*Perceptual and Motor Skills*, 2012, 114, 1, 29-42. 

# OBJECT AND SIZE AWARENESS IN PRESCHOOL-AGE CHILDREN[1, 2, 3]

CAROLINE E. BOYER, ABBY G. CARLSON, AND ROBERT PASNAK

*George Mason University*

*Summary.*—Self-awareness is a skill developed during the first few years of life. Although some research demonstrates that this ability may be incomplete in toddlers, there is little to no literature relating to preschoolers. This study tested 44 preschool-age children on 8 tasks to assess their awareness of the structural characteristics of their own size and weight as well as the size and weight of external objects. The most frequently observed behavior was for children to make an attempt at something that was inappropriate for their size and weight, but overall participants showed a better understanding of their own bodies than other objects. Both the number of attempts required to solve the problems and accuracy of their solutions demonstrated these task differences. These results indicate that the development of body awareness skills is far from complete for 3- and 4-year-olds.

Self-awareness is the understanding of oneself as an active agent interacting with other objects in the world. It is an understanding of the self as *I*, the subject of experience, and *me*, the object of knowledge (Bullock & Lutkenhaus, 1990). Self-awareness is believed to develop over the course of the first several years of life.

Observations of children's behaviors in front of a mirror have suggested the development of an objective self occurs in stages (Amsterdam, 1972; Brooks-Gunn & Lewis, 1984; Lewis, Sullivan, Stanger, & Weiss, 1989). Children ages 6 through 12 months treated the image as a social playmate, suggesting that they had not yet developed an awareness of self. Children ages 13 through 24 months expressed self-consciousness or self-admiration, suggesting they had begun to develop an awareness of self, as one would not exhibit such behaviors unless one was aware that the image was oneself (Brooks-Gunn & Lewis, 1984). Between 20 and 24 months of age, children identified the image as themselves, from which one might infer that they had developed an awareness of their objective selves.

Although a number of researchers have conducted either a mirror recognition study or some variation, this is only one aspect of self-awareness. A separate characteristic of general self-awareness is body self-awareness, an understanding of one's body as an object which can operate in relation

[1]Address correspondence to Caroline Boyer, Department of Psychology, George Mason University, 4400 University Drive 3F5, Fairfax, VA 22030 or e-mail (cboyer1@gmu.edu).
[2]The research reported here was supported by the Institute of Education Sciences, U.S. Department of Education, through Grant R305B070542. The opinions expressed are those of the authors and do not represent views of the Institute or the U.S. Department of Education.
[3]The authors are grateful for the gracious cooperation of the children, parents, teachers, and administrators of the Alexandria Head Start program.

DOI 10.2466/10.22.27.PMS.114.1.29-42 ISSN 0031-5125

to other objects (Brownell, Zerwas, & Ramani, 2007). This construct is concerned with the awareness of characteristics of the body (Moore, Mealiea, Garon, & Povinelli, 2007).

Even though self-recognition (traditionally tested using the mirror task) and body self-awareness are both aspects of self-awareness, they do not develop in the same pattern. Body self-awareness may take longer to develop because it is a more complex construct. To be successful on body self-awareness tasks, children must be aware of the objects in the task as well as their own bodies in relation to those objects. They need to be able to hold the relevant information about the object in their minds and to manipulate representations of their own bodies, taking into account their own bodies' characteristics from multiple perspectives (Brownell, *et al*., 2007).

Studies of the development of body self-awareness (Piaget, 1952; Brownell, *et al*., 2007; Moore, *et al*., 2007) have shown that older children are more successful than younger ones on measures requiring them to be aware of their bodies as obstacles and the dimensions of their bodies. Piaget (1952) observed that at 18 months of age, his daughter, Jacqueline, was unable to recognize herself as an obstacle preventing her from picking up a rug, but a month later she was able to successfully complete this task. This observation suggests that an awareness of one's body as an object develops over time as a result of interactions with the world.

