The Effects of Observation Coaching on Children's Graphic Representations

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Abstract

Education programs have fostered advanced levels of graphic representation ability in young children but have not detailed the specific mechanisms responsible for the accelerated growth. Research suggests that between 6 and 8 years of age children begin to observe more carefully before drawing and that observation prompts aid children's development of graphic representations. This study experimentally investigated the effects of observation coaching on the graphic representations that children produce when looking at models of animate and inanimate objects. Drawings were collected from 22 kindergartners once a week for a month. Half of the children received observation coaching that instructed them to look at objects from multiple angles before, during, and after drawing an object; the remaining half of the children did not receive observation coaching. Both casual inspection and statistical analyses of data from the videotaped sessions revealed that the coaching was effective at encouraging children to look at objects more frequently during the drawing process. Additionally, each child's drawings were evaluated using a detailed scoring system. This rating system revealed that children receiving observation coaching had significantly greater improvements in drawing scores than children who did not receive coaching. All children receiving coaching had improvements in their drawing scores, with advances primarily involving enhanced detail and conceptual accuracy.

Introduction

As children mature, the detail and accuracy of their graphic representations improve from simple scribbles to representing objects that are meaningful to people other than themselves. In fact, there seems to be a consistent trend in the development of representation from drawing simple lines and scribbles at age 3 to then accurately portraying concepts with visual realism, realistic representations of what is actually seen, by the age of 8 or 9 (Luquet, 1913; Lasky & Mukerji-Bergeson, 2001). Despite the clear role of maturation, however, experience observing and interacting with objects may also be a key factor in the development of representational ability.

One example of the impact of experience on representational ability can be found in an analysis of the Reggio Emilia approach to education. Children enrolled in the child care system in Reggio Emilia, Italy, often create representations with visual realism much earlier than their American counterparts (e.g., see drawings in Edwards, Gandini, & Forman, 1998; Cadwell, 2003). Educators inspired by the Reggio Emilia approach assert that students' advanced levels of representational ability are a product of their unique philosophy: children's active, constructive, learning processes are facilitated through experience (Cadwell, 2003). Additionally, the Reggio Emilia philosophy of education advocates fostering children's intellectual development through a systematic focus on symbolic representation, including movement, words, drawing, painting, sculpture, collage, dramatic play, and music, which leads children to impressive levels of communication, symbolic skills, and creativity, relative to their age (Cadwell, 2003).

One possible explanation for the advancements shown by students in programs inspired by the Reggio Emilia approach is the amount of observation children engage in during the drawing process. Sutton and Rose (1998) observed that 8-year-old children who had achieved elementary levels of visual realism not only looked more frequently at the object but also looked intermittently as they drew, in striking contrast to the 4- to 6-year-old children, who only glanced before and after drawing the object. For children who participate in a Reggio-inspired curriculum, perhaps the looking patterns act as a mechanism for accelerating the natural developmental shift.

One possible way of promoting more effective looking patterns is simply to provide a richer observation experience. In a preliminary study, Vlach and Carver (2006) had kindergartners participate in three sessions that provided increasingly deeper experiences with objects. All children were asked to draw objects when (1) given no visual cues, (2) observing photographs taken from multiple angles, and then (3) observing an informational video and/or live presentation. Although no specific instruction was given regarding observation or drawing, researchers found that as children had increasingly richer observation experiences with objects, the accuracy and number of details in their drawings significantly increased. These results suggest that observation experiences may have prompted children to look at objects in ways that facilitated the shift toward visual realism (Vlach & Carver, 2006). However, in this preliminary study, children were not given specific observation instruction but simply the means for a deeper observation experience, and they did not spontaneously conduct these observations in the way that older children, ages 6 to 8, typically do (Sutton & Rose, 1998).

Although historically many art educators believe that simply providing materials and the appropriate environment are the most important responsibilities of the art educator (Thompson, 1995), explicit instruction of observation behavior may be of high importance as well (Cox, 1986; Lewis, Russell, & Berridge, 1993; Kindler, 1995). Research has shown that various verbal activities, such as alternating discussion and the use of graphic language, aid children in their artistic development (Davis, 1983; Davis & Bentley, 1984; Wilson & Wilson, 1982; Cox, 1985). Although much work has been aimed at testing and outlining practices to benefit children's artistic development (Thompson, 1995; Lasky & Mukerji-Bergeson, 2001; Golomb, 2004), limited empirical research exists that outlines a specific mechanism and an associated instructional method (Kindler, 1995; Sutton & Rose, 1998).

The current investigation focuses on developing and experimentally testing a method of teaching young children who have not yet developed the ability to portray concepts with visual realism to purposefully look at objects before, during, and after drawing. By utilizing the mechanism identified in Sutton and Rose (1998), we can experimentally test whether instructing young children to use this mechanism will further their ability to draw objects with visual realism. Can this advanced strategy be explicitly taught to younger children? If such coaching is effective, will it affect children's graphic representations? Will improvements in observing an object foster graphic representations that have a higher level of visual realism? These questions led us to develop a coaching protocol to optimize young children's focused observations, in an attempt to get them to look purposefully at objects and thus cultivate higher levels of visual realism.

Method

Participants

Participants were a class of 22 full-day kindergartners, 9 girls and 13 boys, at the Children's School, a laboratory preschool and kindergarten in the Psychology Department at Carnegie Mellon University. The average age of the children was 5.25 years old, ranging from 61 months to 76 months. Four minority children were part of the sample (18%); one of these children and two Caucasian children did not speak English as a first language, although they were quite fluent. No children had physical or motor ailments that would affect their ability to draw. However, five children had special needs—two children were classified as having social-emotional needs, two children were autistic, and one child had special needs in the area of memory. Children generally came from households with middle to high socioeconomic status, although several children attended the school on a scholarship program for families that could not afford tuition. Additionally, some children had also attended the school for part-day preschool, while others were only attending for their kindergarten year.

Design

Participants were randomly divided into an experimental condition and control condition, with gender as a stratifying variable. All participants were initially given a pretest in which they were asked to draw a model of an animate object and an inanimate object. Children in the experimental condition then received two coaching sessions, one per week, each followed by being asked to draw an object that they had not previously drawn. Children in the control condition were simply asked to draw objects without having coaching. During the final week of the study, participants were given a posttest identical to that of the pretest (see Figure 1).

Group	*N* =	Week 1 Pretest	Week 2 Session 1	Week 3 Session 2	Week 4 Posttest
A (Coaching)	6	Goat Microwave	Zebra	Toaster Oven	Goat Microwave
	5	Zebra Toaster	Microwave	Goat	Toaster
B (No-Coaching)	6	Goat Microwave	Zebra	Toaster Oven	Goat Microwave
	5	Zebra Toaster	Microwave	Goat	Toaster

Figure 1. Schedule and experimental design.

