



Scaffolded reaching can encourage motor development: Commentary on van den Berg & Gredebäck (2020)

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1 | SCAFFOLDED REACHING CAN ENCOURAGE MOTOR DEVELOPMENT: COMMENTARY ON VAN DEN BERG & GREDEBÄCK (2020)

The review entitled "*The sticky mittens paradigm: a critical appraisal of current results and explanations*" by van den Berg and Gredebäck (2020) provides a timely examination of studies published in the past 20 years using the "sticky mittens" paradigm developed by Needham et al. (2002). The review covers the effects of active training with sticky mittens on infants' motor, social, and perceptual development. While summaries regarding social and perceptual development provide a balanced representation of the existing findings, some claims against sticky mittens' effects on motor development seem overstated. In particular, the authors claim that (1) previous studies provide weak support for training effects on reaching and grasping behavior, (2) effects of training may be driven by numerical baseline differences, and (3) inconsistent findings stem from the lack of adequate comparison conditions (van den Berg & Gredebäck, 2020, p. 4). In the following, I will address each of these claims.

2 | STICKY MITTENS STUDIES DEMONSTRATE WEAK SUPPORT FOR EFFECTS ON MOTOR SKILLS

When it comes to the motor domain, only a relatively small number of studies have examined the impact of sticky mittens training. Further, two published studies have re-used data from a prior report (Libertus & Landa, 2014; Libertus & Needham, 2014), inflating the perceived evidence supporting the sticky mittens paradigm's effectiveness. Excluding these studies, at least seven studies have examined the effects of sticky mittens training on manual, visual, and multimodal object exploration behaviors (see Table 1 for a

summary). Five out of these studies (71%) support the position that active training encourages infants' subsequent exploration behaviors. One study reports mixed evidence, with no immediate but delayed effects of active training on manual exploration (Wiesen et al., 2016). Finally, one study reports negative evidence for active training influences on manual exploration behaviors but reports positive evidence for a passive training procedure (Williams et al., 2015). More research is needed, but summarizing the existing results as providing only "weak support" does not seem warranted.

3 | TRAINING EFFECTS MAY BE CAUSED BY NUMERICAL BASELINE DIFFERENCES

Another argument raised by van den Berg and Gredebäck (2020) is that one early study using sticky mittens training (Libertus & Needham, 2010) is not reliable due to *numerical baseline differences* in grasping behavior. Baseline differences raise the possibility that infants receiving sticky mittens training were different from the comparison groups before training onset, invalidating the study's findings, a longitudinal follow-up study (Libertus et al., 2016), and two other studies re-using these data for comparison purposes (Libertus & Landa, 2014; Libertus & Needham, 2014). However, the claim of baseline differences does not seem warranted. First of all, a statistical examination of baseline differences in Libertus and Needham (2010) revealed no significant differences between the three groups in the study at baseline. Second, higher baseline values in the sticky mittens training group reduce the likelihood of significant within-group differences when examining pre- to post-training effects—effectively *masking* rather than strengthening training effects. Despite this, significant pre- to post-training differences were evident only for the active training group and not for passive and untrained comparison groups. Finally, the numbers reported by van den Berg and Gredebäck (2020) exaggerate

