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The Relation between Executive Functioning and Social Cognition

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Introduction

To make sense of and predict the behaviour of those around us, we use a "theory of mind" – an understanding that peoples' actions are caused by idiosyncratic mental states like beliefs, desires, and intentions.[1] For instance, imagine you see a friend grab a glass from the cupboard and head towards the fridge. No matter what your own favorite drink is, you should expect your friend to search for and retrieve the drink that she likes best. Similarly, imagine that your friend tells you she's hungry and then heads towards a kitchen cupboard that you yourself know is empty. You can make sense of your friend's actions by reasoning that she probably believes that the cupboard has food in it, and is acting accordingly. In these examples, being able to decipher your friend's mental states (i.e., what she desires and believes) allows you to both explain and predict her actions.

Understanding the development of a theory of mind has been a main topic of research over the past 20 years. Within this framework, researchers have been particularly interested in children's understanding of false beliefs – instances in which someone holds a belief about the world that

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differs from how the world really is. In one task that researchers often use to measure false belief understanding, children are shown a character (e.g., Sally) hide an object in one location and leave the scene. In Sally's absence, the object is moved to an alternative location. Sally then returns, and children are asked where she will look for the object. In order to pass this task, children must recognize that Sally has a false, outdated belief about the object's wherabouts, and will search for it where she (falsely) believes it to be (i.e., in the location where she left the object before leaving). Correct performance on this task typically develops between 3 and 5 years of age, around the same time as a number of related real-world social-cognitive skills, including pretending,[2] lying,[3] playing games like hide-and-seek,[4] keeping secrets,[4] developing peer relationships,[5] and understanding moral culpability.[6]

A now sizeable body of work shows that there is a connection between preschoolers' abilities to demonstrate theory-of-mind understanding and the development of executive-functioning skills typically associated with the *frontal cortex*. Executive-functioning skills are the processes and abilities that allow us to act in thoughtful, planned ways to achieve our goals. They include the ability to develop goals, plan the steps necessary to achieve those goals, and inhibit urges to do things that do not align with what we are aiming to do. Children's understanding of false-beliefs is most strongly predicted by response conflict executive functioning (RC-EF) – the ability to withhold urges in favour of rule-based behaviours, as is required, for example in the game "Simon Says."

Subject

While research clearly supports a relation between preschool children's RC-EF and their false-belief task performance, there is debate among researchers and theorists regarding why this relationship exists. The goal of this review is to summarize research on the nature of the relationship between RC-EF and false-belief understanding, and discuss implications for understanding social-cognitive deficits.

Research Context

Relations between false-belief task performance and RC-EF skills have been identified in children of different cultures[7] and socioeconomic status,[8] as well as within atypical populations.[9] Moreover, the correlation appears to exist independent of a range of relevant variables, including age, language abilities and general intelligence.[10] An early hypothesis was that the

association might exist because standard tasks used to assess false-belief understanding have non-trivial RC-EF demands.[10] For instance, correctly predicting where someone with a false belief will look for something requires participants to do something unusual – say where something is not. This unusual response is particularly challenging given our habitual tendency to say where something is truly, and it is RC-EF that allows us to negotiate this challenge. Research in support of this view has shown that experimentally manipulating the RC-EF demands of false-belief tasks has predictable effects on children's performance -- as the demands go up, performance on these tasks declines.[11,12,13,14,15]

Though false-belief tasks likely do have non-trivial RC-EF demands like the one just described, it now seems unlikely that these demands provide a complete account of the association between RC-EF and false belief. Instead, recent research suggests that there is a deeper relationship between RC-EF skills and false-belief understanding. Researchers have taken different approaches to examining the possibility that the association is a more intrinsic one. For instance, some have focused on the role played by common factors that may be pacing *cortical* maturation in the systems that are important for both theory of mind and RC-EF (e.g., *dopamine*).[16] Others have suggested ways in which RC-EF and theory of mind tasks might require similar kinds of cognitive abilities.[17] Another particularly interesting possibility is that RC-EF skills enable children to learn from the types of everyday experiences that provide them with information about other people's minds.

Research Results

There are several pieces of evidence that the RC-EF demands inherent to false-belief tasks cannot fully explain the relation between RC-EF and false-belief performance:

- RC-EF skills correlate not only with performance on standard false-belief tasks that involve children responding in ways that are unusual given their typical habits, but also with performance on tasks that do not require such responding. For instance, RC-EF is associated with the ability to accurately explain the false-belief-driven actions of a story character after he is shown to search unsuccessfully for an object.[18] Doing so does not obviously run counter to any established behavioural routine. These findings suggest that the relation between RC-EF and false-belief performance goes beyond superficial RC-EF task demands.

