This study aims to investigate the effect of theory of mind, age and mother tongue on the implicit causality effect in preschoolers from two different language backgrounds. Serbian and Hungarian native speakers aged 3–7 years participated in the study. After taking part in a Theory of Mind task, children were presented verbs in simple „Subject verb Object” sentences describing interactions between two participants, with the interactions being based on emotional, mental or visual experiences. Children were asked “Why does S verb O?” and their responses were categorized as containing an inference about the sentence-S or the sentence-O. The results show that Theory of Mind is a significant factor in the emergence of implicit causality, with age of participants and mother tongue being also contributing to explaining patterns of implicit causality.

Key words: Theory of mind, implicit causality, age, native language

Young children have serious limitations in their understanding of mental entities like thoughts, intentions and beliefs, and they cannot conceive that people can have a point of view that differs from the child’s perspective. Piaget & Inhelder (1990) referred to this as “egocentrism”, which includes difficulties about understanding the way other people think (Gopnik, Meltzoff & Kuhl, 1999). Thus children are thought to have little insight into mental processes, and their understanding of mental states is not only insufficient, but also qualitatively different from the adult way of thinking.

Contemporary research has addressed the question of children’s understanding of mental states. What do children think about phenomena like thoughts, beliefs, desires and intentions; do they understand that mental reality is different from the physical reality surrounding us, and do children conceive
that thoughts are in our mind; and despite these differences, do children realize that mental and physical reality are connected. The ability of “taking a mental perspective”, the ability to think about mental states and processes has been termed Theory of Mind.

One of the earliest and most frequent research topics concerning theory of mind development has been children’s understanding of false beliefs. Raising the question if children, just like adults can sometimes have false beliefs, Wimmer and Perner (1983) constructed one of the most influential models for testing children’s false belief reasoning. In Wimmer and Perner’s False belief task children are told or shown a story involving two characters, a boy named Maxi and his mother: Maxi puts a chocolate bar into a green cupboard. Later, while Maxi is absent, his mother moves the chocolate from the green cupboard into a blue cupboard. When Maxi returns, the children are asked where Maxi will look for the chocolate.

While 4 – and 5-year olds often pass the false belief task, answering that Maxi will look for the chocolate in the green cupboard, younger children mainly answer that Maxi will look for the chocolate in the blue cupboard. This answer is unexpected from an adult point of view, because adults realize that there is no chance for Maxi to know that his chocolate had been removed. Children younger than 4 and half years of age apparently cannot distinguish between information that they possess and information that Maxi has about reality. Three-year-olds do not understand that the main character of the story does not know what they know, thus he is behaving in accordance with his own belief. To answer correctly on this task, children need to understand the nature of beliefs: that beliefs are mental elements that can sometimes differ from reality. Wimmer and Perner’s false-belief task has been developed or adapted in various versions, for example the well known “Sally-Anne” task (Baron-Cohen, Leslie, & Frith, 1985) Around the age of about four years children come to the understanding that they may sometimes hold false belief themselves. This was tested by the “unexpected contents”, or “Smarties” task (Hogrefe, Wimmer & Perner, 1986). In this task children were shown a closed Smarties box containing pencils (rather than the expected sweets). After the tube had been opened, children had to tell what they believed the contents of the tube were before the researcher opened it. The second question children were asked was to tell what one of their friends would think the content of the box was. Rather than the correct answer, candies, 3-year olds often answer “Pencils!” while 4-year olds are more likely to give a correct answer.

Cross-cultural differences are apparent in timing and frequency of everyday psychological reasoning (Wellman, 1999). Children in different communities achieve better-than-chance false belief performance at different average ages ranging from 4 to 7 years (Vinden, 1999).
THEORY OF MIND AND IMPLICIT CAUSALITY

Understanding false belief is connected with an understanding and correct interpretation of information embedded in verbs describing interpersonal events. Gopnik, Sobel, Glymor, Schulz & Kushnir (2004) showed that false-belief reasoning is sufficient for the correct interpretation of information described by verbs related to interpersonal situations in sentences.

Implicit causality was first investigated in psycholinguistic studies (Garvey & Caramazza, 1974). These studies led to the finding that the interpretation of events described by interpersonal verbs depends on the type of the verb: some verbs bias causality primarily to the object of the sentence (typically, state verbs such as ‘love’), while in other verbs the responsibility for the interpersonal event described is attributed to the sentence object (typically action verbs, such as ‘help’, and state-action verbs, such as ‘frighten’). This phenomenon has been referred to as ‘implicit causality’, and has been found in different languages and cultures (Brown & Fish, 1983), both in adults and children (Au, 1986).