TABLE 1 Overview of previous studies using the sticky mittens paradigm

Study	Method and Results	Evidence
1 (Needham et al., 2002)	Active training group ($n = 16$) received about 140 min of in-home experiences with sticky mittens. This group showed more multimodal exploration after training than an untrained comparison group ($n = 16$).	Positive for visual, manual, and multimodal exploration.
2 (Libertus & Needham, 2010)	Compared grasping durations between infants receiving active training ($n = 18$, approx. 125 min), passive training ($n = 18$, approx. 144 min), or no training ($n = 19$). Grasping durations increased significantly only for the active training group.	Positive for grasping behavior.
3 (Libertus & Landa, 2014)	Trained one group of infants at high risk for Autism Spectrum Disorder using the sticky mittens paradigm ($n = 17$). Following two weeks (approx. 140 min.) of training, infants showed a significant increase in grasping behavior during an observation task and scored significantly higher on a parent-report measure of early motor development.	Positive for grasping behavior and overall motor development.
4 (Williams et al., 2015)	Compared active ($n = 13$) and passive ($n = 11$) training groups and an untrained control group ($n = 13$). Trained groups received experimenter-guided training in the infant's own home. Following training, no between-group differences for toy contacts, more visual engagement in toys in the passive compared to the active training group, and steeper increase of intentional toy contacts in passive compared to active training group.	Negative for manual or visual engagement and for intentional toy contacts. Some evidence for effectiveness of passive training.
5 (Wiesen et al., 2016)	Compared object exploration behaviors between infants receiving active ($n = 16$) or passive ($n = 16$) experiences immediately after training and after a 2-month delay. No group differences were present immediately after training. However, longer exploration behaviors were evident for active compared to passive trained infants at the two-month follow-up.	Negative for immediate effects on exploration. Positive for long-term effects.
6 (Needham et al., 2017)	Two experiments compared groups who received a single session (approx. 9 min) of active ($n_1 = 19$, $n_2 = 18$) or passive training ($n_1 = 19$, $n_2 = 18$). Touching behavior increased following active but not passive training.	Positive for touching and multimodal exploration
7 (Nascimento et al., 2019)	Training with 5-month-old preterm infants. After intervention, the trained group ($n = 12$) showed more reaching attempts than a control group ($n = 12$).	Positive for reaching

the actual baseline differences (see Figure 1). The review reports baseline values as 12% for the active training group (actual 11.43%), 5% for a passive training group (actual 6.35%), and 11% for an encouragement experience group (actual 12.11%). Thus, actual numerical differences between the compared groups are smaller than reported by van den Berg and Gredebäck (2020). Furthermore, the active training group reported in Libertus and Needham (2010) did *not show the highest baseline scores* and performed well within the range of scores observed across six different groups (see shaded area in Figure 1). Together, these patterns

do not suggest that numerical differences at baseline may explain the observed training effects.

4 | LACK OF ADEQUATE COMPARISON CONDITIONS

Finally, van den Berg and Gredebäck (2020) argue that the literature's inconsistent findings may stem from a lack of adequate comparison conditions. This argument is surprising, as we alone

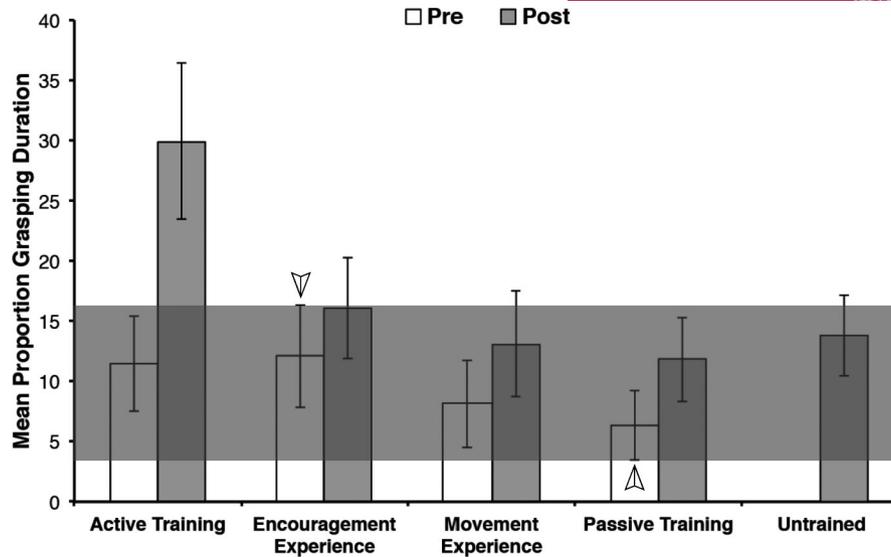


FIGURE 1 Range of baseline grasping duration across four comparison groups. Results for data reported in Libertus and Needham (2014). Baseline grasping durations across four trained groups are shown in the white bars. The total range of grasping durations is highlighted with a gray overlay. Sources for the maximum and minimum range (mean \pm 1 SE) are indicated with white flags.

