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Citation for published version:

Link:
Link to publication record in Edinburgh Research Explorer

Document Version:
Peer reviewed version

Published In:
Proceedings for the Annual Meeting of the Cognitice Science Society 2015

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Learning to reason about desires: An infant training study

Tiffany Doan¹ (tidoan@uwwaterloo.ca), Stephanie Denison* (stephanie.denison@uwwaterloo.ca), Christopher G. Lucas¹ (c.lucas@ed.ac.uk), & Alison Gopnik (gopnik@berkeley.edu)

¹University of Waterloo, Department of Psychology
²University of Edinburgh, School of Informatics
³University of California, Berkeley, Department of Psychology

Abstract

A key aspect of theory of mind is the ability to reason about other people’s desires. As adults, we know that desires and preferences are subjective and specific to the individual. However, research in cognitive development suggests that a significant conceptual shift occurs in desire-based reasoning between 14 and 18 months of age, allowing 18- to 24-month-olds to understand that different people can have different preferences (Lucas et al., 2014; Ma & Xu 2011; Rapacholi & Gopnik, 1997). The present research investigates the kind of evidence that is relevant for inducing this shift and whether younger infants can be trained to learn about the diversity of preferences. In Experiment 1, infants younger than 15 months of age showed demonstrations in which two experimenters either liked the same objects as each other (in one training condition) or different objects (in another training condition). Following training, all infants were asked to share one of two foods with one of the experimenters – they could either share a food that the experimenter showed disgust towards (and the infants themselves liked) or a food that the experimenter showed happiness towards (and the infants themselves did not like). We found that infants who observed two different experimenters liking different objects during training later provided the experimenter with the food they liked, even if it was something they disliked themselves. However, when infants observed two experimenters liking the same objects, they later incorrectly shared the food that they themselves liked.

Introduction

As social creatures, we are constantly trying to figure out what other people are thinking. The ability to infer others’ mental states, such as their desires and beliefs, serves a number of important functions. It allows us to please or irritate others, to understand why they engage in particular actions, and to predict their future behavior. These abilities hinge on our having a well-developed theory of mind – the understanding that people have mental states (e.g., desires, beliefs, intentions) and that these mental states can differ from person to person (Gopnik & Wellman 1994).

Explicit theory of mind emerges at about 18 months of age (Lemke, 2007). In recent years, the most important evidence for the existence of a Theory of Mind has come from research on children’s ability to reason about others’ desires. The hypothesis is that as children grow older they accumulate evidence pushing them away from the simple but incorrect initial model toward a more complex and flexible model, which allows them to consider the consequences of distinct preferences. The suggestion is that during this transition, children must observe or participate in many desire-based interactions where people make choices or produce other signals to suggest that their preferences are incongruent with one another or with the infants themselves.

Keywords: Theory of mind; Desire-based reasoning; Infant learning; Social cognition; Preferences.

Experiment 1: Methods

Participants

Infants in both experiments were recruited by phone and email from the California East Bay Area and Southwestern Ontario. In Experiment 1, 55 infants were tested. We used the strict criterion that only infants who did not share the correct item on an initial pre-test (described below) continued to training. Infants completing training did not already know that preferences are diverse. Twenty infants per condition were tested in the full version of the Diverse Desires Training (DDT) condition (range = 14.1 months to 17.5 months; N=DTT: mean age = 15.6 months; range = 14.4 months to 17.2 months). An additional 15 infants were tested with the Diverse Desires Training due to failing to complete the study because of fussiness (2) or refusing to share on the pre-test and all test trials (13).

Materials

Food. Four sets of food pairs were used in the experiment. The pairs were broccoli and Goldfish crackers, celery and rice puffs, cucumbers and cherries, and green peppers and wheel-shaped infant crackers.

Toys. Two sets of toys were used during the training sessions; each set consisted of one type of animal and one type of vehicle in a transparent container. The sets of toys were 4 trucks and 4 dogs, and 4 planes and 4 monkeys. The toys within each type were not identical; they varied in color and shape.