Moore and colleagues (2007) used a locomotion task, which required that the children recognize they could not push a shopping cart while standing on a mat that was attached to the axles. Their findings were similar to the observations of Piaget: children 21 months of age were significantly more successful than children 16 months of age. Brownell and colleagues (2007) compared tasks that required children to recognize their bodies as obstacles to tasks that required children to be aware of the size and shape of their own bodies. They concluded that the development of body self-awareness is not complete by 2 years of age, as the 26-month-old children in the study still made considerable errors on these tasks. Taken together, these findings suggest a developmental progression in the attainment of these skills. It is likely that awareness of one's body develops over time based on interactions with the world. However, it appears that this development is not complete by 26 months of age, since these children still made a considerable number of errors (Brownell, *et al*., 2007), and those who were successful on these tasks required multiple attempts before eventual success through trial and error (Moore, *et al*., 2007).

Given the egocentric nature of young children, one may suppose they become aware of their own qualities (body self-awareness) before they learn the qualities of other things (other object-awareness). This also

makes sense from a statistical point of view; they experience their selves more than they experience anything that is external. In the course of their interactions with the world around them, children develop an understanding of their own body's size, shape, and mass, and also learn that certain things are too small or large for the body. This may involve clothing or adornments and may also extend to the space into which one can fit or pass through.

DeLoache and colleagues (DeLoache, Uttal, & Rosengren, 2004) found that when toddlers are first given an object like a slide or a chair to play with and then are given miniature replicas of these objects, the typical response is to try to perform the same behaviors on the miniature replicas (e.g., trying to slide down the small slide). DeLoache labeled this inability to adapt behavior to the size of the object with which one is interacting "scale errors."

Scale errors are believed to occur as a result of one of two models (Glover, 2004). The planning-control model suggests that before behavior is initiated, action planning occurs based on memories of past actions, semantics, and visual illusions. Thus, before a child tries to sit on the toy slide, a plan of action is first developed based on the fact that the object is a slide, regardless of its size. The perception-action model suggests that scale errors are a result of children's immature perceptual apparatus, so they mistake the miniature replica for the full-sized object.

At first glance, it may appear that body self-awareness tasks and scale error tasks measure the same construct because both deal with children judging the size of objects. These may be related constructs, but it is clear by the skills that each requires and the performance by the children on these different tasks that they are distinct. The scale error tasks require that the children choose the appropriate behavior for the size of an object, whereas the body self-awareness tasks require children to also access relevant information about their own bodies, first choosing the appropriate object and then choosing the appropriate behavior for the object. Other evidence for uniqueness of constructs is found in the study by Brownell, *et al*. (2007), which used the same eight tasks that are used in the current study. These children made multiple errors across the eight tasks. In addition to errors, children became frustrated and sought alternative strategies, such as requesting assistance from adults and engaging in problem-solving. If such errors were truly scale errors, it is unlikely that the children would not have made repeated efforts to complete each task. With scale errors, the inability to complete tasks may be attributed to an immaturity in visual perception which leads to an initial attempt to interact with the object (Glover, 2004). This error should be corrected after a single interaction with the object, when the child realizes that he has visually misrepresent-

ed an object (Glover, 2004). It is important to note that these tasks (scale error and body awareness) require different, but related, skill sets, so it is likely that a lack of development on one construct could result in errors on a task measuring the other.

The Brownell study (2007) was a comprehensive examination of both self-awareness and object-awareness for toddlers ages 18, 22, and 26 months. Each completed five tasks on which they needed to either be aware of the size of their own bodies or recognize their own bodies as obstacles, and five other tasks on which they needed to either be aware of the size of another object or recognize another object as an obstacle. The 26-month-old toddlers made fewer errors than the 18- and 22-month-old toddlers, who did not differ significantly. There were few systematic differences in performances on the self-awareness and object-awareness tasks. The only consistent finding was that the toddlers made fewer errors on tasks in which their own bodies or an object was an obstacle, as in moving a mat on which they or a heavy weight was sitting. They made more errors dressing themselves or an adult in doll clothes or pushing themselves or toys through doors. This was the starting point for the present research, which is a partial replication and an extension.

