), and giftedness (Feldman & Goldsmith, 1991; Winner, 1996).

Instructions, varying in general or specific ways, can be implicit or explicit. A classic example involving implicit instructions is the Holman, Goetz, and Baer (1977) easel painting study. Children were not told to make new forms when they painted, but every instance of novelty was immediately praised. Over several sessions, novelty (new forms in a session) and variability (number of different, but not necessarily new, forms) not only increased, but were maintained. Multiple studies have examined the effects of explicit instructions that target specific aspects of divergent thinking (Runco et al., 2005). For example, telling children to "be creative" produced original ideas (Harrington, 1975; Runco, 1986), while telling them to "focus on variety" increased flexibility (Runco & Okuda, 1991).

Two *developmental stages* in young children's drawings have been identified (for a review, see Milbrath, 1998). One is conceptual; the other, perceptual. During the first, referred to as *intellectual realism*, children draw what they know about objects. For example, children know that a cup has a handle and will draw the handle whether or not they can see it. Not until they are 7 or 8 do they enter the stage called *visual realism* and begin to draw what they see. Now children omit a handle if it is not visible. They also add details that they do see, making for greater variability, albeit less than that seen in gifted children.

Gifted children are more variable at all stages (Stokes, 2001b, 2006). Their desire for mastery (Winner, 1996) leads to accelerated skill acquisition, wider repertories, and highly variable responding. Realism appears earlier and continues to be the goal of the gifted child (Milbrath, 1998). Realism here includes, among other things, elaboration, detail, and attention to differences—all aspects of divergent thinking, all productive of highly variable productions.

THE CURRENT STUDY

The study was designed to examine how another source—different visual examples—affects variability in children's drawings. This could be important for several reasons.

First, very young children may not fully understand, and thus correctly follow, strictly verbal instructions (as in the Torrance circle activity). Second, a single example, particularly a simple one (like the smiley face used by Eisenberger, Haskins, and Gambelton, 1999) could function as a perceptual constraint. Children may assume that they have to stay inside the circle, thus limiting variability in their drawings. This idea was suggested by the Nine Dot problem: Assuming one has to stay inside the square formed by the dots (the criterion) precludes solving the problem (Scheerer, 1963). Third, visual examples can be copied. If they copy the examples, the children will have practice producing more or less variable drawings.

Because the youngest children in our study were older than 4, the age at which nongifted children draw recognizable forms (Milbrath, 1998), most were expected to produce drawings that were realistic to some degree. It was also expected—as one would with a standard Torrance Test—that more gifted children would produce more detailed, and thus more variable, drawings than less gifted children. Finally, and key to the study, because one set of our examples was dual and more detailed than the other, higher variability scores were expected of all children presented with this set.

Questions About Variability

Given the above, three questions were asked of the data.

First, given the same verbal instructions, did the more unusual, detailed pair of examples generate higher variability in all age groups than the single, simpler one? Second, did children actually copy the examples? Third, were there any children (particularly among the youngest) whose variability scores might identify them as artistically gifted?

METHOD

Participants

Participants were 90 (46 boys, 44 girls) 1st, 3rd, and 5th grade students of varied backgrounds (socio-economic and ethnic) attending a public grammar school in New Jersey, where an earlier study was conducted (Stokes, Holtz, Massel, Carlis, & Eisenberg, 2008). Mean age of 1st graders was 6.75 years; of 3rd graders, 8.8 years; and of 5th graders, 11.1 years.

Materials

Each child was given two things: a sheet of white paper with 16 one-inch diameter circles (4 rows by 4 columns) on it, and a box with 24 crayons to make their drawings.

FIGURE 2 Single example: smiley face.

Procedure

Children in each grade were randomly assigned to one of two groups, each of which was presented with a different visual example or set of examples. The number of boys and girls in each group was approximately equal. Children were tested three at a time, with one experimenter (a research assistant) per child. They were seated at tables facing away from each other, and could neither speak to each other, nor look at one another's drawings.

There were two sets of instructions. The children in the single example group were shown the example in Figure 2 and read the following instructions:

> Professor Stokes likes to hang drawings from the school on the wall outside her office, so we have a sheet of paper and a box of crayons for you to make some drawings. What she'd like you to do is make pictures using the circles. That means the circle should be the main part of whatever you draw.
> (Points to smiley face example)
> See how this circle is the main part of the smiley face?
> Is that clear?

