Title:

Monolingual and bilingual children's use of the "Maximize Presupposition" principle

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Acknowledgments:

The research leading to these results has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no. 613465. The authors would like to express their gratitude to Anne Cheylus, Viviane Déprez, Jean-Baptiste van der Henst, Jacques Jayez for valuable comments and discussion, and all of the staff and children from the Slovenian and Italian schools and school centers in the Primorska region of Slovenia and the province of Friuli-Venezia-Giulia in Italy who collaborated and participated in our study. Any remaining errors or inconsistencies are the authors' responsibility.

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Abstract: This article is an experimental investigation of the status of *Maximize presupposition* as an operative pragmatic principle that regulates speakers' preferences among semantically equivalent attitude reports. We present results from two acquisitional studies. The first study explores explores sensitivity of 5 and 7-year old Slovenian-speaking children to the principle from a developmental perspective. The second study examines the influence of bilingualism on the use of this principle by comparing monolingual Slovenian and Italian children to early bilingual children acquiring both languages. The results suggest that while even the youngest children demonstrate adherence to *Maximize presupposition* in an adult-like manner, bilingualism affects performance in pragmatic tasks and constitutes a potential advantage in the relevant area.

Keywords: Maximize Presupposition, pragmatic ability, implicature, presupposition, Slovenian, Italian, bilingualism

1. Introduction: *Maximize presupposition*

A topic of growing interest in recent pragmatic and semantic studies deals with speaker's competence about choosing among competing linguistic alternatives. The most prominent cases involve the interpretation of questions and focus, disambiguating ambiguous strings and drawing pragmatic inferences, most notably, scalar implicatures. Studies reveal that choosing among alternatives, is governed by linguistic and more general cognitive principles but adherence to them is affected by different factors. The current study focuses on an understudied pragmatic principle, *Maximize presupposition* (MP), which has the potential to view competition phenomena from yet another angle. In this work we investigate processing of inferences that arise due to this principle, and especially the role of the developmental factor as well as bilingualism in the online computation of these inferences.

As an operative pragmatic principle, MP is relevant in contexts where the speaker can choose between alternatives that are truth-conditionally equivalent (see, e.g., Heim 1991, Sauerland 2008, Schlenker 2012, and Lauer 2016, a.o.). It states that in the evaluation of semantically equivalent alternatives whose presuppositional requirements are satisfied in a given context, the speaker chooses the one that presupposes most (Heim 1991). To illustrate it, consider the following example in the spirit of Heim (1991).

(1) a. The capital of Slovenia is Ljubljana

b. #A capital of Slovenia is Ljubljana.

On the assumption that the definite and indefinite article have equivalent assertoric content and differ because the definite one is linked to a uniqueness presupposition, the contrast between (1a) and (1b) is expected under MP. The truth-conditional equivalence of (1a) and (1b) makes both of them relevant in contexts in which they are defined (that is, in any context where countries have a single capital city). MP forces (1a) over (1b) in such contexts because its presuppositional content is greater. On the other hand, a cooperative speaker uttering (1b) conveys an inference, an *implicated presupposition* (in Sauerland's 2003, 2008 terminology)

that the alternative's presupposition is not satisfied in the context of evaluation, i.e. that more than one capital per country is possible. Other examples of implicated presuppositions that contradict common knowledge are linked to the interpretation of (2) and (3) (cf. Sauerland 2008):

(2) #Every nose of Tom is runny.

(3) #Every cheek of Lina is rosy.

Both (2) and (3) are inappropriate in a realistic context because *every* carries an implicated presupposition of anti-uniqueness due to (2)'s competition with its alternative *The nose of Tom is runny* and an implicated presupposition of anti-duality due to (3)'s competition with the alternative *Both cheeks of Lina are rosy*.

The pairs of alternatives whose relevance to MP has been previously argued for are generally limited to the following ones:

- <indefinite, definite article> (Heim 1991, Sauerland 2008);
- <factive *know*-non-factive *think*> (Sauerland 2008),
- <definite article, determiner *every*> (Sauerland 2008, Yatsushiro 2008a, 2008b),
- <determiner *both*, determiner *every*> (Sauerland 2008, Chemla 2007),
- <nominal singular morphology, nominal plural morphology> (Sauerland 2008, Legendre et al 2010),
- <1st and 2nd person participant morphology, 3rd person non-participant morphology > (Heim 1991, Legendre et al 2010),
- <imperative verbal morphology, subjunctive verbal morphology> (Schlenker 2005).

In this study we investigate the processing of MP by focusing on the second pair, *know—think*, from the above list. We experimentally address two questions regarding the status of MP as part of speakers' pragmatic knowledge:

1) Does age affect adherence to MP similarly to what has been claimed in regard to the maxim of Quantity (Noveck 2001 a.o.)?[1]
2) Does bilingualism affect adherence to MP, in light of the studies claiming a bilingual advantage regarding the observance of the Maxim of Quantity (Siegal et al 2010)?

The focus on the developmental dimension of MP that constitutes our first research question is motivated by a parallel between MP and the Quantity maxim. Adherence to both principles requires almost the same set of competences. Similarly to implicated presuppositions, scalar implicatures are derived as a result of competition between relevant alternatives. The alternatives satisfy, however, different criteria: while MP alternatives are truth-conditionally equivalent and differ with respect to presuppositional load, scalar alternatives are based on asymmetric entailment (cf. Chierchia 2004). This difference amounts to a smaller set of requirements for processing scalar implicatures - that process is unrelated to knowledge of presuppositions. But crucially, scalar implicature acquisition requires a language user's knowledge of competing alternatives and an ability to resolve competition. Given this parallel and the amount of research on the acquisition of scalar implicatures which traces a developmental trajectory (cf. Noveck 2001, Gualmini et al. 2001, Papafragou & Musolino 2003, Guasti et al. 2005, Pouscoulous et al. 2007), we believe it is important to ask whether the acquisitional path of implicated presuppositions is similar to that of scalar implicatures.

Our interest in the second research question was driven mainly by the current gap in understanding how bilingualism might affect the ability to compute MP in real time. There exists a limited amount of studies addressing the question of how bilingualism affect pragmatic abilities, notably in the domain of implicatures and implicated presuppositions (see below and Section 2), but, to our knowledge, no study up to now has directly addressed the

[1] The maxim of Quantity is one of the four maxims proposed by Grice that complement his 'cooperative principle' regulating speakers' behavior in a conversation (see Grice 1989). It comprises two submaxims: i) Make your contribution as informative as is required; and ii) Do not make your contribution more informative than is required.

influence of bilingualism on MP. Furthermore, in order to appreciate a special role that bilingualism might play in this domain, let us clearly articulate what "knowledge of MP" implies for our purposes. We assume that knowledge of MP encompasses the following competences:

i) knowledge about asserted meaning,

ii) knowledge about presupposed meaning,

iii) knowledge of competition between relevant alternatives/accessibility of the alternatives

iv) ability to resolve the competition.

