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PAPER

Early bilingualism enhances mechanisms of false-belief reasoning

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Abstract

In their first years, children's understanding of mental states seems to improve dramatically, but the mechanisms underlying these changes are still unclear. Such 'theory of mind' (ToM) abilities may arise during development, or have an innate basis, developmental changes reflecting limitations of other abilities involved in ToM tasks (e.g. inhibition). Special circumstances such as early bilingualism may enhance ToM development or other capacities required by ToM tasks. Here we compare 3-year-old bilinguals and monolinguals on a standard ToM task, a modified ToM task and a control task involving physical reasoning. The modified ToM task mimicked a language-switch situation that bilinguals often encounter and that could influence their ToM abilities. If such experience contributes to an early consolidation of ToM in bilinguals, they should be selectively enhanced in the modified task. In contrast, if bilinguals have an advantage due to better executive inhibitory abilities involved in ToM tasks, they should outperform monolinguals on both ToM tasks, inhibitory demands being similar. Bilingual children showed an advantage on the two ToM tasks but not on the control task. The precocious success of bilinguals may be associated with their well-developed control functions formed during monitoring and selecting languages.

Introduction

Complex social interactions require the ability to recognize that humans are driven by unobservable mental states, such as goals, plans and beliefs. By taking into account other people's beliefs and desires, which can be different from our own, we are able to understand situations that otherwise would be hard to explain.

The term 'theory of mind' (ToM) refers to the ability to ascribe beliefs, desires and intentions to oneself and to others, and to predict and interpret the behavior of others depending on these mental states. ToM is linked to the development of social competence, and its impairment may be an important feature of autistic disorders (Baron-Cohen, Leslie & Frith, 1985). Adults use mental state reasoning in their everyday lives with great ease, possibly automatically (Friedman & Leslie, 2004; but see Apperly, Riggs, Simpson, Chiavarino & Samson, 2006). Children, in contrast, seem to have difficulties in understanding complex mental states before the age of 4 (Wellman, Cross & Watson, 2001). Although young infants are sensitive to some unobservable mental contents, such as goal-directedness and intentionality (Gergely, Nádasdy, Csibra & Bíró, 1995), attributing goals to agents is not always sufficient for making correct predictions about the actions of others. Subjective representations of the external world, that is, beliefs that may or may not coincide with reality, modulate the final outcome of people's behavior.

There may be special circumstances that help young children to make inferences about mental states. In this study we investigate the mechanisms by which one such circumstance, namely growing up in a bilingual environment, influences ToM reasoning. Experience with diverse mental contents in language-switch situations could help bilingual children to develop ToM competencies earlier than monolinguals. These circumstances may make bilinguals aware that interlocutors may not know both of their languages. Alternatively, bilinguals' practice in controlling multiple languages could enhance the development of their executive control abilities, which in turn enable them to perform better on ToM tasks that require such abilities. Preschool bilingual children in fact outperform monolinguals on executive control tasks (Bialystok, 1999).

Developmental transitions in understanding others' beliefs have often been assessed using the so-called false-belief task, commonly used to test ToM in children (Wimmer & Perner, 1983). In this task, the first protagonist hides an object in location A. In her absence, the second protagonist transfers the object from location A to location B. In the test phase, children have to infer that the first protagonist will look for the object where she falsely believes it to be. Most children succeed in this task around the age of 4, while younger children typically fail by erroneously predicting that the protagonist will look for the object where it really is.

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There is an ongoing debate about the mechanisms responsible for the development of ToM abilities, often referred to as the competence–performance debate (Wellman *et al.*, 2001; Scholl & Leslie, 2001). On the one hand, an important change may take place in children's conceptual competence during the preschool years, and the ability to deal with complex belief representations may emerge at this time (Wellman *et al.*, 2001; Wimmer & Perner, 1983). Younger children fail on ToM tasks because they cannot reason about complex mental states, such as beliefs (Perner, 1991). If so, successful performance on false-belief tasks reflects the emergence of an understanding of others (and oneself) in terms of mental contents.