All drawing sessions were conducted in a laboratory room that was equipped with two video cameras. Participants were videotaped from an aerial view, focused on the drawing paper, and from the front, focused on the child's upper body. The dual-screen videotaping allowed for detailed coding of observation behaviors (i.e., number of looks, number of long looks, etc.) and the actual drawing process (i.e., process of drawing, order of components drawn, etc.).

Because the entire experiment was completed during a 4-week period, maturation was minimized as a possible variable in performance. The control group's performance reflects the improvement caused by maturation plus practice in the laboratory context. Any difference in the experimental group's performance should therefore be a result of the coaching provided during weeks 2 and 3.

Models of Animate and Inanimate Objects

Children were asked to draw two items during the pretest and posttest sessions and one item in each of the coaching or no-coaching sessions (see Figure 1). The drawing models included a realistic stuffed goat and zebra and a real microwave and toaster (see Figure 2). The items were chosen because they were gender-neutral, familiar enough to be drawn from memory, but not likely to be commonly drawn objects. The goat and zebra are distinct yet require similar representational components, and the same is true of the microwave and toaster oven. Additionally, the animate/inanimate distinction reflects the diverse objects studied by other researchers (Golomb, 2004; Lasky & Mukerji-Bergeson, 2001). It was also interesting because of the different types of lines, features, and imagined actions to be observed and graphically represented. Note that the counterbalancing of drawing objects involved in the design (see Figure 1) yields the possibility of unconfounded pretest and posttest comparisons, as well as experimental and control group comparisons.

Object: Goat

Object: Zebra

Object: Microwave

Object: Toaster Oven

Figure 2. Photographs of objects drawn by children in all conditions.

Procedure: Pretest Session

Testing for all sessions was done according to established Children's School research procedures (refer tohttp://www.psy.cmu.edu/childrensschool).
Editor's note: This url has changed:
http://www.psy.cmu.edu:16080/childrensschool/ Children were taken from their classroom individually and asked to sit at a table in a lab room by the experimenter, who had one classroom familiarization session with the students before the start of the study. They were presented with one object at a time and were told to look at the object and try their best to draw it. Children were given no instruction on how to look at the object or how to draw it. Each child was given a black felt tip marker and a white 8.5" x 11" piece of paper for each drawing. Figure 3 displays sample pretest drawings of all four objects from the middle of the range for each gender.

Example	Drawing by Boy	Drawing by Girl

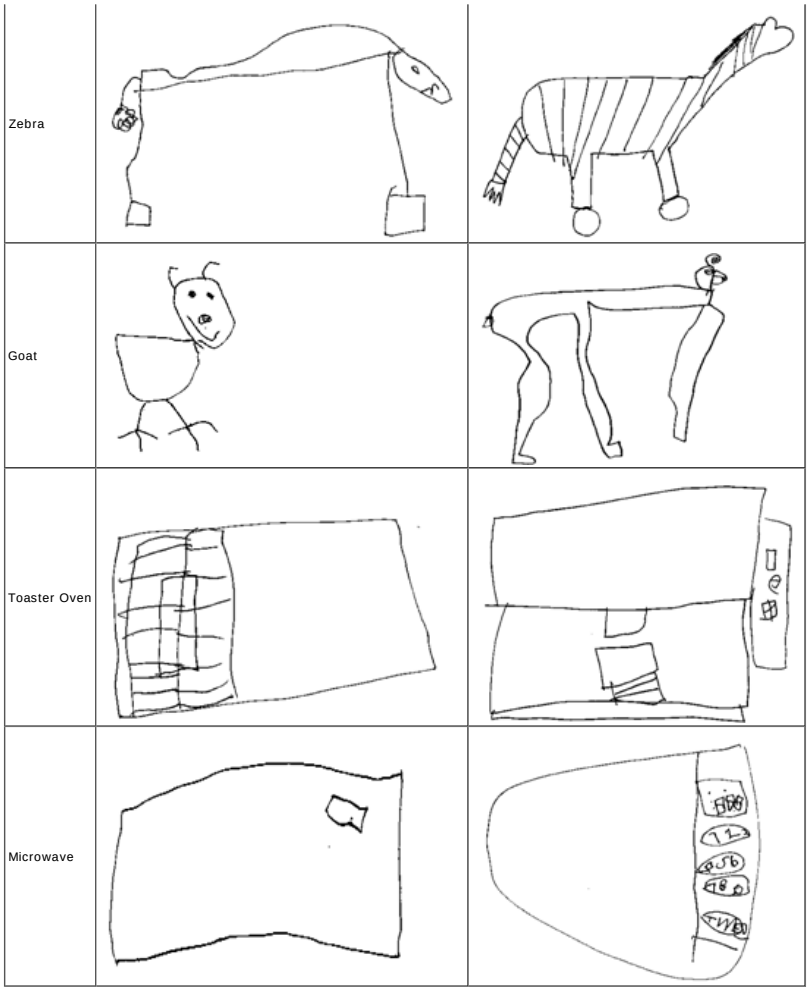


Figure 3. Sample drawings from pretest by gender.

Procedure: Coaching and No-Coaching Sessions

Children were taken from their classroom and asked to sit at a table in a lab room by the experimenter. Children in the no-coaching condition were simply asked to try their best to draw an object, the same procedure as the pretest but with only one object. Children in the coaching condition received brief instruction about how to look at an object when drawing. Children were instructed to look at the object very closely before drawing it, to look up at the object periodically while drawing, and to do a thorough examination after finishing drawing to make sure they had included everything they wanted in their picture. While giving a specific instruction, the experimenter modeled this behavior by drawing a toy cow or tiger using this technique (i.e., if the experimenter was talking about looking closely at an object before drawing, the experimenter would literally look closely at the object and move her head and eyes in such a way as to suggest that she was looking at the entire object). Children were then asked a series of comprehension questions (e.g.: "What do I do before I start drawing?" "What do I do while I am drawing?") to assure that they were listening and understood what they were being taught. After receiving the coaching, children were told a mnemonic to help them remember the coaching ("In the beginning I look close, in the middle I look a lot, and at the end I look one more time."). After telling children the mnemonic, the experimenter instructed the children to draw an object using the same steps that the experimenter had used to draw the tiger or cow. Each child was given a black felt tip marker and a white 8.5" X 11" piece of paper for the drawing. Note that the total coaching time, including the questions and presentation of the mnemonic, was less than 5 minutes. Because there were two coaching sessions, the total instructional time was less than 10 minutes.

