

(Draft 19 March 2015 – Please do not quote without permission)

## **Selective imitation in ostensive-communicative contexts**

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Running head: Selective imitation

Word count of main text excluding cover and abstract: 3,828 words

## **Abstract**

The study investigated whether the facilitating effect of novel word on imitation was due generally to an expectation of new information or to the model's intention to communicate. In Experiment 1A, a model presented different verbal information before demonstrating how to activate a light box with the forehead. In the three hands-occupied conditions, after having seen the model's hands occupied with a blanket, infants either received a familiar orienting sentence, or one containing a novel verb, or one in unfamiliar language. In the hands-free condition, infants received a familiar orienting sentence but saw the model's hands rest on the table. Infants imitated the head action more often in the hands-free and novel word hands-occupied conditions. Experiment 1B tested whether infants were sensitive to the model's specific intention. We altered the sentence so that the novel verb was not a privileged index of intention. The tendency to imitate was reduced when the model intended to communicate about the result (rather than the action) of the event. The present study replicated and extended the finding of Chen and Waxman (2013), who studied infants from an English-speaking environment, to infants from a Mandarin-speaking environment. From very early, infants' imitation is flexible depending on the ostensive behavioral cues available for rational assessment and verbal cues for intention attributions.

*Keywords:* Intention; Imitation; Ostensive communication; Teleological reasoning

## **Introduction**

A growing body of research indicates that goal representation is implicated in children's propensity to imitate. For example, after seeing an adult use a contralateral hand to touch a marked location on the table, 3- to 6-year-olds tended to match the end with simplified ipsilateral movements, but the errors decreased when the contralateral hand was directed to an unmarked location (Bekkering, Wohlschläger & Gattis, 2000; see also Gleissner, Meltzoff & Bekkering, 2000). Similarly, 12-18-month-old infants were less likely, for example, to imitate the manner by which an adult moved a toy mouse when the mouse was placed into one toy house than when no house was presented at the end location (Carpenter, Call & Tomasello, 2005). Such differential imitation suggests that imitation involves goal selection processes in which the effects of body movements take priority over the body movements themselves, so that infants reproduced the effects at the cost of details of the model's strategy when resources were limited (Bekkering et al., 2000) or when the task required them to make a choice between the components (Elsner & Pfeifer, 2012).

Furthermore, recent research has shown that imitation by children is mediated not only by the perceived goal of an ongoing action but also by what they think the demonstrator is deliberately trying to do. In a seminar study, Gergely, Bekkering and Kiraly (2002) showed that infants as young as 14 months imitatively construe a specific action in different contexts as associated with different intentions: they imitated touching the light box with their head

when they were shown a model perform the action with her hands placed on the table (hands free), but not when she used the hands to hold up a blanket around her shoulders (hands occupied). According to the authors, the hands-free manner was a signal to the infants to identify the head touch as relevant for reproduction, because a more efficient strategy (hand touch) was readily available but the model rather adopted a less efficient one. By contrast, the hands-occupied situation gave the model no choice but to use the head and the infants appear to understand that they were not expected to copy the unusual action as their hands were free.

Recently, alternative accounts have challenged the view that infants selectively imitate based on evaluation of the efficiency of an action. The failure to imitate in the hands-occupied condition has been interpreted as difficulties with motor simulation (bending forward without hand support while maintaining a stable position; Paulus, Hunnius, Vissers, & Bekkering, 2011) or distraction from the outfit (Beisert, Zmyi, Liepelt, Jung, Prinz, & Daum, 2012). However, more recent evidence indicates that when the model provides a novel action word (“blick” the light) before the demonstration, infants are able to imitate the hands-occupied head touch (Chen & Waxman, 2013). Although this study suggests that novel word highlights the model’s intention of performing an unconventional behavior, an expectation of novelty is not tested explicitly. Infants might be more likely to expect new information following utterances containing a novel word than following familiar utterances. This overshadows the conclusion that the novel word guides infants to interpret the model’s intention in the

hands-occupied condition as referring to the head touch.

The current study tested whether the imitation tendency facilitated by novel action word could be due generally to novel linguistic features. In Experiment 1A, we presented infants with a modified hands-occupied condition in which the model interacted with them in an unfamiliar language. If novel linguistic features bias infants to expect that the model is about to show novel information, both novel word and unfamiliar language utterances would push them toward imitation of the head touch in the hands-occupied condition as frequently as did the hands-free demonstration, and more often than the hands-occupied demonstration per se.