The children in the double example group were shown the examples in Figure 3, and read the following instructions:

> Professor Stokes likes to hang drawings from the school on the wall outside her office, so we have a sheet of paper and a box of crayons for you to make some drawings. What she'd like you to do is make pictures using the circles. That means the circle should be the main part of whatever you draw.
> (Points to fishbowl and bicycle examples)
> You can use one circle at a time—like the goldfish bowl here.
> Or you can use more than one—like the bicycle here.
> Is that clear?

Children had 10 min to draw. If they filled all the circles on one sheet of paper, they could ask for a second sheet. After a child was finished, the experiment said, "Those are very nice. Could we put titles under each one? A title can just be the name of what you drew."

After the drawings were labeled and before they returned to their classrooms, the children were asked not to tell any of their classmates about the task.

Measurements

A coding scheme was developed to objectively categorize and assign points for the drawings. Points were assigned on two bases: frequency in category and complexity.

Frequency in Category

The categories and points assigned to each on the basis of frequency are shown in Table 1.

The first category is called *frame*: It includes all drawings that used the circle as a frame to enclose a drawing of a separate object. The remaining three were defined by relative frequency in the overall data set. The *basic* category includes abstract designs, which are common in younger children's drawings. The *middle* includes subjects popular in children's drawings from the ages of 6 to 10. The *advanced* category includes subjects considered more advanced developmentally. For example, clothing and electronics are not primarily circular, rather they have circular components (buttons on clothing, beads in jewelry, the opening in an electric guitar). Finally, the inclusion of objects seen in the room is based on the idea that younger children draw what they know but older—and more gifted younger—children draw what they see (Milbrath, 1998; Willats, 2005). In fact, many of the older, but almost none of the younger, children were observed looking around the classroom/outside the windows for circular objects.

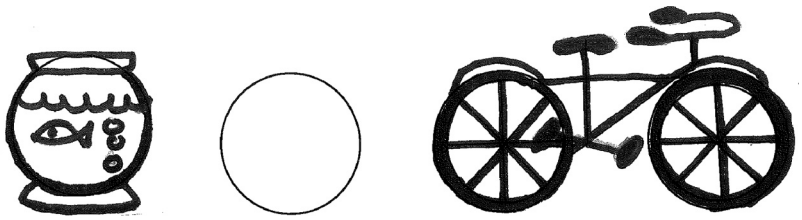


FIGURE 3 Paired examples: fishbowl and bicycle.

TABLE 1
Drawing Categories

Category	*Description/Examples*	*Points*
Frame	Use of the circle as a frame around another drawing (e.g., a flower drawn inside the circle)	1
Basic	Use of the circle as part of: a) a copy of an example b) an abstract design c) a complete circular object (eg., a pizza or baseball)	5
Middle	Use of the circle as part of: a) household objects, including foods (e.g., a fried egg) b) natural objects (e.g., the sun with protruding rays) c) bodies (e.g., people or animals)	8
Advanced	Use of the circle as part of: a) clothing and accessories (e.g., a coat with buttons) b) electronics (e.g., an iPod) c) vehicles (e.g., a car, a scooter) d) observed objects (e.g., a fan on the ceiling)	9

Each category was assigned a number of points based on its relative standing in the totals. Drawings in the *frame* category did not satisfy the requirement (the circle as the main part of the drawing). However, to acknowledge that the student did attempt the assignment, they were assigned one point each. To arrive at a scoring system that would represent each remaining category's standing in the total, the total number for a category was divided by the overall total, this fraction was multiplied by 10 and rounded to the nearest whole number. This left the *basic* category with five points, the *middle* with two points, and the *advanced* with one point. To have higher scores correspond to higher variability, we subtracted these numbers from 10, giving the points shown in Table 1.

Complexity

There were more or less complex drawings within the *basic, middle*, and *advanced* categories. A more complex drawing was defined as *elaborate*, including elements outside, as well as inside, the circle, or as *multicircular*, using more than one circle. Points were added to account for these: an elaborate drawing using a single circle counted as 1.5 drawings; drawings that included two or three circles were counted as two or three drawings.

The following example is based on drawings by a first grader in the *simple* example (smiley face) group. She produced 10 frames, 3 basic drawings with elaboration, and 3 middle drawings, one with elaboration. Her total points were calculated as follows:

Frame: 10×1 (points for category) $= 10$ points
Basic: 3 with elaboration $(\times 1.5) = 4.5 \times 5$ (points for category) $= 22.5$ points
Middle: 2 with one circle $(\times 1) = 2 \times 8$ (points for category) $= 16$ points
1 with elaboration $(\times 1.5) = 1.5 \times 8$ (points for category) $= 12$ points
Total points: 60.5

RESULTS

Variability

Two measures—frequency of drawings in each of four categories, and combined frequency/complexity scores—were used to examine variability in the children's drawings.