While the first two competences can be directly linked to linguistic knowledge, the abilities to know about and to resolve competition, as in iii) and iv), are relevant in general cognitive domains. Competition resolution, understood as *inhibition* of competing information, is widely argued to be part of executive control processes (Baddeley 1986, Posner and Petersen 1990, Miyake et al 2000). A relevant example in the domain of language production regards lexical access. Numerous studies have linked it to inhibition on the basis of the evidence that more words than the ones included in each utterance are activated (in a 'cohort' manner) and excluded because they do not match sufficiently the target concepts (de Zubicaray et al 2001, Guo et al 2011, Roelofs et al 2011, a.o.). With respect to bilingualism, a number of lexical access studies reveal that interlocutions activate translational equivalents in the bilingual mind and those in the non-target language are also inhibited thus suggesting that inhibition, being an executive function, is positively influenced by bilingualism (Green 1998, Abutalebi and Green 2007, Costa et al 1999, Costa et al 2008, Ivanova and Costa 2008, Guo et al 2011, Misra et al 2012). That bilingualism contributes to an enhanced inhibition function of the executive control system was also a conclusion of a number of experimental studies on perceptual conflict tasks (e.g. Stroop, Simon tasks, etc.) which require inhibition of irrelevant information. Typically, such studies emphasize the claim we just discussed: that activation of both target and non-target languages in the bilingual brain leads to inhibition of the non-target

one in each communication process, thus boosting the inhibitory potential (cf. Bialystok et al 2012). To the extent these findings pertain to choosing among competing alternatives, they provide a further motivation for our research question 2) above, inquiring into the role of bilingualism in processing inferences due to MP assuming competition resolution as a relevant mechanism.

In the present study we report a series of two experiments intended to shed light on the above research questions. Experiment 1 addresses the effect of age on the comprehension of implicated presuppositions as a by-product of the computation of MP. Following the findings of Feeney et al., (2004), Guasti et al., (2005), Foppolo et al. (2012), Katsos and Bishop (2011), and Skordos and Papafragou (2014), among others, on the acquisition of scalar implicatures in children between 4 and 8 years of age, we assumed that the interval between 5 and 7 years of age will be informative with respect to the acquisition of implicated presuppositions. This experiment conveys findings from testing Slovenian-speaking children of that age range with a paradigm relevant to MP and based on the verbs *misliti* "think" and *vedeti* "know". Experiment 2 using a protocol similar to that of Experiment 1 and based on the use of the same Slovenian verbs and their Italian counterparts *pensare* "think" and *sapere* "know" examines the role of bilingualism on children's sensitivity to MP in the age interval between 9 and 13 years. On the basis of the results obtained in this study, we argue that a) MP is highly respected in all age and language groups; b) there is an effect of age that is possibly dependent on knowledge about presupposed content, and c) bilingualism significantly affects performance in this pragmatic task.

2. An overview of experimental literature

2.1 Executive control functions, bilingualism and pragmatic abilities

Results from an impressive number of studies suggest a bilingual cognitive advantage in the domain of executive control abilities (see Bialystok 1999, 2010, 2011, Bialystok et al 2009,

Antoniou et al 2016). Importantly, most experimental work suggests that such cognitive advantages are associated with children, including pre-verbal ones (cf. Kovács and Mehler 2009a, 2009b, Brito and Barr 2012), as well as older populations experiencing deficits in the cognitive reserve, but not often with speakers in their cognitive prime, i.e. (young) adults (cf. Bialystok et al 2005, Bialystok et al 2008, Salvatierra and Rosselli 2010).[2] As discussed in Section 1, the relevance of these studies to our research questions follows from the assumption that adherence to MP depends on competition resolution and consequently an enhanced inhibitory function. Consequently, these findings motivated our choice of participants in Experiment 2 in favour of children over adults (see Section 4.1).

A few studies compared the development of pragmatic abilities of early bilingual and monolingual children. The state of the art provides two divergent claims, although the second one is heavily prevailing:

1. Early bilinguals slightly outperform monolingually developing children in the production of implicatures. The advantage could be attributed to non-linguistic abilities linked to bilingualism (Siegal et al 2007, Siegal et al 2009, Siegal et al 2010).
2. There is no robust evidence that suggests a multilingual advantage in the comprehension of scalar implicatures (Antoniou et al 2013, Dupuy, Stateva et al 2018, Syrett et al (2017), Antoniou and Katsos 2017).

The results of Antoniou et al (2013) can be subjected to scrutiny given that they compare multilingually growing children to children speaking two dialects of Greek and in that sense the study does not really evaluate bilingualism as a factor in comprehending scalar implicatures. No such obvious objections can be raised against the findings of Dupuy, Stateva et al (2018) and Antoniou and Katsos (2017). These works show a numerical advantage of the

[2] Cognitive reserve is commonly understood as a resource resulting from intelligence, education, life-time acquired knowledge (cf. Stern 2009). Deficits in the cognitive reserve are generally related to varieties of brain damage.

bilingual participants in the comprehension of scalar implicatures, which, however, does not reach significance.

Finally, some studies attempted to establish a correlation between enhanced performance on executive abilities tasks and a higher rate of implicature comprehension (cf. Siegal et al 2007, Siegal et al 2009, Siegal et al 2010) but the results again do not reach significance. Against the background of these findings we aim to subject the bilingual advantage hypothesis in the pragmatic domain to a different test and investigate if the domain of implicated presuppositions would be revealing in that respect.

2.2. Processing implicated presuppositions

The literature on implicated presuppositions is largely limited to two papers by Yatsushiro (2008a, 2008b) who investigated the acquisition of the anti-uniqueness presupposition of *jeder* (every) in German children.[3] In an experiment reported in Yatsushiro (2008a), participants were presented with three target conditions: a scalar implicatures using *einige* (*some*); a test of the lexical presupposition (existence) of *jeder*; and a test of the implicated presupposition (anti-uniqueness) of *jeder*. The items used a visual context for two sentences played out by two dolls. The participants had to reward the doll that said better what happens in the picture. Two tested sentences are true relative to the picture, but one of them is more felicitous than the other. As an example, in the implicated presupposition condition, a picture of a single girl playing football was shown, while the sentences were:

(4) Das Mädchen hier spielt Fussball.
The girl here is playing soccer.

(5) Jedes Mädchen hier spielt Fussball.
Every girl here plays soccer.

[3] To be more precise, both studies claim to investigate the acquisition of implicated presuppositions and scalar implicatures but given that they employ a preference task, they rather examine sensitivity to MP and the Maxim of Quantity.