Procedure: Posttest Session

Children were taken from their classroom and asked to sit at a table in a lab room. Children followed the same procedure as the pretest; they were presented with two objects, one at a time, and asked to look at the object and try their best to draw each one. Children were given no instruction on how to look at the object or how to draw it, and those in the coaching condition were not reminded of the coaching or mnemonic. Each child was given a black felt tip marker and a white 8.5" x 11" piece of paper for each drawing.

Results

Response to the Coaching: The Drawing Process

All sessions of the experiment were videotaped from two angles, one camera focused on the participant's upper body and face and the other camera focused directly on the child's drawing paper. In the videotapes of the experimental group, it appeared that the children clearly understood the coaching instruction and often would imitate the experimenter while she was modeling the behavior. While drawing, they looked at the object considerably more frequently and for longer durations than children in the control group.

Coding the Process

In order to document the observation process both objectively and quantitatively, the experimenter devised a coding system for the videotapes. The coders were asked to record all events chronologically, including the components drawn, the number of looks, the number of long looks (a long look was considered one greater than 3 seconds),

looks at the experimenter and/or other objects in the room, and any other important notes that would be relevant to the drawing process (i.e., interesting comments, frustration with the task, etc.). Coding of the videotapes was done by the experimenter and an independent rater, an undergraduate student who worked in a different classroom at the school. The first coder developed the coding system and evaluated all of the videotapes; the second coder evaluated 10% of these tapes in order to establish inter-rater reliability. Because correlations between raters on scoring for each of the four objects were high, .81 (number of looks per item), .83 (number of long looks), and .92 (order of objects drawn), the data used for analysis were taken from the first coder's records.

Data: Number of Looks and Long Looks

When comparing drawing performance across objects, many studies make a distinction between drawing animate and inanimate objects (Vlach & Carver, 2006; Golomb, 2004). Because of this distinction, data were analyzed by type of object model, animate or inanimate. Furthermore, we saw significantly different drawing scores between the models of animate and inanimate objects (see later section on drawings scores). There were no differences in the number of looks between the goat and zebra at the pretest (M = 5.58, SD = 2.75 vs. M = 6.20, SD = 2.53, respectively), $F(1, 20) = .30$, $p = .59$, or at the posttest (M = 7.50, SD = 3.85 vs. M = 9.70, SD = 4.45), $F(1, 20) = 1.55$, $p = .23$. There were also no differences in the number of looks between the microwave and toaster oven at the pretest (M = 6.75, SD = 4.94 vs. M = 6.30, SD = 2.79, respectively), $F(1, 20) = .065$, $p = .80$, or at the posttest (M = 7.42, SD = 3.75 vs. M = 8.70, SD = 4.14), $F(1, 20) = .58$, $p = .46$. Thus, making a comparison using the categories of animate and inanimate seemed reasonable.

For models of animate objects, a repeated measures ANOVA revealed that there was a significant interaction of experimental condition (no-coaching and coaching) and testing period (pretest and posttest) on the number of looks, $F(1, 20) = 12.32$, $p = .002$. Children in the coaching condition started with a number of looks in the pretest session (M = 4.91, SD = 2.43) similar to the number of looks of children in the control group (M = 6.82, SD = 2.52), but they had a greater number of looks in the posttest session (M = 10.91, SD = 4.16) than the control group (M = 6.09, SD = 2.59). These results are shown in Figure 4; please note that each child received one coaching session for each animate and inanimate object, represented by the difference in N in Sessions 1 and 2.

For inanimate objects, a repeated measures ANOVA revealed that there was a significant interaction of experimental condition (no-coaching and coaching) and testing period (pretest and posttest) on the number of looks, $F(1, 20) = 4.63$, $p = .044$. Children in the coaching condition started with a number of looks in the pretest session (M = 6.09, SD = 4.06) similar to children in the control group (M = 7.00, SD = 4.12), but they had a greater number of looks in the posttest session (M = 9.73, SD = 4.00) than the control group (M = 6.27, SD = 3.31). These results are shown in Figure 5; please note that each child received one coaching session for each animate and inanimate object, represented by the difference in N in Sessions 1 and 2.

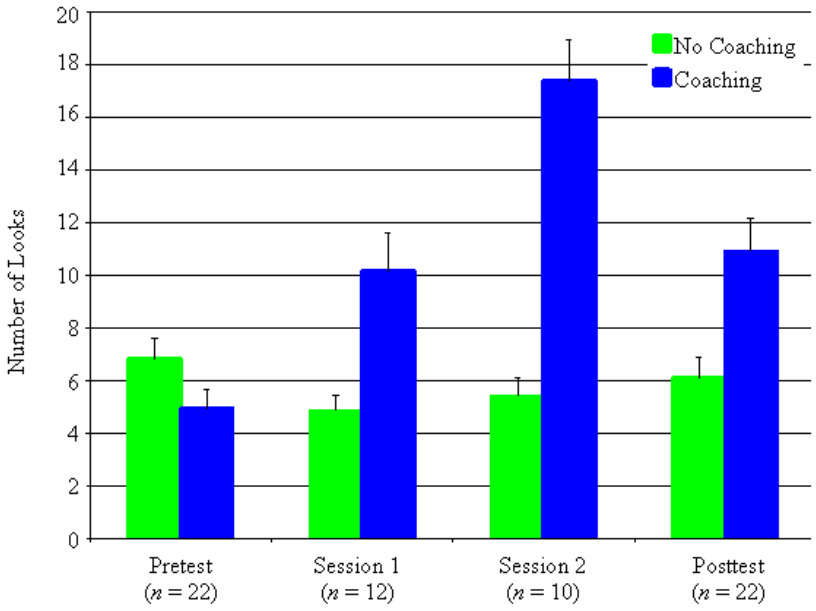


Figure 4. Average number of looks (±SE) for drawing sessions with animate objects between the coaching and no-coaching conditions.