Procedure, Design and Predictions

All infants were tested individually in a quiet lab setting. They sat in a high chair in front of a table and their parent sat in a chair beside them. Before the study began, two experimenters played a passing game with the infant. This allowed the infant to warm up to the experimenters and to

Therefore, simplicity, we will characterize younger infants as assuming that preferences are universal. An alternative possibility is that infants are instead sensitive to the relative desirability of objects, reasoning that some things are inherently more desirable than others. This reasoning would also result in infants sharing primarily the food that they themselves preferred, regardless of her preferences. The 18-month-olds also correctly gave the experimenter the food that they liked, whether the infants themselves preferred this food or not. However, infants younger than 18 months may have a very simple notion of preferences in which they assume that preferences are universal, rather than varying between people. In contrast, older infants seem to recognize that desires are diverse. At about 18 months, infants begin to understand that different people can have different preferences. This ability to infer others’ preferences is universal, rather than varying between people. In contrast, older infants seem to recognize that desires are diverse. At about 18 months, infants begin to understand that different people can have different preferences. This ability to infer others’ preferences is universal, rather than varying between people.

What occurs between the ages of 14 and 18 months to promote such a significant advance in Theory of Mind? In a recent paper, Lucas et al. (2014) suggested that infants might first favor the simpler or “universal” model of preferences because it gives a parsimonious explanation for most of the data they observed. For example, they often observe that experimenters share a food that the experimenter showed disgust towards (and the infants themselves liked) or a food that the experimenter showed happiness towards (and the infants themselves did not like). However, when infants observed two experimenters liking the same objects, they later incorrectly shared the food that they themselves liked. This reasoning would also result in infants sharing primarily the food that they themselves preferred, regardless of her preferences. The 18-month-olds also correctly gave the experimenter the food that they liked, whether the infants themselves preferred this food or not. However, infants younger than 18 months may have a very simple notion of preferences in which they assume that preferences are universal, rather than varying between people. In contrast, older infants seem to recognize that desires are diverse. At about 18 months, infants begin to understand that different people can have different preferences. This ability to infer others’ preferences is universal, rather than varying between people.
ensure that they could share with the experimenters. The warm-up consisted of each experimenter passing a toy (e.g., a ball or toy keys) to the infant and asking her/him to pass it back by placing it in the experimenters’ hands.

Pretest. Based on Repacholi & Gopnik (1997), Experimenter 1 slid a plate of food consisting of a few pieces of vegetables and snacks (e.g., raw broccoli and Goldfish crackers) towards the infant and encouraged the infant to try some. The experimenter gave the infant a 45 second time frame to taste the foods and the experimenter determined which of the two foods the infant preferred. We used the same coding as in Repacholi & Gopnik (1997) to determine food preferences on all trials (pre- and post-tests).

Inter-conder agreement for preferences was 97%. When the infant’s preference was determined, the experimenter took a container consisting of the same foods the infant had tried. The experimenter then demonstrated that she liked the food that the infant did not show a preference for and was disgusted by the food that the infant preferred. The experimenter showed her preferences by saying, e.g., “Eww! Crackers! I tasted the crackers! Eww!” and “Mmm! Broccoli! I tasted the broccoli! Mmm!”. The experimenter showed a liking and disliking towards each of the two toys three times and she did this using facial expressions based on the descriptions of Ekman & Friesen (1975). Next, the experimenter placed broccoli on one side of a tray and Goldfish crackers on the other, placed her hand with her palm up towards the infant, said, “can you give me some?” and slid the tray towards the infant. The infant was given 45s to pass the food to the experimenter. If the infant gave the experimenter the food that the experimenter showed a preference towards, then the infant passed the pre-test. If the infant gave the experimenter the food that she disliked, or did not provide the experimenter with any food, then the infant failed the pre-test.

Training Trials. Infants who failed the pre-test were introduced to either the DDT condition or the N-DDT condition. Infants in the DDT condition saw two experimenters liking and disliking different toys and infants in the N-DDT condition saw two experimenters liking and disliking the same toys.