This competence change could take place due to the children's growing experience with certain conjectures. By the age of 4, they encounter diverse situations where they perform an action but fail to achieve their goal (e.g. they search for the ball in the box where they hid it but cannot find it). They may then come to explain these unsuccessful actions by inferring critical differences between their own mental representations (they thought the ball was in the box) and reality (the ball is not there). Eventually, experience with such situations could help them to understand how complex mental states (that is, beliefs that can be true or false) guide behavior, and thus to develop ToM (Brown, Donelan-McCall & Dunn, 1996; Sabbagh, Xu, Carlson, Moses & Lee, 2006).

In contrast to such competence change accounts, the failure of 3-year-olds and the success of 4-year-olds on ToM tasks can be viewed as a marker of change in specific performance factors, rather than a conceptual change (Bloom & German, 2000; Fodor, 1992; Leslie & Thaiss, 1992). According to this scenario, children possess basic ToM abilities before the age of 4, but solving a typical false-belief task requires the development of other abilities, such as problem solving (Fodor, 1992) or inhibition and selection (Leslie, German & Polizzi, 2005; Carlson, Moses & Hix, 1998). A change in these domain-general performance factors could be responsible for the success of older children in ToM tasks.

Leslie and collaborators (Leslie & Polizzi, 1998; Leslie *et al.*, 2005) proposed a dual-component model of ToM reasoning. The first constituent, the theory of mind mechanism (ToMM), allows us to represent beliefs and desires and it may be domain-specific with a strong innate basis. However, the ToMM in itself is not sufficient for effective false-belief reasoning because, in such situations, the default assumption that beliefs are usually true has to be inhibited. Hence, a domain-general component was introduced, the selection processor that matures gradually and is responsible for the inhibitory demands of the ToM tasks. If the inhibitory requirements are increased, even children who pass the standard task have difficulty in solving these ToM problems (Leslie *et al.*, 2005).

Many studies suggest a functional link between ToM and the development of high-level control abilities also labeled executive functions (EF; Carlson & Moses, 2001; Leslie & Polizzi, 1998). Evidence for a ToM–EF relationship comes from several fields. Autistic children show associated impairments in ToM and EF (Oznoff, Pennington & Rogers, 1991), normally developing children show age-related improvements in EF around the age of 4 (Gerstard, Hong & Diamond, 1994), and individual performance on ToM correlates with performance on EF tasks (Carlson & Moses, 2001).

As a response to the performance change proposals, advocates of the conceptual change account (Wellman *et al.*, 2001) argued that performance factors cannot convincingly explain why developmental changes are still observable with simpler, computationally less demanding versions of the standard ToM task (Freeman & Lacohee, 1995). However, recent data seem to provide further support for the performance change accounts (Southgate, Senju & Csibra, 2007). Studies suggest that 13- to 15-month-old infants expect an actor to search for an object based on the actor's beliefs about its location in non-verbal tasks (Onishi & Baillargeon, 2005; Surian, Caldi & Sperber, 2007).

In the present study, we introduce a novel approach in order to tease apart two hypotheses derived from the competence and performance accounts. We investigate how growing up with two languages from birth ('crib bilingualism') could influence children's performance on false-belief tasks.

Our first hypothesis was inspired by the experience-based competence change account claiming that young children initially have difficulty in representing mental states, but as they grow older, experience provides them with many opportunities to reflect upon the difference between their own mental states, those of others, and reality. This, in turn, helps them to develop ToM abilities (Brown *et al.*, 1996). Even brief training on mental state reasoning under laboratory conditions (by giving children feedback in the standard task) can improve performance on ToM tasks (Melot & Angeard, 2003).[1]

Children living in a bilingual environment often encounter situations where they gain extra experience about conflicting mental representations. When a bilingual child addresses a monolingual one in the language that the latter does not speak, failure to communicate may not be processed in the same way by the two children, because only the bilingual can resolve the conflict by actively switching languages. Such situations could make bilinguals aware of a difference between their own mental contents (that is, their known languages) and those of a monolingual. Indeed, there is good evidence that bilingual children know that interlocutors may not speak both of their languages, since they address them in the appropriate language before the age of 3 (Genesee, Nicoladis & Paradis, 1995).

[1] Outside the laboratory, a change in ToM competence may occur due to factors unrelated to experience (e.g. maturational factors). However, since we are not aware of evidence about differences in such factors between bilingual and monolingual children, it seemed pertinent to test the experience-based view of conceptual change in this study.