In the current study, focus was on whether self-awareness and other object-awareness continue to develop through the preschool years or are complete by 4 years of age. Whether self-awareness develops before or at the same time as other object-awareness was a second interest. It was hypothesized that the older children would be more successful on these tasks and require fewer trials than younger children, who were thought to be developing these skills. It was also hypothesized that all children would be more successful on tasks which required an awareness of the self than on tasks which required an awareness of other objects.

## Method

### *Participants*

The participants were 44 children (20 girls) in three age groups: 29–39.5 mo. ($M = 36.8$, $SD = 2.44$), 40–45 mo. ($M = 42.54$, $SD = 1.49$), and 45.5–48 mo. ($M = 46.60$, $SD = 0.88$). The 29–39.5-mo.-old group contained seven boys and eight girls, the 40–45-mo.-old group contained 10 boys and three girls, and the 45.5–48-mo.-old group contained seven boys and nine girls. They were recruited from seven early intervention preschool centers in a Washington, DC, suburb. Fourteen were Hispanic, 13 were African American, 10 were West African, and seven were Middle Eastern.

### *Measures*

The procedures were adapted from those used by Brownell, *et al*. (2007). All children were administered four tasks to assess body self-

awareness and four comparison tasks to assess their awareness of other objects.

*Body Self-awareness Tasks*

The four body self-awareness tasks were administered to judge how aware the children were of the dimensions of their own bodies. Two of the tasks required the children to consider their own bodies' dimensions in relation to the dimensions of another object. The other two tasks required children to assess their bodies as an obstacle to the completion of the task.

For the doll-clothes task, children demonstrated whether they understood that doll clothes were much too small for them to wear. They were first asked to help the researcher to change the clothes on a 40.5-cm doll. After the doll was changed, the researcher handed the doll clothes to the participant and asked, "Can you wear these clothes?" If the child did not spontaneously attempt to put on the clothing, the researcher would prompt the child again by asking, "Do these clothes fit you?" If the child requested assistance from the researcher, the researcher would do so to the extent possible; for example, holding the shirt while the child attempted to put an arm in the sleeve.

For the door choice task, children were asked to choose which door they could fit through to get to the other side of a wall. The wall was 1 × 2 m with a tall, skinny door 10 cm wide × 80 cm tall and a short, wide door 30 cm wide × 30 cm tall. One researcher would stand on the same side of the wall as the children and tell them to go to the other side of the wall to play a game with attractive toys held by a second researcher. The children were shown both of the doors and were told specifically that they needed to go through one of the doors to get to the other side. The children could only fit through the short, wide door. If they chose the tall, skinny door, the researchers would prompt them by saying, "You need to go through one of the doors in order to get to the other side."

For the stroller task, the participants were required to recognize their own bodies as an obstacle to pushing a stroller. The children stood on a blanket attached by ropes to the stroller handles, and they were asked to push the doll stroller from Point A to Point B (approximately 1 m). They needed to recognize that they had to either step off the blanket or detach the ropes from the stroller handles to move the stroller successfully.

For the mat task, children needed to recognize their bodies as an obstacle in order to pick up a mat. They first were asked to sit on a mat to have a conversation with the researcher, and after spending several minutes talking to the researcher about their favorite activities in school, they were asked to help clean up by picking up the mat and folding it. In order to do this, they had to first recognize that they had to get off the mat before they could pick it up.

*Other Object-awareness Tasks*

Four other object-awareness tasks were used as comparison tasks for the body self-awareness tasks, and they mirrored the four self-awareness tasks. Two tasks required that the children be aware of the relevant dimensions of the objects. The other two required the children to recognize the objects as obstacles.

For the doll-clothes task, the children were required to judge whether a researcher would be able to wear clothing that was much too small for her. They were first asked to assist the researcher with changing the clothes on a 40.5-cm doll. After the doll was changed, the researcher handed the doll clothes to the children and asked, "Can I wear these clothes?" If the participants responded "yes," the researcher would ask the children to help her get dressed, putting an arm out for the children to attempt to put the shirt on.

