APPEALS TO 'THEORY OF MIND' NO LONGER EXPLAIN MUCH IN LANGUAGE EVOLUTION

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Theory of Mind (ToM) — the ability to represent or reason about others' mental states (Apperly, 2012) — carries a significant burden in explaining how humans communicate (Woensdregt & Smith, 2017; Tomasello, Carpenter, Call, Behne, & Moll, 2005; Dunbar, 2004), especially when it comes to inferring someone's communicative intentions in the absence of a conventional language. If we accept that language use requires sophisticated pragmatics (Scott-Phillips, 2014), then ToM must be either a necessary condition for language evolution or something that co-evolved with language (Woensdregt & Smith, 2017; Heyes, 2018; Sterelny, 2012; Levinson, 2006). In either case, it is an important component of the study of language evolution.

However, there is increasing recognition that 'Theory of Mind' does not refer to a single cognitive mechanism, and that ToM research employs a variety of methods that tap numerous distinct cognitive mechanisms (Apperly, 2012; Schaafsma, Pfaff, Spunt, & Adolphs, 2015). Recent empirical work demonstrates low levels of agreement between various individual-differences scales that are meant to tap ToM ability (Warnell & Redcay, 2019; Gernsbacher & Yergeau, 2019). Thus, the role of ToM in human communication — and by implication, in language evolution — is radically underspecified (Irvine, 2018).

We report two studies that aim to improve this state of affairs. Study 1 examined relationships between various measures of ToM ability. Study 2 examined whether ToM measures and several other non-ToM-related problem solving abilities predicted performance on a linguistic signaling task.

In Study 1, we administered a battery of ToM individual-differences measures to 50 adults. We included a False Belief measure (Valle, Massaro, Castelli, & Marchetti, 2015) — the gold-standard test of ToM ability (Apperly, 2012); a coordination task (Mehta, Starmer, & Sugden, 1994); a Keynesian beauty contest (Keynes, 1938); the 'Understanding Others' subscale of the Autistic Spectrum Quotient (Stewart & Austin, 2009; Baron-Cohen, Wheelwright, Skinner, Martin, & Clubley, 2001); and a task based on the Rational Speech Act (RSA) frame-

work, in which people produce and interpret visual cues to disambiguate between a set of referents (Goodman & Frank, 2016). We found low, non-significant correlations between most of the measures, even though they all ostensibly involve reasoning about others' minds. This was also true of the False Belief task, despite its purported centrality to ToM. One exception was a Schelling coordination task (Mehta et al., 1994), success on which required participants to leverage salient features of shared knowledge. This task had moderate correlations with several ToM measures (even though the ToM measures did not correlate with each other), though notably not with the False Belief task.

In study 2 (n=106), we examined whether various ToM measures predicted performance on a linguistic signaling task which required taking the perspective of the one's interlocutor (Sulik & Lupyan, 2018). Because a pilot study showed that certain problem-solving skills (creative: Bowden & Jung-Beeman, 2007; analytic: Frederick, 2005) positively correlated with performance on this signaling task, we included assessments of these two reasoning measures in this study. This also allowed us to examine whether analytic and creative problem-solving explained any of the covariance between ToM measures. Although there were significant zero-order correlations between performance on the perspective-taking task and the ToM measures, the first-order partial correlations (controlling for the effect of analytic problem solving) were not significant, except for the first-order correlation between RSA task and Schelling task. For the remaining tasks, the apparent relationship is largely driven by analytic problem solving ability. In addition, creative problem solving predicted unique variance in the perspective-taking task, but not the other ToM tasks. Thus, most common tasks in this field lack an element crucial for the linguistic perspective-taking task — creativity — and this represents an important gap in the current literature on the evolution of pragmatics.

The ability to take the perspective of others — frequently encompassed under the umbrella term 'Theory of Mind' — is claimed to be central to the human ability to learn and use language (Levinson, 2006). Here, we found that measures purporting to assess ToM did not correlate with one another (Study 1) — a surprising finding if ToM tasks tap into a single general ToM trait. One exception was that the ability to discover salient coordination points (as assessed by the Schelling task), was correlated with several ToM measures, hinting that something like "salience reasoning" may be a better description of the relevant cognitive mechanism. Further, performance on ToM tasks — while varying between individuals — did not predict performance on a linguistic perspective-taking task (Study 2). Instead, better perspective taking was predicted by better performance on non-ToM tasks such as creative and analytic reasoning. Taken together, our results challenge the explanatory power accorded to ToM in human communication. We argue that to explain the evolution of human pragmatic inference, we need a better understanding of relevant cognitive mechanisms. We have identified several candidates, including creative reasoning and analytic reasoning.

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