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Characteristics of brief sticky mittens training that lead to increases in object exploration

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ABSTRACT

The onset of independent prehension marks the beginning of infants' direct interaction with the physical world. The success infants have in contacting objects with their hands and arms can have both visual and auditory consequences; objects may move and collide with other objects or fall onto table surfaces. Seeing and hearing these events could have important consequences for infants' learning about objects and their subsequent behavior toward objects. The current research assessed the effects of brief object manipulation experiences and how a specific characteristic of training, auditory feedback produced by hard plastic toys colliding with a tabletop surface, affects pre-reaching infants' subsequent object exploration. In Experiment 1, infants participated in either active "sticky" mittens training or passive "nonsticky" mittens training with a set of toys; before and after this experience, infants explored a teether. Results showed that infants participating in active training increased looking toward and sustained touching of the teether from pre- to post-training, whereas infants receiving passive training decreased their looking toward and touching of the teether following training. To investigate whether infants' exploration behaviors were related to the amount of auditory feedback produced by the objects during training, in Experiment 2 data were collected from infants who received active sticky mittens training that had either more or less auditory feedback potential. Results showed more robust increases in infants' exploratory activity from pre- to post-training in the *more* auditory

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feedback condition compared with infants' exploratory activity in the *less* auditory feedback condition. These findings support the idea that active control of objects, including experiencing contingent feedback through multiple sensory modalities, promotes the development of object exploration during early infancy.

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Introduction

As infants begin to gain more control over the movement of their arms, they can swipe at and hit objects with their hands or arms, resulting in salient feedback from the visual and auditory modalities. This feedback may consist of the visual stimulus of objects moving through their visual fields or the auditory stimulus of objects colliding with other objects, table surfaces, or the floor. This feedback could also be reinforcing. How do these sources of feedback contribute to infants' learning? This is the question addressed by the research reported in this article.

Perceptual feedback from actions

Experiencing the contingency between actions and the consequences of those actions has far-reaching implications for learning and development. As [Held and Hein \(1963\)](#) famously observed in their "kitten carousel" experiments, the kittens who actively produced and observed the effects of their own movements around the carousel apparatus were subsequently able to navigate through space more effectively than the kittens who passively experienced these movements. It follows that moving one's body and experiencing the feedback produced by that movement are critical for developing perception and action systems. Researchers have demonstrated that this is true for human infants as well ([Adolph, 2000](#); [Gibson, 1988](#)).

The feedback in the [Held and Hein \(1963\)](#) study just described was visual and proprioceptive in nature, but we know that infants are very sensitive to auditory information as well. Even prior to birth, fetuses hear, learn, and remember sounds that enter the uterine environment, and newborns prefer to listen to the sounds they recognize from the fetal period ([DeCasper & Spence, 1986](#); [Hepper, 1991](#); [Kisilevsky, Hains, Jacquet, Granier-Deferre, & Lecanuet, 2004](#)). Newborns show evidence of visual investigation of the sources of sounds by looking toward sound sources ([Clarkson & Clifton, 1985](#); [Clarkson, Morrongiello, & Clifton, 1982](#); [Morrongiello, Clifton, & Kulig, 1982](#)). This behavior likely supports learning about intermodal stimuli and helps infants to link up the visual and auditory components of events. Research has also shown that sounds reengage infants' attention to a visual stimulus and can even cause dishabituation to a previously habituated stimulus ([Kaplan, Fox, Scheuneman, & Jenkins, 1991](#)). This evidence suggests that infants regard auditory information as relatively straightforward to attend to, learn, and remember.

Infants learn about the limits of their body movements as they add new postures to their motor repertoires (e.g., reaching, sitting, crawling, walking; [Adolph, 1997, 2000](#)). Infants are also highly sensitive to contingencies between their own actions and the perceptible consequences of these actions (e.g., [Bahrick & Watson, 1985](#); [DeCasper & Carstens, 1981](#); [Rovee-Collier & Gekoski, 1979](#)). These experimental results and others (e.g., [Adolph & Avolio, 2000](#); [Rochat & Striano, 1999](#)) indicate that infants can learn quickly about the match between their physical abilities and opportunities in the environment.

Infants' propensities for exploration lead them to learn about the kinds of action opportunities that are available within a given level of ability. This may be what leads infants to engage in actions such as pulling up to a standing position once they can crawl up to a stable coffee table ([Thelen, 2005](#), pp. 264–265). Knowing that infants are capable of taking advantage of novel possibilities for action in their

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