For the door-choice task, the participants were required to judge which door a tall, skinny doll would fit through. The doll was constructed out of poster board and stabilized by wooden rods so that the participants could not fit it through the short, wide door. The participants were told that the doll was a friend of the researcher on the other side of the wall and that they needed to help him by passing him through one of the doors in the wall (previously described in the self-awareness door-choice task). In order to pass the doll through the wall successfully, the children had to choose the tall, skinny door.

For the stroller task, the children were required to recognize an object as an obstacle so they could push a stroller. They were asked by the researcher to push a stroller from Point A to Point B (approximately 1 m). The stroller was connected to a blanket attached by ropes to the stroller handles, and there was a weighted stuffed animal on the blanket which prevented the children from moving the stroller. To push the stroller, the children had to either move the weighted stuffed animal or detach the ropes.

For the mat task, the children needed to recognize an object as an obstacle to picking up a mat. They were asked to sit on the floor with a researcher next to a mat on which sat a weighted stuffed animal so that they could have a picnic. After several minutes, the children were asked to help clean up by picking up the mat and folding it. To pick up and fold the mat, the children had to recognize that the stuffed animal had to first be moved from the mat.

*Coding*

Both researchers coded the child's behaviors after the completion of each task; each was kept blind to the code given by the other researcher. For each task, the child's behaviors were coded as: Success, Trial and suc-

cess, Success with help, or Failure. A "Success" was successfully completing the task on the first attempt. A score of "Trial and success" meant that the child successfully completed the task on his own after making at least one error. A score of "Success with help" was given when the child was able to complete the task successfully with assistance from the researchers after at least one error. A failure indicated that the child did not successfully complete the task even after making errors and receiving assistance from the researchers. The number of attempts that the child made to complete the task was also recorded, with a greater number indicating more failed attempts before completion. There was no limit to the number of attempts that a child could make on each task.

*Procedure*

After approval by the Human Subjects Review Board, parental consent was obtained prior to selection of participants. All children for whom consent was obtained were initially included in the study. Two of the original male participants were excluded from the study. One spoke no English and the other had no language abilities. Participation was contingent on communication with the researchers, so these two children were not included in the study. All other students participated for the duration of the study.

Within the preschool centers, tasks were administered in a random order by a team of two researchers, who both coded the participants' behaviors. The children were given the opportunity to complete each task on their own, but if they referenced a researcher or asked for assistance, the researcher assisted them in completing the task.

## Results

*Successes*

Interrater reliability between the two coders for successes was excellent ($r = .98$, $p < .001$). A 3 (age) × 2 (self vs other object) × 4 (task type) mixed analysis of variance (ANOVA) was applied to examine differences in success rates among these measures. Means and standard deviations for success on each task are given in Table 1.

Children had significantly greater success on the self-awareness tasks than on the other-awareness tasks. Mauchly's test indicated a violation of the assumption of sphericity for the task main effect [$\chi^2(5) = 15.55$, $p < .05$], therefore, the Greenhouse-Geisser test is reported ($\varepsilon = .76$). The main effect of task type was statistically significant, indicating that success was affected by type of task. There was also a statistically significant interaction of awareness type (self vs other) by task type. Test statistics, $p$ values, and effect sizes (partial eta squared) for success are given in Table 2. Multiple $t$ tests were conducted to follow up these findings, comparing self-

