

Imitation research: Infants are sensitive to being taught

Infants are more likely to imitate novel actions when receiving ostensive and referential signals.

- Newborns imitate facial gestures^{1,2}
- 13-month-olds imitate inefficient, non-goal directed actions³
- 14-month-olds imitate unusual actions after a 1-week delay⁴
- 14-month-olds selectively imitate unusual actions⁵, *if the action is demonstrated with ostensive and referential signals*⁶
- 3- and 5-year-olds imitate both causally necessary and irrelevant steps in an action sequence and interpret them as normative⁷

Theory of Natural Pedagogy^{8,9,10}

Imitation supports learning of cognitively 'opaque' information (e.g. cultural practices).

Imitation is facilitated by teaching: knowledge demonstrations with ostensive, referential cues (e.g. eye contact, pointing).

RQ: Do 'pedagogical signals' need to be presented for every demonstration of a novel action or do children take and maintain a 'pedagogical stance'?

Study I: Do we have to teach all the time?

Method	Results	Discussion																
<p>Participants 44 18-month-old infants</p> <p>Design Model familiarity: familiar model vs. stranger model Pedagogical communication: with signals vs. without signals Baseline: familiar model, with pedagogical signals</p> <p>Procedure 1. Warm up with Experimenter 1 (free play with pedagogical communication) 2. Four different test trials a) with either the familiar experimenter (E1) or a 'stranger' (E2) b) with pedagogical signals before and during action demonstration or without signals: e.g., eye contact, "Watch this, [name]!", pointing vs. no talking, no eye contact, no pointing</p>	<p><i>Baseline.</i> Imitation on 9% of trials in baseline and on 44% of trials in experimental conditions ($p < .05$)</p> <p>Communication. Infants were more likely to imitate after a signalled demonstration than after a non-signalled demonstration.</p> <p>Model familiarity. Infants were more likely to imitate a familiar model than a stranger model.</p> <table border="1"> <thead> <tr> <th></th> <th>Familiar model</th> <th>Stranger model</th> <th>Total</th> </tr> </thead> <tbody> <tr> <td>With signals</td> <td>66.7%</td> <td>46.9%</td> <td>57.4%</td> </tr> <tr> <td>Without signals</td> <td>40.0%</td> <td>23.1%</td> <td>32.0%</td> </tr> <tr> <td>Total</td> <td>52.6%</td> <td>34.3%</td> <td>44.0%</td> </tr> </tbody> </table> <p>Table: Imitation rates broken down by model familiarity and pedagogical communication in average per cent of trials. Significant differences between communication conditions ($p < .01$ total, $p < .05$ familiar/stranger) and familiarity conditions ($p < .05$ total/ with/ without signals)</p>		Familiar model	Stranger model	Total	With signals	66.7%	46.9%	57.4%	Without signals	40.0%	23.1%	32.0%	Total	52.6%	34.3%	44.0%	<p>Communication facilitates imitation in infants.</p> <p>However, when investigating how often children copy a novel action, children perform the novel action many times, irrespective of pedagogical communication during action observation.</p> <p>Furthermore, infants are more likely to imitate a familiar person than a stranger.</p> <p>Results of imitation studies are likely influenced by the familiarity of the participant with the experimenter (e.g. through warm-up).</p> <p>How does imitation develop with age? Do parents actually teach their children as described by natural pedagogy?</p>
	Familiar model	Stranger model	Total															
With signals	66.7%	46.9%	57.4%															
Without signals	40.0%	23.1%	32.0%															
Total	52.6%	34.3%	44.0%															

Theory and reality: Imitation is not so simple

While the authors claim that natural pedagogy^{8,9,10} is human specific and do not give age specifications for the applicability of their theory, most work has been conducted with children up to age 2 years. BUT:

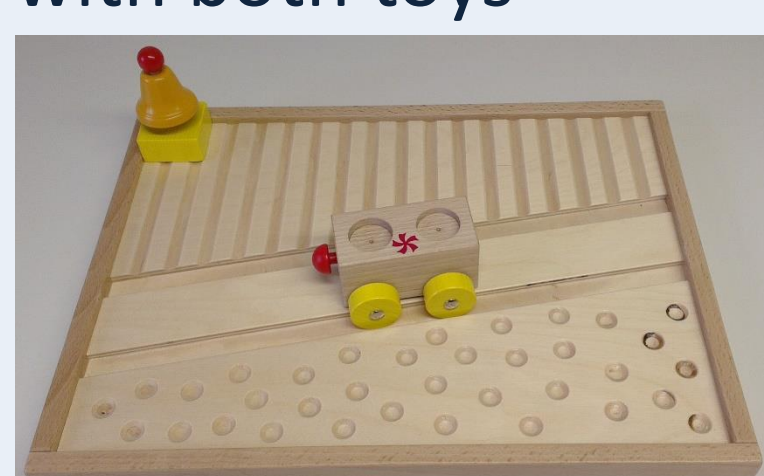

- 14-month-olds rarely imitate novel, 'unsuccessful' actions^{6,11} and they selectively imitate only the efficient actions if presented with more than one means to achieve a goal¹²
- 14-month-olds are less likely to imitate actions which are physically difficult for them¹³
- 18-month-olds are less likely to imitate unusual actions if they know of alternative means to achieve the goal¹⁴
- 3-year-olds imitate intentional actions without pedagogical signals¹⁵
- 4- and 5-year-olds are more likely to imitate a reliable model than an unreliable model¹⁶

Finally, most of this research has been done in a laboratory setting with experimenters. But do parents actually use ostensive signals to pass on action knowledge? And, if they do, does this ostensive cueing also lead to increased imitation in their children in a naturalistic setting?

According to the theory of natural pedagogy^{8,9,10} people are naturally motivated to teach and learn from their conspecifics.

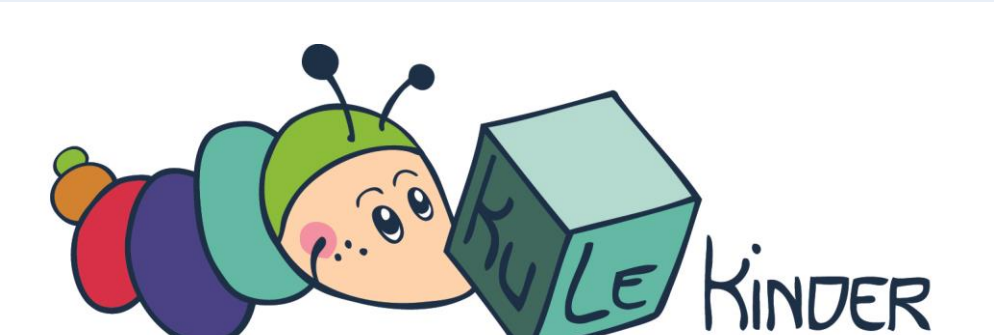
RQ: Do parents demonstrate actions for their children and do parents use pedagogical communication for their demonstrations? Do children imitate their parents after teaching?

Study II: Do parents actually teach their children?