Frequency in Drawing Categories

Figures 4a and 4b show total frequency of drawings in *frame, basic, middle*, and *advanced* categories.

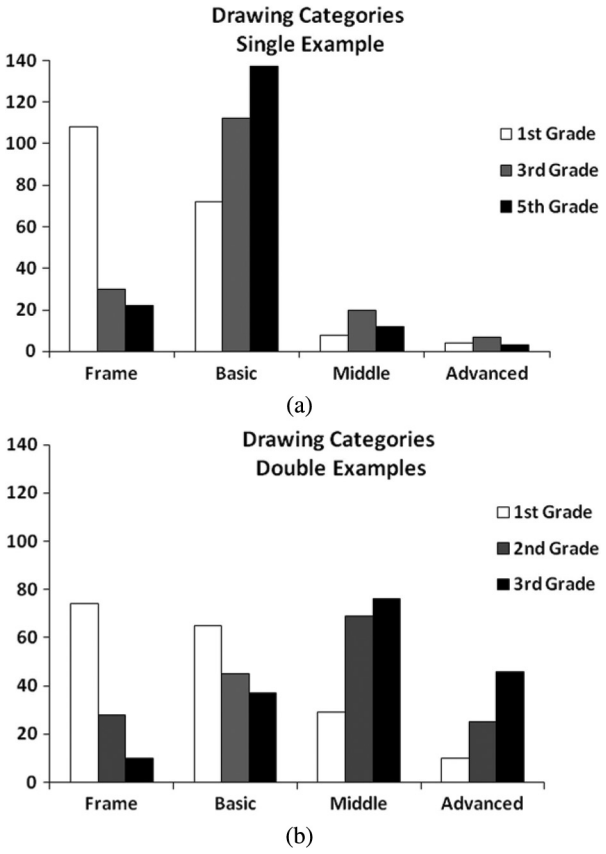
A single question was asked of this data: Were there observable systematic changes in frequency of drawings in each category by grade, by condition, or by both? As seen in the figures, the frequency of drawings in the *frame* category decreases with grade with both conditions (single and double examples). The frequency of *basic* category drawings increases with grade in the *single* condition and vice versa (decreases with grade in the *double* condition). The frequency of *middle* and *advanced* drawings also increases with grade, but only in the *double* condition.

Variability Scores

Figure 5 shows mean variability (combined frequency and complexity scores) by grade and condition.

Variability differences between grades. Two-way ANOVAs with grade (1, 2, 3) and condition (single, double) as the main factors were run. There were main effects of condition, $f(1, 42) = 26.7862$, $p = .000$, $r^2 = .389$, and grade, $f(2,42) = 8.681$, $p < .001$, $r^2 = .292$. The grade $\times$ condition was also significant, $f(1,42) = 3.225$, $p < .05$, $r^2 = .133$. Post-hoc LSD tests showed that first graders were less variable in both conditions than third ($p < .01$) or fifth ($p < .001$) graders.

Variability differences within grades. One-way ANOVAs with condition as the main factor were run separately for each grade. Condition (single or double



FIGURES 4a and 4b 4a: Total frequency of drawings in frame, basic, middle, and advanced categories for single example groups. 4b: Total frequency of drawings in frame, basic, middle, and advanced categories for double example groups.

examples) had no effect on variability in 1st graders, $f(1,28) = 1.408$, $p = .245$, $r^2 = .423$. However, there were significant effects of condition on variability in both 3rd, $f(1,28) = 4.877$, $p < .05$), $r^2 = .747$, and 5th graders, $f(1,28) = 19.364$, $p < .01$), $r^2 = 1.252$. Third and 5th graders were more variable in the double, compared to the single example, condition.

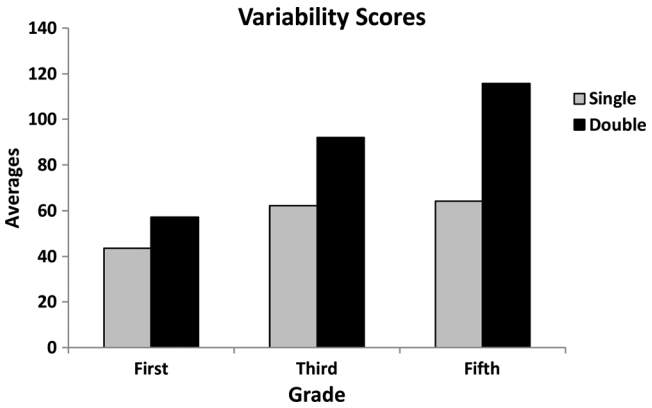


FIGURE 5 Variability scores for 1st, 3rd, and 5th grades.