TABLE 1
MEANS AND STANDARD DEVIATIONS FOR SUCCESSES AND NUMBER OF ATTEMPTS ON EIGHT TASKS

| Task | Successes | | Attempts | |
|---|---|---|---|---|
| | *M* | *SD* | *M* | *SD* |
| Stroller self-awareness | 1.91 | 0.68 | 1.65 | 2.13 |
| Doll self-awareness | 2.12 | 1.20 | 1.37 | 1.73 |
| Door self-awareness | 1.89 | 0.95 | 1.39 | 1.87 |
| Mat self-awareness | 1.05 | 0.30 | 0.20 | 0.70 |
| Stroller object-awareness | 2.69 | 0.78 | 5.05 | 3.66 |
| Doll object-awareness | 2.55 | 1.09 | 2.67 | 2.51 |
| Door object-awareness | 1.58 | 0.73 | 0.79 | 1.10 |
| Mat object-awareness | 2.13 | 0.97 | 2.50 | 3.02 |

and other-awareness for each task type, as well as within-awareness (self or other) comparisons. A Bonferroni inequality was applied, and all effects are reported at the .003 level of significance. See Table 3 for test statistics, confidence intervals, and effect size *d* for these comparisons.

TABLE 2
MIXED ANALYSIS OF VARIANCE FOR SUCCESS RATES

| Variable | *df* | *F* | η | *p* |
|---|---|---|---|---|
| Age | 2 | 2.09 | 0.10 | .14 |
| Self/Other | 1 | 37.77 | 0.51 | < .001 |
| Task type | 3 | 13.15 | 0.26 | < .001 |
| Self/Other × Age | 2 | 0.03 | 0.02 | .97 |
| Task × Age | 6 | 0.85 | 0.04 | .54 |
| Self/Other × Task | 3 | 14.72 | 0.29 | < .001 |

When comparing self- and other-awareness within task types, children did statistically significantly better on the self-awareness tasks for the stroller and mat conditions, while they did better on the other-awareness task for the doll condition. There were no statistically significant differences between self- and other object-awareness for the door condition.

Within the self-awareness tasks, the only statistically significant differences were found for successful completion of the mat task, which re-

TABLE 3
*t* TEST COMPARISONS OF MEAN SUCCESS DIFFERENCES BETWEEN SELF-AWARENESS AND OTHER OBJECT-AWARENESS TASKS

| Comparison | *df* | *t* | *d* | 95%*CI* | *p* |
|---|---|---|---|---|---|
| Self/Other stroller task | 40 | 4.34 | 1.09 | 1.18, 0.43 | < .001 |
| Self/Other door task | 43 | 1.34 | 0.28 | 0.27, 0.63 | .19 |
| Self/Other doll task | 40 | 3.53 | 0.42 | 0.73, 0.20 | < .001 |
| Self/Other mat task | 39 | 6.82 | 1.59 | 1.39, 0.76 | < .001 |

TABLE 4
*t* Test Comparisons of Mean Success Differences Within Self-awareness and Other Object-awareness Tasks

| Comparison | *df* | *t* | *d* | 95%*CI* | *p* |
|---|---|---|---|---|---|
| Other object-awareness tasks | | | | | |
| Stroller/Door | 41 | 6.18 | 1.47 | 0.75, 1.48 | < .001 |
| Stroller/Doll | 40 | 0.85 | 0.16 | −0.20, 0.50 | .40 |
| Stroller/Mat | 39 | 3.10 | 0.71 | 0.22, 1.03 | < .001 |
| Door/Doll | 41 | −4.38 | 0.94 | −1.32, −0.49 | < .001 |
| Door/Mat | 39 | −2.68 | 0.61 | −0.92, −0.13 | .01 |
| Doll/Mat | 39 | 2.21 | 0.46 | 0.04, 0.91 | .03 |
| Self-awareness tasks | | | | | |
| Stroller/Door | 42 | 0.16 | 0.04 | −0.27, 0.31 | .87 |
| Stroller/Doll | 41 | −1.07 | 0.23 | −0.62, 0.19 | .29 |
| Stroller/Mat | 42 | 7.02 | 1.56 | 0.61, 1.11 | < .001 |
| Door/Doll | 42 | −0.83 | 0.18 | −0.64, 0.27 | .41 |
| Door/Mat | 43 | 5.73 | 1.13 | 0.53, 1.11 | < .001 |
| Doll/Mat | 42 | 5.40 | 1.15 | 0.63, 1.37 | < .001 |

quired fewer attempts than the stroller, doll, and door tasks. There were no other differences for any other group comparisons. Within the other object-awareness tasks, successful completion of the door task required fewer attempts than both the stroller and the doll tasks. The stroller task required more attempts than the mat and door tasks. There were no other group differences. See Table 4 for test statistics, confidence intervals, and effect size *d* for these comparisons.

