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Parental Reports of Children's Scale Errors in Everyday Life

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Scale errors refer to behaviors where young children attempt to perform an action on an object that is too small to effectively accommodate the behavior. The goal of this study was to examine the frequency and characteristics of scale errors in everyday life. To do so, the researchers collected parental reports of children's (age range = 13–21 months at onset) scale errors over a 6-month period. All but 1 of the parents (N = 30) reported at least 1 scale error with an average of 3.2 scale errors per child. These results suggest that most, if not all, children commit scale errors during early childhood.

Scale errors refer to behaviors where young children attempt to perform an action on an object that is too small to effectively accommodate the behavior. Initial anecdotal reports of scale errors described children attempting to sit on a small-scale chair, slide down a small-scale slide, and climb into a small-scale car. DeLoache, Uttal, and Rosengren (2004) referred to these behaviors as *scale errors* and showed that they could be elicited in a laboratory environment. The aim of the present study was to examine the frequency and characteristics of scale errors committed by young children in everyday situations.

In the original study by DeLoache et al. (2004), 18- to 30-month-old children were brought into a laboratory and presented with an appropriately sized chair, slide, and toy car. These objects supported actions that the child could easily perform such as sitting, sliding, and climbing in. These body-scaled items were then replaced by miniature scale replicas of the same items. Roughly half of the children (25/54) exposed to the miniature items committed at least one scale error—attempting to perform the same action on the miniature item that they could successfully perform with the larger item. We refer to these behaviors as *body scale errors*.

Ware, Uttal, Wetter, and DeLoache (2006) demonstrated that young children also make scale errors involving dolls and smaller inappropriately scaled objects. We label this type of behavior involving two objects as *object scale errors*. Ware et al. examined the doll play behavior of children between 16 and 40 months of age in a laboratory setting using a similar study design as the original study (DeLoache et al., 2004). On average children performed 1.4 object scale errors, with older children (35–40 months) making more errors than younger children (16–24 months). These researchers suggest that older children may have made more scale errors because they were more interested in the toys, engaged in more toy play, and thus had more opportunities to commit scale errors.

Brownell, Zerwas, and Ramani (2007) extended past research on scale errors in a study examining the development of body self-awareness in 18- to 26-month-old children. They found that most children committed both types of errors, with 90%–100% of participants committing body scale errors and 42%–82% committing object scale errors, with the frequency of scale errors declining with age. Brownell et al. suggest that scale errors stem from the fact that young children have difficulty thinking about their bodies as physical entities.

A different perspective is provided by DeLoache et al. (2004) who proposed that scale errors are an indication of a lack of integration between perception and action in typically developing young children. They suggested that scale errors are likely due to lack of inhibitory control and because visual information for action planning is not integrated with visual information for controlling the action (Glover, 2002, 2004; Milner & Goodale, 1995). When a child sees a miniature scale replica, this visual

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information may activate a representation of the larger object or class of objects that the replica represents. Accompanying this representation may be the activation of an action plan associated with the larger object or category. That is a child sees a small chair, the representation of ''chairs'' is activated along with an action plan (i.e., ''sitting in the chair''). Due to poor inhibitory control, the action plan is not inhibited and the child attempts the action (i.e., tries to sit in the too small chair). This argument is supported by research showing connections between motor and cognitive representations (Barsalou, Simmons, Barbey, & Wilson, 2003; Tucker & Ellis, 1998, 2001).

A common question with respect to scale errors is how these behaviors differ from pretense. Pretense at this age generally involves different types of actions than those described as scale errors. That is, rather than attempting to climb into a tiny car, children pretending will often move the car with their hands while simultaneously making motor sounds. The work by DeLoache et al. (2004) and Brownell et al. (2007) suggest that coders can easily and reliably distinguish between scale errors and pretend play. Individuals who witness a child performing a scale error find them inherently fascinating because they seem to indicate that the young child committing the scale error responds to a particular object in ways that are distinctly different from that of older children and adults. Although these behaviors have been documented anecdotally and elicited in many children studied in laboratory situations, at present we really do not know how prevalent these behaviors are in children. If this is a rare phenomena, present only in a few children or only elicited in highly controlled laboratory settings, then it is not clear whether this behavior is of much value to developmentalists, as it may be nothing more than an interesting, but strange behavior sometimes performed by children. If, however, scale errors are something that most, if not all, children perform at some time, then this behavior may result from some fundamental aspect of brain organization characteristic of a particular point in development. If this is the case, further investigation of these behaviors may lead to important insights into the development of the brain.