Since the competence change account presented above holds that exposure to conflicting mental states assists children to develop ToM, it would predict that bilinguals' experience with differing mental contents in language-switch situations may give them an advantage in solving ToM problems. Possibly, in order to switch languages appropriately, crib bilinguals develop an understanding about certain attributes of others' minds. If so, bilinguals might be selectively advantaged in solving false-belief problems in language-switch situations.

However, there is also a performance change scenario according to which bilinguals may perform better on ToM tasks. Crib bilinguals could show an advantage on ToM tasks due to their precociously developed inhibitory and selection processes, since these also appear important for false-belief inferences. Indeed, there is growing evidence that inhibitory control is more efficient in bilingual adults (Bialystok, Craik, Klein & Viswanathan, 2004; Costa, Hernández & Sebastián-Gallés, 2008), and in preschool-aged bilingual children (Bialystok, 1999). It is thus possible that young bilinguals' inhibitory abilities are sharpened by extensive selection of one language and inhibition of the other. Exercise on tasks that require inhibition can actually improve children's performance on ToM tasks (Kloo & Perner, 2003). Hence, bilinguals' practice with language selection may transfer and enhance performance on all ToM tasks that involve inhibition.

We used two ToM tasks to test the predictions of the competence and performance change scenarios. In addition to the standard ToM task (Wimmer & Perner, 1983), we constructed a modified ToM task depicting a language-switch situation that led to different belief attributions for monolingual and bilingual characters (see Procedure). A control task was employed to check whether the groups differed in general information processing unrelated to ToM reasoning (Zaitchik, 1990).

Both the competence and the performance accounts predict that bilingual children outperform monolinguals on the language-switch ToM task, but not on the control task. For the standard ToM task, however, the two accounts may make different predictions. According to an experience-based competence change account, experience with language-switch situations trains bilingual children to develop ToM. Hence, they should be selectively enhanced to solve false-belief problems in such situations. Previous studies suggest that the performance of 3-year-olds on different ToM tasks is not necessarily 'all or nothing'; a child may succeed on one task, but may well fail on another (Wellman & Bartsch, 1988). Small modifications can make the task more 'salient' and thus easier, for example by emphasizing a previous representation, introducing a second object, or modifying the test question (Freeman & Lacohee, 1995; Wellman & Bartsch, 1988). Thus in our case bilinguals should do better on the modified ToM task that depicts a language-switch context.

The performance change account, in contrast, makes a different prediction. If bilinguals are better on ToM tasks because of a general advantage in inhibitory processing, they should outperform their monolingual peers on both the modified and standard ToM tasks, because these are structurally similar and pose equal executive demands.[2]

Method

Participants

Thirty-two Romanian-Hungarian bilingual (mean age = 3.3, age range 2.10–3.6, 16 females) and 32 Romanian monolingual children (mean age = 3.3, age range 2.10–3.6, 16 females) participated in the study. An additional 12 children were excluded for not performing all the tasks or failing the memory questions (see Procedure). The criteria used to select bilinguals were that they have: (a) parents of different mother tongues who each address the child in their native language; and (b) daily exposure to both languages. The groups were matched for socio-economic status and intelligence on the Binet test (Lénárt & Baranyai, 1972, adaptation after Terman & Merrill, 1960) and the WPPSI-R test (Kun & Szegedi, 1996, adaptation after Wechsler, 1989). The children's scores were: Binet mental age monolinguals 110 (*SD* = 11), bilinguals 109 (*SD* = 9), *ns*; WPPSI-R total raw scores: monolinguals 5.2 (*SD* = 1.7) vs. bilinguals 5.4 (*SD* = 1.5), *ns* (vocabulary subscale: 5.6, *SD* = 1.7 vs. 5.4, *SD* = 1.4, *ns*). Bilinguals and monolinguals were recruited from the same kindergartens in two Romanian cities (region of Transylvania), where both languages are spoken. Participants were from middle- and upper middle-class families.

Materials

In the standard ToM task we used a colored illustration of a short false-belief story (Wimmer & Perner, 1983). In the modified ToM task (see below) we used two easily distinguishable dolls and two illustrated cards, one with a picture of an ice-cream stand and the other with a picture of a sandwich stand. In the control task we used a mechanical cardboard device ('gizmo') and small plastic toys. The gizmo was constructed by gluing a cardboard tube into a larger cardboard box at a 30° angle. In the middle of the tube, a red rod was inserted, which could block the tube and prevent the toys from falling into the box (Zaitchik, 1990).