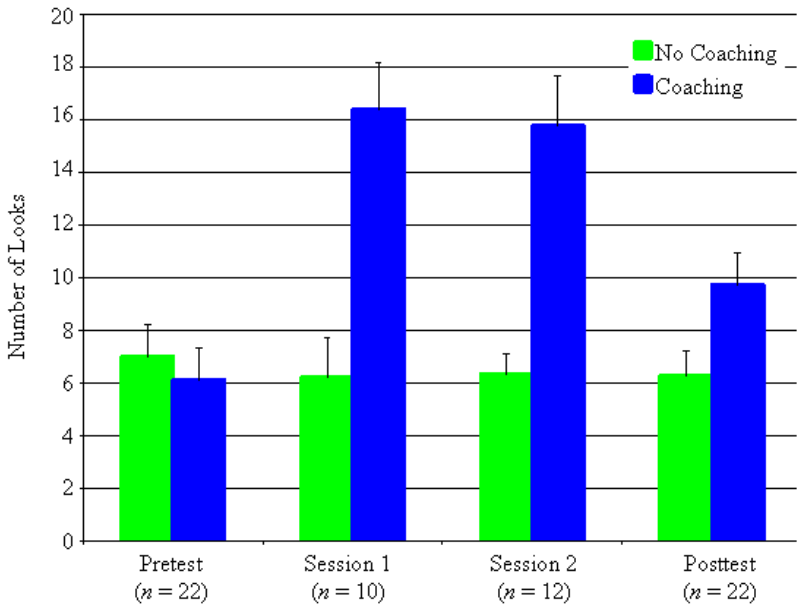
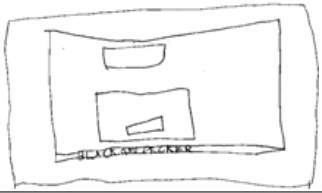
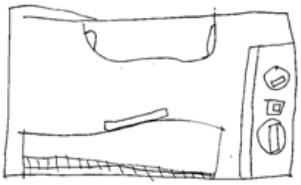


Figure 5. Average number of looks (±SE) for drawing sessions with inanimate objects between the coaching and no-coaching conditions.

In addition to considering the number of looks, we also examined the number of looks lasting longer than 3 seconds. For animate objects, a repeated measures ANOVA revealed that there was a significant interaction of experimental condition (no-coaching and coaching) and testing period (pretest and posttest) on the number of long looks, $F(1, 20) = 9.45$, $p = .006$. Children in the coaching condition started with a low number of long looks in the pretest session ($M = .09$, $SD = .302$) similar to the number of long looks of children in the control group ($M = .45$, $SD = .688$), but they had a small increase in the number of long looks in the posttest session ($M = 1.00$, $SD = 1.183$) when compared to the control group ($M = 0.00$, $SD = .000$). For inanimate objects, a repeated measures ANOVA revealed that there was a trend for an interaction of experimental condition (no-coaching and coaching) and testing period (pretest and posttest) on the number of long looks, $F(1, 20) = 2.87$, $p = .10$. Children in the coaching condition started with a low number of long looks in the pretest session ($M = .18$, $SD = .41$) similar to the number of looks of children in the control group ($M = .18$, $SD = .60$), but they had a small increase in the number of long looks in the posttest session ($M = 1.45$, $SD = 2.21$) when compared to the control group ($M = .18$, $SD = .60$).

Impact of the Coaching: The Drawings

Upon a first glance at the drawings children produced, there appeared to be qualitative differences between children in the coaching and no-coaching conditions (for examples of individual children's progress, see Figures 6a and 6b). Children in the coaching condition appeared to have included more components with increased accuracy than those children who were in the no-coaching condition. However, to test whether these differences were statistically significant, the drawings had to be evaluated quantitatively. In order to do this analysis, scoring criteria were developed to evaluate the drawings.

Participant #	Pretest Drawing	Posttest Drawing
Participant #3 (male) Zebra		
Participant #1 (female) Toaster Oven		
Participant #12 (female) Goat		
Participant #6 (male)		

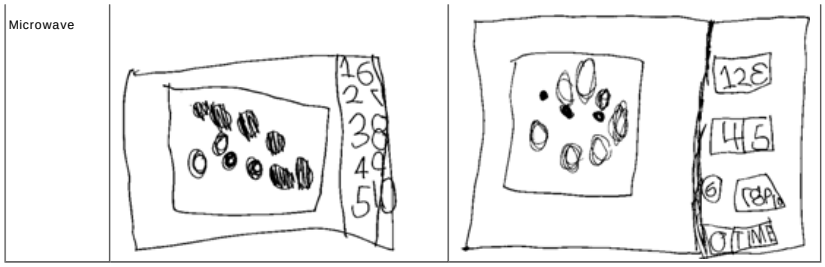


Figure 6a. Sample pretest and posttest drawings by condition and gender: Coaching condition.

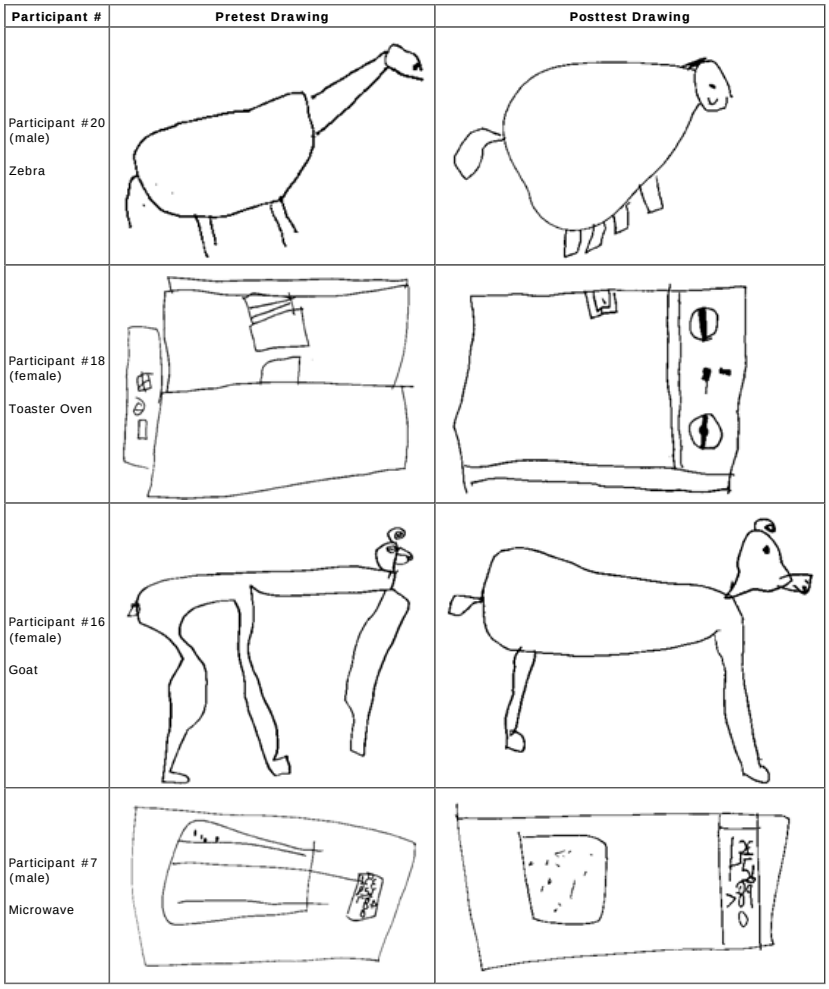


Figure 6b. Sample pretest and posttest drawings by condition and gender: No-coaching condition.