Yatsushiro found a difference between the 6-year-old and the 7-year-old groups, with the younger children giving less pragmatic answers in the scalar and implicated presupposition conditions. She interpreted this as support for the hypothesis that the acquisition of both types of inferences have similar developmental trajectories. It should be noted that this conclusion is not straightforward, however. The low percentage of pragmatic answers in the younger group in that experiment was largely due to the fact that about a quarter of children (23% for implicated presupposition and 19% for scalar implicatures) did not choose between the offered alternatives (and rewarded the two dolls). Because of this potential confound, it is hard to pinpoint a specific developmental path in the acquisition of implicated presuppositions relative to lexical presuppositions; whether such a path exists at all, thus remains an open question.

2.3. Acquisition of the pair know—think

Before we review the main findings of the experimental studies on the acquisition of the pair *know-think* we clarify the relevant interpretational properties of these verbs in light of MP.

Standard theories of propositional attitude verbs (*believe, think, know, regret, want,* etc.) go back to Hintikka (1969). These verbs embed propositions to which the referent of the subject of the main clause holds a specific attitude. Focusing on the pair *know—think*, we observe that (6) and (7) differ in that, for the proposition in (7) to hold, it must be in the common ground that Mary went to the theatre on Saturday, while this is not necessary for (6):

(6) Peter thinks that Mary went to the theatre on Saturday.

(7) Peter knows that Mary went to the theatre on Saturday.

In other words, (7) presupposes the truth of the embedded proposition (Kiparsky and Kiparsky 1970, Karttunen 1971, a.o.). That is why negation in (8) affects only the asserted but not the presupposed content (the asserted content for (8) is "NOT Peter knows X" and the presupposed part is X, where X is "that Mary went to the theatre on Saturday"):

(8) Peter does not know that Mary went to the theatre on Saturday.

In view of MP, (6) and (7) are potential alternatives because they are truth-conditionally equivalent and differ by presupposed content. Consider contexts that satisfy the presupposition triggered by *know* in (7). The competition between (6) and (7) is resolved in the felicitous use of (7). The use of the *think*-alternative in such contexts could be true if Peter holds a belief that the embedded proposition holds (viz. that Mary went to the theatre on Saturday) but it is infelicitous given that the *know*-alternative is presuppositionally stronger. In contexts that do not support the presupposition of (7), the latter is infelicitous. On the other hand, under the MP, the interpretation of (6) in such contexts is strengthened by adding an implicated presupposition that the presupposition of its alternative is not satisfied.

Although, to our knowledge, there is no experimental literature that directly addresses the implicated presupposition of *think*, there is a bulk of research on the acquisition of the pair *know—think*. That literature has addressed two different questions: i) the development of children´s Theory of Mind (ToM)/ ability to ascribe false beliefs and ii) acquisition of factive verbs. The central test of ToM is the false-belief paradigm, which has most often used a displacement story in which one character, A, places a given object in a specific location before leaving the room. A second character, B, changes the location of the object. Then A returns. Participants are asked where A will look for the object. The right answer is of course the first location, where A (falsely) believes the object is, not the second, actual location. Most ToM studies have shown that the earlier age at which the false test is solved is 4 years of age (Wimmer and Perner 1983, Baron-Cohen, Leslie and Frith 1985, Wellman et al 2001, a.o.). This strongly suggests that, given that the implicated presupposition of *think* is an anti-factivity inference (see Chemla 2008, Percus 2006), mastery of false belief is necessary to derive it. Hence the participants in the implicated presupposition experiment should be well above the age of success for false belief.

Processing implicated presuppositions is contingent on knowledge about presuppositions. For a child to comprehend that *think* triggers an anti-factive inference, she must have acquired the presuppositional component of *know*. Dudley et al (2015) present a comprehensive systematization of the kinds of developmental studies which investigate the acquisition of the factive verb *know* (cf. Harris 1975, Hopman and Maratsos 1978, Scoville and Gordon 1980, Moore and Davidge 1989, Moore et al 1989, Falmagne et al 1994, Léger 2007, Schulz 2003, among others). Many of these studies suggest that younger children do not have an adult-like representation of *know*. In contrast, Dudley et al (2015) argued that even children as young as 3 can have an understanding of the presuppositional property of *know*. Relevant to our purposes, while none of these studies directly addressed implicated presupposition acquisition, some of the previous results can be re-interpreted in the light of MP. This is the case for Moore and Davidge's (1989) study, where children (aged 3-6 and divided into four age groups) were asked to find a candy hidden in one of two differently coloured boxes, following the hints given by two bears. One of the bears would use *think* ('I think it's in the red box'), and the other would use *know* ('I know it's in the blue box'). To choose the bear that 'knows' rather than the bear that 'thinks', children have not only to have mastered factivity relative to *know*, they also need to comprehend the infelicitous choice of *think* when the *know*-alternative is optimal. The results showed that 3-year-olds scored significantly lower than all other age groups, suggesting that the implicated presupposition is not drawn before 4 years of age. These results were confirmed by a later study (Moore et al. 1989).

Considering the extensive evidence to the view that most younger children do not have an adult-like representation of *know,* as cited above, these findings suggest that the difficulty that 3 and some 4 year-old participants from the Moore and Davidge (1989) and Moore et al's (1989) studies face in solving a task which requires knowledge of MP can be attributed to difficulties in the prerequisites for it: either ToM is not yet in place or *know* is not yet

identified as a factive verb. These studies thus underscore the importance of both prerequisites in approaching the issue of children's use of implicated presuppositions in the light of MP.

2.4. A theoretical detour: The phenomenon of Neg-raising differentiating the Slovenian and Italian counterparts of think

Before proceeing with the experimental setup, we also want to clarify some cross-linguistic properties of translational equivalents of *think* and *know* in the languages under investigation. In many languages, the verb *think* has the formal properties of a *Neg-raising* verb. Neg-raising is a phenomenon attributed to a subset of the non-factive attitude verbs that allows inferences from (9) to (10) (cf. Fillmore 1963, Ross 1973, Lakoff 1969, Horn 1978, Gajewski 2007, among others):

(9) John doesn´t think that Mary visited her friend on Tuesday.

(10) John thinks that Mary didn´t visit her friend on Tuesday.

Not all languages feature Neg-raising in the sense of the above inference. According to Bošković (2008), the following bi-conditional statement holds:

(11) Languages that do not have articles disallow neg-raising while languages that have articles allow it.[4]

In Experiment 2, we are going to compare performance with respect to MP in two unrelated languages, namely, Slovenian and Italian. Italian features (definite and indefinite) articles, while Slovenian, as most Slavic languages, has none. In other words, Italian could be viewed as a "Neg-raising language" in this sense, while Slovenian is, correspondingly, a non-Neg-

[4] Bošković and Gajewski (2009) approach the generalization in (11) by arguing that only neg-raising predicates have an “opinionatedness” presupposition concerning the embedded proposition, along the lines proposed by Bartsch (1973). That presupposition is associated with the categorical status of the verb’s complement as a Determiner Phrase (DP), a structural layer containing the usual noun phrase (NP) as well as a determiner. According to these authors, languages without articles, rather, project only the NP. Consequently, languages without articles cannot lexically specify an opinionatedness presupposition in their verbs of belief. Rather, inferences from (9) to (10) are derived only in a pragmatic manner without relevance to structural input (cf. Horn 1989).

raising language. In this context, the Neg-raising proposal implies that a pair of examples involving negation such as (12)-(13) is relevant to MP only in Slovenian because only in that language the two alternatives have the same assertoric content:

(12) Granny doesn´t know that the cake is on the window.