[2] According to a third account, solving ToM tasks in bilingual contexts could actually be harder for bilinguals than for monolinguals. Since bilinguals can speak both languages they may not understand why a monolingual cannot understand a speaker. However, this seems to be inconsistent with the fact that bilingual children address members of their community in the appropriate language before the age of 3 (Genesee *et al.*, 1995). If they found it hard to conceive that speakers may not understand both of their languages, it is difficult to see why they switch languages according to their interlocutors.

Procedure

The children were tested individually in a quiet area in their kindergarten. All children performed the three tasks in counterbalanced order. The tasks were presented in the language of instruction used in the children's preschool group (Hungarian N = 17). In the standard ToM task (Wimmer & Perner, 1983), children were told the story of a boy who puts his chocolate in a cupboard; in his absence his mother moves it into another cupboard. The test question was: 'Where will the boy look for the chocolate when returning to the room?' Children were considered to have succeeded if their answer took the false belief into account and were excluded if they gave an incorrect answer to one of memory questions, namely 'Where did the boy put the chocolate in the beginning?' and 'Where is the chocolate now?'

The modified ToM task (Figure 1) was constructed to be structurally similar to the standard task as far as ToM is concerned, and it mimicked a language-switch situation. In this task children had to infer a false belief by taking into account others' understanding of diverse languages. The scenario was the following. Two characters, a monolingual and a bilingual puppet, want to buy ice-cream. There are two stands, one selling ice-cream and the other sandwiches. As the characters approach, the ice-cream vendor announces in the language that the monolingual puppet does not speak that he has run out of ice-cream but that the sandwich vendor still has some. This phrase was translated and it was pointed out that the monolingual puppet did not understand what the vendor said. The test question was: 'Where will the monolingual puppet go to buy ice-cream?'

To control for general information processing differences, we used the gizmo task developed by Zaitchik (1990). This task is claimed to be structurally similar to ToM tasks, but does not require reasoning about mental contents. Both the ToM and the control task respectively entail predicting two different outcomes depending on different antecedents.[3] The tube of the gizmo was equipped with a rod, which could be pulled or pushed to free or block the passage through the tube. Toys were dropped into the tube and the children were required to predict the final location of the toys when the rod was pulled out and when it was pushed in.

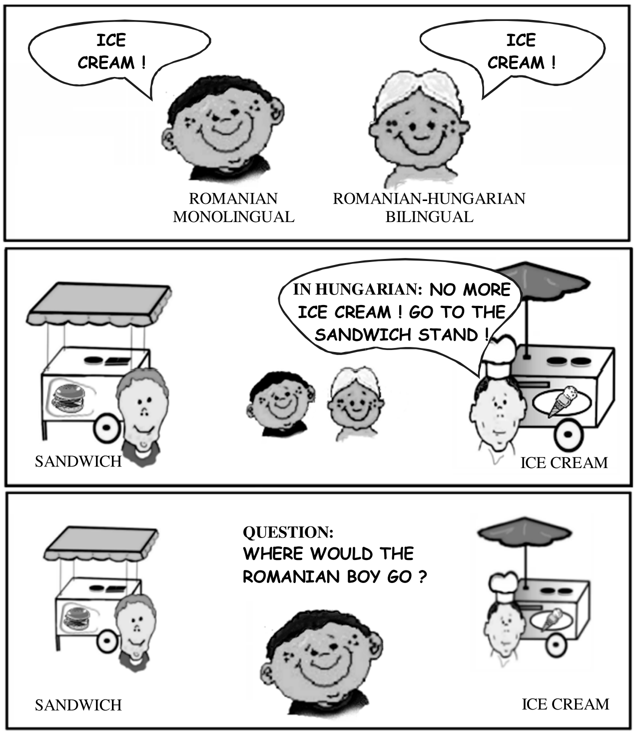

Figure 1 *Schematic illustration of the modified ToM task.*

Results and discussion

The percentage of children succeeding on the three tasks is presented in Figure 2. Twice as many bilingual children passed the standard and the modified ToM task, but they and monolinguals performed similarly on the control task. We analyzed the counts using generalized linear models with binomial link functions (Venables & Ripley, 2002, p. 190). An analysis with the factors group (monolingual vs. bilingual) and ToM task (standard vs. modified) revealed a main effect of group, $\chi^2(1, N = 64) = 13.6, p < .01$, but no effect of ToM task, nor an interaction. Bilinguals performed better on both ToM tasks than monolinguals (ToM: $p = .01$; MToM: $p = .03$, Fisher's exact). Bilinguals were thus enhanced on both ToM tasks in a similar manner, and their performance was not better on the modified task than on the standard task (McNemar Binomial $p = .34$, *ns*). Monolinguals did not perform differently on the two ToM tasks either (McNemar Binomial *ns*, $p = .72$). Children's performace