The goal of the present study was to investigate the frequency of scale errors in the everyday lives of children. Ware, Uttal, and DeLoache (in press) have attempted this by using an online survey. They found that many parents have witnessed their children spontaneously performing scale errors. Although their study provides important evidence for the occurrence of scale errors in the everyday lives of children, their sampling procedure does not allow for an in-depth assessment of the frequency of these behaviors across time. This was the goal of the present study. To accomplish this, we asked parents to record the frequency and characteristics of any scale errors committed by their children over a 6-month period.

Method

Participants

Participants were mothers of 30 children (15 male, 15 female). At the start of the study the children were between 12.5 and 26 months of age (average initial age = 18.3 months). We started children at different ages when they were enrolled in the study to enable a larger age range to be examined (see Table 1). Parents were recruited using flyers placed at local preschools and in other laboratories in the psychology department, as well as from local contacts in the community. Participants were predominantly White and middle-class.

Procedure

Parents individually attended a 40-min training orientation. During this orientation, an experimenter first explained the purpose of the study and defined the different types of scale errors. Body scale errors were defined as actions involving a child and a miniature object (e.g., a tiny chair) that did not support the successful completion of the action due to the size differential between the child and object. Attempts by a child to fit an object into or onto a more miniature item that was not scaled appropriately for the original object were described as object scale errors.

The participants then viewed four videotaped examples of the target behaviors (three examples of body scale errors and one example of an object scale error). Following each videotaped example, parents were asked to describe the behavior observed using a standardized form. Specifically, parents were asked to rate the behavior on a 5-point scale indicating whether it was 1 = *definitely serious*, 2 = *probably serious*, 3 = *not clear*, 4 = *probably pretending*, and 5 = *definitely pretending*. They were also asked to provide details about the event, any objects involved in the event, as well as the child's reaction to unsuccessful actions. An experimenter discussed the parent's rating of the examples to ensure that the parent

Table 1
Age Distribution (in Months) of Body and Object Scale Errors (SE) by Participant

	Serious SE				Pretense SE			
Age of entry	Age of first body SE	Age range of body SE	Age of first object SE	Age range of object SE	Age of first body SE	Age range of body SE	Age of first object SE	Age range of object SE
12.5	14.0	14.0–18.0 (2)	—	—	—	—	—	—
12.5	15.0	15 (1)	13.0	13.0–16.0 (2)	—	—	—	—
13.5	14.0	14.0–16.0 (2)	—	—	—	—	18.0	18 (1)
13.5	15.0	15 (1)	—	—	—	—	—	—
14.0	15.0	15 (1)	—	—	—	—	19.0	19 (1)
14.0	16.0	16.0–20.0 (6)	15.0	15.0–18.0 (2)	—	—	—	—
14.0	16.0	16 (1)	—	—	—	—	—	—
15.0	16.0	16.0 (2)	—	—	—	—	—	—
15.5	16.0	16.0 (2)	—	—	—	—	—	—
15.5	16.0	16.0–17.0 (4)	17.0	17.0–20.0 (3)	—	—	—	—
16.5	—	—	—	—	17.0	17 (1)	—	—
16.5	17.0	17.0–18.0 (2)	—	—	—	—	17.0	17 (1)
17.0	20.0	20 (1)	22.0	22 (1)	18.0	18 (1)	—	—
17.5	19.0	19.0–23.0 (4)	20.0	20.0–23.0 (4)	20.0	20.0–22.0 (2)	23.0	23 (1)
17.5	18.0	18.0–21.0 (7)	—	—	—	—	—	—
17.5	18.0	18.0–24.0 (6)	23.0	23 (1)	—	—	—	—
18.0	18.0	18.0–24.0 (5)	18.0	18 (1)	—	—	—	—
18.0	18.0	18.0–20.0 (3)	23.0	23 (1)	—	—	—	—
18.0	—	—	19.0	19 (1)	19.0	19 (1)	—	—
18.5	19.0	19.0–21.0 (2)	—	—	—	—	—	—
19.5	20.0	20.0–25.0 (5)	21.0	21 (1)	—	—	—	—
20.0	20.0	20.0–22.0 (5)	—	—	—	—	—	—
20.0	21.0	21.0–24.0 (2)	—	—	—	—	22.0	22 (1)
21.0	24.0	24 (1)	—	—	24.0	24 (1)	—	—
22.5	23.0	23.0–23.0 (2)	—	—	—	—	—	—
22.5	27.0	27 (1)	—	—	—	—	—	—
23.0	—	—	24.0	24 (1)	—	—	—	—
23.5	24.0	24.0–26.0 (7)	26.0	26 (1)	—	—	25.0	25.0–29.0 (3)
25.5	26.0	26.0–27.0 (3)	—	—	26.0	26.0–27.0 (2)	—	—
26.0	27.0	27 (1)	—	—	27.0	27 (1)	—	—
Total behaviors	79 body SE		19 object SE		9 body SE		8 object SE	