(13) Granny doesn´t think that the cake is on the window.

Some speakers, however, might construe the Italian version of (13) with negation in the embedded clause, as in (14), since *pensare* is a neg-raising verb:

(14) Granny thinks that the cake is *not* on the window.

But the content of the belief is different in the cases with matrix-clause and embedded clause negation. In case of lower construal of negation, which is only possible in Italian but not in Slovenian, the competition between the Italian counterparts of (12) and (13) will not be resolved as a result of reasoning due to MP, since the condition on its application is not satisfied. In other words, examples involving neg-raising are irrelevant to the computation of MP in Italian. This discussion will be relevant in structuring the predictions of Experiment 2, which includes an experimental condition involving sentences with negation.

3. Experiment 1

In Experiment 1 we ask whether age / developmental aspect affects knowledge of MP in the domain of use of the *think-know* pair in the Slovenian language. We address this question via analyzing performance on two tasks: one testing the knowledge of ToM (see Section 2.3), and the other testing sensitivity to MP in two different age groups, namely, the groups of 5 and 7 year olds.

3.1. Predictions

We assume that sensitivity to MP and the Maxim of Quantity requires a similar set of competences, suggesting that acquisition of linguistic behaviour related to both principles

should go in parallel (cf. Section 1). Thus we have two sets of predictions depending on the acquisition of factivity.

I. If participants from all age groups have acquired the lexical presupposition of *vedeti,* specifically, that *vedeti* (‘know’*)* is factive, then, under Noveck´s (2001) hypothesis postulating a developmental trajectory in the domain of scalar implicatures with younger children going for less pragmatic alternatives than older ones, we predict a similar trajectory on the condition that tests sensitivity to MP across age groups. Under this hypothesis, all participants are expected to score at ceiling on the lexical presupposition (factive) condition while age should interact with factor condition, suggesting a developmental aspect of knowledge on MP. An alternative hypothesis, where age does not interact with condition, is that age does not affect sensitivity to MP within the tested age interval. Such results would suggest no developmental path within the tested age interval.

II. The second series of predictions is based on the state of affairs whereby age positively affects the results on the lexical presupposition condition. Taking knowledge of lexical presupposition to be a prerequisite for sensitivity to MP (see Section 2.3), under this scenario we hypothesize two possibilities: one in which success rate on the MP condition is lower than the success rate on the lexical presupposition condition, and one in which success rates on both conditions are comparable within the age group. Under both hypotheses, we expect a main effect of age to be revealed. The first hypothesis can be linked to a developmental trajectory pertaining to MP. The second one is only consistent with it.

3.1. Materials and procedure

As discussed above, within the pair *know*-*think*, MP is related to drawing an anti-factivity inference upon the choice of the *think*-alternative. However, if ToM/ability to assign false

beliefs is not yet in place for a child, then she will be incapable of assigning falsity to beliefs.[5] Experiment 1, therefore, included a ToM task followed by the main task; the two were separated by an optional short break. To test children's acquisition of the ToM we used a Sally-Anne type of task. We constructed three short stories which included acted-out storylines using two main character puppets and props that were moved or hidden by one of the character in the course of narration. Two of the stories were spin-offs of the Red Riding Hood story and always followed each other in the task, with the third story preceding or following this pair. Each story ended with a question addressed to the child as to where s/he thinks the location of the displaced object should be, according to the main character (see Appendix). The order of presentation and the direction of object displacement to its final location was balanced across stories and participants: two of the three stories involved object movement from left to right, and one from right to left. This part of the experiment was short (ca. 5 minutes) and implemented in the form of a play.

The main task involved testing the children's knowledge of the factivity of *vedeti* ('know') and sensitivity to MP. The material we created for this task was similar to material used in ToM tasks because it manipulates false and true beliefs of the attitude holder, with one important modification: the task we designed was a felicity judgment task in which participants are expected to choose between two truth-conditionally equivalent assertions, one of which is more felicitous than the other which related to the background story. Every item in our experimental material includes a sequence of 4 images, each of which accompanied by a sentence, that together tell a short story involving two main characters. There were two conditions in the stimuli and 8 story items per condition. Condition LP (for "lexical

[5] Current state of the art shows that non-verbal versions of false believe tasks have been passed by children as young as 15 months. However, meta-analyses on the standard, linguistically demanding false belief task report that socio-economic and educational status of parents affect the age with the upper age limit being pushed up to 6 years of age (cf. Liu et al 2008, Wellman et al 2001).

presupposition") examines children´s representation of *know* as a factive verb and tests for a respective lexical presupposition. It describes an event in which Character 2 moves the relevant object to a new location but the test sentence makes reference to the initial location. A sample item from the Condition LP is given in Fig.1:

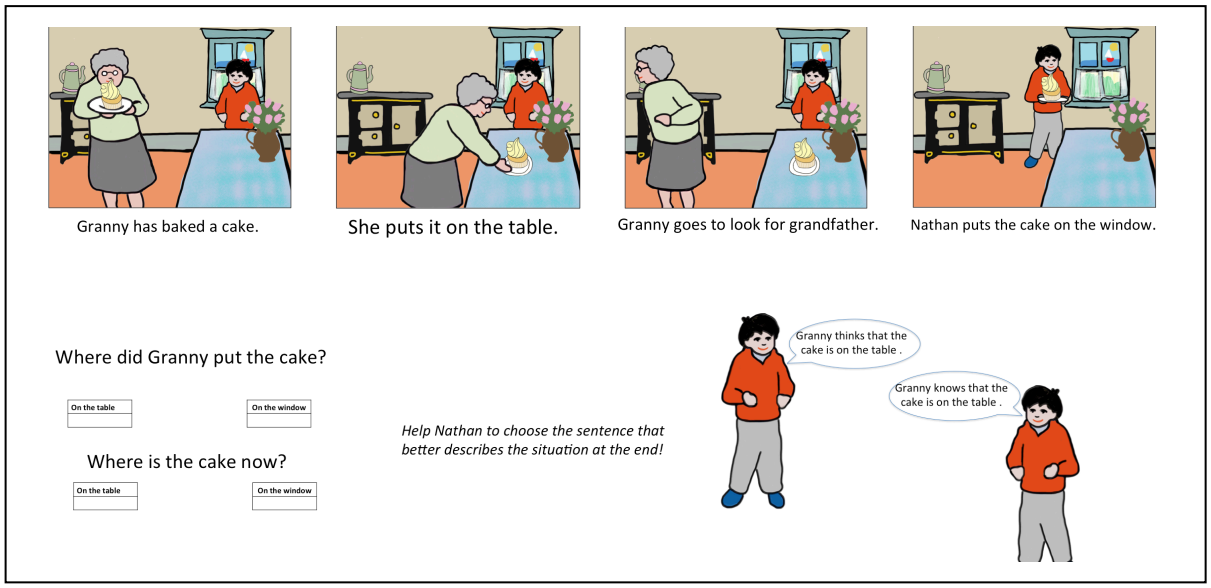

Figure 1. Sample story for Condition LP

In this condition, the pair contains an example like (15) whose presupposition is not satisfied in the context and a minimally different sentence (16) which is both felicitous and true.