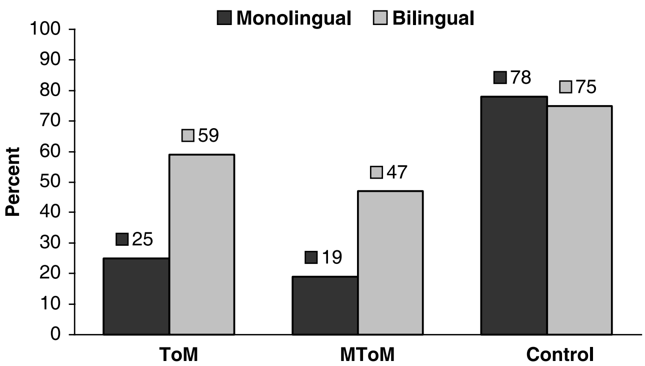

Figure 2 *Percent of children succeeding on the standard ToM (left); the modified ToM (middle); and the control task (right).*

[3] In the ToM tasks, children have to develop differential predictions about the behavior of a person depending on whether that person has a true or a false belief. In the control task, children have to predict the different locations of an object depending on whether a rod blocks its trajectory or not.

on the two ToM tasks was significantly correlated (phi coefficient = .41, p = .002).

We then performed an analysis with the factors group (monolingual vs. bilingual) and task type (ToM vs. control). Analyzing the combined counts of the two ToM tasks and the control task we found a main effect of task type, $\chi^2(1, N = 64) = 28.3, p < .01$, a main effect of group, $\chi^2(1, N = 64) = 7.5, p < .01$, and an interaction between the factors group and task type, $\chi^2(1, N = 64) = 4.9, p < .05$. We followed up the interaction with separate analyses for the tasks. There was an effect of group for the ToM tasks, $\chi^2(1, N = 64) = 13.6, p < .01$, but not for the control task.[4] Participants thus performed globally better on the control task than on the ToM tasks, and, crucially, bilinguals' performance was better than monolinguals' on both ToM tasks but not on the control task.

Taken together, the results show that bilingual children have an important advantage over their monolingual peers that is specific to performing ToM tasks. The effect of bilingualism cannot be explained by differences in general information processing abilities, as we found no effect for group on the control task. Nor can it be due to the other factors for which we controlled, such as different socioeconomic status or intelligence. Performance on verbal and non-verbal intelligence scales and ToM tasks did not correlate (r = .12, *ns*; r = .10, *ns*). We can also rule out the possibility that the two ToM tasks differed in general complexity, since monolinguals' performance was similar on both tasks. This can be taken as a baseline to compare the performance of bilingual participants.

The enhanced performance of bilingual children on the two ToM tasks might be due to their better inhibitory abilities involved in such tasks. As mentioned earlier, there is indeed independent evidence for improved inhibitory control abilities in bilingual children (Bialystok, 1999). This scenario predicted a main effect of group with a similar advantage of bilinguals on both ToM tasks. Our results show precisely such an effect. Hence, they are consistent with the predictions of the account that the bilingual advantage may be inhibition-related.

In contrast, the data do not seem to support the predictions derived from a competence change account based on specific experience. This account holds that experience with language-switch situations would lead to an early consolidation of ToM in bilinguals. Thus, it predicts that the advantage of bilinguals should be specific to the modified task, because this task mimics a context similar to the situations that presumably train bilinguals to develop their ToM competence. In contrast, bilinguals showed a general enhancement and outperformed monolinguals on both the standard and the modified ToM tasks.

We conjecture that bilinguals' extensive practice in selecting and monitoring two languages – possibly beginning already in the crib[5] – may result in improved inhibitory processing, which thus may give them an advantage in all ToM tasks that involve inhibitory control.