A number of studies identified a link between aspects of early language acquisition, communicational skills and theory of mind (Watson, Painter & Bornstein, 2001; Astington & Jenkins, 1999; Hughes, 1998). Milligan, Astington & Dack (2007) carried out a meta-analysis on more than 100 studies concerning the correlation between theory of mind development and various aspects of language development. The authors concluded that advanced language abilities accelerate theory of mind development. As Doherty (2009) argues, this acceleration may be due to the usage of language as a tool for thinking and speaking about mental states. Although the results of Milligan et al. (2007) suggest that false belief understanding is a result of general language development, the authors also suggest another possibility, namely, that false belief understanding predicts language development later in childhood.

Considering that understanding of implicit causal information is an aspect of language development that has not been linked to theory of mind development, in this study we raise the question if implicit causality is linked to success on theory of mind tasks. Although implicit causality is found to be a relative robust phenomenon, and is found in different languages (Brown & Fish, 1983), comparisons across languages have been carried out comparing across different studies, which often involved different lists of verbs. In the present study we address the cross-linguistic comparison directly, by comparing two different languages on exactly the same list of verbs. Potential differences may correspond to differences in the strength of the verbal bias in different languages, as Goikoetxea, Pascual, & Acha (2008) suggested on the basis of Spanish. For example, a study by Franco, Tasso, Levorato & Russel (2000) on English and Italian samples pointed out some differences in occurrence of implicit causality in these languages, although the general pattern of answering was the same in both languages.
RESEARCH PROBLEM AND AIMS

This paper examines the effect of theory of mind reasoning, age and mother tongue on implicit causality. There are three aims: (1) to explore the age of emergence of theory of mind in preschool children living in the same region (Vojvodina) but whose native language was different, Serbian and Hungarian respectively; (2) to explore the effect of theory of mind acquisition and age on the emergence of the implicit causality bias; (3) to clarify whether there are differences in the occurrence of implicit causality depending on the children’s native language. Serbian and Hungarian originate from different language families (Indo-European versus Uralic), thus if there are any cross-linguistic differences in implicit causality, these may be more likely to emerge within these two distant languages.

Method

Participants: The sample consisted of 128 pre-schoolers, 70 Serbian and 58 Hungarian native speakers. Participants were drawn from nurseries in Novi Sad, Temerin and Bečej. The structure of the sample is provided in table 1.

<table>
<thead>
<tr>
<th>Age</th>
<th>Serbian</th>
<th>Hungarian</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-4</td>
<td>20</td>
<td>19</td>
<td>39</td>
</tr>
<tr>
<td>4-5</td>
<td>30</td>
<td>19</td>
<td>49</td>
</tr>
<tr>
<td>6-7</td>
<td>20</td>
<td>20</td>
<td>40</td>
</tr>
<tr>
<td>Total</td>
<td>70</td>
<td>58</td>
<td>128</td>
</tr>
</tbody>
</table>

Materials: A box of Plazma biscuit (300 gr), which contains a toy instead of its usual content (biscuits) for the theory of mind task; two sets of 18 schematic drawings in color (Appendix 1), one set for boys and one set for girls, 36 drawings in total. On each drawing two boys (male set) or two girls (female set) are depicted. The drawings are used to support the implicit causality task (one drawing per verb item).

Procedure: The procedure lasted 15 to 25 minutes per child, depending on age and motivation of the participant.

False belief task: the unexpected content task: Children were presented the box of “Plazma” biscuits and asked what they thought was inside. The correct answer was “Plazma” or “biscuits”. After giving the answer children were handed the box and invited to open it. The participants where then asked what they thought another child who had not opened the box would think was inside of the box. The answer “toy” constituted a fail, while the answer “Plazma” or “biscuits” was identified as an indicator of theory of mind reasoning, thus marked as a pass.

Implicit causality task: The drawings were presented one after another, one for each verb tested. For each picture the depicted characters were named and the interaction between the two characters was shortly described (Person A verb person B, e.g., “Ana helps Maria”). The children were asked to decide which of the characters was causally responsible for the
interaction. The question asked was “Why does person A {verb} person B?” In following an example of the procedure is presented with verb {love}:

Introduction of the characters: “This is Ana (the experimenter points to the first participant of the interaction – sentence subject), and this is Maria (the experimenter points to the second character – sentence object).