There were no statistically significant age differences in success among the three age groups. A significant interaction for age by task or for age by awareness type was not found. The three-way interaction between awareness type, task type, and age was not statistically significant either (see Table 2).

A *t* test was conducted to see if there were mean group differences for boys and girls. As a group, girls ($M = 1.52$, $SD = 0.42$) were more successful than boys ($M = 1.91$, $SD = 0.47$) on the self-awareness tasks, but not on the object-awareness tasks.

*Attempts*

Interrater reliability for attempts was also excellent ($r = .98$, $p < .001$). Means, standard deviations, test statistics, confidence intervals, and effect

TABLE 5
Mean Gender Differences For Successes and Attempts

| Comparison | *df* | *t* | *d* | 95%*CI* | *p* |
|---|---|---|---|---|---|
| Success | 42 | 2.85 | 0.89 | 0.10, 0.55 | .01 |
| Attempts | 42 | 0.83 | 0.26 | −0.53, 1.26 | .41 |

sizes for attempts on each task are given in Table 1. A 3 (age) × 2 (self vs other object) × 4 (task type) mixed analysis of variance was used to examine the differences for number of attempts needed before successful completion of the task. There were statistically significant differences between the self-awareness tasks and the other object-awareness tasks in number of attempts.

The main effect for task type indicated different mean performance for the four different task types, but the focus is on the self versus other by task type interaction. Mauchly's test indicated a violation of the assumption of sphericity [$\chi^2(5) = 12.12$, $p < .05$], therefore, the Greenhouse-Geisser test is reported ($\varepsilon = .33$). There was a statistically significant interaction between awareness type and task type. There was no significant main effect of age and also no interactions for age by task or age by awareness type. The three-way interaction was not statistically significant either. Test statistics, *p* values, and effect size (partial eta squared) for success are given in Table 6.

TABLE 6
Mixed Analysis of Variance For Attempts Prior to Completion

| Variable | *df* | *F* | η | *p* |
|---|---|---|---|---|
| Age | 2 | 0.22 | 0.01 | .79 |
| Self/Other | 1 | 28.85 | 0.42 | < .001 |
| Task type | 3 | 17.78 | 0.31 | < .001 |
| Self/Other × Age | 2 | 0.38 | 0.02 | .68 |
| Task × Age | 6 | 0.90 | 0.04 | .49 |
| Self/Other × Task | 2.46 | 72.68 | 0.24 | < .001 |

Multiple *t* tests were conducted to follow up these findings, comparing self- and other-awareness for each task type as well as within-awareness (self or other) comparisons. A Bonferroni inequality was applied and all effects are reported at the .003 level of significance. When comparing self- and other object-awareness within task types, children did statistically significantly better on the self-awareness tasks for the stroller and mat conditions. There were no statistically significant differences between self-

TABLE 7
*t* Test Comparisons of Mean Attempt Differences Between Self-awareness and Other Object-awareness Tasks

| Comparison | *df* | *t* | *d* | 95%*CI* | *p* |
|---|---|---|---|---|---|
| Self/Other stroller task | 43 | 4.58 | 1.09 | 1.82, 4.68 | < .001 |
| Self/Other door task | 42 | −1.94 | 0.41 | −1.28, 0.03 | .06 |
| Self/Other doll task | 43 | 4.14 | 0.61 | 0.66, 1.93 | < .001 |
| Self/Other mat task | 42 | 4.97 | 1.10 | 1.40, 3.30 | < .001 |

and other object-awareness for the doll and door conditions. See Table 7 for test statistics, confidence intervals, and effect size *d* for these attempt comparisons.