The well-developed inhibitory abilities might help bilinguals to perform ToM tasks on at least two levels. When dealing with beliefs, bilinguals might be better at overcoming their true beliefs (that may act as a default), and thus succeed earlier in considering others' mental content, even though it may be consistent neither with their own beliefs nor with reality (Leslie *et al.*, 2005). On the other hand, at the response level, they could be better at inhibiting the object-related prepotent response involved in the ToM tasks. Such prepotent responses could be the tendency to indicate locations where objects really are, even if children know that others do not share this knowledge (Carlson *et al.*, 1998). A possible way to tease apart these two alternatives would be, for instance, to test monolinguals and bilinguals on a modified ToM task where the object that could induce a prepotent response disappears. The account that bilinguals may be better at inhibiting object-related prepotent responses is supported by the observation that bilingual children outperform monolinguals on other tasks that require the suppression of a previously valid prepotent response (Bialystok, 1999).

Our results thus seem to fit well with a performance change account of ToM development. Still, there can be other possible scenarios that would emphasize conceptual changes. For example, bilingual children may have better representational abilities due to more developed linguistic capacities. De Villiers and Pyers (2002) proposed that syntactic complements (e.g. grammatical arguments that are embedded under mental state verbs) provide the representational basis for encoding false beliefs. Other studies suggested that general language abilities are related to ToM understanding (Astington & Jenkins, 1999; Tardiff, So & Kaciroti, 2007). In our study, however, we found no relation between vocabulary scores and ToM performance. Neither are we aware of evidence suggesting that bilingual children may have more advanced language abilities. In fact, bilinguals and monolinguals seem to achieve linguistic milestones at the same time (Petitto, Katerelos, Levy, Gauna, Tetreault & Ferraro, 2001) and do not differ in understanding syntactic complements (Kovács, 2007b). Hence, it is highly unlikely that a possible linguistic advantage could explain the superior performance of bilinguals.

[4] We also compared the control task to the standard ToM task and to the modified ToM task separately, in order to have the same number of data points in both conditions. The results of these analyses are virtually the same as the results reported above. There was no effect of language of instruction for bilinguals.

[5] Kovács (2007a) reports a study where crib bilinguals and monolinguals were tested on ToM and executive function tasks. Bilinguals performed better on some of the tasks; but children were not matched for intelligence and general processing abilities. Conversely, a study comparing the performance of children who entered a foreign language kindergarten after the age of 2 with that of monolinguals did not find differences in the critical standard false-belief task, but the first group showed a slightly better performance on other ToM-related tasks (Goetz, 2003). Seemingly, exposure from birth to two languages plays an important role in such performance.

There is still another scenario that can be interpreted both as a competence and as a performance account. Bilingual children may notice that a concept has two equivalent verbal labels, one in each language. This, in turn, may help them in maintaining alternative mental representations, which are also necessary for false-belief tasks. While monolinguals assign two labels to an object only at around the age of 4 (Perner, Stummer, Sprung & Doherty, 2002), bilinguals in order to communicate successfully must do this much earlier. This scenario, however, makes similar predictions to the competence and performance accounts described above. On the one hand, experience with alternative labels may lead to a qualitative change in understanding the nature of representations (that the same reality may lead to different representations). If such a change takes place earlier in bilinguals due to their experience in assigning double labels, language-switch situations (as depicted by the modified task) should enhance performance on false-belief tasks, as these are precisely the conjectures where bilinguals make use of alternative labeling.

Alternatively, being able to deal with multiple representations may be a consequence of improved processing abilities. If children can already represent single mental states, forming an alternative representation may be a performance-related issue. Hence, if enhancement in executive functions helps bilinguals to deal with alternative representations, they should be equally advantaged on the two ToM tasks.

However, such an advantage of alternative labeling should disappear once monolinguals also start using different labels for the same concept (after the age of 4; Perner *et al.*, 2002). Since the standard ToM tasks would be too easy for children over 4, more complex tasks could be used to test this possibility, such as the avoidance-desire false-belief tasks (Leslie & Polizzi, 1998).[6]

In conclusion, our data showing that 3-year-old bilinguals outperform monolinguals on ToM tasks in language-switch and standard contexts bring new evidence to the competence–performance debate on ToM reasoning, suggesting that basic ToM abilities may be present before the age of 4. However, it is unlikely that the advantage displayed by the bilinguals is due to a change in a core human competence. Infants may already perceive their conspecifics as similar to them in a critical way, that is, as intentional agents driven by unobservable mental states (Onishi & Baillargeon, 2005). A more plausible possibility is that crib bilingualism leads to an enhancement of the inhibitory control abilities that are required for successful performance on a typical ToM task.