## **Experiment 1A**

### **Method**

#### *Participants*

Eighty 17-month-olds (44 females, 36 males;  $M = 17.0$  months,  $SD = 0.4$ ) participated in the experiment. Twelve additional infants were excluded due to fussiness (five), shyness (five), and procedural error (two). All subjects were Han ethnic Chinese and full-term, healthy infants from Mandarin-speaking families in Taipei, Taiwan. They were generally middle-class

recruited by internet advertising and word of mouth.

### *Materials*

Materials were a light box and a yellow blanket (140 × 180 cm). The box (Fig.1), adapted from Meltzoff (1988), consisted of a translucent square box (15 × 20 × 5 cm), a translucent half-globe (11.5 cm in diameter), and LED light bulbs inside the box. The bulbs could be switched on when the half-globe was touched.



**Fig. 1.** Light box used in the present study.

### *Procedure and Design*

Before starting the experiment, the female experimenter, who was bilingual in Mandarin

and English, familiarized the child with the test room. The interaction was basically nonverbal. The child was shown stuffed toys and the experimenter said, “Kan4 (Look)!” “Wa2 (Wow)!” “Hao3 (All right),” and so on. After the brief warm-up, the child sat on the parent’s lap across the table from the experimenter. As in previous studies, the general procedure was: the experimenter brought out the box, pretended to be cold (hence putting on the blanket), demonstrated the head touch, and then gave the box to the child for a 20-s response period.

Infants were randomly assigned to one of four conditions (orienting hands-free, orienting hands-occupied, novel word hands-occupied, and unfamiliar language hands-occupied). The experimenter spoke English in the unfamiliar language hands-occupied condition and Mandarin in the other three conditions.

In the orienting hands-free condition, the experimenter draped a blanket over her shoulders, and put her hands on the table next to the box. In the orienting hands-occupied condition, she held the blanket tightly so that her hands were occupied. In both conditions, she presented infants a familiar sentence as a prelude to the upcoming event. After announcing “Kan4 wo3 zen3 mo1 wan2!” (“Watch how I play with it!”), she proceeded to illuminate the box with her forehead for 2 s, and then restored the upright posture. This sequence was repeated three times. When the demonstration was complete, she placed the box in front of the child and said “Your turn.” The only difference between the three hands-occupied conditions was the content of verb information before the demonstration. In the novel word

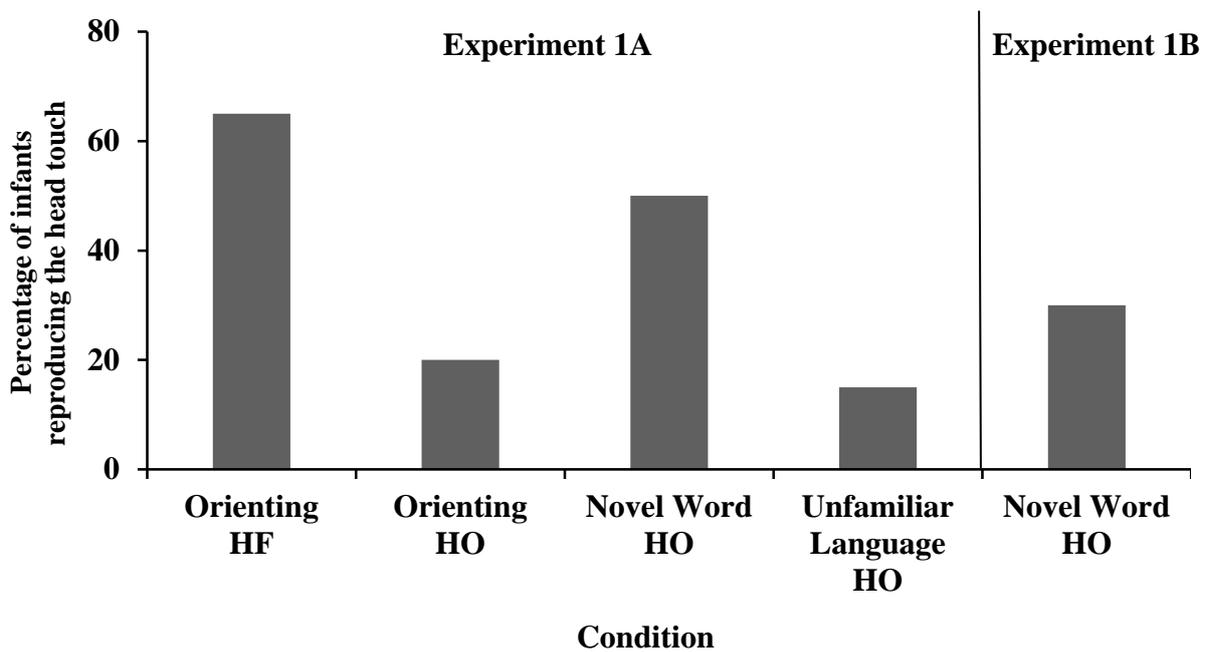
hands-occupied condition, she presented a sentence containing a novel word, “Kan<sup>4</sup> wo<sup>3</sup> zen<sup>3</sup> mo<sup>2</sup> *duai*!” (“Watch how I *duai* with it!”), in which *duai* is not a word in Mandarin. In the unfamiliar language hands-occupied condition, she said, “Watch! Shall we blick?”