Describing the interaction using one of the interpersonal verbs: “Ana {loves} Maria.”

Asking the question: “Why does Ana love Maria?”

If children were shy, the experimenter would repeat the question, adding: “Why does Ana love Maria? is it because of something to do with Ana or something to do with Maria?”.

Design: A mixed design was used for the experiment. The independent factors were: age group (3 levels: from 3 years to 4 years; from 4 years to 5 years; and from 6 to 7 years), Theory of mind classification (2 levels: passed or failed the unexpected contents task), language (2 levels: Serbian, Hungarian), whereas the factor Type of Verb (2 levels: state-action verbs, state verbs) was within-subjects.

The stimuli included 18 verbs related to interpersonal experiences. The stimuli have been used also in previous studies (Franco, Tasso, Levorato & Russel, 2000; Levorato Franco, Tasso, & Russel, 2005; Regber, 2006). The verb items belonged to three semantic domains: mental verbs (verbs that refer to mental processes, e.g., thinking, believing and remembering), emotion verbs (verbs referring to emotional processes, e.g., love, help and hate), and vision verbs (verbs referring to visual processes, e.g., see, recognize and notice), respectively. Half of the verbs from each domain were state verbs (with more likely object-bias), and the other half were state-action verbs (with more likely subject-bias). The list of stimuli is presented in Appendix 2.

The dependent variable was the participant’s answers for each item, in the form of subject– or object attribution. Responses in which causality was attributed to both subject and object of the sentence (e.g., “…Because they are friends”), were discarded from the analysis.

Two separate analysis were conducted; one for Theory of mind classification as a within-subject factor, and one for Theory of mind classification as a within-subject factor.

Results

The effect of Theory of Mind and Language on the emergence of implicit causality bias

Boys and girls were equally successful on the false belief task (Table 2). The mean age of the emergence of theory of mind in this sample was 4 years and 8 months, which is consistent with previous findings (Vinden, 1999).

Hungarian participants scored lower on the false belief task in comparison to Serbian participants ($\chi^2(1, 119)=6.94; p<.01$), table 2., the largest difference between Serbian and Hungarian participants regarding theory of mind is in girls.

Table 2. Frequencies and percents of Serbian and Hungarian boys and girls who passed/failed the false belief task

<table>
<thead>
<tr>
<th>Sex</th>
<th>ToM</th>
<th>Serbian</th>
<th>Hungarian</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boys</td>
<td>Passed</td>
<td>15 (60.0%)</td>
<td>10 (40.0%)</td>
<td>25 (100%)</td>
</tr>
<tr>
<td></td>
<td>Failed</td>
<td>18 (50.0%)</td>
<td>18 (50.0%)</td>
<td>36 (100%)</td>
</tr>
<tr>
<td>Girls</td>
<td>Passed</td>
<td>20 (71.4%)</td>
<td>8 (28.6%)</td>
<td>28 (100%)</td>
</tr>
<tr>
<td></td>
<td>Failed</td>
<td>17 (43.6%)</td>
<td>22 (56.4%)</td>
<td>39 (100%)</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>70 (54.7%)</td>
<td>58 (45.3%)</td>
<td>128 (100%)</td>
</tr>
</tbody>
</table>
In order to test the effect of theory of mind and language on understanding implicit causality, a mixed analysis of variance was carried out with repeated measures on Verb Type. The main effect of the variable *Verb Type* was statistically significant: $F(1,112) = 9.35; p<.005; \eta^2 = .007$. Children make more Subject attributions on State-Action verbs than on State verbs, in general (Figure 1).

![Figure 1. Average number of Subject attributions on State – Action Verbs and State Verbs](image1)

The main effect of the variable *Language* was also statistically significant ($F(1,112) = 20.70; p<.0001; \eta^2 = .147$); Hungarian native speakers showed a more pronounced preference toward subject-attributions than Serbian native speakers (Figure 2).