(15) Granny knows that the cake is on the table.

(16) Granny thinks that the cake is on the table.

This pair is irrelevant to MP since the constraint requires that only alternatives that are both true and felicitous in a given context are compared. The targeted answer (16) demonstrates the participant´s knowledge of the relevant lexical presupposition.

The second condition, Condition MP, was intended to probe into knowledge of MP. In the respective story, Character 2 does not move the relevant object from its initial position. Fig. 2 is a sample item for this condition.

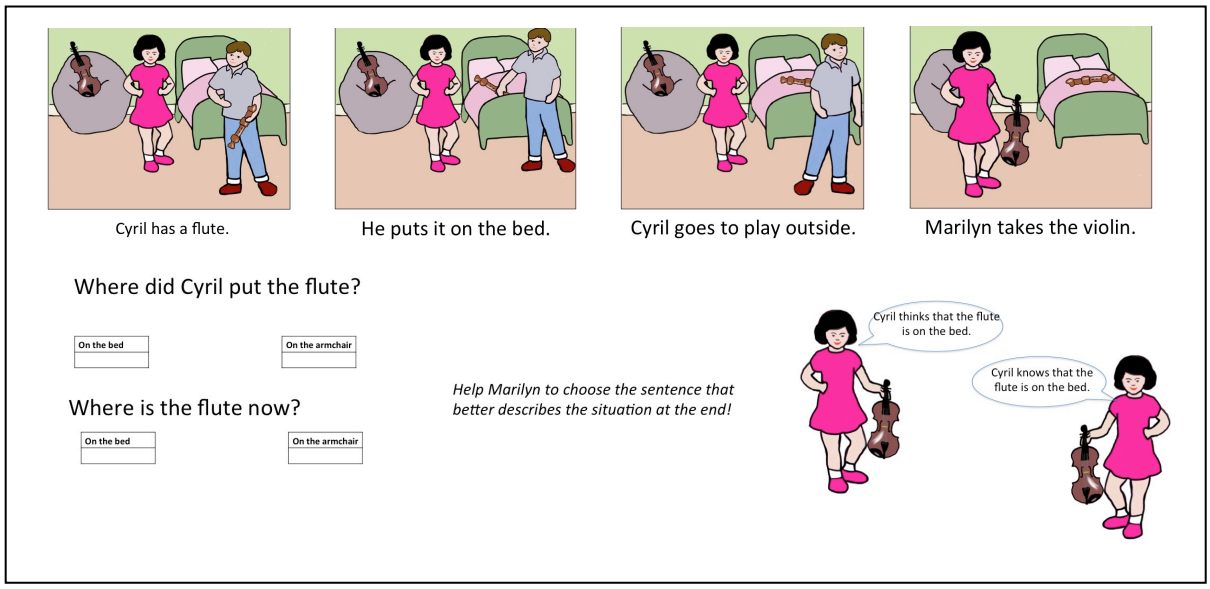

Figure 2. Sample story for Condition MP.

A sample target pair of sentences in Condition MP was as in (17)-(18):

(17) Cyril thinks that the flute is on the bed.

(18) Cyril knows that the flute is on the bed.

MP predicts (18) to be preferred in this context since only it presupposes the truth of its complement.

Following Dupuy et al (2016) which argued that the greater amount of contextual cues facilitates the derivation of pragmatic inferences, in each story item we included two closed type comprehension questions related to the content of the story (48 questions total). A sample pair, related to the story in Fig. 2, is given in (19)-(20):

(19) Where did Cyril put the flute? a) on the bed b) on the armchair

(20) Where is the flute now? a) on the bed b) on the armchair

This comprehension task served an additional purpose to check participant´s attentiveness.

All 16 stories were pseudo-randomized by condition and target answer, resulting in 10 different randomization lists, half starting with Condition LP, half with Condition MP.

The participant's task was to help Character 2 choose one of two possible sentences which characterized Character 1's mental state in the respective story. The two options were

presented on the last screen, each in a bubble containing a sentence for evaluation. The number of appearances of each verb from the *believe-know* pair in the left or right bubble was balanced within conditions. Before the beginning of the task, there was a training part with one story of each condition. Overall, the main task took around 10-15 minutes to complete.

3.2. Participants

Fifty-three children (27 female) whose native language was Slovenian were recruited from two kindergartens and an elementary school in the Sežana region of Slovenia, on the basis of parent-signed consent forms. Based on age, 28 children (15 females) were assigned to the group of 5-year olds (mean age 5.45, SD=0.32), and 25 (12 females) to the group of 7-year olds (mean age 7.63, SD=0.30). All participants had normal or corrected to normal vision and reported no history of hearing or other neurological disorders.

3.3.Statistical analyses

For all analyses in this study, we used mixed effects logistic regression models in R version 3.5.0, using the *glmer* function from the lme4 package version 1.1-12 (Baayen et al 2008, Bates et al. 2014, Jaeger 2008, R Core Team 2014). Felicitousness of the chosen alternative in answering the target question (cf. Figures 1-3) was coded as a binary-valued dependent variable reflecting felicitous and non-felicitous answers, respectively. Logit model estimates are given in log odds (logarithms of odds of giving a targeted answer), which can be converted to probabilities by taking an inverse logit [$\text{logit}^{-1}(\alpha) = \exp(\alpha)/(1 + \exp(\alpha)$]. Effects are graphically illustrated by predicted probabilities on the logit scale. In estimating main effects and interactions, we report χ^2 and *p*-values based on the likelihood-ratio test, whereby a model containing the fixed effect of interest is compared to a model that is identical in all respects except the fixed effect in question. In each analysis, the best fitting model was chosen by comparing pairs of models with different degree of complexity using the likelihood

ratio test. The simplest model considered included only by-subject and by-item random intercepts. More complex models included by-subject and by-item random intercepts and slopes varying across subjects and items. For each pair of models, the results of the likelihood ratio test were used to evaluate whether inclusion of additional random-effects parameters provided a better fit to the data, so that more complex models were excluded only if the p-value for the significance of the difference between the two models was above 0.2 (cf. Matuschek et al 2017). Posthoc planned comparisons were performed as Tukey's estimations using the *multcomp* package in R.