Note. Values in parentheses represent total number of specific behaviors exhibited by a particular child.

understood the task and provided the desired level of detail. Other than the definition provided above, parents were not explicitly instructed that a behavior was a scale error or pretense but were told to use the child's own behavior and the context in which the behavior occurred to determine how best to rate the behavior. Parents were instructed to record repeated attempts in the same episode as a single scale error. Parents then viewed an additional four examples of body scale errors and were asked to code these behaviors. The same experimenter then discussed the parent's coding and responded to any questions. Parents were given a binder with a set of forms and asked to record their children's behavior for 6 months. Parents were called by the experimenter who conducted the training on a monthly basis to confirm that the parent was maintaining the observational logs, to ask about any scale errors that had occurred, and to ask the parents if they had questions. At the end of the 6-month period, parents met with the experimenter to return their diaries and received $50 for their participation.

Results

All parents reported at least one of the targeted behaviors (n = 127). Twenty-nine of thirty parents reported at least one serious scale error. There were a total of 98 scale errors (M = 3.2 per child) that were reported as serious attempts (rating of 1 or 2). Parents reported an additional 12 behaviors that they were not sure were scale errors (rating of 3) and 17 behaviors that were rated as pretense (ratings of 4 or 5). In the rest of the results we use the term *scale error* to refer only to serious scale errors.

Scale errors were made by children from 13 to 27 months of age (entire range investigated = 12.5–32 months). Although some children performed only one scale error (n = 8), other children performed as many as seven or eight scale errors (n = 5). All parents reported that their children had previous experience with larger versions of the objects that were involved in the scale errors, although only a few parents reported that their children performed scale errors with exact replicas of the larger objects. Parents reported fewer pretend behaviors than scale errors, and these were exhibited over a more limited age range (18–29 months). We examined whether the frequency of scale errors was related to the frequency of pretense and found that they were not significantly correlated, $r(28) = .10$, $p = .60$. As many of the parents did not report numerous pretend behaviors, this result should be viewed with caution.

We enrolled children between the ages of 12.5 and 26 months in order to get a larger window (12.5–32 months) to examine the frequency and emergence of scale errors. Table 1 provides information about the enrollment, frequency, and type of behaviors recorded for individual children. The overall frequency of scale errors and pretend behaviors by age is shown in Figure 1. The data in the figure are normalized by the number of children at each data point due to the fact that we staggered start time. The frequency of scale errors appears to be highest between 16 and 24 months and to drop off by 27 months. The frequency of pretend behaviors was relatively low throughout the age range investigated, but these behaviors appear to increase toward the older ages.

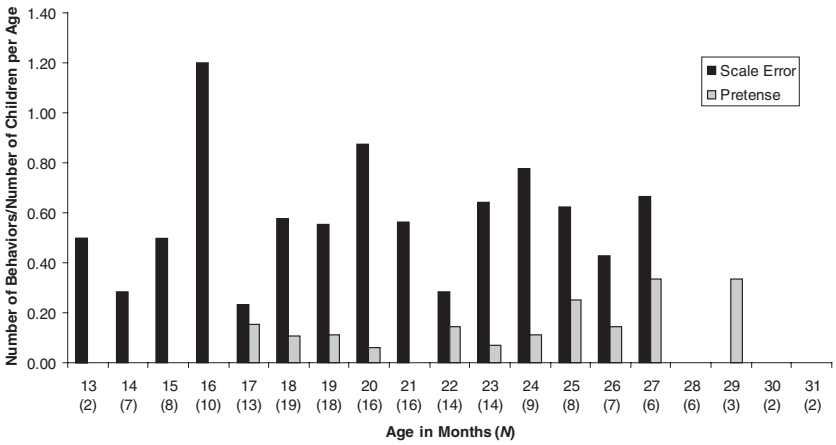

Figure 1. Number of scale error and pretense behaviors reported by parents divided by the number of children at each age. Values in parentheses represent the number of children providing data for a particular age in months.

