Brief Report

Sticky mittens, prickly Velcro, and infants’ transition into independent reaching: Response to Williams, Corbetta, and Guan (2015)

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Abstract

Williams, Corbetta, and Guan (2015) report findings on the effects of active and passive motor training in three-month-old infants and argue that passive task exposure is sufficient to encourage future reaching behaviors. In this commentary, we relate these new findings to our body of published work using sticky mittens and describe important differences in the materials and procedures used. In particular, Williams et al. (2015) used modified sticky mittens that allowed infants’ fingers to make direct contact with prickly Velcro on the toys, and they used a different training procedure that required infants to discover the hidden functionality of the sticky mittens by themselves. We argue that these differences explain the apparent conflicts between our prior work and the results reported by Williams et al. (2015). The Williams study presented infants with a learning context that was quite different from the one infants encountered in our research, and so it is not surprising that infants in their study showed such different patterns of behavior.

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The emergence of successful reaching around 3–5 months of age affects infants’ exploration and engagement with the social and physical world (Berthier & Keen, 2006; Gibson, 1988). Due to its importance for the developing child, the transition into independent reaching and the consequences of achieving this motor milestone have been studied closely (e.g., Thelen et al., 1993; von Hofsten, 1984, 1991). More recently, our own labs have conducted a number of studies that have systematically examined the experiences that encourage and facilitate independent reaching and subsequent grasping behaviors (Libertus & Landa, 2014; Libertus & Needham, 2010, 2014; Needham, Barrett, & Peterman, 2002). Across four separate studies, our results demonstrate that scaffolded reaching experiences using ‘sticky mittens’ encourage successful reaching in three-month-old infants.

Recent findings by Williams, Corbetta, and Guan (WCG, 2015) add to this growing literature, but report some surprising and inconsistent findings that merit closer examination and comparison with previous findings. Specifically, WCG (2015) report that after 14 days of training, infants who participated in a non-sticky mittens condition reached for and touched objects almost twice as much as infants receiving sticky mittens training. This finding is completely inconsistent with all of our studies involving sticky mittens. Williams and colleagues explain their discrepant findings by stating that repeated task exposure alone seems sufficient to encourage independent reaching. However, we have shown that this is not the case when

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comparing sticky mittens training to three other training paradigms that also involved repeated task exposure (Libertus & Needham, 2014). Further, the Williams et al. (2015) results are quite perplexing because if repeated task exposure facilitated reaching among infants in the non-sticky mittens condition, it should have also encouraged reaching among infants in the sticky mittens condition. But this is not the pattern of results that was obtained. Rather, it seems that critical methodological differences may account for the discrepant findings between our established work and the new findings by WCG (2015). In the following we will discuss these key differences and their implications for our understanding of motor skill development in early infancy.

1. Bare fingers on prickly Velcro

As in our previous studies, WCG (2015) examined the effects of scaffolded reaching experiences using sticky mittens on the development of independent reaching skills. In particular, their goal was to determine whether experience with sticky mittens facilitates infants’ independent reaching or whether infants would reach more over time simply due to the repeated exposure to a small toy presented very close to their hands. This is an interesting question that merits closer examination. Unfortunately, WCG (2015) introduced a number of substantial changes to our materials and procedures, which can explain their surprising findings.

The most consequential difference between our scaffolded reaching paradigm and their altered paradigm is that WCG (2015) used mittens with open ends that allowed for direct finger contact with the toys (see Fig. 1 of WCG). While this change was included in order to enhance tactile feedback during the training experiences, it also created a crucial confound that could explain the low levels of reaching shown by infants in the sticky mittens group: The toys in the sticky mittens condition were unpleasant to touch. In the sticky mittens condition, the toys were covered with strips of prickly Velcro hook, but the toys in the non-sticky mittens condition were free of Velcro. So, the infants in the sticky mittens condition felt prickly Velcro when contacting the toys, while infants in the non-sticky condition did not. Making the objects unpleasant to touch for infants in the sticky mittens condition but not for infants in the non-sticky mittens condition is a noteworthy confound that could explain their pattern of results and the major discrepancy between our multiple published sets of findings and this new finding.

In our previous research using the sticky mittens paradigm, we also presented infants with toys that had prickly Velcro on them. However, thick fleece mittens protected infants’ fingers from the unpleasant sensation of touching it with their bare fingers. Thus, when considering the reinforcement infants received from their actions, infants in our sticky mittens studies were reinforced for their object-directed actions by observing the consequences of their own actions (gaining control of the toy and moving it), whereas infants in the sticky mittens group of WCG (2015) were likely discouraged from further reaching attempts due to the unpleasant sensory feedback they received from the objects. We believe that this is the reason that infants in the sticky mittens condition of the WCG (2015) study reached so little. We predict that if Williams and colleagues were to use closed mittens as in our prior research, they would observe an increase in reaching activity in their sticky mittens group as well.