Scoring the Drawings

In order to document the improvement in the drawings both objectively and quantitatively, we devised a scoring system. Children's drawings received points for representing object features and using accurate detail. For each object, five major components were identified and evaluated. For the zebra and goat, the major components included the head, body, tail, legs, and hooves. For the microwave, the major components included the opening button, door, number pad, buttons, and electrical plug. For the toaster oven, the major components included the handle, clear door and inside of oven, round knobs, square knob, and electrical plug. Children received 1 point for representing each of the major components and then were given 0 to 3 additional points for the accuracy and appropriateness of each component's detail. Additionally, each scoring guide also asked whether there were other distinguishing features, like stripes on the zebra, horns on the goat, words on the toaster oven, timer on the microwave, etc. Each object had three distinguishing features, features that were special to the particular model but not a major component of the object, for which children could receive one additional point (for scoring guides, see the appendix). The total possible number of points for each drawing was 23, 4 points for each of the five major components and 3 points for the distinguishing features.

Scoring of the drawings was done by the experimenter and an independent rater, an undergraduate student who worked in a different classroom at the school. The first rater developed the scoring guides and evaluated all of the drawings; the second rater evaluated 10% of these drawings in order to establish inter-rater reliability. Because correlations between raters on scoring for each of the four objects were high, .94 (toaster), .94 (microwave), .95 (goat), and .95 (zebra), the data used for analysis were taken from those of the first rater.

Scores for Drawings

The descriptive statistics for the data indicate that children's scores strikingly differed between the models of animate and inanimate objects. Both boys and girls scored higher on the drawings of animate objects than the drawings of inanimate objects, suggesting that they initially were better at drawing animate objects, $t(21) = 3.44$, $p = .002$. This finding is similar to that of other studies making the animate and inanimate distinction (Vlach & Carver, 2006; Golomb, 2004). Because of the significant difference, the rest of the data analysis was conducted separately for the animate and inanimate objects. There were no differences in the drawing scores between the goat and zebra at the pretest ($M = 11.17$, $SD = 4.53$ vs. $M = 12.20$, $SD = 4.32$, respectively), $F(1, 20) = .30$, $p = .59$, or at the posttest ($M = 15.25$, $SD = 3.28$ vs. $M = 9.70$, $SD = 4.45$), $F(1, 20) = 1.13$, $p = .30$. There were also no differences in the drawing scores between the microwave and toaster oven at the pretest ($M = 7.33$, $SD = 3.45$ vs. $M = 8.90$, $SD = 4.84$, respectively), $F(1, 20) = .78$, $p = .39$, or at the posttest ($M = 10.08$, $SD = 3.97$ vs. $M = 12.30$, $SD = 6.00$), $F(1, 20) = 1.08$, $p = .31$. Thus, making a comparison using the categories of animate and inanimate seemed reasonable.

For animate objects, a repeated measures ANOVA revealed that there was a significant interaction of experimental condition (no-coaching and coaching) and testing period (pretest and posttest), $F(1, 20) = 7.552$, $p = .012$. Children in the coaching condition started with pretest scores ($M = 11.27$, $SD = 4.268$) similar to children in the control group ($M = 12.00$, $SD = 4.626$), but they had higher scores on posttest drawings ($M = 17.45$, $SD = 3.560$) than the control group ($M = 14.45$, $SD = 2.622$) (see Figure 7). Although both groups showed improvement, those children in the coaching condition had a greater increase in score than children in the no-coaching condition (55% vs. 20%).

For inanimate objects, a repeated measures ANOVA revealed that there was a significant interaction of experimental condition (no-coaching and coaching) and testing period (pretest and posttest), $F(1, 20) = 6.014$, $p = .024$. Children in the coaching condition started with having pretest scores ($M = 8.73$, $SD = 4.174$) similar to scores of children in the control group ($M = 7.36$, $SD = 4.130$), but they had higher scores on posttest drawings ($M = 13.18$, $SD = 3.790$) than the control group ($M = 9.00$, $SD = 5.329$) (see Figure 8). Analogous to the trend of the animate object data, those children in the coaching condition had a greater increase in scores than children in the no-coaching condition (51% vs. 22%).

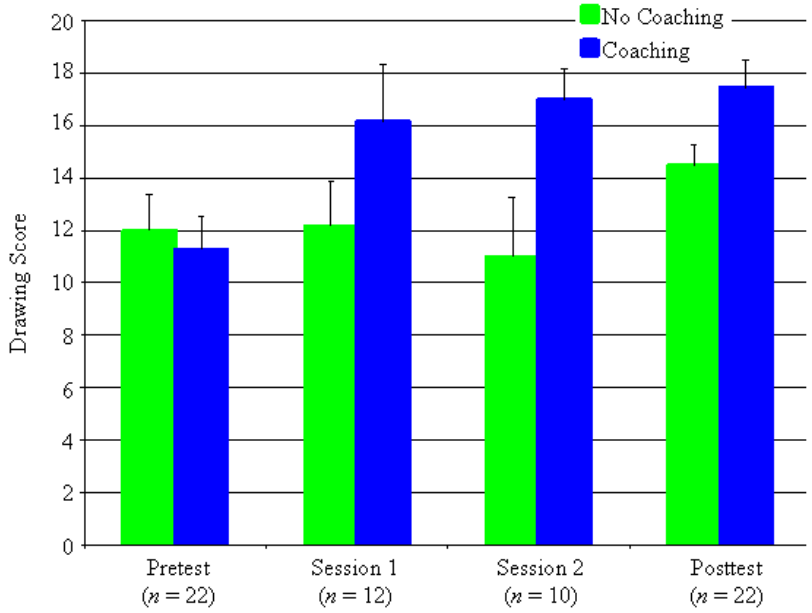


Figure 7. Average drawing scores (±SE) for drawing sessions with animate objects between the coaching and no-coaching conditions.