Method	Results example	Discussion																																																						
<p>Participants. 10 18-month-olds and 4-year-olds</p> <p>Materials. 2 novel toys with multiple hidden features</p> <p>Procedure. 1. Parent watches 2 videos: action demonstration on toy A, no action on toy B (counterbalanced) 2. Parent (P) and child (C) play freely for 10 min. with both toys</p>  	<p>Participant 1: 18 months</p> <table border="1"> <tr> <td>Exploring together</td> <td>P: point → car front, "What can it do?"</td> <td>C: grabs car and bell</td> </tr> <tr> <td>with</td> <td>P: moves C's hand to ring bell</td> <td>C: [action with hand]</td> </tr> <tr> <td>pedagogy</td> <td>P: "Look here", [action]</td> <td>C: gaze away</td> </tr> <tr> <td></td> <td>P: "Can you do it?", [action] –repeatedly-</td> <td>C: [exploration],[imitation]</td> </tr> </table> <p>Participant 2: 4 years</p> <table border="1"> <tr> <td>Pedagogy successful</td> <td>P: "Look here, what this is"</td> <td>Pedagogy successful, then P explores</td> </tr> <tr> <td></td> <td>P: [action], gaze → C</td> <td></td> </tr> <tr> <td></td> <td>C: [imitation]</td> <td></td> </tr> <tr> <td>Pedagogy failed</td> <td>C: [plays with function 1]</td> <td></td> </tr> <tr> <td></td> <td>P: "Look here", [action]</td> <td></td> </tr> <tr> <td></td> <td>C: [plays with function 1]</td> <td></td> </tr> <tr> <td>Exploring together</td> <td>P: [action 1], gaze → C</td> <td></td> </tr> <tr> <td></td> <td>C: [imitation 1], [explore]</td> <td></td> </tr> <tr> <td></td> <td>P: -verbal description 2-</td> <td></td> </tr> <tr> <td></td> <td>C: [action 2]</td> <td></td> </tr> </table> <p>Participant 3: 4 years</p> <table border="1"> <tr> <td>Pedagogy successful</td> <td>P: "Pay attention. If you..." [action]</td> <td></td> </tr> <tr> <td></td> <td>C: [imitation]</td> <td></td> </tr> <tr> <td></td> <td>P: takes toy, performs same action from different angle</td> <td></td> </tr> <tr> <td></td> <td>C: -distracted-, [imitates 1st action]</td> <td></td> </tr> </table>	Exploring together	P: point → car front, "What can it do?"	C: grabs car and bell	with	P: moves C's hand to ring bell	C: [action with hand]	pedagogy	P: "Look here", [action]	C: gaze away		P: "Can you do it?", [action] –repeatedly-	C: [exploration],[imitation]	Pedagogy successful	P: "Look here, what this is"	Pedagogy successful, then P explores		P: [action], gaze → C			C: [imitation]		Pedagogy failed	C: [plays with function 1]			P: "Look here", [action]			C: [plays with function 1]		Exploring together	P: [action 1], gaze → C			C: [imitation 1], [explore]			P: -verbal description 2-			C: [action 2]		Pedagogy successful	P: "Pay attention. If you..." [action]			C: [imitation]			P: takes toy, performs same action from different angle			C: -distracted-, [imitates 1st action]		<p>Sometimes, parents use pedagogical signals to teach their children. Then, children might imitate their parents.</p> <p>But often times parents direct their child's attention and then 'leave them space' to detect the toy's function themselves. The actions are then together developed further.</p> <p>Parents seem to direct and guide younger children more than older children</p>
Exploring together	P: point → car front, "What can it do?"	C: grabs car and bell																																																						
with	P: moves C's hand to ring bell	C: [action with hand]																																																						
pedagogy	P: "Look here", [action]	C: gaze away																																																						
	P: "Can you do it?", [action] –repeatedly-	C: [exploration],[imitation]																																																						
Pedagogy successful	P: "Look here, what this is"	Pedagogy successful, then P explores																																																						
	P: [action], gaze → C																																																							
	C: [imitation]																																																							
Pedagogy failed	C: [plays with function 1]																																																							
	P: "Look here", [action]																																																							
	C: [plays with function 1]																																																							
Exploring together	P: [action 1], gaze → C																																																							
	C: [imitation 1], [explore]																																																							
	P: -verbal description 2-																																																							
	C: [action 2]																																																							
Pedagogy successful	P: "Pay attention. If you..." [action]																																																							
	C: [imitation]																																																							
	P: takes toy, performs same action from different angle																																																							
	C: -distracted-, [imitates 1st action]																																																							

References

- Meltzoff & Moore (1977). Imitation of facial and manual gestures by human neonates
- Meltzoff & Moore (1983). Newborn infants imitate adult facial gestures
- Sakalou, et al. (2013). Infants show stability of goal-directed imitation
- Meltzoff (1988). Infant imitation after a 1-week delay
- Gergely, Bekkering, & Király (2002). Rational imitation in preverbal infants
- Király, Csibra, & Gergely (2013). Beyond rational imitation
- Keupp, Behne, & Rakoczy (2013). Why do children overimitate? Normativity is crucial
- Csibra & Gergely (2006). Social learning and social cognition: The case for pedagogy
- Csibra & Gergely (2009). Natural pedagogy
- Csibra & Gergely (2011). Natural pedagogy as evolutionary adaptation
- Paulus, Hunnius, Vissers, & Bekkering (2011a). Bridging the gap between the other and me
- Gergely & Csibra (2005). The social construction of the cultural mind
- Paulus, Hunnius, Vissers, & Bekkering (2011b). Imitation in infancy: Rational or motor resonance?
- Pinkham & Jaswal (2011). Watch and learn? Infants privilege efficiency over pedagogy during imitative learning
- Schmidt, Rakoczy, & Tomasello (2011). Young children attribute normativity to novel actions without pedagogy or normative language
- Rakoczy, Warneken, & Tomasello (2009). Young children's selective learning of rule games from reliable and unreliable models



Contact
Angelique Eydam - a.eydam@tum.de

This work was supported by an EPS Small Grant to the last author, the Marie-Curie Initial Training Network, "TESIS: Towards an Embodied Science of InterSubjectivity" (FP7-PEOPLE-2010-ITN, 264828), HABA and LEGO.