have published five variations on the sticky mittens paradigm differing in parent-training protocols, durations, and training materials (Libertus & Needham, 2014; Needham et al., 2017). Another training study by Williams et al. (2015) differed from the original sticky mittens procedure in administration method (experimenter vs. parent), materials (open vs. closed mittens), and child-directed encouragement. These differences in approach effectively create another comparison condition to the original sticky mittens paradigm (Needham et al., 2015). Finally, other attempted comparisons may be underreported due to publication biases. For example, we excluded a within-group comparison of sticky mittens training to an interactive song training paradigm from one of our publications due to negative results (Libertus & Landa, 2014). These unpublished results are provided in Figure 2 and show that interactive songs designed to encourage motor skill growth were effective, but not as effective as active training using sticky mittens. Other "failed" comparison conditions may exist hidden away in desk drawers. Hence, the problem may not be a lack of comparison conditions but a lack of published null results.

5 | CONCLUSIONS

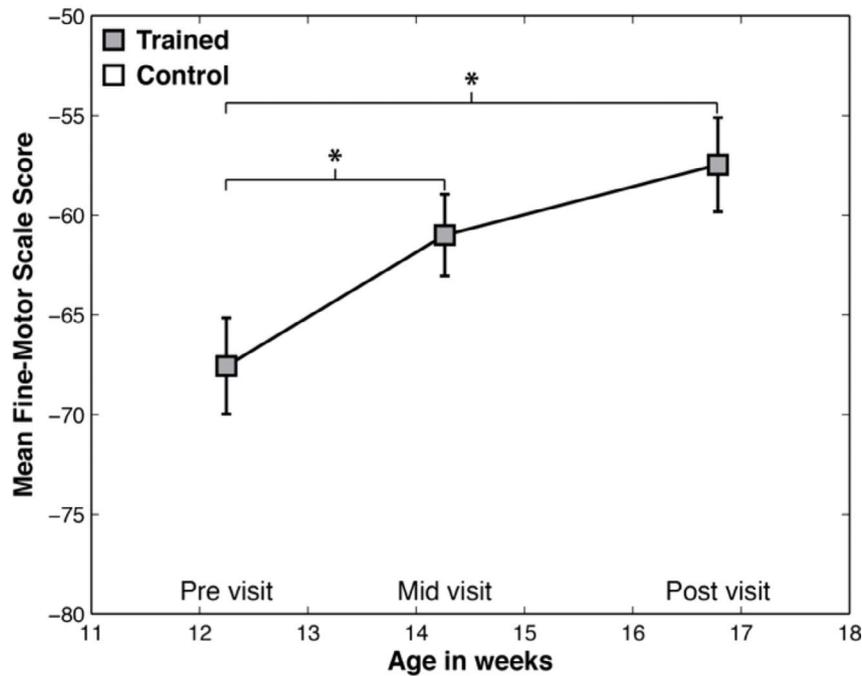
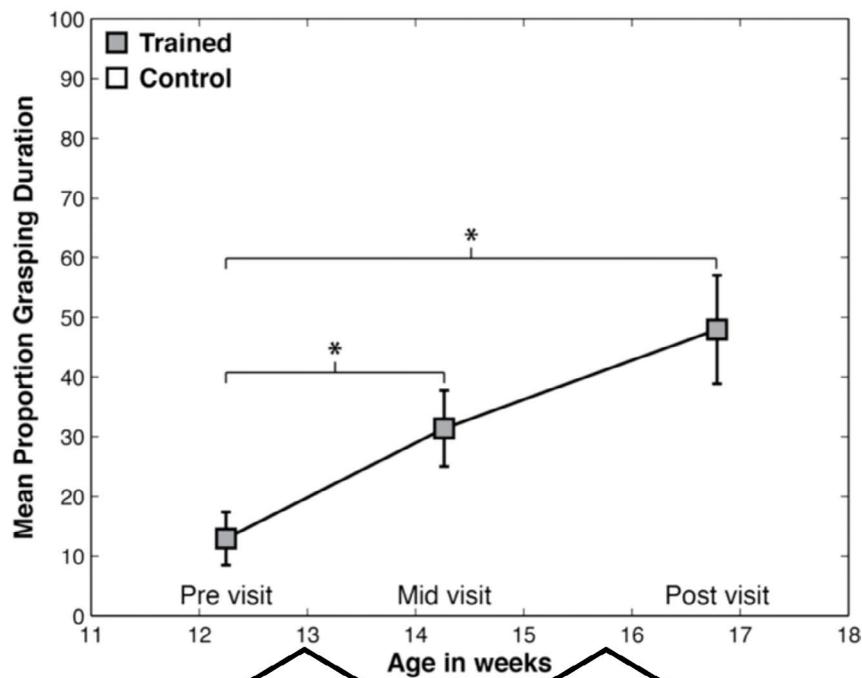
The review by van den Berg and Gredebäck (2020) provides a good overview of the existing literature on the sticky mittens paradigm and its effects on motor, social, and perceptual development. However, the impact of active training using sticky mittens on infants' motor development seems more robust than the review suggests. More research on this topic is needed to examine what kind of training experiences can or cannot encourage early motor development.