![Figure 2. Average number of Subject attributions in Serbian and Hungarian native speakers](image2)

There was also a significant interaction of *Type* with *Theory of Mind*: $F(1,118) = 3.65; p<.05; \eta^2 = .030$. Children who failed the false belief task had the same number of subject attributions regardless of the type of verb; on the contrary, participants who passed the false belief task made different attributions depending on the type of the verb, along with the implicit causality model: in the case of State-Action verbs, subject attributions are higher than for State Verbs (Figure 3). On State-Action verbs all the participants answered with an equally high number
of subject attributions, while on State Verbs there is a difference in attribution between children who passed and children who failed the false belief task. This result suggests that implicit causality may be linked to theory of mind reasoning.

The effect of Age and Language on the emergence of implicit causality bias

In order to test the effect of language and age on understanding implicit causality, a mixed analysis of variance was carried out with repeated measures on Verb Type.
There was a significant interaction of Age with Type: \( F(2,118)=21.311; \ p<.0001; \ Eta^2=.149 \). The oldest children made more Subject attributions on State-Action Verbs, and less Subject attribution on State Verbs, than the two other age groups (Figure 4).

DISCUSSION

The average age of emergence of theory of mind in this study is 4 years and 8 months. This result is consistent with previous studies (Vinden, 1999; Wellman, 2004). The age differences between the first (3–4 years) and the second (4–5 years) age group show a relationship of theory of mind with implicit causality, in that implicit causality biases are significantly more often present in participants with theory of mind; on the other hand, there is no difference in the expression of implicit causality between younger (4–5 year olds) and older (6–7 year olds) participants who do pass the false belief task.

Goikoetxea, Pascual, & Acha (2008) found that implicit causality is more pronounced in state verbs. The findings of the current study suggest the following conclusion: in children, implicit causality in State verbs emerges only in interaction with theory of mind. Younger children show a general preference for attributions to the sentence-subject. The possible explanation of interaction of theory of mind and type of verb is that described interpersonal scenarios are interpreted differently by children than they would be interpreted by adults. In order to interpret interpersonal interactions like “person A verb person B” children may take more often a first-person perspective and imagine themselves in the role of the sentence subject (person A), while in the place of the sentence object they may imagine someone else. Children often described an event from their personal experience, replacing the subject of the described interpersonal event with themselves (“Why did Stephen surprise Mark?” “That’s because I bought him a present”). In such cases it was explained to the children, that they are listening to a story of boys and girls who they don’t know, about characters from the drawings. Despite this instruction, the youngest participants (age group from 3 to 4 years) would persist representing the situation in egocentric terms. Sentences with State verbs turn the attention to the object of the sentence, i.e. to other persons (e.g. parent, sibling, friend etc.), hence a younger child may get confused by events that are described by State verbs because him/herself is less salient in the story. Thus, sentences with State verbs are more challenging to an egocentric view than sentences with State-Action verbs. Paying attention mostly to one’s own experiences is a specific feature of this age (Piaget & Inhelder, 1990). Thus, the result that implicit causality emerges in State verbs only in association with theory of mind is evidence that implicit causality is linked to third-person perspective (non-egocentric thinking).
The results of this research have also highlighted differences in the emergence of theory of mind in children from two different language backgrounds. These differences more pronounced in female participants: girls whose mother tongue is Serbian appear to pass the false belief task earlier than girls with Hungarian mother tongue. This finding is consistent with results of previous studies about possible cross-cultural differences on the age of the emergence of theory of mind reasoning (Vinden, 1999). Hungarian children who participated in this study lived in a bilingual environment. Having bilingual experiences during the course of growing up accelerates the emergence of theory of mind (Kovacs, 2009). However, this is not the case with children participating in this study. The cause of this difference may be due to the fact that Hungarian and Serbian children were from different areas of the same region: while Serbian participants are mainly from nurseries in the centre of the city of Novi Sad, Hungarian participants are mainly from suburban areas like Temerin, or from Bečej. The results suggest that theory of mind development in girls is more sensitive to the potentially aversive effects of a less stimulating, rural environment, in comparison to theory of mind development in boys. The nature of factors that contribute to this difference is yet to be discovered. However, one may speculate that more families in suburban areas are engaged in agriculture. These urban and suburban areas have the same schooling system, thus the differences in Theory of Mind development can’t be due to differences in the education system. Parent’s engagement in agriculture may result in reducing the amount and quality of time spent with their children. The frequency of early conversations about mental states predict later understanding of belief and false belief reasoning (Dunn, Brown, & Beardsall, 1991), and the results of this study suggest that girls are more sensitive than boys to a lack of / reduced frequency of conversation about mental states. This hypothesis could be the basis of future studies.