Crib bilingualism results in changes that go well beyond the language domain and may speed up the development of abilities important for socio-cognitive development. Such powerful cross-domain enhancements are reflected in the performance of bilingual children when they are faced with false-belief situations.

[6] The author thanks an anonymous reviewer for raising this possibility. In avoidance-desire ToM tasks, children usually have to point to the real location of the object while attributing a false belief and an avoidance desire. Such studies could also shed light on the question whether the advantage manifested by young bilinguals stems from a better control at inhibiting belief-contents or response inhibition.

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References

Apperly, I.A., Riggs, K.J., Simpson, A., Chiavarino, C., & Samson, D. (2006). Is belief reasoning automatic? *Psychological Science*, **17**, 841–844.

Astington, J.W., & Jenkins, J.M. (1999). A longitudinal study of the relation between language and theory-of-mind development. *Developmental Psychology*, **35**, 1311–1320.

Baron-Cohen, C., Leslie, A.M., & Frith, U. (1985). Does the autistic child have a 'theory of mind'? *Cognition*, **21**, 37–46.

Bialystok, E. (1999). Cognitive complexity and attentional control in the bilingual mind. *Child Development*, **70**, 636–644.

Bialystok, E., Craik, F.I., Klein, R., & Viswanathan, M. (2004). Bilingualism, aging, and cognitive control: evidence from the Simon task. *Psychology and Aging*, **19**, 290–303.

Bloom, P., & German, T.P. (2000). Two reasons to abandon the false belief task as a test of theory of mind. *Cognition*, **77**, B25–B31.

Brown, J.R., Donelan-McCall, N., & Dunn, J. (1996). Why talk about mental states? The significance of children's conversations with friends, siblings and mothers. *Child Development*, **67**, 836–849.

Carlson, S.M., & Moses, L.J. (2001). Individual differences in inhibitory control and children's theory of mind. *Child Development*, **72**, 1032–1053.

Carlson, S.M., Moses, L.J., & Hix, H.R. (1998). The role of inhibitory control in young children's difficulties with deception and false belief. *Child Development*, **69**, 672–691.

Costa, A., Hernández, M., & Sebastián-Gallés, N. (2008). Bilingualism aids conflict resolution: evidence from the ANT task. *Cognition*, **106**, 59–86.

de Villiers, J., & Pyers, J.E. (2002). Complements to cognition: a longitudinal study of the relationship between complex syntax and false-belief-understanding. *Cognitive Development*, **17**, 1037–1060.

Fodor, J.A. (1992). A theory of the child's theory of mind. *Cognition*, **44**, 283–296.

Freeman, N.H., & Lacohee, H. (1995). Making explicit 3-year-olds' implicit competence with their own false beliefs. *Cognition*, **56**, 31–60.

Friedman, O., & Leslie, A.M. (2004). Mechanisms of belief-desire reasoning: inhibition and bias. *Psychological Science*, **15**, 547–552.

Genesee, F., Nicoladis, E., & Paradis, J. (1995). Language differentiation in early bilingual development. *Journal of Child Language*, **22**, 611–631.

Gergely, G., Nádasdy, Z., Csibra, G., & Bíró, S. (1995). Taking the intentional stance at 12 months of age. *Cognition*, **56**, 165–193.

Gerstard, C.L., Hong, Y.J., & Diamond, A. (1994). The relationship between cognition and action: performance of children 3, 5–7 years old on Stroop-like day-night test. *Cognition*, **53**, 129–153.

Goetz, P.J. (2003). The effects of bilingualism on theory of mind development. *Bilingualism: Language and Cognition*, **6**, 1–15.

Kloo, D., & Perner, J. (2003). Training transfer between card sorting and false belief understanding: helping children apply conflicting descriptions. *Child Development*, **74**, 1823–1839.

Kovács, Á.M. (2007a). Beyond language: childhood bilingualism enhances high-level cognitive functions. In I. Kecskés & L. Albertazzi (Eds.), *Bi- and multilingualism and cognition* (pp. 301–324). Dordrecht, The Netherlands: Springer Science.

