

The Development of Handedness in Role-Differentiated Bimanual Manipulation in Relation to Handedness for Apprehension in 11 to 14 Month old Infants

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Introduction

Handedness reflects a distinct lateralized asymmetry in hemispheric functioning (Serrien, Ivry, & Swinnen, 2006).

Handedness development could be represented as a progressive expansion of hand-use preference across a wider range of increasingly complex skills (e.g., from simple reaching to role-differentiated bimanual manipulation (RDBM), object construction skills, tool-use, etc.).

The goal of the present study was to explore the development of RDBM in association with handedness for reaching and acquisition, and specify differences and similarities in the development of RDBM for infants with and without a stable hand-use preference.

Method

Participants:

➤ 101 infants (54 males)

63 infants (33 males) – right hand-use preference
38 infants (21 males) – no distinct hand-use preference

➤ tested monthly from 6 to 14 months (9 visits) for reaching and acquisition

➤ tested monthly from 11 to 14 months (4 visits) for RDBM

Apparatus:

➤ 24 simple one-part toys for reaching and acquisition

➤ 13 multiple-part toys for RDBM assessment

Procedure:

➤ A validated handedness assessment task (Michel et al., 1985) – number of toys acquired (for reaching) or actively manipulated (for RDBM) by the right and left hand by each infant at each visit

$$\text{Handedness Index} = \frac{\text{Right}}{(\text{Right} + \text{Left})}$$

Development of RDBM

Figure 1. Observed and estimated average number of RDBM actions

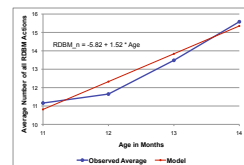


Figure 2. Observed average number of RDBMs in right-handers and infants without a hand preference

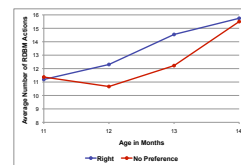


Figure 3. Observed average number of pokes, strokes and spins

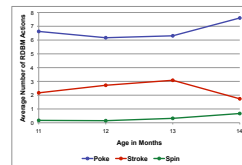


Figure 4. Observed and estimated average proportion of right-hand RDBM actions

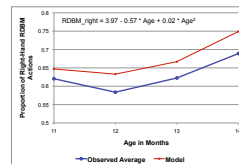


Figure 5. Observed average proportion of right-hand RDBMs in right-handers and infants without a hand preference

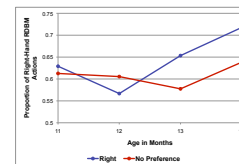


Figure 6. Observed average proportion of bimanual acquisitions before RDBM

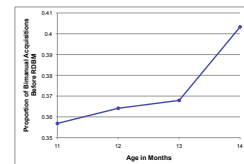


Figure 7. Estimated relationship between proportion of bimanual acquisitions and average number of RDBM actions

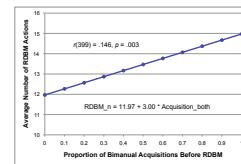


Figure 8. Observed average proportion of bimanual acquisitions before RDBM in right-handers and infants without a hand preference

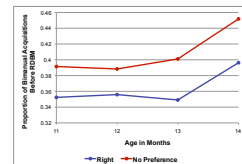


Table 1. Distribution of infants in handedness groups according to reaching and RDBM

		RDBM Handedness			Total Number
		No Preference	Right	Left	
Reaching	No Preference	12 (32%)	18 (47%)	8 (21%)	38
Handedness	Right	23 (36%)	37 (59%)	3 (5%)	63
	Total	35	55	11	101

$$\chi^2(2, N = 101) = 6.50, p = .039$$

Results

Figure 1 - The total number of RDBM actions increases with age, and average trajectories are very similar in right-handers and infants without a distinct hand preference (Figure 2).

Figure 3 - Number of pokes increases, whereas the number of strokes decreases between 13 and 14 months. Thus, infants become more often involved in finger movements that demand higher level of precision.

Figure 4 - The proportion of right-handed RDBMs on average increases between 12 and 14 months, and average trajectories are quite distinct in right-handers and infants without a stable preference (Figure 5).

Figure 6 - Infants increase in the proportion of bimanual toy acquisitions that lead to RDBM between 11 and 14 months, and this increase is associated with an increase in the total number of RDBMs (Figure 7).

Figure 8 - However, right-handed infants that on average are less likely to acquire toys bimanually, perform slightly more RDBM actions between 11 and 14 months (Figure 2).

Table 1 - Infants who are right-handed in reaching are more likely to be right-handed in RDBM, whereas infants without hand preference in reaching are more likely to be left-handed for RDBM.

Discussion

The analysis showed that RDBM actions increase in frequency from 11 to 14 months.

However, different RDBM actions have different developmental trajectories. Thus, the number of RDBM actions that require fine motor movements (pokes, spins) increases between 13 and 14 months, whereas the number of the whole-hand actions (strokes) decreases.

During the entire interval from 11 to 14 months, infants increase in the proportion of bimanual toy acquisitions that lead to RDBM. However, the increase in frequency of RDBM actions does not require the increase in bimanual acquisitions.

Chi-square analysis suggests that handedness for reaching is significantly associated with handedness for RDBM.