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REFERENCES

- Libertus, K., Joh, A. S., & Needham, A. W. (2016). Motor training at 3 months affects object exploration 12 months later. *Developmental Science*, 19(6), 1058–1066. <https://doi.org/10.1111/desc.12370>.
- Libertus, K., & Landa, R. J. (2014). Scaffolded reaching experiences encourage grasping activity in infants at high risk for Autism. *Frontiers in Psychology*, 5, 1071. <https://doi.org/10.3389/fpsyg.2014.01071>.
- Libertus, K., & Needham, A. (2010). Teach to reach: The effects of active vs. passive reaching experiences on action and perception. *Vision Research*, 50(24), 2750–2757. <https://doi.org/10.1016/j.visres.2010.09.001>.
- Libertus, K., & Needham, A. (2014). Encouragement is nothing without control: Factors influencing the development of reaching and face preference. *Journal of Motor Learning and Development*, 2(1), 16–27. <https://doi.org/10.1123/jmld.2013-0019>.
- Nascimento, A. L., Toledo, A. M., Merey, L. F., Tudella, E., & Soares-Marangoni, D. A. (2019). Brief reaching training with "sticky mittens" in preterm infants: Randomized controlled trial. *Human Movement Science*, 63, 138–147. <https://doi.org/10.1016/j.humov.2018.11.015>.
- Needham, A., Barrett, T., & Peterman, K. (2002). A pick-me-up for infants' exploratory skills: Early simulated experiences reaching for objects using 'sticky mittens' enhances young infants' object exploration skills. *Infant Behavior and Development*, 25(3), 279–295. [https://doi.org/10.1016/S0163-6383\(02\)00097-8](https://doi.org/10.1016/S0163-6383(02)00097-8).
- Needham, A., Wiesen, S. E., Hejazi, J. N., Libertus, K., & Christopher, C. (2017). Characteristics of brief sticky mittens training that lead to increases in object exploration. *Journal of Experimental Child Psychology*, 164, 209–224. <https://doi.org/10.1016/j.jecp.2017.04.009>.
- Needham, A., Wiesen, S. E., & Libertus, K. (2015). Sticky mittens, prickly Velcro, and infants' transition into independent reaching. *Infant Behavior and Development*.

(a) **Parent report measure**(b) **Direct observation**

Active Training



Interactive Songs



FIGURE 2 Unpublished comparison conditions for sticky mittens training. Unpublished within-subject comparison between active training (pre to mid) and an interactive song comparison (mid to post; $n = 17$) originally reported in Libertus and Landa (2014). The interactive songs resulted in numeric gains in parent-reported fine motor skills (A) and observed grasping behaviors (B), but gains were not statistically significant compared to the mid-point observation.

- van den Berg, L., & Gredeback, G. (2020). The sticky mittens paradigm: A critical appraisal of current results and explanations. *Dev Sci*, e13036. <https://doi.org/10.1111/desc.13036>.
- Wiesen, S. E., Watkins, R. M., & Needham, A. W. (2016). Active motor training has long-term effects on infants' object exploration. *Frontiers in Psychology*, 7, 599. <https://doi.org/10.3389/fpsyg.2016.00599>.
- Williams, J. L., Corbetta, D., & Guan, Y. (2015). Learning to reach with "sticky" or "non-sticky" mittens: A tale of developmental trajectories. *Infant Behavior and Development*, 38, 82–96. <https://doi.org/10.1016/j.infbeh.2015.01.001>.

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