Kovács, Á.M. (2007b). Enhanced executive functions boost performance in theory of mind tasks: the case of bilinguals. Paper presented at the SRCD Biennial Meeting, Boston, 30 March.

Kun, M., & Szegedi, M. (1996). *Az intelligencia mérése*. Budapest: Akadémiai Kiadó.

Lénárt, E., & Baranyai, E. (1972). A budapesti Binet-tipusú értelmi fejlodési vizsgálat [The Budapest revision of the Binet test of mental development]. In L. Tunkli (Ed.), *Tanulmányok a nevelési tanácsadás körébol*. Budapest: Fővárosi Tanács.

Leslie, A.M., German, T.P., & Polizzi, P. (2005). Belief–desire reasoning as a process of selection. *Cognitive Psychology*, **50**, 45–85.

Leslie, A.M., & Polizzi, P. (1998). Inhibitory processing in the false belief task: two conjectures. *Developmental Science*, **1**, 247–253.

Leslie, A.M., & Thaiss, L. (1992). Domain specificity in conceptual development: neuropsychological evidence from autism. *Cognition*, **43**, 225–251.

Melot, A.M. & Angeard, N. (2003). Theory of mind: is training contagious? *Developmental Science*, **6**, 178–184.

Onishi, K.H., & Baillargeon, R. (2005). Do 15-month-old infants understand false beliefs? *Science*, **308**, 255–258.

Oznoff, S., Pennington, B.F., & Rogers, S.J. (1991). Executive function deficits in high functioning autistic children: relationship to theory of mind. *Journal of Child Psychology*, **32**, 1081–1105.

Perner, J. (1991). *Understanding the representational mind*. Cambridge, MA: MIT Press.

Perner, J., Stummer, S., Sprung, M., & Doherty, M. (2002). Theory of mind finds its Piagetian perspective: why alternative naming comes with understanding belief. *Cognitive Development*, **17**, 1451–1472.

Petitto, L.A., Katerelos, M., Levy, B.G., Gauna, K., Tetreault, K., & Ferraro, V. (2001). Bilingual signed and spoken language acquisition from birth: implications for the mechanisms underlying early bilingual language acquisition. *Journal of Child Language*, **28**, 453–496.

Sabbagh, M.A., Xu, F., Carlson, S.M., Moses, L.J., & Lee, K. (2006). The development of executive functioning and theory of mind: a comparison of Chinese and US preschoolers. *Psychological Science*, **17**, 74–81.

Scholl, B.J., & Leslie, A.M. (2001). Minds, modules, and meta-analysis. *Child Development*, **72**, 696–701.

Southgate, V., Senju, A., & Csibra G. (2007). Action anticipation through attribution of false belief by two-year-olds. *Psychological Science*, **18**, 587–592.

Surian, L., Caldi, S., & Sperber, D. (2007). Attribution of beliefs by 13-month-old infants. *Psychological Science*, **18**, 580–586.

Tardiff, T., So, C.W-C., & Kaciroti, N. (2007). Language and false belief: evidence for general, not specific, effects in Cantonese-speaking preschoolers. *Developmental Psychology*, **43**, 318–340.

Terman, L.M., & Merrill, M.A. (1960). *Stanford-Binet Intelligence Scale: Manual for the Third Revision Form L-M*. Boston, MA: Houghton Mifflin.

Venables, W.N., & Ripley, B.D. (2002). *Modern applied statistics with S* (4th edn.). New York: Springer.

Wechsler, D. (1989). *Manual for the Wechsler Preschool and Primary Scale of Intelligence – Revised*. San Antonio, TX: Psychological Corporation.

Wellman, H.M., & Bartsch, K. (1988). Young children's reasoning about beliefs. *Cognition*, **30**, 239–277.

Wellman, H.M., Cross, D., & Watson, J. (2001). Meta-analysis of theory-of-mind development: the truth about false belief. *Child Development*, **72**, 655–684.

Wimmer, H., & Perner, J. (1983). Beliefs about beliefs: representation and the containing function of wrong beliefs in young children's understanding of deception. *Cognition*, **13**, 103–128.

Zaitchik, D. (1990). When representations conflict with reality: the preschoolers' problem with false beliefs and 'false' photographs. *Cognition*, **35**, 41–68.

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