3.4. Results

3.4.1 Pre-processing the data

The following exclusion criteria were used: i) both experimental tasks must be completed; ii) correct (felicitous) responses to at least two out of the three pre-test stories, and iii) 85% or above correct responses to comprehension questions. Based on these criteria, data from ten (nine 5-year old and one 7-year old) subjects were excluded from further analyses, with 5 children failing criterion i), four children failing criterion ii) and one failing criterion iii), respectively. This left the data from 43 children for further analyses.

In the analyses of the results of Experiment 1, we entered CONDITION (LP; MP) and AGE (5 year old, 7 year old) as fixed factors. Treatment coding of factors (default in R) was used whereby the 5-year old group and Condition LP were assigned reference values. Stories and participants were entered as random effects with intercepts and slopes (see Section 3.3).

3.4.2 Estimations and main effects

A logistic mixed-effects model fit to the data revealed a main effect of AGE (Estimate=2.58, SE=1.01, z= 2.54, p = 0.01) corresponding to a 92% increase in probability of giving a felicitous answer by the 7-year olds compared to the 5-year olds, but no main effect of

CONDITION (Estimate=-0.34, SE=0.88, z= -0.39, *ns*) and no interaction of the two factors (Estimate=-0.34, SE=0.88, z= -0.39, *ns*). In other words, children in each age group did not differ in their success in evaluating the felicitousness of the sentences pertaining to lexical presupposition of *know* as well as of MP, but they do show progress in the respective success rate across the age groups. These results are illustrated in Figure 3.

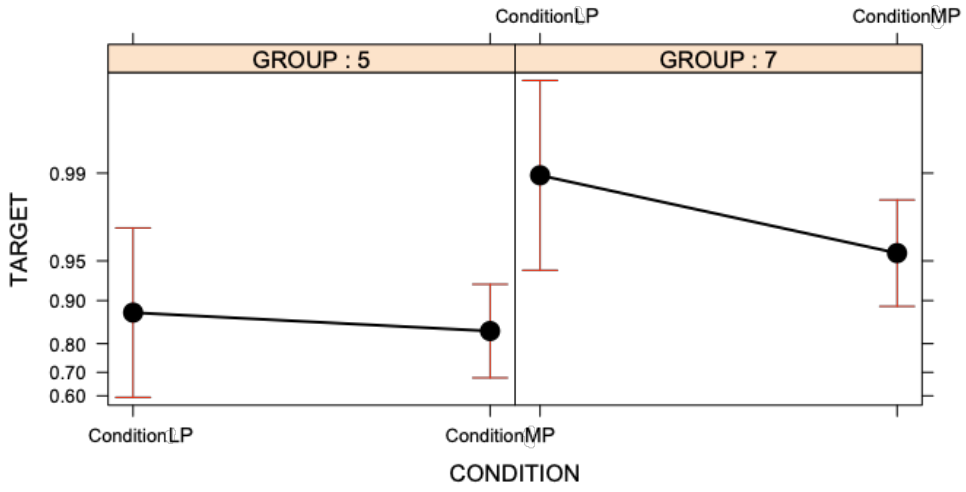

Figure 3. Estimated probabilities of giving a felicitous response in Conditions LP and MP by the 5- and 7- year old children, Experiment 1

3.5. Discussion

Experiment 1's results revealed a main effect of Age but no main effect of Condition or interaction between the two factors which we interpret to suggest that acquisition of *vedeti ('know')* is not in place for all participants at the lower age group. Consequently, the developmental hypothesis could not be validated within the first two scenarios that were based on adult-like knowledge of factivity across ages. These results are not surprising in view of previous results on the acquisition of the English verb *know*. As we mentioned, at least one previous study acknowledges that some children show adult-like understanding of *know* even at the age of 3 years (Dudley et al 2015), but at the same time non-adult-like performance with respect to factivity of *know* may persist at least until the end of the pre-school period or up to 11 years of age for some children (cf. Falmagne et al 1994).

The results we obtained match the second hypothesis within the second set of predictions. Children enrich their competence on MP in parallel to progress of the acquisition of factivity. To the extent that these results are consistent with a developmental hypothesis, they lend support for it. Another interesting result from Experiment 1 is that even 5 year-old participants in it achieve a very high success rate (more than 80%) though not as high as the participants in Foppolo et al's (2012) Felicity Judgement Task (96%). However, 7 year old participants in Experiment 1 already show adult-like state of knowledge. This suggests a parallel in children's sensitivity to MP and the Maxim of Quantity. Further studies should be able to also investigate a potential parallelism in the acquisition of respective inferences that pertain to MP and Maxim of Quantity, i.e. implicated presuppositions and scalar implicatures.[6]

4. **Experiment 2**

4.1. Materials

Experiment 2 investigates the status of MP as a pragmatic constraint by adding the bilingualism factor. The material used in Experiment 2 was presented in three conditions. Two conditions, namely, Condition LP, and Condition MP, were identical to those in Experiment 1. Correspondingly, we used the same set of testing materials for these two conditions. The new Condition MP-Neg probes into knowledge of MP in more complex sentences because of the Neg-raising factor relevant for our tested pair of languages (cf. Section 2.4 and examples (12)-(13)). In Condition MP-Neg, Character 2 moves the object to a new location and the test sentences as in (21)-(22) make reference to that location, as illustrated in Figure 4.

[6] There have been proposals to analyze implicated presuppositions as a kind of implicatures modulo some additional assumptions that widen the domain of the *Maxim of Quantity* (cf. Singh 2011, a.o.).

