Does language matter for implicit theory of mind? The effects of epistemic verb training on implicit and explicit false-belief understanding

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We examined the effects of epistemic verb training on preschoolers’ implicit and explicit inferences about epistemic states. Eighty-four children (mean age 3;5), who initially failed explicit measures of false-belief understanding, were trained with visual scenes of true- and false-belief. Across three training groups, linguistic input was manipulated so that children heard narrations that contained either: (a) the description of an agent’s actions without an epistemic verb, (b) a familiar epistemic verb (thinks), or (c) the familiar epistemic verb in contexts of true-belief and a novel epistemic verb (g supposed) in contexts of false-belief. Significant post-training improvements were exclusively observed on implicit measures of false-belief and only for children who received training with epistemic verbs. Findings indicate that linguistic training facilitates the implicit processing of epistemic states but these effects may be limited to specific contexts of false-belief reasoning.

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1. Introduction

Is language important for theory of mind development? Over the past 20 years, there has been an abundance of evidence to suggest that children’s language ability is causally related to the development of mental state reasoning abilities (Aston

196, 2005; Astington & Baird, 2005; Milligan, Astington, & Dack, 2007). Evidence from longitudinal (Ruffman, Slade, Devitt, & Crowe, 2002) and training studies (Hale & Tager-Flusberg, 2003; Lohmann & Tomasello, 2003) has further demonstrated that exposure to mental state language (i.e., verbs and syntax used to denote epistemic states) promotes children’s understanding of epistemic states. More recent evidence of false-belief understanding in pre-verbal infants (e.g., Onish

1995), however, has raised important questions about the nature of this relation. Namely, are emergent forms of theory of mind during infancy influenced by language development and is linguistic experience necessarily associated with the development of epistemic reasoning? To address this issue the current study was designed to examine the effects of linguistic understanding on children’s implicit and explicit reasoning of belief.

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1.1. Do different response measures assess different levels of understanding?

Traditionally, the development of epistemic reasoning has been tested via explicit, or elicited, measures of false-belief understanding. For example, in a standard Unexpected Location task, children are asked to directly infer the searching behavior of an agent who fails to witness the transfer of a target object to a new location and therefore forms a false-belief about the object’s location. In these tasks, epistemic reasoning is typically assessed via explicit verbal or behavioural responses to direct questions (e.g., “Where will Sally look for her toy?”).

However, explicit tasks are typically administered to children over the age of two who have developed the requisite linguistic and cognitive ability to interpret a verbal request and provide a direct verbal or behavioural response. To assess epistemic reasoning in younger children, implicit measures have been developed that rely exclusively on spontaneous and non-verbal responses. For example, measures that assess either children’s attention to unexpected outcomes of events (e.g., Onishi & Baillargeon, 2005; Surian, Caldi, & Sperber, 2007) or anticipatory gaze to locations on a visual display that correspond with an agents’ belief and subsequent actions (e.g., Clements & Perner, 1994; Southgate, Senju, & Csibra, 2007). While children do not typically succeed on explicit response measures of false-belief until approximately 4.5 years of age (Wellman, Cross, & Watson, 2001), studies using implicit measures have shown that infants as young as seven months can accurately form inferences about another person’s belief state (Kovács et al., 2010). What remains an issue of much theoretical contention is whether differences in task performance are indicative of differences in task demands across different measures or evidence of underlying developmental differences in epistemic representations.

On one hand, processing load accounts have suggested that implicit and explicit measures tap into the same level of reasoning but what changes between infancy and the preschool years is children’s ability to engage in explicit response selection and inhibition processes (Baillargeon, Scott, & He 2010; Leslie, German, & Polizzi, 2005). Response selection is the cognitive process of retrieving and selecting the correct representation (e.g., representation of an agent’s false belief) to produce an accurate response. Response inhibition is the ability to inhibit a conflicting prepotent response (e.g., response that corresponds to the true state of reality). Both abilities assist children in making accurate controlled responses on explicit measures of false-belief, but in doing so, also incur greater processing demands. By contrast, it has been proposed that response selection and inhibition abilities are not required to generate responses on implicit measures of false-belief because these measures assess spontaneous responses (He, Bolz, & Baillargeon, 2012). Thus, on implicit measures, infants can access their representations of mental states whilst bypassing the cognitive demands inherent in making an explicit verbal response. According to this account, performance on explicit measures of false-belief understanding would also be contingent on the development of cognitive abilities associated with response selection and inhibition (i.e., executive function) that would allow children to express their understanding of mental states. However, findings from cross-cultural research have challenged this latter hypothesis (Wang, Devine, Wong, & Hughes, 2016; Sabbagh, Xu, Carlson, Moses, & Lee, 2006). For example, Sabbagh et al. (2006) found that while preschool children from mainland China outperformed American children on several measures of executive function, they did not show a significant advantage on explicit measures of false-belief understanding. These findings therefore suggest that the development of executive function alone cannot account for discrepancies between implicit and explicit task performance.

Alternatively, it has been argued that the ability to represent and reason about conflicting perspectives does not in fact develop until four years of age and that infants’ success on implicit measures may be attributed to different levels of representation such as behavioural rules or experiential records of an agents’ actions (Perner, 2010; Perner & Roesler, 2012). More recently, a two-systems account has been proposed to reconcile the evidence for both implicit understanding during early childhood and later developing explicit reasoning (Apperly & Butterfill, 2009; Butterfill, & Apperly 2013; Low, Apperly, Butterfill, & Rakoczy, 2016). According to this account, mental state reasoning is handled by two distinct systems. The efficient system, which is evident early in development and remains stable throughout the lifespan, specializes in the processing of “minimal mental representations” – i.e., the ability to infer what an agent can perceive based on represented relations between agents, objects, and locations (Low et al., 2016). Because the efficient system is automatized and does not depend on the function of central cognitive abilities such as response inhibition and working memory, it is said to account for infants’ early success on implicit measures of false-belief understanding. However, according to this account, there are signature limits of the efficient system which prevent it from generating inferences about complex representations such as Level II perspective taking – i.e., the ability to ascribe multiple perspective to the same item or event. These types of inferences are instead processed by a flexible system that is associated with the development of cognitive control and does not emerge until the preschool years. It is the flexible system that is said to account for children’s performance on explicit measures of theory of mind. Recent studies have provided evidence of signature limits in the implicit processing of false-belief (Low, Drummond, Walmsley, & Wang, 2014; Low & Watts, 2013; Surtees, Butterfill, & Apperly, 2012). For example, Low et al. (2014) demonstrated that while children and adults showed correct anticipatory responses on measures of Unexpected Location, they were significantly less accurate on implicit measures of Appearance Reality – i.e., contexts where the identity of a single object can be dually represented by conflicting perspectives. Evidence of such limits indicates that accuracy across different measures of false-belief may be dependent on underlying differences in representational complexity (i.e., registration of object location vs. representation of dual identity) and not just the method of response assessment (i.e., implicit vs. explicit). If different levels of understanding underlie different modes of assessment, how might language interact with these distinct levels?
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