Journal of Experimental Child Psychology 151 (2016) 40–50

Contents lists available at ScienceDirect

Journal of Experimental Child Psychology

journal homepage: www.elsevier.com/locate/jecp

Labels affect preschoolers' tool-based scale errors

Samuel B. Hunley [1], Erin R. Hahn *

Department of Psychology, Furman University, Greenville, SC 29613, USA

ARTICLE INFO

Article history:
Available online 28 February 2016

Keywords:
Scale errors
Labeling
Tool use
Artifacts
Cognitive development
Language
Action

ABSTRACT

Scale errors offer a unique context in which to examine the interdependencies between language and action. Here, we manipulated the presence of labels in a tool-based paradigm previously shown to elicit high rates of scale errors. We predicted that labels would increase children's scale errors with tools by directing attention to shape, function, and category membership. Children between the ages of 2 and 3 years were introduced to an apparatus and shown how to produce its function using a tool (e.g., scooping a toy fish from an aquarium using a net). In each of two test trials, children were asked to choose between two novel tools to complete the same task: one that was a large non-functional version of the tool presented in training and one novel functional object (different in shape). A total of four tool–apparatus sets were tested. The results indicated that without labels, scale errors decreased over the two test trials. In contrast, when labels were present, scale errors remained high in the second test trial. We interpret these findings as evidence that linguistic cues can influence children's action-based errors with tools.

Introduction

Children are notorious for doing and saying things that amuse and sometimes even befuddle adults. One such example is a scale error: a serious attempt to act on an object that is obviously the wrong size. Originally, scale errors referred to instances in which the size of a target object was

* Corresponding author.
E-mail address: erin.hahn@furman.edu (E.R. Hahn).
[1] Current address: Department of Psychology, Emory University, Atlanta, GA 30322, USA.

http://dx.doi.org/10.1016/j.jecp.2016.01.007
0022-0965/

prohibitively small in relation to the size of the child's body (DeLoache, Uttal, & Rosengren, 2004). For instance, children may try to sit in a doll-sized chair or attempt to enter a miniature car that is not even large enough to accommodate their foot, let alone their entire body. In its current use, the term also refers to errors in which there is a mismatch between the relative sizes of two objects such as when a child tries to force a doll into a tiny crib (Ware, Uttal, Wetter, & DeLoache, 2006) or retrieve a toy fish from an aquarium using a net that is substantially larger than the aquarium itself (Casler, Eshleman, Greene, & Terziyan, 2010). Parental reports indicate that scale errors also occur in the natural environment with some regularity, demonstrating that they are not simply an artifact of unusual lab conditions (Rosengren, Gutiérrez, Anderson, & Schein, 2009; Ware, Uttal, & DeLoache, 2010).

Scale errors likely arise from multiple factors. Three primary explanations have been offered. For one, weak integration between dorsal and ventral streams of visual input and immaturities in the prefrontal cortex associated with children's poor inhibitory control are thought to play a role (e.g., DeLoache et al., 2004). On seeing a miniature chair, for example, communication breaks down between the ventral pathway, which is responsible for object identification and the formation of action plans, and the dorsal pathway, which processes the size of the object. A second account of scale errors involves limitations in children's concepts of their own bodies (Brownell, Zerwas, & Ramani, 2007). That is, children might not fully understand that their bodies are too large relative to an object. Finally, scale errors have also been attributed to the teleofunctional bias or the manner in which the human cognitive system privileges functional information (e.g., Kelemen, 1999). According to this view, attention to function is so robust that it can override other perceptual features such as size (Casler et al., 2010). The finding that adults also commit scale errors in some circumstances lends support to the idea that neural immaturity alone cannot fully explain these errors (Casler, Hoffman, & Eshleman, 2014).

At their core, all of these explanations entail a breakdown between planning and action. Children develop an action plan based on an object's identity, including its shape, function, and relevant categorical information. The object's size is not considered—perhaps because of neural immaturity (DeLoache et al., 2004), an inability to inhibit a planned action (Diamond, 2002), a failure to understand one's own body size (Brownell et al., 2007), attention to competing cues (Casler et al., 2010), or a combination of these factors. In the end, scale errors emerge when the motor system then executes the faulty plan while also appropriately scaling the action to accommodate the object's size.

The dorsal and ventral pathways that are often highlighted in neural accounts of scale errors are also closely tied to language processing. Sensorimotor aspects of speech, such as the repetition of non-words, are mediated by the dorsal pathway, whereas the ventral stream serves higher level comprehension (Hickok & Poeppel, 2004, 2007; Saur et al., 2008). The ventral overlay between the linguistic processing of meaning and the formation of action plans suggests that scale errors could feasibly be influenced by language. Links between language and other action tasks have been documented in earlier research. For example, children's success in various means–ends tasks (e.g., using a stick to obtain an object) are related to the production of words denoting success/failure, whereas performance in object concept tasks (e.g., retrieving hidden objects) is strongly associated with the acquisition of words signaling disappearance (Gopnik & Meltzoff, 1986). Similar connections with language development have been documented in spatial tasks (e.g., Balcomb, Newcombe, & Ferrara, 2011; Pruden, Levine, & Huttenlocher, 2011).

Dependencies between language and action are one of the hallmarks of grounded cognition. According to this theoretical framework, object concepts are multimodal, including both linguistic and motor information (e.g., Barsalou, 1999, 2008). Labels derive their meaning from sensorimotor activity throughout development (e.g., Barsalou, 1999, 2008; Glenberg & Robertson, 2000). Simply hearing an object's label can trigger stored sensorimotor information. For example, hearing the word *hammer* reactivates motor patterns and sensory input that have been previously associated with hammers (e.g., pounding, the hand grip used to hold it, its weight). Thus, the combination of seeing an object and hearing its label could result in the erroneous retrieval and execution of an action plan that is appropriate for the same object of a different size. In essence, the object and its label may override cues about size.

To be sure, labels do more than point to objects' functions; they also act as "invitations to form categories" (Waxman & Markow, 1995, p. 298). In the presence of labels, infants are attuned to perceptual