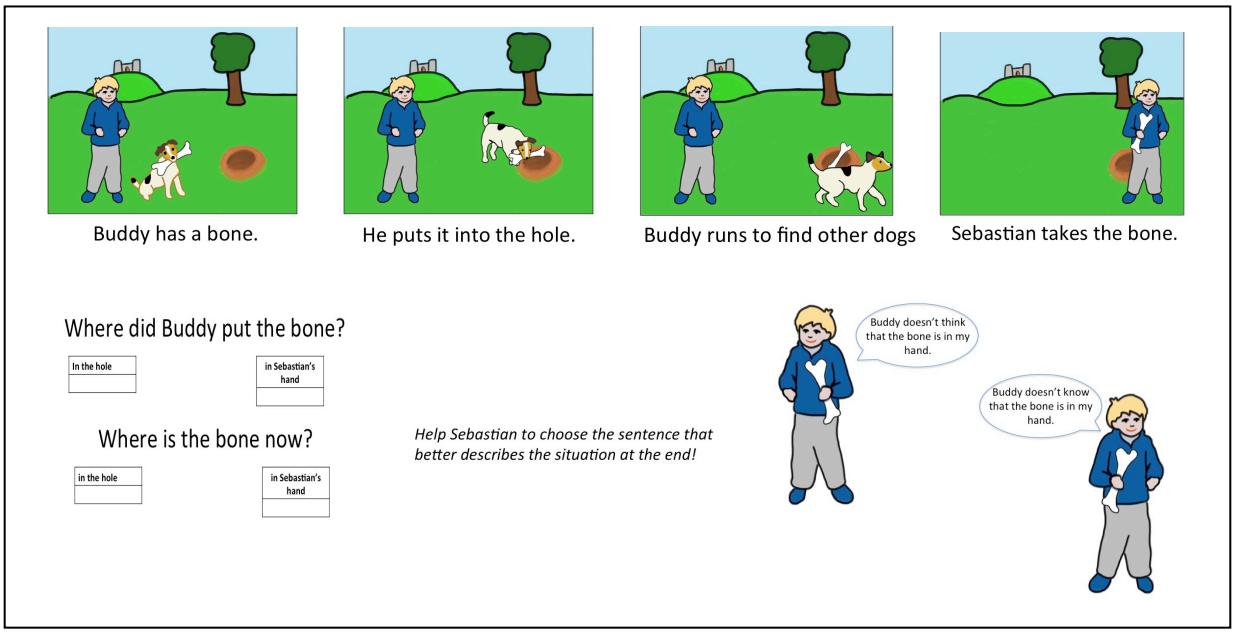

Figure 4. A sample item for Condition MP-Neg in Experiment 2

(21) Buddy doesn´t know that the bone is my hand.

(22) Buddy doesn´t think that the bone is my hand.

In that context both sentences are true but (18) presupposes more and is the targeted choice in view of MP. Similarly to Experiment 1, a comprehension task also accompanied each item in the testing sequence.

Following the methodology in Dupuy, Stateva et al (2018) we tested the bilingual participants in both of their languages.[7] Every bilingual participant was therefore tested on all 24 items similarly to monolingual participants. However, bilingual speakers received half of the items in Slovenian and the other half in Italian (see Section 4.3. for details).

Our experimental prediction was that there will be a main effect of condition given that *Maximize presupposition* can only be observed if the presuppositional load of the two alternatives *know* and *believe* can be evaluated in an adult-like manner. Furthermore, we also

[7] This methodology is chosen for a better assessment of the bilingualism factor. In the case of non-balanced bilingualism, very offen, theories make different predictions about processing language in L1 and in L2. In the literature on experimental pragmatics Slabakova (2010) is a good example of such a difference. As for early bilingualism studies like ours, hypotheses can be further falsified against each of the languages.

expected that the rate of expected responses to Condition MP-Neg might be lower than that of Condition MP given added complexity of negation, which interacts with the assertive part of the sentences.

4.2. Participants

Sixty-three monolingual Slovenian, fifty-nine monolingual Italian and sixty-four bilingual Slovenian-Italian participants (total N=186), assigned to three age groups, namely 9 year olds, 11 year olds and 13 year olds, were recruited on the basis of an extensive questionnaire filled out by the parents in addition to a signed parent consent form. The questionnaire had a different form for potential monolingual and bilingual participants concerning their language background. Bilingual children were recruited from four elementary schools serving the bilingual communities in the Gorizia region of Italy, the cities of Izola, Piran, and Koper in Slovenia and the Music school in Nova Gorica, Slovenia. Monolingual participants were recruited from five other elementary schools in the region of Nova Gorica, Slovenia, two elementary schools in the region of Gorizia and Udine and two summer camps in Gorizia and Udine, Italy, respectively. We targeted early bilinguals who were introduced to either Slovenian or Italian at birth and AoA (age of acquisition) of the second language of the pair was not greater than 3. We also checked that each group of monolingual children contained only children who were not exposed to any other language outside of the standard school curriculum. The monolingual and bilingual groups were matched by age and socio-economic status. In addition, 20 adult native speakers of Italian and 22 adult native speakers of Slovenian participated in the experiment serving as controls.

Our decision about the 9-13 year age interval of the target group relied on previous findings regarding language development in the context of bilingualism. A number of studies which evaluate language proficiency of bilingually growing children show that they lag behind their monolingual peers. Bialystok et al (2010) reports data from a meta-analysis of

PPVT (Peabody Picture Vocabulary Test; Dunn and Dunn 1997) being assigned to 1738 children between 3 and 10 years of age divided into 8 age groups. This meta-analysis shows that in each of these groups the bilinguals demonstrate a significantly lower score of receptive vocabulary in English. Similar results from studies of smaller scale have been reported in Siegal et al (2007) and Antoniou and Katsos (2017), among others. The latter also evaluated language proficiency with grammatical variables, in addition to vocabulary. We therefore invited children participants in the above indicated age groups where, we believe, language proficiency in both languages and sensitivity to the Maxim of Quantity would allow a better identification of the effect of bilingualism on sensitivity to MP.

4.3. C-test

To estimate the linguistic proficiency of our participants in the written modality, a c-test was administered to both monolingual and bilingual groups. A c-test is a version of a cloze test based on a short text in which the second half of every second word is truncated (the first two and the last two sentences are left intact). The participants are asked to fill in the missing word parts. The ratio of correctly reconstructed words to the total words is taken to be a measure of general language proficiency. C-tests are mainly used for estimating the vocabulary size, but also sometimes seen in the literature as an integrative measure of linguistic knowledge in the written modality including morphology and syntax as well (Eckes & Grotjahn 2006, Karimi 2011).

In our study, we constructed c-tests based on two short texts extracted from children books that were approved for the respective ages, not included in school reading lists, and written either in Slovenian or in Italian. Bilingual participants received the test in their non-dominant language.[8] The decision about language dominance for each participant was based

[8] The term non-dominant language is used rather liberally in this case. All participants had a very low AoA and systematic input and use of both languages on a daily basis. Assignment to

on an analysis of extensive questionnaire data filled in by parents. 37 bilingual participants were assigned to a dominant-Italian group and received a Slovenian c-test, whereas 23 bilingual participants were assigned to the dominant-Slovenian group and received an Italian c-test. 57 monolingual Italian participants and 60 monolingual Slovenian participants completed a c-test in their respective native language. The texts were balanced by targeted age (9, 11 or 13 year old), size, and the word type/token ratio (about 73%). Each text was presented separately on a computer screen in its entirety. The number of gaps for 9, 11 and 13 year olds was equally balanced across the texts and was 40, 50 and 50, respectively. The deleted word parts were substituted with mini-windows that were all of the same size, where the participants could type in their responses. There was no time limit on this task, which took about 15 minutes to complete.