Further differences between Serbian and Hungarian children concern the general preference for subject attributions found in Hungarian children. On the other hand, implicit causality effects are more often present in Serbian children. Although the superficial level of complexity was the same for the sentences as presented in the two languages, it is possible that some structures specific to each language may have facilitated or limited the emergence of implicit causality effects, particularly at the young ages of the participants in this study. It will therefore be important to collect further data with adult in order to separate effects which are due to specific aspects of the languages from developmental effects.

The differences between children with and without false belief understanding suggest that implicit causality is linked to theory of mind reasoning. This result is consistent with findings of previous studies showing a general link between language and theory of mind development (Milligan et al., 2007; Watson, Painter, & Bornstein, 2001; Astington & Jenkins, 1999; Hughes, 1998). Implicit causality in interaction with theory of mind occurs in verbs which bias responsibility for the interaction towards the sentence object (state verbs).
This result suggests that children’s ability to put themselves in someone else’s role is related to the understanding of implicit information carried by state verbs, while state-action verbs elicit the “correct” answer (according to the implicit causality model) without shifting one’s perspective. Future research on the link between theory of mind and implicit causality should investigate more deeply the implicit causality bias in state verbs, in order to discover the factors that are in the background of the connection between theory of mind and implicit causality. Adult-like interpretations of events and success in false belief tasks appears to require the same ability: the ability to put yourself in someone else’s place (“When your friend enters this room, I will ask him what does he think is in this box. What will he answer?). In order to interpret correctly the events in implicit causality tasks, children need the ability to imagine themselves in someone else’s role; this ability is required in interactions that grammatical object is responsible for (state verbs). If the cause of interaction is in the sentence subject (as in State-Action verbs), children’s ability of putting themselves in someone else’s place is not required; children give adult-like explanations of action and state-Action verb events simply by recalling some situation from their experience that was similar to the described event, and in which they were the main characters (“Why did Ana surprised Milena? “Because I bought Milena a present”). This kind of reasoning does not necessarily involve the ability of changing perspective. Thus, the differences relative to native language are most likely due to the interaction with theory of mind reasoning and age. To obtain a clearer view of the importance of theory of mind in implicit causality, it would be useful in future research to focus on the “critical” age when theory of mind emerge, with equal number of children with and without theory of mind (from 4 to 4 and half year olds). In this way effects of age and theory of mind could be disentangled and analysed separately.

REFERENCES


Appendix 1

Example of drawings for the implicit causality task

Appendix 2

List of stimuli: Verb domain, type and individual verbs in the two languages

<table>
<thead>
<tr>
<th>Domain</th>
<th>Type</th>
<th>Verb</th>
<th>Verb-Serbian</th>
<th>Verb –Hungarian</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emotion</td>
<td>State</td>
<td>Love</td>
<td>voleti</td>
<td>szeretni</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hate</td>
<td>mrziti</td>
<td>útálni</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Be afraid</td>
<td>plašiti se</td>
<td>félni</td>
</tr>
<tr>
<td></td>
<td>Action</td>
<td>Frighten</td>
<td>uplašiti</td>
<td>megijesztényi</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cheer up</td>
<td>razveseliti</td>
<td>felvidítani</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Surprise</td>
<td>iznenadidti</td>
<td>meglepni</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Forget</td>
<td>zaboraviti</td>
<td>elfeledni</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Believe</td>
<td>verovati</td>
<td>hinni</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Remember</td>
<td>pamtiti</td>
<td>emlékezni</td>
</tr>
<tr>
<td>Cognitive</td>
<td>State</td>
<td>Lie</td>
<td>lagati</td>
<td>hazudni</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Help</td>
<td>pomoći</td>
<td>segíteni</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tiese</td>
<td>zadirkivati</td>
<td>piszkálni</td>
</tr>
<tr>
<td></td>
<td></td>
<td>See</td>
<td>videti</td>
<td>látni</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Recognize</td>
<td>prepoznati</td>
<td>felismerő</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Notice</td>
<td>primetiti</td>
<td>észrevenné</td>
</tr>
<tr>
<td>Vision</td>
<td>Action</td>
<td>Stare at</td>
<td>buljiti</td>
<td>bánulni</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Spy</td>
<td>uhoditi</td>
<td>kémkedni</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Keep eye on</td>
<td>posmatrati</td>
<td>figyelni</td>
</tr>
</tbody>
</table>