Figure 2 shows the number of body and object scale errors, pretense behaviors, and unclear examples (not sure) that were reported. To examine this issue more closely we conducted a 2 (focal item: body, object) × 2 (action: scale error, pretense) × 2 (sex: male, female) analysis of variance (ANOVA) with focal item and action type as repeated measures. The figure shows that the majority of scale errors reported were body scale errors rather than object scale errors, $F(1, 28) = 32.9$, $p < .001$, $\eta_p^2 = .541$. Parents also reported more scale errors than pretense actions, $F(1, 28) = 32.2$, $p < .001$, $\eta_p^2 = .535$. A significant interaction was also found between these two factors, $F(1, 28) = 19.6$, $p < .001$, $\eta_p^2 = .412$, showing that body scale errors were more frequent than object scale errors. There was no difference in the frequency of the different focal items involved in pretense. Although there were no significant interactions involving sex, females exhibited significantly more scale errors than males, $F(1, 28) = 4.8$, $p = .036$, $\eta_p^2 = .147$.

Repeated attempts in the same episode occurred on 62% of the episodes involving scale errors. Some children were very persistent, repeating the action as many as 10 or more times. Parents reported that their children exhibited frustration, confusion, or anger for roughly one third of the scale errors (32.9%).

Discussion

Twenty-nine of the thirty parents reported that their child performed at least one scale error and many reported multiple observations of scale errors. This result suggests that most, if not all, children commit scale errors in early childhood. Our procedure provided only a small window into the lives of young children because of the limitations of parental reports and the 6-month period that we investigated. Thus, we expect that our data represent only a subset of the actual number of scale errors that children commit during their everyday lives.

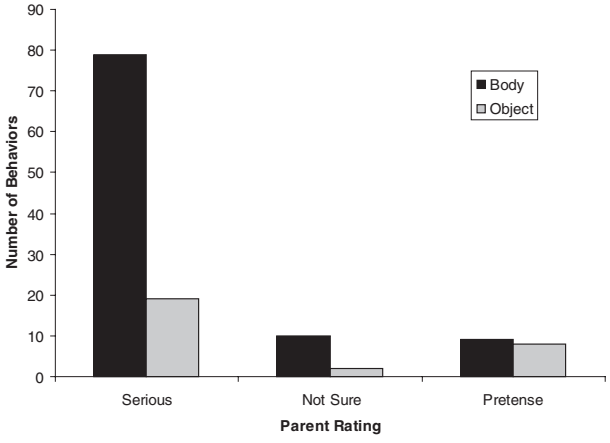

Figure 2. Number of behaviors reported by parents as scale errors, not clear examples, or pretense behaviors as a function of whether they involved the child's body or an object.

In previous laboratory studies (DeLoache et al., 2004; Ware et al., 2006) children were primed with exposure to larger items with the notion that recent exposure to the larger item might increase the likelihood of scale errors. Priming may have this effect in the laboratory, but our results suggest that priming may not be necessary in the real world. That is, some past experience with items from a category and the presence of a replica object is likely more important than recent experience with the larger, appropriately scaled object. Another factor influencing scale errors is obviously opportunity—some miniature objects must be present in the environment. It also seems that the child must find the toys engaging (Ware et al., 2006) and interesting (Brownell et al., 2007). These factors may account for the sex difference we found, as girls may find small replica items more engaging and interesting than boys do.

Parents reported no problems with making the distinction between scale errors and pretense in our study; only 12 of the 127 behaviors observed were classified as unclear examples. Similar to past results (Brownell et al., 2007; DeLoache et al., 2004), many of our parents reported that scale errors were accompanied by repeated attempts and signs of frustration in the child when they failed to complete the desired action. To our knowledge, frustration has not been documented during pretense. Based on these behaviors and past research in this area we feel confident that scale errors are a distinct phenomenon from pretense.

Obviously, this research is limited by general issues involving the accuracy and subjectivity of parental reports. On the one hand, parents generally spend more time with their children and are more likely to observe relatively infrequent behaviors such as scale errors, than are other observers. On the other hand, parents clearly are biased to see their children in the best possible light. This bias, however, should work to suppress reports of scale errors, as parents may perceive these behaviors as characteristic of less mature, perhaps less intelligent children. All but one of the parents reported their children performing scale errors; thus, we think that our parents provided a fairly accurate

depiction of scale errors in the everyday lives of their children.

Parents reported more body than object scale errors. We think this difference in frequency is likely due to differences in how salient the two behaviors are to observers. Specifically, we think body scale errors are more salient than object ones because the body scale errors involve a larger violation of typical behavior than do most object scale errors. Although in our training we included more body than object scale error examples, we think the difference in saliency, or even the actual frequency of these behaviors, underlies the difference in reporting, rather than the effect of training.

Our results suggest that most, if not all, children between 12 and 27 months attempt to perform actions on miniature objects that do not support the action. Further research should examine more closely how child and object characteristics interact to influence the frequency and occurrence of scale errors.

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