Among the self-awareness tasks, the only statistically significant differences were found for successful completion of the mat task, which required fewer attempts than the stroller, doll, and door tasks. Other statistically significant comparisons were from the other object-awareness tasks. Successful completion of the door task required fewer attempts than both the doll and the mat tasks. The stroller task required more attempts than the doll, door, and mat tasks. The mat and doll tasks did not differ statistically significantly.

In order to assess whether there were mean sex differences in number of attempts needed for completing a task, *t* tests were conducted. On measures of self-awareness, differences between girls ($M = .88$, $SD = 0.81$) and boys ($M = 1.43$, $SD = 1.04$) fell short of statistical significance, as girls made fewer attempts. There were no sex differences for number of attempts on the object-awareness tasks.

TABLE 8
STUDENT *t* TEST COMPARISONS OF MEAN ATTEMPT DIFFERENCES WITHIN SELF-AWARENESS AND OTHER OBJECT-AWARENESS TASKS

| Comparison | *df* | *t* | *d* | 95%*CI* | *p* |
|---|---|---|---|---|---|
| Other object-awareness tasks | | | | | |
| Stroller/Door | 42 | 7.17 | 1.59 | 3.06, 5.45 | < .001 |
| Stroller/Doll | 43 | 3.61 | 0.75 | 1.01, 3.58 | < .001 |
| Stroller/Mat | 42 | 4.21 | 0.76 | 1.30, 3.28 | < .001 |
| Door/Doll | 42 | −4.59 | 0.93 | −2.78, −1.08 | < .001 |
| Door/Mat | 42 | −3.46 | 0.72 | −2.80, −.74 | < .001 |
| Doll/Mat | 42 | 0.28 | 0.06 | −1.02, 1.34 | .78 |
| Self-awareness tasks | | | | | |
| Stroller/Door | 43 | 0.95 | 0.17 | –0.38, 1.06 | .35 |
| Stroller/Doll | 43 | 0.82 | 0.17 | –0.49, 1.18 | .42 |
| Stroller/Mat | 43 | 4.50 | 0.95 | 0.84, 2.21 | < .001 |
| Door/Doll | 43 | 0.00 | 0.00 | –0.75, 0.75 | 1 |
| Door/Mat | 43 | 3.98 | 0.84 | 0.58, 1.78 | < .001 |
| Doll/Mat | 43 | 4.43 | 0.91 | 0.64, 1.72 | < .001 |

## DISCUSSION

Previous researchers (Bullock & Lutkenhaus, 1990; DeLoache, *et al*., 2004; Ware, Uttal, Wetter, & DeLoache, 2006; Brownell, *et al*., 2007; Moore, *et al*., 2007) reported that toddlers had a quite incomplete sense of physical self-awareness. In this research, children had not completely developed an awareness of their own size, shape, and weight by preschool. Except for the task involving getting off a mat before attempting to move it, the median success score was 2.0 on self-awareness tasks (i.e., although chil-

dren varied, the typical performance was to make an initial error and then to make the correct decision). Even the oldest children had mean scores of 1.6, so it is clear that the developmental processes of self- and other object-awareness were still not completed by the preschool sample.

Other object-awareness tasks required a mean of three attempts for successful task completion, indicating children had greater difficulty on these tasks than the self-awareness tasks. Perhaps this may indicate a progression of development of self-awareness prior to other object-awareness. This difference makes sense; children have more experience with their own bodies than with other objects. It is easier to conceptualize the dimensions of their bodies than dimensions of objects with which they have less experience.

This skill development is more difficult when objects must be understood in relation to other objects, such as understanding how one's own body or an unfamiliar object may relate to another object. The lack of significant differences between self- and other object-awareness on the door tasks illustrates this. This task required an understanding of the body's dimensionality, while the mat and stroller tasks required understanding of the body as an obstacle. Although there was a difference in performance on the doll task, the magnitude was less than that for comparisons with the body as an obstacle. Perhaps children do not master this aspect of body dimensionality until sometime during the early elementary school years, although such research is incomplete.