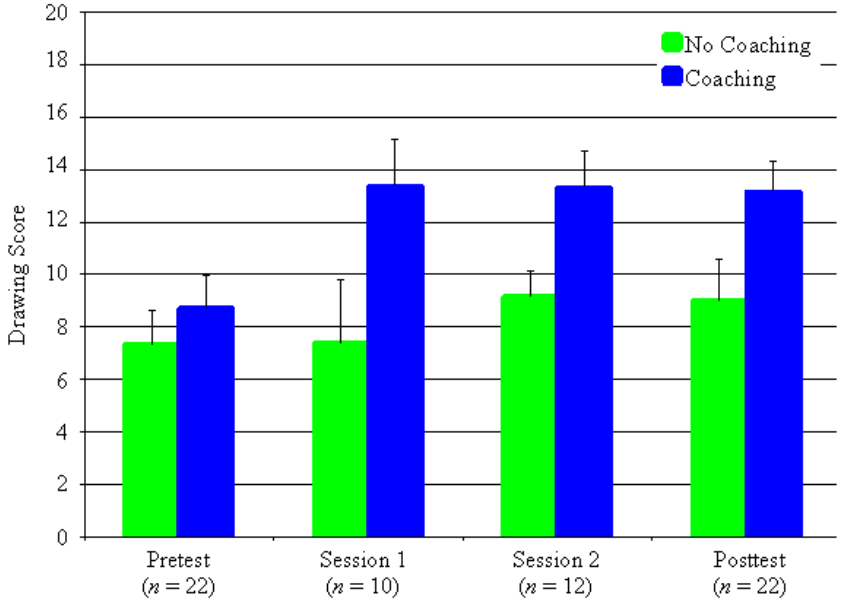


Figure 8. Average drawing scores (±SE) for drawing sessions with inanimate objects between the coaching and no-coaching conditions.

Individual Changes in Drawing Score

Although the overall mean scores showed no significant differences in scores between the children in the coaching and no-coaching conditions, it is important to determine whether each child benefited from the coaching. Additionally, it is interesting to determine the role of simple practice in children's drawing scores (to see whether some children improved equivalently by practice alone). For this analysis, a child was considered to have an increase in score if his or her posttest score was greater than the pretest, no change if the scores were the same on each test, and a decrease in score if the posttest score was lower than the pretest score. All 11 children benefited from the coaching, while only about half the children benefited from simple practice (see Table 1). Also, the range of improvements was only half as large for the control group as for the experimental group.

Table 1
Individual Change in Score of Animate and Inanimate Objects by Condition

Type of Change	*N* (Animate)	Range	*N* (Inanimate	Range
Coaching Condition				
Positive change in score	11	2 to 12	11	2 to 10
No change in score	0		0	
Negative change in score	0		0	
No-Coaching Condition				
Positive change in score	7*	1 to 7	5*	1 to 6
No change in score	3	No change	3	No change
Negative change in score	1	-1	3	-2 to -1

*The same five children who had increases in score on the inanimate objects also had increases in score on the animate objects.

From the First Looks to the Final Drawing

Although we have thoroughly examined the observation process and the final product—the drawing itself—there is a rich data set in the actual drawing process. Is there a common order in which children draw components of the objects? What accounts for the increase in drawing scores? Did children add one specific component to each drawing, or did they advance in detail and accuracy across all components?

To investigate these questions, we examined whether coaching aided children in adding more components or enhancing the detail of the existing components. After splitting children by condition and object, the sample size was dramatically cut (n = 5 or n = 6), making it difficult to find statistically significant results. We analyzed each presence and detail score, for each component, as well as the presence of distinguishing features, totaling 13 variables per object, 52 variables total. We did find that children in the coaching condition had a few items where there were statistically more components and detail than the children in the no-coaching condition (9 of 52), however, most were not statistically significant. There did not appear to be a trend for these 9 items; they ranged from being the tail of the goat to the plug on the microwave. However, it is important to note that, for the vast majority of all measures of components and detail, children in the coaching condition had higher values, although not statistically higher (38 of 52). The sum of all of the small differences resulted in the statistically higher overall drawing scores.

We also analyzed the order of components drawn and found no significant effects of order, for both children in the coaching and no-coaching conditions. However, we did not hypothesize that there would be a difference in order because of the coaching. The coaching was designed to simply provide a tool for the drawing process, not a template. We observed that children would start with a variety of components and would use varying shapes and lines for different parts (e.g., some children started drawing the zebra hooves, while other children started with the head). Although we instructed the children to look, we did not want to affect their creative thinking processes or artistic expression. Although other research has found that children tend to draw certain objects with specific shapes and in specific order (Golomb, 2004), further research is needed to examine whether there is a certain drawing order with the object models used in this study.

Discussion

This study experimentally tested the effects of brief but explicit observation coaching on children's observation behaviors and resulting graphic representations. We predicted that by training children to purposefully look at objects before, during, and after drawing, children's representation ability would improve in detail and accuracy. Although the coaching was relatively simple and brief, we hypothesized that it would be enough training to cause significant effects on graphic representations. If so, the coaching should be easy for educators to incorporate into their own teaching practices.

Both casual inspection and statistical analyses of data from the videotaped sessions revealed that the coaching was effective at encouraging children to look at objects more frequently during the drawing process. The coaching also was successful in cultivating increased detail and accuracy in the drawings, suggesting that promoting the purposeful behavior of closely looking at an object throughout the drawing process can lead to higher levels of visual realism in the children's graphic representations. Every child who received coaching had an increase in drawing score, suggesting that the coaching would be effective for a variety of children. Moreover, this coaching may be able to be used with children who have varying levels of representational ability; although children started with varying drawing scores, all children benefited from the coaching in that they all had increases in drawing scores.

The findings in this study have many implications for educators and psychologists, as well as for parents. Not only can observation coaching be a valuable and effective tool in designing educational drawing experiences, but training children to partake in their own observations without direct instruction can cause significant improvements in their graphic representations. Because the instruction was explicit, modeled, and not specifically related to drawing, it could be used for a variety of activities, and it is possible that the observation behaviors encouraged by the coaching could be transferable to other tasks (i.e., painting, sculpting, etc.). Research shows that mediated instruction, a combination of explicit instruction and modeling, has been an effective method for building transferable skills (Carver & Klahr, 1986). However, future research is needed to confirm that these skills are in fact transferable. Does the coaching effect transfer into the classroom? Does the coaching effect generalize to areas other than drawings, such as painting and sculpting? If so, does observation coaching still retain its efficacy to the same degree as it does for drawing? These questions should be analyzed to determine the specific situations in which observation coaching would be useful in designing curriculum.