- Cross-cultural work shows that attaining a particular level of RC-EF skills does not alone translate to successful performance on false-belief tasks.[7,19] For example, Sabbagh and colleagues showed that Chinese and U.S. preschoolers performed similarly on false-belief measures, but the Chinese children were notably advanced in their RC-EF task performance relative to their age-matched U.S. counterparts; Chinese 3.5-year-olds performed similarly to U.S. 4.0-year-olds on the RC-EF tasks.[7] These findings suggest that RC-EF abilities alone are not sufficient to promote performance on measures of false-belief understanding – otherwise, the Chinese preschoolers would have demonstrated advantages on the false-belief measures as well.

Evidence that RC-EF skills are necessary for acquiring relevant theory-of-mind concepts comes from the following work:

- In the cross-cultural study described above, the relative levels of RC-EF skills in the Chinese and U.S. samples differed. Nevertheless, the relation between RC-EF and false-belief task performance was significant within both the U.S. and Chinese groups, and the magnitudes of the relations were similar. These findings suggest that RC-EF skills may be necessary, although not sufficient, for false belief understanding.
- Longitudinal work shows that early RC-EF skills predict later false-belief abilities, while the reverse relation—between early false belief and later RC-EF—is not significant.[20,21,22] Although a fully-controlled analysis has yet to be conducted, this relation holds true when a number of relevant variables are controlled, including age, verbal ability, and initial false-belief knowledge. Studies have found this general pattern of results when testing preschool-aged children across periods ranging from 5 months to a year.[20,21,22] These findings suggest that RC-EF skills contribute to the transitions in false-belief understanding that are taking place over this time.

Future directions

Assuming that RC-EF skills are important for children's developing understanding of mind, a next step is to characterize how exactly RC-EF skills might have this facilitative effect. Many researchers have argued that RC-EF abilities equip children with the tools necessary to learn about other minds from their experiences (see Benson & Sabbagh[23] for a review). Inherent to this theory is that relevant experience is also critical for theory-of-mind development. Indeed, a wealth of research shows that theory-of-mind is related to experiential factors, including parental

use of mental state terms,[24] number of siblings in the home,[25] parenting style,[26] attachment[27] and socio-economic status.[28]

There are at least two mechanisms through which RC-EF might facilitate the process of learning about other minds from experience. First, having developed RC-EF skills might make children more likely to elicit and maintain naturalistic social interactions that provide a source of information about other minds.[21,22,29] Second, once children are engaged in an interaction, RC-EF skills might enable them to make use of the available false-belief-relevant information. Executive functioning may contribute to learning from experience by enabling children to 1) identify and attend to relevant variables,[29,30] 2) notice discrepancies between previously-established expectations and subsequent outcomes (i.e., expectation mismatches),[31] and, more speculatively, 3) flexibly update prior knowledge based on new information. Future research is necessary to better understand the role that RC-EF plays both in supporting social interactions and in learning from socially-relevant feedback.

Conclusions

Research suggests that RC-EF skills are important for the development of a core aspect of social cognition – theory of mind – during the preschool years. Though more research needs to be done, we believe that RC-EF skills help children in the process of learning about other minds. More specifically, RC-EF skills help children to capitalize on the types of experiences that are important for developing their social-cognitive knowledge. Further work is necessary to clarify the more fine-grained mechanisms through which RC-EF skills exert their effect on this developmental process.

Implications for Parents, Services and Policy

Understanding others' mental states is critical for everyday communication and coordinated social interaction. With this in mind, an important question concerns how to best promote the development of these understandings among children who appear to have difficulties in understanding other minds. It might seem natural, for instance, for a parent or a daycare provider to encourage a child who has taken anothers' toy to "think about how that made her feel" in an effort to bolster the child's sensitivity to others' mental states. Research on the association between RC-EF and theory of mind, however, suggests that these natural interventions may have limited success unless children have the RC-EF skills necessary to make

use of that information. Accordingly, supporting the development of young preschoolers' RC-EF skills might provide an important foundation for building knowledge about others' internal mental states. Fortunately, RC-EF skills have been shown to improve across a number of training experiences.[29] Our sense is that as these improve, so too will children's receptivity to information about others' mental states.

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