These results mesh nicely with the frequency of drawing categories shown in Figures 4a and 4b. In the double example condition, more complex drawings (middle and advanced categories), which were awarded more variability points, increased in 3rd and 5th, but not in 1st graders.

Copying of Examples

Figure 6 presents total frequencies by grade for copying either single or double examples. Most copies were made of the smiley face (single) and most of these in the 3rd and 5th grades. Very few children in any grade copied either the fishbowl or bicycle (double) examples.

Artistically Gifted Children

Artistically gifted children were tentatively identified as outliers whose variability scores appeared to be outliers in 1st grade or in 3rd and 5th grades, equal to/higher than the highest score in the grade immediately below theirs. Two 1st graders (120 and 132), two 3rd graders (142 and 156), and three 5th graders (156, 158, 172) fit in this category. Among these children, two were in the single example group, one from 1st and one from 3rd grade.

Drawings by children with the highest scores included mini-themes. One drew a ladle and a pan, both with appropriate handles, along with a chef wearing a toque. Another drew the tools of a rock band—electric guitar, drum, amplifier, and microphone. The amplifier used two circles, as did drawings by a third child, who joined pairs to make dumbbells, a boom box, and glasses. Drawings elaborating on a single circle included a fried egg, an i-Pod, a ring with a huge stone, a wristwatch, and a snow-globe. Several of these drawings, copied by one of us, appear in the Appendix.

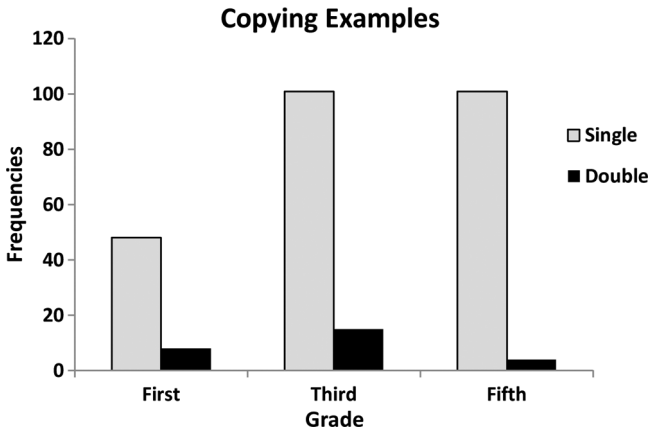


FIGURE 6 Frequency of copying examples.

DISCUSSION

Like Eisenberger's (Eisenberger & Armeli, 1997; Eisenberger et al., 1999), our measures are variations of those used in the Torrance Tests of Creative Thinking (Torrance, 1990). The method elaborated on both. The Torrance Circles activity uses verbal instructions; Eisenberger et al. (1999) added a single visual example, a smiley face; children in this study were presented with two different sets of visual examples.

Findings

This study examined the effects of grade/age and visual examples on variability in children's drawings. Answers to our initial questions follow.

Given the Same Verbal Instructions, Did the More Unusual, Detailed Pair of Examples Generate Higher Variability Drawings Than the Single, Simpler One?

Yes, but variability scores between conditions differed only in older children, those in 3rd and 5th grades. The youngest children, those in 1st grade, earned low variability scores in both conditions. This result reflects both the complexity of the drawings and the categories into which these were sorted (see Figures 4a and 4b). With both single and double examples, most 1st graders used the circle as a frame around a smaller noncircular drawing: These drawings earned only 1 point each. Few older children produced frames in either condition. Rather, categories into which their drawings were sorted changed systematically with examples. The single example generated the highest frequency of drawings in the *basic* category, which included completely circular objects like faces, balls, clocks, and pizzas. These drawings earned 5 points each. The double example generated the highest frequency of drawings in the *middle* category, which included objects that were not completely circular, but had circular features. These drawings earned 8 points each. It also increased the frequency of drawings in the *advanced* category, where each earned 9 points. Third and 5th graders also produced more complex drawings, earning extra points for extending a drawing outside the circle or using multiple circles.

Did Children Copy the Examples?

Yes, but predominantly the single smiley face. Interestingly, there were many more drawings of smiley faces among 3rd and 5th graders than among 1st graders (see Figure 6). Very few copies of either the fishbowl or bicycle example were seen in any grade. However, as noted, 3rd and 5th graders in the doubles condition produced more complex drawings, extending outside the circle (like the fishbowl) and using multiple circles (like the bicycle). Also, many older children shown the bicycle example drew other wheeled vehicles. These included cars, trucks, a bulldozer, a skateboard, a scooter, and a catapult.