Furthermore, studies are needed to determine the longitudinal effects of the coaching. Will the coaching continue to be effective over a full-year period? During what points in development is the observation coaching effective at fostering advanced graphic representations? Do children receiving coaching experience an earlier developmental shift in observation behavior? Additionally, are other coaching strategies effective in promoting purposeful focused observation, such as examining shapes, textures, and patterns within objects? These strategies should be experimentally tested in order to determine their efficacy alone and in conjunction with the observation coaching tested in this study. Because a limited amount of empirical research has been conducted outlining a specific mechanism and effective instruction method for this mechanism, as noted by many authors (Kindler, 1995; Vlach & Carver, 2006; Sutton & Rose, 1998), it is imperative that more research be conducted in order to define the conditions under which observation coaching can be an effective educational tool.

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Appendix

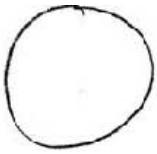
Scoring Guides

Zebra Evaluation

Head

Does the zebra have a head? _____ (1 = Yes, 0 = No)

Detail



0 POINTS - The head is represented by a circular shape.

1 POINT - The head is represented by a circular shape with incorrect detail.

2 POINTS - The head is represented by a more head-like shape and some correct detail and some incorrect detail.

3 POINTS - The head is represented by a correct shape with correct detail.

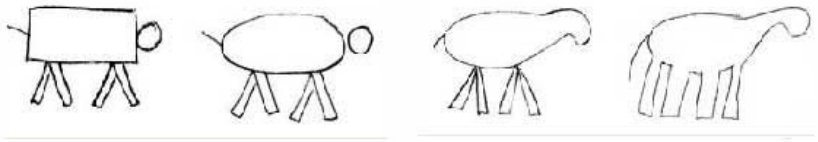
Detail Rating:

____ (0, 1, 2, or 3 points)

Body

Does the zebra have a body? _____ (1 = Yes, 0 = No)

Detail



0 POINTS - The body is represented by an incorrect shape.

1 POINT - The body is represented by an oval shape, with a detached head and tail.

2 POINTS - The body is represented by an oval shape and has some integration of parts.

3 POINTS - The body is represented by an oval shape that integrates the head, body, and legs.

Detail Rating:

____ (0, 1, 2, or 3 points)

Legs

Does the zebra have legs?_____ (1 = Yes, 0 = No)

Detail

0 POINTS - The leg(s) are represented by a simple line.

1 POINT - The leg(s) are represented by a thick shape, usually a scribble.

2 POINTS - The leg(s) are represented by a rectangular shape.

3 POINTS - The leg(s) are represented by a shape that reflects the presence of a knee.

Detail Rating:

____ (0, 1, 2, or 3 points)

Tail

Does the zebra have a tail? _____ (1 = Yes, 0 = No)

Detail

0 POINTS - The tail is represented by a line.

1 POINT - The tail is represented by a scribble.

2 POINTS - The tail is represented by a shape that resembles a horse tail.

3 POINTS - The tail is represented with correct shape and detail.

Detail Rating:

____ (0, 1, 2, or 3 points)

Hooves

Does the zebra have feet? _____ (1 = Yes, 0 = No)

Detail

0 POINTS - The hooves are represented by a scribble.

1 POINT - The hooves are represented by a circular shape.

2 POINTS - The hooves are represented by a square shape with a lack of hoof shaping.

3 POINTS - The hooves are represented by a correct hoof shape.

Detail Rating:

____ (0, 1, 2, or 3 points)

Other Distinguishing Features:

- Does the zebra have stripes? _____ (1 = Yes, 0 = No)

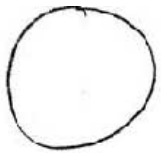
- Does the zebra have ears? _____ (1 = Yes, 0 = No)
- Does the zebra have a mane? _____ (1 = Yes, 0 = No)
- List all additional parts of the zebra and/or setting: _____
- Total # of other parts: _____

Goat Evaluation

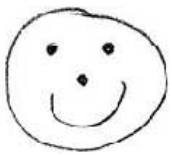
Head

Does the goat have a head? _____ (1 = Yes, 0 = No)

Detail



0 POINTS - The head is represented by a circular shape.



1 POINT - The head is represented by a circular shape with incorrect detail.

2 POINTS - The head is represented by a more head-like shape and some correct detail and some incorrect detail.

3 POINTS - The head is represented by a correct shape with correct detail.

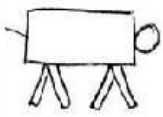
Detail Rating:

____ (0, 1, 2, or 3 points)

Body

Does the goat have a body? _____ (1 = Yes, 0 = No)

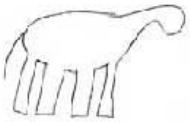
Detail



0 POINTS - The body is represented by an incorrect shape.

1 POINT - The body is represented by an oval shape, with a detached head and tail.

2 POINTS - The body is represented by an oval shape and has some integration of parts.



3 POINTS - The body is represented by an oval shape that integrates the head, body, and legs.

Detail Rating:

____ (0, 1, 2, or 3 points)

Legs

Does the goat have legs? _____ (1 = Yes, 0 = No)

Detail

0 POINTS - The leg(s) are represented by a simple line.

1 POINT - The leg(s) are represented by a thick shape, usually a scribble.

2 POINTS - The leg(s) are represented by a rectangular shape.

3 POINTS - The leg(s) are represented by a shape that reflects the presence of a knee.

Detail Rating:

____ (0, 1, 2, or 3 points)

Tail

Does the goat have a tail? _____ (1 = Yes, 0 = No)

Detail

0 POINTS - The tail is represented by a line.

1 POINT - The tail is represented by a scribble.

2 POINTS - The tail is represented by a circular shape.

3 POINTS - The tail is represented with correct shape and detail.

Detail Rating:

____ (0, 1, 2, or 3 points)

Feet

Does the goat have feet? _____ (1 = Yes, 0 = No)

Detail

0 POINTS - The hooves are represented by a scribble.

1 POINT - The hooves are represented by a circular shape.

2 POINTS - The hooves are represented by a square shape with a lack of hoof shaping.

3 POINTS - The hooves are represented by a correct hoof shape.

Detail Rating:

____ (0, 1, 2, or 3 points)

Other Distinguishing Features:

- Does the goat have horns? _____ (1 = Yes, 0 = No)
- Does the goat have ears? _____ (1 = Yes, 0 = No)
- Does the goat have fur? _____ (1 = Yes, 0 = No)
- List all additional parts of the goat and/or setting: _____
- Total # of other parts: _____

Toaster Oven Evaluation

Cord / Plug

Does the toaster oven have a plug? _____ (1 = Yes, 0 = No)