## **Results and discussion**

Following the criteria of previous studies (Huang, 2012; Meltzoff, 1988), a head touch was coded if infants used their head to touch the box or bent over but missed contact no more than 10 cm within the 20-s response period. A research assistant coded infants’ responses from all videotaped sessions. A second rater naive about the study coded 50% of the data (ten per condition). Inter-rater agreement was excellent (98%).

All infants activated the light using their hands at least once during the response period. Considering whether they touched the light with their head (see Fig.2), however, a significant difference appeared across conditions,  $\chi^2(3, N = 80) = 14.72, p = .002$ . Similar to previous studies (e.g. Chen & Waxman, 2012; Gergely et al., 2002), the head touch was imitated 65% of the time (13 of 20) in the orienting hands-free condition compared to 20% (4 of 20) in the orienting hands-occupied condition,  $\chi^2(1, N = 40) = 8.29, p = .004$ , despite explicit verbal information orienting them to the forthcoming action. Note that the experimenter’s hands were not available in the novel word hands-occupied condition, but the head touch was imitated 50% of the time (10 of 20), significantly higher than that in the orienting

hands-occupied condition,  $\chi^2(1, N = 40) = 3.96, p = .047$ . There was no difference between the novel word hands-occupied and orienting hands-free conditions,  $\chi^2(1, N = 40) < 1$ . By contrast, only 3 of 20 infants (15%) imitated the head touch in the unfamiliar language hands-occupied condition in which the experimenter's hands were also not available, significantly fewer than in the orienting hands-free condition,  $\chi^2(1, N = 40) = 10.42, p = .001$ , but not different from the orienting hands-occupied condition,  $\chi^2(1, N = 40) < 1$ .



**Fig. 2.** Percentage of infants reproducing the head touch in each of the experimental conditions in Experiments 1A and 1B.

Note. HF: hands-free; HO: hands-occupied.

Experiment 1A found the same pattern of reproduction in infants, who live in a Mandarin-speaking environment, as was shown by Chen and Waxman (2013) in infants who live in an English-speaking environment. Although previous research has suggested that the hands-free (but not the hands-occupied) manner cues infants to interpret the novel action as the model's intended goal, infants in the orienting hands-free and novel word hands-occupied conditions imitated equally often, both of whom outperformed those in the orienting hands-occupied condition. Given that infants in the unfamiliar language hands-occupied condition imitated as infrequently as those in the orienting hands-occupied condition, exposure to novel acoustic features of speech itself is not sufficient to direct their attention away from the situational constraints. This pattern of findings implies that novel word can serve as an alternative source of information about the intended goal of an action when the situational constraints on the actor's movements are uninformative.