Training proceeded as follows: Training trial 1 occurred right after the pre-test. During training trial 1, Experimenter 1 put a toy (e.g., dogs and trucks) onto the table and subsequently pulled out three toy of one type (e.g., dogs) and two of another type (e.g., trucks) and placed them. The experimenter pulled out three toys of the other type (e.g., trucks) and expressed dislike towards them. The dialogue and facial expressions used were identical during the pre- test. The experimenter expressed her preferences by saying, “Yay! A dog! I got a dog! Yay!” and “Eww! A truck! I picked up a truck! Eww!” Once Experimenter 1 expressed her emotions for each type of toy three times, Experimenter 2 took over. Experimenter 2 showed liking and disliking towards the same toys as Experimenter 1 if the infant was in the N-DDT condition (e.g., liked dogs and disliked trucks) and she showed liking and disliking towards the opposite toys as Experimenter 1 if the infant was in the DDT condition (e.g., liked trucks and disliked dogs).

Training trial 2 involved Experimenter 2 and the infant. It was similar to the pre-test, except that it involved a different set of food (e.g., a toy and fruit) and if each that each food item appeared on the food dish during the sharing part of the pre-test and post- training tests was randomized. For training trials, if Experimenter 2 and disliked vehicles in the first training trial, she would continue to like animals and dislike vehicles in subsequent training trials. For half the participants, Experimenter 1 liked animals and for the other half, Experimenter 1 liked vehicles. This was crossed with half of the infants seeing disliked expressed first and half seeing liked expressed first. None of these counterbalancing factors led to any systematic differences in the data (when entered into ANOVA’s, all p’s > .05 for these factors).

Predictions. We predicted that infants in the DDT condition would be more likely to offer the experimenter the correct food on the post-terms than infants in the N-DDT condition even though both conditions provided infants with practice in considering other people’s preferences and desires. In the N-DDT condition, infants saw two experimenters liking the same foods – this does not provide the infants with any information that allows them to learn that different people can have different mental states. In the DDT condition, infants saw two experimenters display different preferences from each other, which would provide a great deal of evidence to suggest that different people can have different preferences.

Experiment 1: Results

Of the initial 55 infants who participated in the experiment, 15 passed the pre-test by giving the correct food (p < .01, binomially, significantly fewer than chance), 34 infants shared the incorrect food, and 6 infants shared nothing, replicating that infants age 15 months perform below chance on this task (Repacholi & Gopnik, 1997). This confirms that, in general, infants below 18 months are unable to share the item that they themselves prefer, nor the item for which another person has shown a preference. For the 40 infants who failed the pre-test and continued to training, post-training test 1 performance was identical across training conditions (DDT: 7/20 correct; N-DDT: 7/20 correct). However, performance differed by training condition for post-training test 2 (DDT: 15/20 correct; N-DDT: 7/20 correct, X²(1) = 8.04, p = .004). Only the performance on post-training test 2 for infants in the DDT condition was significantly above chance (p = .04, binomial).

For the first 10 infants in both training conditions, the food on post-training test 2 was identical to the food on training trial 2 (which the infant used with Experimenter 2 on Day 1 but did not share). We switched this to a new food type to ensure that any improvement in infants’ performance on Day 2 in DDT could not be explained by already being familiar with these foods.

Experiment 1: Discussion

Our results suggest that the type of information provided during training was crucial in shaping desires when infants were provided with a large number of instances indicating that two different people can like different things, they appeared to share the information that they disliked but the experimenter preferred. However, infants’ performance did not improve when they saw preferences that were not diverse: infants in the N-DDT condition did not share the correct food with the experimenter on any post-training tests. This suggests that training with appropriate evidence can result in significant changes to children’s explicit Theory of Mind.

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test 2, even though the experimenter demonstrates that she likes the food that the infant also prefers. We maintained the exact same procedure as in the DDT condition of Experiment 1, including using an “unmatched” trial type for post-training trial 1, as the effect was observed only in post-training test 2 and so every aspect of the experimental session must remain the same until that point.

Experiment 2: Methods

Participants
Participants were 29 infants and, as in Experiment 1, only children who failed to give the correct food on the initial pre-test continued to training with 20 infants tested in the full training procedure (mean age = 15.5 months; Range = 14.4 months to 17.0 months). An additional 10 infants were tested but not included in analyses due to failing to complete the study because of fussiness (1), parental interference (1) or refusing to share anything with the experimenters on all test trials (8).

Materials
Food. The food was the same as in Experiment 1 except that the wheel-shaped crackers were replaced with Animal Crackers. This was done because we could no longer find the wheel-shaped crackers.