Detail

0 POINTS - The plug is represented by a scribble.

1 POINT - The plug is represented by a long rectangular shape with little or no detail.

2 POINTS - The plug is represented by a thick line and box shape, perhaps with incorrect detail.

3 POINTS - The plug is represented by a thick cord and square plug shape.

Detail Rating:

____ (0, 1, 2, or 3 points)

Round Knobs

Does the toaster oven have a round knob? _____ (1 = Yes, 0 = No)

Detail

0 POINTS - The knob(s) are represented by a scribble.

1 POINT - The knob(s) are represented by an oval shape, with the presence of only one knob.

2 POINTS - The knob(s) are represented by a circular shape, with the presence of only one knob.

3 POINTS - The knob(s) are represented by a circular shape with the presence of two knobs.

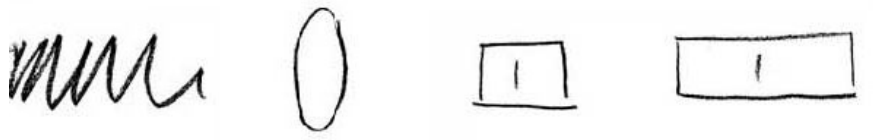
Detail Rating:

____ (0, 1, 2, or 3 points)

Rectangular Knob

Does the toaster oven have a square knob? _____ (1 = Yes, 0 = No)

Detail



0 POINTS - The knob is represented by a scribble.

1 POINT - The knob is represented by an incorrect shape.

2 POINTS - The knob is represented by a square shape.

3 POINTS - The knob is represented by a rectangular shape.

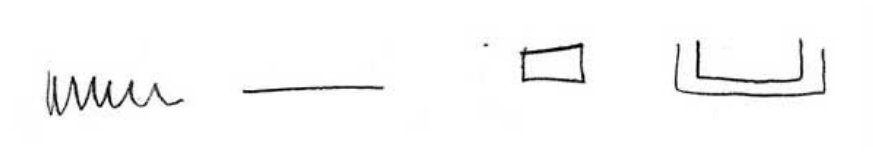
Detail Rating:

____ (0, 1, 2, or 3 points)

Handle

Does the toaster oven have a handle? _____ (1 = Yes, 0 = No)

Detail



0 POINTS - The handle is represented by a scribble.

1 POINT - The handle is represented by a line.

2 POINTS - The handle is represented by a square.

3 POINTS - The handle is represented with correct shape and detail.

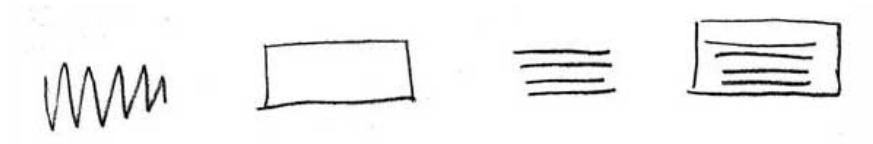
Detail Rating:

____ (0, 1, 2, or 3 points)

Glass Door / Inside Rack

Does the toaster oven have a glass door and/or inside rack? _____ (1 = Yes, 0 = No)

Detail



0 POINTS - The door is represented by a scribble.

1 POINT - The door is represented by a square/rectangular shape.

2 POINTS - The door is represented by lines of the inside rack.

3 POINTS - The door is represented by a square or rectangular shape with the inside rack.

Detail Rating:

____ (0, 1, 2, or 3 points)

Other Distinguishing Features:

- Does the toaster oven have words? _____ (1 = Yes, 0 = No)
- Does the toaster oven have an inside (other than rack)? _____ (1 = Yes, 0 = No)
- Does the toaster oven have numbers? _____ (1 = Yes, 0 = No)
- List all additional parts of the toaster oven and/or setting:
  _____
- Total # of other parts: _____

Microwave Evaluation

Cord / Plug

Does the microwave have a plug? _____ (1 = Yes, 0 = No)

Detail

0 POINTS - The plug is represented by a scribble.

1 POINT - The plug is represented by a long rectangular shape with little or no detail.

2 POINTS - The plug is represented by a thick line and box shape, perhaps with incorrect detail.

3 POINTS - The plug is represented by a thick cord and square plug shape.

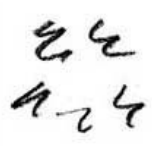
Detail Rating:

____ (0, 1, 2, or 3 points)

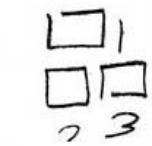
Number Pad

Does the microwave have a number pad? _____ (1 = Yes, 0 = No)

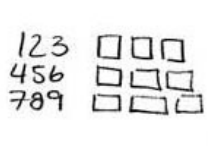
Detail



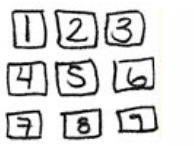
0 POINTS - The number pad is represented by a scribble.



1 POINT - The number pad is represented by a few numbers and/or boxes.



2 POINTS - The number pad is represented by a correct set of numbers or a correct set of boxes.



3 POINTS - The number pad is represented by a correct set of numbers with boxes.

Detail Rating:

____ (0, 1, 2, or 3 points)

Buttons

Does the microwave have a button? _____ (1 = Yes, 0 = No)

Detail

0 POINTS - The button(s) are represented by a scribble.

1 POINT - The button(s) are represented by a circular shape.

2 POINTS - The button(s) are represented by a square shape.

3 POINTS - The button(s) are represented by a square shape with wording.

Detail Rating:

____ (0, 1, 2, or 3 points)

Opening Button

Does the microwave have an opening button? _____ (1 = Yes, 0 = No)

Detail

0 POINTS - The button is represented by a scribble.

1 POINT - The button is represented by a line.

2 POINTS - The button is represented by a square.

3 POINTS - The button is represented by a rectangle.

Detail Rating:

____ (0, 1, 2, or 3 points)

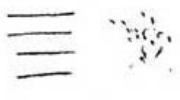
Door

Does the microwave have a door? _____ (1 = Yes, 0 = No)

Detail

0 POINTS - The door is represented by a scribble.

1 POINT - The door is represented by a square/rectangular shape.



2 POINTS - The door is represented by lines or dots.

3 POINTS - The door is represented by a square or rectangular shape with the lines and dots.

Detail Rating:

____ (0, 1, 2, or 3 points)

Other Distinguishing Features:

- Does the microwave have words? _____ (1 = Yes, 0 = No)
- Does the microwave have a clock? _____ (1 = Yes, 0 = No)

- Does the microwave have numbers (other than the number pad)? _____ (1 = Yes, 0 = No)
- List all additional parts of the microwave and/or setting:
  _____
- Total # of other parts: _____