## **Experiment 1B**

The results of Experiment 1A suggest that infants exploited novel word as a guide to consider whether the model was deliberately showing the head touch. However, the novel word served as a verb, which simultaneously specified the model's intention, raising the

question of whether infants simply construed a novel action word as the model's intent. That is, they may not have acquired a full-fledged understanding of intention. Experiment 1B was designed to clarify whether infants would appreciate novel word as a privileged source of information about intention in the hands-occupied condition when it did not refer simultaneously to the verb referent and the model's specific intention. We altered the utterances to highlight the model's intention toward the result of the event while preserving the verb-action relationship. If the labeling effect on imitation was due specifically to the intended content of utterances, imitation in the new novel word hands-occupied condition of Experiment 1B should occur as infrequently as that in the orienting hands-occupied condition of Experiment 1A, and less often compared to that in the orienting hands-free condition of Experiment 1A.

## **Method**

### *Participants*

Twenty 17-month-olds (11 females, 9 males;  $M = 17.0$  months,  $SD = 0.4$ ), recruited as in Experiment 1, participated in Experiment 2. Four additional infants were excluded due to fussiness (two) and procedural error (two).

### *Apparatus and procedure*

As in Experiment 1A, all participants were tested individually at a laboratory in the

department. The apparatus and procedure followed the novel word hands-occupied condition of Experiment 1 except for instruction before demonstrating the head action. Instead of emphasizing the upcoming action, the experimenter verbally drew infants' attention to the result of the event. She said, "Kan4 wo3 *duai*1 she2 mo2!" ("Watch what I *duai*!"), and then proceeded with the demonstration.

## **Results and discussion**

Scoring was identical to Experiment 1A. Sessions from 10 infants were coded independently to assess inter-rater reliability. Agreement was excellent (100%). The head touch was imitated 30% of the time (6 of 20) in the new novel word hands-occupied condition (see Fig.2). Planned comparisons across experiments showed that infants in the orienting hands-free condition (Experiment 1A) reproduced the head action more frequently than infants in the new novel word hands-occupied condition (Experiment 1B),  $\chi^2(1, N = 40) = 4.91, p = .027$ , who did not differ from infants in the orienting hands-occupied condition (Experiment 1A),  $\chi^2(1, N = 40) < 1$ .

The two novel word hands-occupied conditions of Experiments 1A and 1B involved the same novel verb but differed in the model's specific intention; therefore, if novel verb served as a privileged source of information about intention, many infants in both conditions should have reproduced the head touch. The findings of Experiment 1B suggest that infants

differentially imitate the head touch depending on whether the model intends to communicate about the action or the result of the event.

## **General discussion**

In two experiments, we explored the facilitating effect of novel word on imitation, capitalizing on the study by Chen and Waxman (2013) who, after demonstrating to infants how to switch on a light box with the forehead, found that the infants, who were not supposed to imitate the unusual action after having seen the model's hands occupied, imitated better when the model announced a sentence containing a novel verb before the demonstration. Experiment 1A replicated and extended the Chen and Waxman (2002) study, showing similar facilitating effects in ethnic Chinese infants from a Mandarin-speaking environment. Very few infants imitated the head touch when a foreign language (English) was presented as a verbal prompt. In Experiment 1B, the model labeled the forthcoming action with the same novel verb while intentionally drawing infants to the result of the event, and imitation was as infrequent as when no novel verb was presented before the hands-occupied demonstration.

Like previous work suggesting involvement of intention inference when participants imitatively learn a specific action after having seen the model perform actions with intentional

or accidental exclamation (e.g., Carpenter, Akhtar, & Tomasello, 1998; Tomasello & Barton, 1994), our results support this view by ruling out novel acoustic features of speech as an explanation, and extend previous work by showing that the intended content of communications privileges the act of labeling an unfamiliar action with a novel word.

Novel word facilitated imitative responses not only because infants were drawn to the forthcoming action; in the orienting hands-occupied condition, a familiar sentence also directed their attention to the action but imitation was not evident. The effect is unlikely to arise from acoustic saliency that reduced attention to the hands-occupied situation, because poor imitation was shown in the unfamiliar language (Experiment 1A) and novel word (Experiment 1B) hands-occupied conditions where the verbal cues were potentially distracting. Note that there was a rising pitch when the model intended to use the novel word to communicate about the unfamiliar action, and a falling pitch when she intended to communicate about the its result. Possibly, instead of being based on verb referent, the effect might be have been due to a sensitivity to prosodic features inherent in Mandarin speech, given previous research showing that 14-18-month-old infants are able to infer intentions from prosodic information in the absence of lexical cues (Sakkalou & Gattis, 2012). However, it cannot explain the differing rates of imitation in Experiment 1A, in which the model's utterances ended in high intonation in all conditions.