2. Discovering affordances and hidden functions

A second major difference between our approach and that used by WCG (2015) is procedural. In our scaffolded reaching procedure, infants are provided with demonstrations of the sticky mittens’ functionality at the beginning of each training session. Specifically, one of the infant’s mitten’s hands is guided over to a toy, the toy is then touched to the mitten, and the arm is raised up until the toy lifts off the table. Given the young age of infants in our studies, this demonstration may be critical for infants’ learning about how the mittens can be used. Without this demonstration, infants are required to discover the functionality of the mittens on their own. The discovery of inter-object relations and affordances gradually unfolds across the second half of the first year of life and into the second year (Gibson, 1988; Kahrs, Jung, & Lockman, 2012, 2013). Further, the functional property of the mittens and toys is not readily apparent. Instead of requiring infants to determine this hidden function on their own, we demonstrate the functionality of the mittens and observe how infants subsequently use this new action potential to interact with objects. To determine whether infants are able to utilize the functionality of the mittens to pick up objects, it seems imperative to reveal this hidden functionality first.

In contrast, WCG (2015) did not demonstrate the stickiness of the mittens and this property remained hidden to infants until (and unless) they discovered it on their own. As a result, WCG (2015) were basically investigating whether young infants could discover this novel hidden property of the sticky mittens without any cues to assist them. We think this is an interesting question, but it is a different question than the one we have investigated in our work. We also note that prior research suggests that three-month-old infants may not be skilled at extracting such complex affordances from objects (Gibson, 2000).

3. Social encouragement motivates actions

A third difference between our work and the approach taken by WCG (2015) relates to the encouragement infants received during the training. The experimenters in WCG (2015) did not verbally encourage infants to make contact with the objects and did not participate in any kind of social interaction with infants during their training sessions. This contrasts with our
prior studies in which verbal encouragement was offered by the infants’ parents during the parent-guided training. Indeed, it is not at all unusual for infants to be encouraged to engage in motor actions within the context of studies on motor skill development (e.g., Adolph, 1995, 1997). Further, encouragement also occurs naturally during the course infants’ typical daily experiences outside the lab. Importantly, we specifically examined the influences of verbal encouragement to act on toys in a recent article and found that both object manipulation experiences and encouragement are necessary to increase infants’ motivation to act on their environments (Libertus & Needham, 2014). During their daily interactions, infants typically experience strong social encouragement to engage in actions that they are not quite ready to perform. The lack of social interaction between infants and the experimenter during training in the study by WCG (2015) is unnatural and may explain why infants were less likely to reach for the toys—in particular in the sticky mittens condition where this strange situation was paired with unfamiliar objects, mittens, and novel sensory feedback from the toys. Further, this difference may also explain the very large number of infants who became fussy and did not complete the study by WCG (2015). It would be interesting to see whether the infants would discover the hidden function (or stickiness) of the mittens more quickly using the procedure used by WCG (2015) but with added encouragement from the experimenter or the parent.

4. Parent-guided training: more than meets the eye

Our studies also differ from WCG (2015) in regard to who is administering the training procedures. In our studies, we have trained parents to implement our training paradigms in their homes. In contrast, in WCG (2015) an experimenter led all training sessions during daily home visits. We believe there is added value to involving parents in early motor interventions. In fact, research shows involving parents in early motor interventions leads to more positive outcomes (Mahoney & Perales, 2006; Rogers et al., 2014). Parents who are more aware of their infants’ development and the progress their infants are making in learning to reach may be more likely to incorporate opportunities for reaching into their infants’ daily activities. They may also become aware of ways to better support their infants’ object exploration, for example by ensuring their infants have adequate postural support by using cushions or holding their infants’ midsections to make reaching easier for them (Hadders-Algra, 2013). Thus, training in our prior sticky mittens studies may have influenced parent-child interactions outside the training context (Libertus, 2010), thereby increasing the effectiveness of the training. This potential added benefit from parent-led training was not available in the WCG (2015) study. It should be noted, however, that this possible change in parent-child interactions is not a problematic or unique aspect of our studies. Instead, these kinds of changes happen regularly as infants’ abilities develop in a dynamic social context (Karasik, Tamis-LeMonda, & Adolph, 2014).

5. Further clarifications

In addition to the key procedural differences between our previous studies and the one reported by WCG (2015), we also would like to clarify some points about our research that were not explained accurately. First, our experimental paradigm provides a more stringent test of what infants learn during sticky mittens experience. In our studies, the toys used for training and testing were different: Infants were always trained with one set of toys and tested with a different toy. This difference is important to ensure that infants are not just learning specific patterns of action tailored to each training toy and then reproducing these actions during testing. In our procedure, any increases in infants’ reaching or exploring must be generalized across training toys and testing toys.

Further, WCG (2015) state that we always used a ‘pile of toys’ to assess infants’ reaching, but this is not true. Only the Needham et al. (2002) study used this approach. In our more recent studies (e.g., Libertus & Needham, 2010, 2014; Libertus & Landa, 2014) infants were trained with three sets of Lego Duplo blocks. The three sets of training toys consisted of one, two, and three blocks, respectively. Testing was done with a single infant rattle toy that was not used or shown during training.