Toys. The sets of toys were 4 hippos and 4 trucks, and 4 cats and 4 planes. Again, all of the toys within an individual type were slightly different in shape and/or color.

Procedure and Design
The experimental procedure, counterbalancing and randomization were identical to Experiment 1 DDT.

Predictions
We predicted that infants would perform at chance on post-training test 1, as they did in Experiment 1. If infants again gave the experimenter the correct food on post-test 2 (the food that both the therapist and the infant liked), then this will suggest that infants in Experiment 1 did not simply learn to play a game of opposites but instead learned that preferences are diverse.

Experiment 2: Results

Again we replicated the findings from Repacholi & Gopnik (2014)–9/20 infants passed the pre-test (p = .06, binomial, marginally significantly fewer than chance), 18 infants shared the incorrect food and 2 infants shared nothing.

Six out of 20 infants were correct on post-training test 1 and 13 out of 20 were correct on post-training test 2, both significantly different from chance (p = .12 and p = .26, respectively).

The critical comparison is between infants’ performance on post-training test 2 in the Experiment 1 DDT condition and in Experiment 2. This comparison addresses whether infants in Experiment 1 simply learned to play a game of opposites and would have shared the opposite food type to their own preference regardless of what the experimenter demonstrated on post-test 2. For this analysis, we coded infants’ performance in terms of whether they gave the experimenter the opposite food to what the infant preferred (which is correct in Exp 1 DDT but incorrect in Exp 2). We gave infants a score of 1 for sharing the opposite food and a score of zero for sharing the same (non-opposite) food. This resulted in a score of 72/20 for infants in Experiment 2 and 15/20 on post-training test 2 in the DDT condition of Experiment 1. Using a Fisher’s Exact test, we found that the performance of these trials was significantly different from one another, X²(1, N=40) = 6.46, p = .01, suggesting that infants in Experiment 1 were more likely to share the opposite food than infants in Experiment 2, where they would have been incorrect in doing so.

Experiment 2: Discussion

Overall, most infants gave the experimenter the food that she preferred (and that the infant also preferred) on post-training test 2 (this was not significantly different from chance using a binomial test). Though we would have expected infants to share the correct food at higher than chance levels in this “matched” trial, we suspect that the non-significant result is due to a lack of statistical power caused by having relatively few participants for binomial statistics. In general, the percentage of infants offering the correct, “matched” food on this trial is very similar to the percentage of younger infants who did so in Repacholi & Gopnik (1997) (65% vs. 72%, respectively).

The purpose of Experiment 2 was to eliminate the possible explanation that participants in the Experiment 1 DDT condition only learned to give the experimenter the opposite food of what they themselves wanted. Comparison of Experiments 1 and 2 suggest that this was not the case, as infants shared the food that they preferred in Experiment 2 and did not reflexively give the experimenter the opposite food following training.

General Discussion

Together, these findings show that infants younger than 18 months can learn about the subjectivity of preferences when they are given a chance to do so in the presence of an adult who napped perform better than those who did not. It is possible that the infants in our experiment performed better on post-training test 2 because they had slept. To address the sleep hypothesis, one could conduct an experiment similar to those here, except with the entire procedure occurring on the same day. After infants complete post-training test 1, half of the infants would take a nap and half would experience a similar delay without taking a nap. Follow-up that infants would complete post-training test 2. If the infants who napped perform better than those who do not, then this would suggest that sleep consolidation is a crucial aspect of their improved performance.

Conclusion

Research on children’s desire-based reasoning has persisted for decades. Here we examined a prediction from a particular model of how children attribute preferences to others, namely that appropriate training regarding the diversity of desires could result in infants undergoing a significant shift in conceptual development (Lucas et al., 2014). We found that following exposure to different people demonstrating divergent desires, infants were able to move from a model of universal preferences to a model that allows for the individualization of preferences. The success of this training procedure more broadly suggests that early advances in Theory of Mind could be due to experience.

Acknowledgments

We thank Justine Hoch and Sophie Bridgers for an immense amount of help with data collection and infant recruitment. We also thank Elizabeth Attias, Emily McNichol, Meghan McGrath, Julia Henius, Christen Calabasa, and Gina Mandracchia for assistance with data collection. Thanks also to the parents and infants for their participation.

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