Understanding the influence of social context on learning: A replication of Xu and Tenenbaum (2007b)

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Abstract

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Introduction

Imagine you were on a hike and saw a rock positioned oddly at an ambiguous intersection of trails. If you thought you were on a trail which no one had been on in years, you probably wouldn't think much of that rock. But, if you knew that your camp mate had traveled the same trail earlier that day, you might interpret the rock differently: You might interpret the rock as an sign intended to point you to the correct path. This intuition—that the source of a piece of information influences the strength of the inference that should be drawn—suggests that social context may be an important factor in human learning.

Xu and Tenenbaum (2007) examine this phenomenon in the context of a particularly difficult inductive problem: Concept generalization in word learning. Faced with a novel word and its referent, children must decide between an infinite number of hypotheses about the concept extension of that word. For example, consider a child who hears the word "banana" in the context of a single banana on a table. While the reference of that object is clear in the moment of language use (i.e., the particular banana on the table), the broader concept is highly ambiguous: "banana" could refer to the category of bananas, the category of fruit, that particular species of banana (e.g., plantains), yellow things, or any number of other ad-hoc categories.

Xu and Tenenbaum (2007) ask whether children make use of the information source about a new word to guide their inferences about how to generalize its meaning. In particular, they test a prediction that falls out of their word learning model. In their Bayesian model, learners observe data as word-object pairs and make inferences about the concept associated with that word from a hypothesis space of all possible meanings. Critically, the model predicts that an ideal learner should generalize more broadly when the exemplar is sampled from the full hypothesis space of meanings (*weak sampling*), and should generalize more narrowly when the exemplar is sampled only from the true concept of the word within the full hypothesis space (*strong sampling*).

In their experiment, Xu and Tenenbaum (2007) manipulate sampling "strength" through the presentation source of the data: The learner is either presented with three exemplars of the target

word from a knowledgeable teacher or the learner makes (correct) guesses about the referent of the word. Since the teacher is knowledgeable of the true concept, the data are sampled strongly from only the true concept. But, in the learner-generated condition, the learner is naive about the true underlying concept and thus the data are sampled weakly from the full hypothesis space. The key prediction is that, given a hypothesis space with hierarchical concepts (basic, subordinate, superordinate; i.e., banana, plantain, fruit), participants in the teacher condition should be more likely to generalize broadly to the basic level, while participants in the learner condition should generalize more conservatively to only the subordinate condition. Their data strongly support this prediction in both adults and children ($d_{adults} = .5$, $d_{children} = .5$).

Replication attempts of other predictions of this model have shed doubt on this framework. (Spencer, Perone, Smith, & Samuelson, 2011) (Jenkins, Samuelson, Smith, & Spencer, 2015)

There are additional reasons to conduct a replication of this particular study. (Navarro, Dry, & Lee, 2012). More generally, evidence suggests that effects that rely on social manipulations are less likely to replicate than effects in more "cognitive" domains (Open Science Collaboration, 2015).

Furthermore, this study is important to replicate because the broad theoretical question—how the source of information influences learning—has far-reaching implications for our understanding of human learning. Every piece of data observed in the world, including the experimental context, is observed in a social context. While the source of this social pressure may vary (consider yourself observing flowers alone in a forest as opposed to a case where you observe flowers you received from your partner on Valentine's day), humans are always part of a social system. Thus, in our effort to understand how learners make inferences on the basis of observations in the world, it is important to understand what factors influence this inference, and the source of these observations is likely an important factor.

The social context of human learning also has practical consequences for the interpretation of data collected in psychological experiments. This is because experimental data are often

consistent with at least two accounts—an account that relies on reasoning about the intention of the experimenter, and an account that relies on context-independent reasoning. Consider two examples. A well-known phenomenon in word learning is that children are biased to select a novel object for a novel word, given the presence of both a familiar and novel object (often referred to as *mutual exclusivity* in the literature, Markman & Wachtel, 1988). This pattern is difficult to account for psychologically, however, because there are at least two accounts of this behavior. On the one hand, this result could be due to a context-independent bias to assume that lexicons are structured with one word mapping to one concept, and one concept mapping to one word. Another possibility relies on reasoning about the intentions of the experimenter—Why would the experimenter use a strange word to refer to the familiar object if she meant the familiar one (Clark, 1987, 1988)? Both of these accounts make similar predictions, and are therefore difficult to disentangle empirically.

Another example of this interpretative ambiguity is the well-known Heider and Simmel (1944) study, in which participants projected animate qualities onto objectively inanimate stimuli. Participants viewed a short movie showing several geometric shapes moving in a way that appeared to be contingent. Nearly all participants spontaneously interpreted the video as depicting animate beings, rather than as simple shapes moving around. There are at least two ways to interpret this result, however. One possibility is that participants rely on low level features of the scene to infer animacy (e.g., contingency), but another possibility is that participants infer the intention of the experimenter who created the videos. These two cases—mutual exclusivity and animacy projection—represent a sample of a pervasive theoretical issue in experimental psychology: Data consistent with both a pragmatically rich account and a context-independent account. Xu and Tenenbaum (2007) represents a insightful attempt to systematically understand the influence of the social context on learning that would shed light on this practical issue.

Thus, given the uncertainty associated with the Xu and Tenenbaum (2007) result, as well as its theoretical and practical significance, we sought to replicate it. We conducted four replications of Xu and Tenenbaum (2007), three online and one in-lab. Our data replicate the original effect,

but suggest an effect much smaller in magnitude than the original report. In the General Discussion, we suggest a number of factors that may influence the magnitude of this effect that should be explored in future work.

Experiment 1

Methods

Participants.

Stimuli. [1]

- learning context influences the ultimate structure of the

Procedure.

Results and Discussion

Conclusion

Experiment 2

Methods

Participants.

Stimuli.

Procedure.

[1] All stimuli, experiments, raw data and analysis code can be found at XX. Analyses can be found at: XX.

Results and Discussion

Conclusion

Experiment 3

Methods

Participants.

Stimuli.

Procedure.

Results and Discussion

General Discussion

- would be nice to have paradigm where sampling didn't come from learner in learning conext (other random way) - vary variability parametrically

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