6. Immediate effects of scaffolded reaching

In their review of prior findings, WCG (2015) did not mention any of the well-established immediate consequences stemming from a single training session using sticky mittens (Gerson & Woodward, 2014a, 2014b; Rakison & Krogh, 2012; Skerry, Carey, & Spelke, 2013; Sommerville, Woodward, & Needham, 2005). Although these studies admittedly do not aim to investigate infants’ transitions into reaching, they do provide further evidence for the benefits of sticky mittens training. Certainly, if there were detrimental effects of infants’ use of sticky mittens, it should be apparent in these studies as well. However, the difference in infants’ performances in each of these studies from pre- to post-training indicate that sticky mittens training positively affects infants’ cognitive abilities. Sticky mittens training has been shown to positively impact infants’ perception of goal-directed actions, action understanding, causal understanding, and sensitivity toward the efficiency of actions (Gerson & Woodward, 2014a, 2014b; Rakison & Krogh, 2012; Skerry et al., 2013; Sommerville et al., 2005).

In research from our lab that is currently under review, we show that infants who had 10 min of active experience with sticky mittens show more exploration of an object unrelated to the toys they were trained with compared to infants who had 10 min of passive object-watching experience while wearing mittens (Needham, Gibson, Libertus, & Christopher, 2015). This evidence all very consistently points to the positive effects of sticky mittens experience, contrary to the WCG (2015) findings.
7. Interpretation of findings

Finally, we would like to offer some thoughts on the interpretation of the findings reported by WCG (2015). Specifically, they raise the possibility that infants are not ready for object exploration until they become able to reach out and touch objects on their own. In support of this claim, they cite Lobo and Galloway (2008) as showing that infants in their study did not engage in much object exploration until after the onset of reaching.

However, the argument made by WCG (2015) that babies are not ready for object exploration until they begin independent reaching is in conflict with many other findings in the literature (Bushnell & Boudreau, 1998; Molina & Jouen, 1998; Rochat, 1987, 1989; Streri & Gentaz, 2003; Striano & Bushnell, 2005). For instance, Rochat (1989) showed clear evidence of major increases in infants’ exploration of objects placed in their hands between 2 and 5 months of age and prior to the onset of independent reaching. Also, Bushnell and Boudreau (1998) theorized that infants’ haptic perception of object properties is likely limited by two factors: infants’ inability to perform certain actions (i.e., Exploratory Procedures) necessary to detect the particular object characteristic, and infants’ limited attentional capacities. They also make the point that “these bounds can be exceeded—that is, infants can show sensitivities at earlier ages—if they are somehow coaxed into making certain hand movements ‘before their time’” (p. 151). We agree with (and our results are consistent with) the idea that beginning to reach for objects motivates infants to explore objects more actively. Findings from our multiple published studies show that independent reaching and object exploration develop in tandem. Therefore, the notion that infants in this age range are somehow not ‘ready’ to explore objects is simply inconsistent with several empirical findings and theoretical positions about infant development.

Finally, we are confused by the claim made by WCG (2015, p. 93) that sticky mittens experience is “unlikely to enhance grasping abilities, even at a later developmental stage.” This statement is inconsistent with the majority of the evidence reported in the literature. Our first report using sticky mittens showed that infants who had sticky mittens experience dropped a toy less during a subsequent test trial than the infants from an untrained comparison group (Needham et al., 2002). Dropping an object less must involve grasping it better. Secondly, in a more controlled follow-up examination, infants with sticky mittens experience showed significantly more grasping compared to infants with passive training and infants with no training (see p. 2754, Fig. 3b in Libertus & Needham, 2010). More recently, these findings have been replicated in a sample of infants at high risk for Autism Spectrum Disorder (ASD; Libertus & Landa, 2014). In this paper, we report a nearly identical increase in grasping activity following training in infants at high-risk for developing ASD (see p. 5, Fig. 3) as we saw in the sample of typically developing infants tested in Libertus and Needham (2010). Further, this study also reports converging evidence for the effectiveness of sticky mittens training using a parent-report measure of early motor skills (Early Motor Questionnaire; Libertus & Landa, 2013) that reveals a significant increase in motor skills following two weeks of training (see p. 5, Fig. 4). These findings are particularly interesting, given that infants at risk for or later diagnosed with ASD have been reported to show deficits in their grasping skills at six months of age (Libertus, Sheperd, Ross, & Landa, 2014).

8. Conclusions

The findings reported by WCG (2015) raise a number of interesting questions about the development of reaching skills during the first months of life. However, we do not agree with the interpretations they offer for some of their data. We have provided several alternate explanations for the findings reported by Williams et al. (2015), which we believe resolve the apparent conflict between our prior findings and their results. Further, the alternate explanations we discuss here open up several interesting new lines of research that should be pursued in the future to increase our understanding of the factors and experiences that shape the development of reaching skills in early infancy.

References