Were There Any Children (Particularly Among the Youngest) Whose Variability Scores Identified Them as Artistically Gifted?

Yes, with a caveat. This is the first time that this scoring system has been used. Thus, our outlier criteria—scoring noticeably above one's grade (for 1st graders) or above a lower grades' highest score (for 3rd and 5th)—is an approximation, a tentative best guess at giftedness.

Implications and Conclusion

Lower variability scores and higher rates of copying among 3rd and 5th graders in the single example condition suggest that the smiley face acted both as criterion (draw something familiar inside the circle) and constraint (do not draw outside the circle). Third and 5th graders in this condition drew something very familiar (i.e., copies of the face) inside the perimeter of the circle. Opposite criteria (draw something less familiar, draw outside the circle) were provided by the double examples, which generated fewer copies and more variable drawings. Neither result was seen in 1st graders, whose performances did not differ with the two sets of examples. First graders in both conditions most often used the circle as a frame around a smaller drawing. Several implications can be drawn from the above results.

First, for older children, visual examples provide effective performance criteria.

Second, younger children may need more explicit criteria, both visual and verbal. For example, a drawing using the circle as a frame could be presented as "incorrect," with a verbal explanation of why: It does not use the circle as part of the drawing (inside the circle). Along with the "incorrect" drawing, a "correct" example (the smiley face, etc.) should also be presented, again with a verbal explanation of why: It uses the circle as part of the drawing. Alternatively, younger children who are not artistically gifted may simply not have had sufficient practice drawing to do so in highly variable ways.

Third, multiple examples of the sort provided in museum art classes contribute two things that increment variability in younger and older children. One is a performance criterion: Do things differently. The other is what painter Larry Rivers called a "first chorus" (1987). A first chorus provides a repertoire, here visual elements which can be combined and recombined in

different ways (Stokes, 2006). For example, at both the Brooklyn and Metropolitan Museums of Art in New York, children are first taken to multiple galleries to look at and discuss different ways of seeing/rendering the same subject/object. One such class had young children look at wings on Assyrian sculptures, stained glass windows, and Renaissance oil paintings. In the galleries, the children talked about the shapes, the colors, and even the weight of the wings. Back in the studio, each child lay down on brown paper and drew angel wings with a magic marker in each hand. Then they used tempera paints to draw and color in the interior shapes of their wings. The variety was clearly the product of the multiple examples to which they had been exposed.

The conclusion is straightforward: Visual examples matter, perhaps more so than age. They must be chosen carefully because they provide children with criteria for "correctness." In sufficient numbers, they can also provide a first chorus on which children can effectively and variably improvise.

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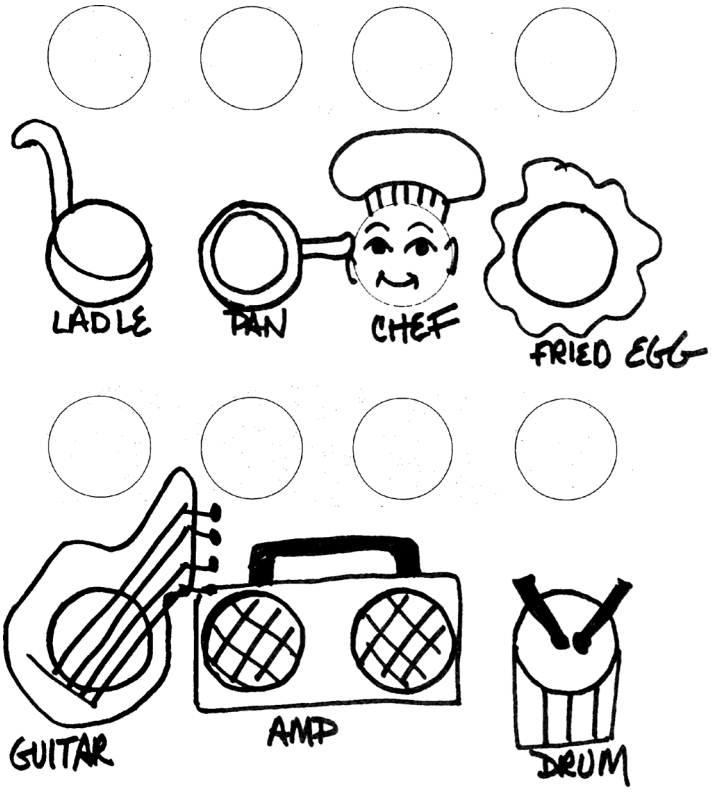
APPENDIX



Black and white copies of drawings done by high-variability children.