The toddlers in Brownell, *et al*.'s study (2007) showed no differences on tasks for self- versus other-awareness, and Moore, *et al*. (2007) reported only limited support for such a difference on the stroller task. Preschoolers in the present sample have had more time than toddlers to put their extra experience to use in understanding the implications of their own dimensions.

Progress in developing self-awareness seemed relatively even. The preschoolers had similar success on the stroller, door, and doll self-awareness tasks and did not differ in the number of attempts they made on any of these tasks. However, they were significantly better on the mat self-awareness task than any of the other self-awareness tasks. This task may have been easier because some form of it must be performed at school during circle time. Brownell, *et al*.'s toddlers (2007) only showed differences between the mat and the stroller tasks, with statistically significantly better performance on the former. It is possible that the mat task is better learned by kindergarten or that performance on all tasks has improved enough to be similar.

Becoming aware of the interaction between one's own size, shape, and weight and the appropriateness of actions with objects and barriers gener-

ally precedes awareness of those interactions involving other objects. This was illustrated by better performance on the stroller, mat, and doll self-awareness tasks when compared with their object-awareness uses. There was some variation from task to task, but both success and the number of attempts generally showed somewhat better performance on the door object-awareness task and poorer performance on the stroller object-awareness task. This indicates better understanding of the dimensions of other objects than of other objects as obstacles. Following the same line of thought, young children have more experience with external objects in the form of toys or objects they handle and manipulate, which would give an understanding of objects' dimensionality. There is comparatively less experience with objects as obstacles at this age.

The present experiment showed self-awareness generally developed sooner for these girls than for the boys. No explanation can be given for this difference, even though the boys made nearly twice as many errors as the girls.

Lack of age differences for both success and number of attempts was surprising, but with the children's age range of 1.5 yr., participants fell between 36 and 48 mo. Although results from this study indicate that there is a developmental progression involved in the mastery of these skills, there seems to be no sizable leap forward on these skills during the preschool years. Children are still trying to master this developmental skill during preschool.

Children's awareness of the limitations imposed on their activities by their own body dimensions and by dimensions of external objects continues to develop during the preschool period. Both self-awareness and other object-awareness in a physical sense remain incomplete, as children failed to anticipate problems posed by objects as obstacles or by their own dimensions, but they could correct these errors after the initial failure. Such errors are likely to decrease with age as children grow older and experience continued exposure to themselves and their environments.

*Limitations*

This small sample was of children from one early intervention preschool which must be kept in mind when considering the limited relative generalizability of these results.

REFERENCES

Amsterdam, B. (1972) Mirror self-image reactions before age two. *Developmental Psychobiology,* 5, 297-305.

Brooks-Gunn, J., & Lewis, M. (1984) The development of early visual self-recognition. *Developmental Review,* 4, 215-239.

Brownell, C. A., Zerwas, S., & Ramani, G. B. (2007) So big: the development of body self-awareness in toddlers. *Child Development,* 78, 1426-1440.

Bullock, M., & Lutkenhaus, P. (1990) Who am I? Self-understanding in toddlers. *Merrill-Palmer Quarterly,* 36, 217-238.

DeLoache, J., Uttal, D., & Rosengren, K. (2004) Scale errors offer evidence for a perception-action dissociation early in life. *Science,* 304, 1027-1029.

Glover, S. (2004) What causes scale errors in children? *Trends in Cognitive Sciences,* 8, 440-442.

Lewis, M., Sullivan, M. W., Stanger, C., & Weiss, M. (1989) Self development and self-conscious emotions. *Child Development*, 60, 146-156.

Moore, C., Mealiea, J., Garon, N., & Povinelli, D. (2007) The development of body self-awareness. *Infancy*, 11, 157-174.

Piaget, J. (1952) *The origins of intelligence in children*. New York: International Univer. Press.

Ware, E., Uttal, D., Wetter, E., & DeLoache, J. (2006) Young children make scale errors when playing with dolls. *Developmental Science,* 9, 40-45.

*Accepted December 5, 2011.*