Report

Current Biology

Comprehensive Longitudinal Study Challenges the Existence of Neonatal Imitation in Humans

Highlights

- Human infants were shown 11 gestures at 1, 3, 6, and 9 weeks of age
- Infant production of these gestures was independent of what was modeled
- Purported imitation effects were replicated but vanished in light of extra controls
- The findings demand a reconceptualization of the roots of human social cognition

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In Brief

Oostenbroek et al. carried out the largest-ever longitudinal study of neonatal imitation in humans. Newborns were shown a variety of gestures at four time points and found to be just as likely to produce matching and non-matching actions in response. The results challenge claims that imitation is an innate human capacity evident at birth.

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Comprehensive Longitudinal Study Challenges the Existence of Neonatal Imitation in Humans

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SUMMARY

Human children copy others' actions with high fidelity, supporting early cultural learning and assisting in the development and maintenance of behavioral traditions [1]. Imitation has long been assumed to occur from birth [2–4], with influential theories (e.g., [5–7]) placing an innate imitation module at the foundation of social cognition (potentially underpinned by a mirror neuron system [8, 9]). Yet, the very phenomenon of neonatal imitation has remained controversial. Empirical support is mixed and interpretations are varied [10–16], potentially because previous investigations have relied heavily on cross-sectional designs with relatively small samples and with limited controls [17, 18]. Here, we report surprising results from the most comprehensive longitudinal study of neonatal imitation to date. We presented infants (n = 106) with nine social and two non-social models and scored their responses at 1, 3, 6, and 9 weeks of age. Longitudinal analyses indicated that the infants did not imitate any of the models, as they were just as likely to produce the gestures in response to control models as they were to matching models. Previous positive findings were replicated in limited cross-sections of the data, but the overall analyses confirmed these findings to be mere artifacts of restricted comparison conditions. Our results undermine the idea of an innate imitation module and suggest that earlier studies reporting neonatal imitation were methodologically limited.

RESULTS

With approval by the University of Queensland's Behavioural and Social Sciences Ethical Review Committee, our study was designed to chart the prevalence, time course, and social-cognitive correlates of neonatal imitation using a large sample and a comprehensive longitudinal design. Infants (n = 106) were presented with 11 models for 60 s each when the infants were 1, 3, 6, and 9 weeks of age. These models (see Figure 1) included four facial gestures (tongue protrusion, mouth opening, happy face, and sad face), two non-social objects simulating the facial gestures (a spoon protruding through a tube and a box opening), two hand gestures (index finger protrusion and grasping), and three vocal gestures ("mmm," "eee," and "click" sounds). We scored the number of times the infants displayed each of the nine facial, hand, and vocal gestures when viewing the models (see Table S1 for coding guidelines and inter-rater reliabilities). Unlike in other studies of neonatal imitation, this allowed us to compare the frequency of infants' behavior that matched the model with the frequencies of that same behavior in response to ten different control models. Imitation would be evident if matching responses (e.g., infant makes tongue protrusions while viewing a tongue protrusion model) were more frequent than non-matching responses (e.g., infant makes tongue protrusions while viewing a happy face model). We excluded from analyses all infants who were sleeping or crying during a testing session, resulting in a final sample of 64 infants for the longitudinal tests and a range of 77–90 infants for the cross-sectional tests (see Supplemental Experimental Procedures for further details).

For each gesture we ran a series of generalized linear mixed model (GLMM) analyses. The dependent variable for each series of GLMMs was the number of responses produced by the infants averaged over four 15-s trial periods for each gesture modeled. The fixed predictors of infant behavior included (1) the gesture modeled by the experimenter (i.e., the matching gesture or one of the ten control gestures), (2) the age of the infant at the time of testing, and (3) the interaction of the previous two predictors (to account for any change in imitation over time). These full GLMMs were tested against simpler nested GLMMs: gesture and age only without the interaction term, gesture only, age only, and a null model containing no fixed effects (see Supplemental Experimental Procedures for more details and justification of these statistical analyses and also for details of the model selection process for each gesture).

Contrary to expectations, the longitudinal analyses failed to uncover any evidence for imitation of any of the nine social gestures (see Figure 2). Specifically, for three gestures (mouth opening, sad face, and eee sound), there were no differences between the frequencies of the gestures in response to the matching models versus the control models and no changes in the frequencies of the gestures over time. For three other gestures (index finger protrusion, grasping, and click sound), the infants' likelihood of producing the gestures changed linearly over