The results of Experiment 1B showed that infants did not imitatively respond to the

novel verb when the model intended to communicate about the result of the event. It is less clear whether the results necessarily imply that they understood different intentions suggested by the model. It could be argued that infants always treat a novel verb as signaling the intention of an agent to perform an impending action. The infrequency of imitation in the novel word condition of Experiment 1B was perhaps because the sentence gave the verb a less salient medial position relative to the final position it occupied in the novel word condition of Experiment 1A. Previous research has shown that words in utterance-final position are salient to children and are more likely to be learned (Gentner, 1982; Slobin, 1973). A verb bias in Chinese children's early vocabularies has been found to correlate closely with the tendency of Mandarin-speaking caregivers to place verbs at the ending of utterances (e.g., Tardif, Shatz, & Naigles, 1997). It remains to be shown whether the word's less salient position detracted from a susceptibility to novel verbs in the novel word condition of Experiment 1B. The differential imitation effect would be less vulnerable to this interpretative problem if the model had announced her intention toward the object by placing the novel verb in utterance-final position. However, given that such utterances are ungrammatical expressions in natural Mandarin, the effects could not be due to a novel word's impact outlined above, and therefore it is not clear whether resolution of this issue would serve the purpose of the present study. It should be noted that the English-speaking infants benefit from a novel verb in utterance-medial position in the Chen and Waxman (2013)

study, suggesting at least their use of novel word to encode intentions is not restricted to the salient positions.

Ostensive verbal cues can potentially modulate reproduction of action components. Infants' selective imitation is apparently biased toward semantic intentions when both rational assessment and verbal information are available. The results from studies using ostensive communicative cues are broadly in line with our own. Infants use communicative cues to decide which aspects of an action are important during imitative learning: they privilege goals over novel action styles when utterances diffusely refer to the event; however, action styles are privileged when goals are verbalized (Southgate, Chevallier, & Csibra, 2009). Young children selectively reproduce action goals directed toward low-salient objects only after having seen the objects being labeled (Elsner & Pfeifer, 2012). The present study provides preliminary support for this work by suggesting that infants consider intentions conveyed by ostensive communicative cues even when rational assessment of the action, the goal and the situational constraints suggests different intentions. Although the hands-occupied demonstration was highly likely to induce infants to emulate the result of the event, they imitated the model after having seen this demonstration informed by novel word utterances referring to an intention for how to act on the box. Infants did not decipher the novel verb used to label a specific action as generally speaking of an intention to perform action. They did not show imitation when novel word utterances emphasized the result of the event. Given

that the modeled behavior was identical in both novel word conditions, the intended content of communications was sufficient to modulate infants' imitation.

An interesting area for future research could be to examine the role of unfamiliar actions in understanding verb-intention relationships. If the labeling effect is reliant on the unfamiliar nature of an action (Behrend & Scofield, 2006), infants will not benefit from mapping words unto intentions when there is clear information about the causal mechanisms or affordances of the task. This question is related to the issues of cognitive opacity (Gergely & Csibra, 2006): infants weigh physical-causal efficiency and ostensive communicative cues between their own privileged knowledge state and the model's knowledge (Király, Csibra, & Gergely, 2013). In future studies, it would be interesting to clarify whether the labeling effect may have been due to a susceptibility to the model's prior intention (Carpenter, Call, & Tomasello, 2002; Huang, 2013). While labeling an unfamiliar action increases infants' sensitivity to others' intentions, they are required to bootstrap their understanding of utterances in the ongoing behavior stream. If understanding prior intention is contributing to this effect, infants will resort to rational assessment when novel word utterances are presented simultaneously with the action or after the action (for a similar view, see Tomasello, 1995).

## **Acknowledgements**

The current study was supported by a grant from the Ministry of Science and Technology in Taiwan (NSC100-2410-H-004-044-MY2). I gratefully acknowledge helpful discussions on the initial design idea by Dr. Feng-Ming Tsao. I am indebted to Li-Ya Sun and Yue-Ju Yang for their assistance in data collection and coding. I would like to thank the parents and infants who participated in the research.

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