In terms of results, the percentage of correct reconstructions for the monolingual groups varied in the range between 52-86% (Italian) and 65-78% (Slovenian). The success rate for the bilingual group varied in the range between 48-81% (Italian) and 50-66% (Slovenian). There was no significant difference in the mean success rate between the two groups in Italian ($t = 0.9125$, $df = 43.522$, $p > 0.10$, Welch two-sampled t-test), but bilinguals performed partially worse than monolinguals in Slovenian ($t = 5.8139$, $df = 77.105$, $p < 0.001$): the discrepancy persists through the 9 and 11 year old groups, and phases out in the 13 year old group. Together with the early AoA, we take these results to suggest a level of linguistic proficiency sufficient for testing the impact of bilingualism on pragmatic abilities.

4.4. Experimental procedure

Each participant was tested individually in a quiet room by a native Slovenian or native Italian experimenter in the case of monolingual participants and by two experimenters in the case of bilingual participants. The experimenters had a short warming up conversation (for

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one of the groups on the basis of slight disbalances in the hours of daily language use was done to avoid administering the proficiency test in both languages.

bilingual participants, the introductions occurred in both target languages) intended to supplement the information about general language abilities that was provided in parents´ questionnaires. The children were informed that they can decline further testing at any part of the experiment. They received a sticker of their choice as a reward for participation.

Each session began with a short training containing 1 item per condition, altogether 3 items. During the session, participants read out loud the sentences accompanying each image, as well as the questions that followed. The monolingual participants saw all 24 items in their native language: Slovenian and Italian, respectively. The bilingual participants saw two blocks of items, one in Slovenian and one in Italian where the order of presentation was counterbalanced across participants. Each block was composed of 4 items per each of the three conditions with the items being randomized. Bilingual participants were assigned to two groups in which the order of language blocks was counterbalanced. The presentation of items was randomized. The experiment lasted approximately 15 minutes for faster readers and maximally 20 minutes for the slowest ones. Following the experiment participants were offered a short break and then asked to complete a c-test which lasted approx. 10 minutes (see Section 4.3 for details).

4.5. Results

4.5.1. Pre-processing the data

At the pre-processing stage, the resulting data were cleaned using the following criteria: i) correct responses to comprehension questions above 85%; ii) close fit to the age criterion, and iii) performance on the language ability test (see Section 4). Data from 4 participants was removed due to a lower score of correct responses. The data from 5 children and 1 adult was removed as outliers with respect to criterion ii). Finally, we excluded 2 child participants who showed inability to understand the task in the language ability test. This left the data from 175

children and 41 adult for further statistical analysis. Table 1 shows distribution of participants per group after cleaning.

Group	Mean age in years (SE)	Number of participants
Monolingual Italian	9,09 (0,23)	18
	11,63 (0,48)	20
	13,74 (0,27)	19
		Total: 57
Early bilingual	9,79 (0,23)	20
	11,84 (0,30)	20
	13,77 (0)	18
		Total: 58
Monolingual Slovenian	9,58 (0,23)	20
	11,58 (0,45)	20
	13,65 (0,34)	20
		Total: 60
Adult Italian	26,10 (4,7)	20
Adult Slovenian	26,9 (4,85)	21
		Total: 41

Table 1. Distribution of participants after pre-processing

We entered the following measures as fixed factors: i) GROUP (monolingual, bilingual); ii) CONDITION (LP; MP; MP-Neg); iii) AGE (9,11,13, adults); and iv) LANGUAGE (Italian, Slovenian). Treatment coding of factors (default in R) was used whereby the Italian language, bilingual group and Condition LP were assigned reference values. The data from the control group of participants who were over 18 years of age were uniformly coded as adult.

4.5.2. (Monolingual) adults

A model fit to the adults-only subset of the data revealed a main effect of factors LANGUAGE ($\chi^2(1)=6.72$, $p = 0.009$), CONDITION ($\chi^2(2)=59.11$, $p < 0.0001$), as well as their interaction ($\chi^2(2)=46.36$, $p < 0.0001$). Post hoc pairwise comparisons in the form of Tukey estimations revealed a significantly higher rate of correct responses given by the

Slovenian speakers than by the Italian speakers in Condition LP (0.99 vs. 0.92; β = 3.04, SE=0.93, z = 3.26, p = 0.01) as well as Condition MP-Neg (0.95 vs. 0.68; β = 2.19, SE=0.60, z = 3.59, p = 0.003), whereas there was no significant difference in response rates in Condition MP (0.94. vs. 0.98; β = -1.28, SE=0.73, z = -1.75, *ns*). These contrasts are illustrated in Figure 5.

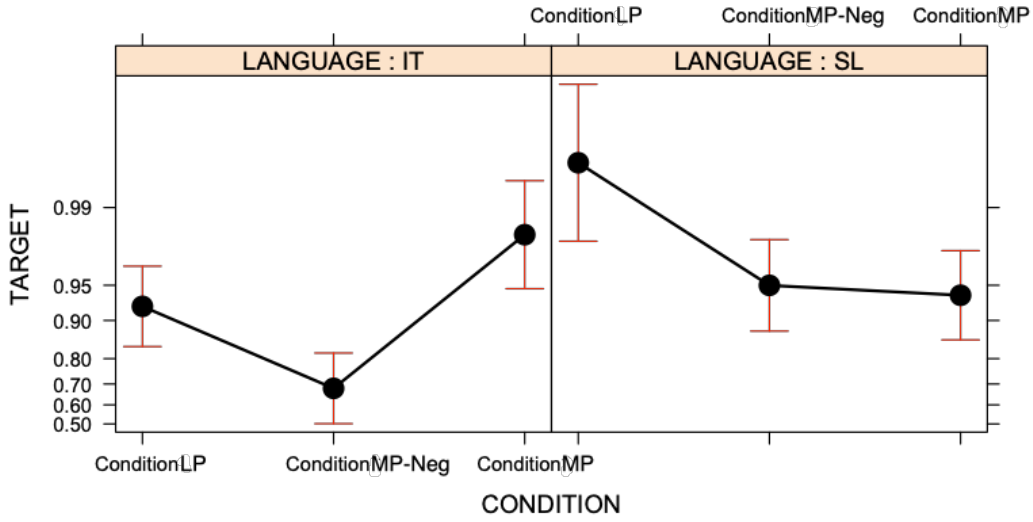

Figure 5. Interaction of factors LANGUAGE and CONDITION in adult controls, given in estimated probabilities of correct answers

4.5.3. Children: No developmental aspect

The percentages of correct answers per age group and condition are shown in Table 2.

	% correct answers per age group				
	9	*11*	*13*	*Total children*	*Adults*
Condition LP	79	84	84	82	93
Condition MP-Neg	77	80	78	78	76
Condition MP	88	90	93	90	91
Total	81.43	85.20	85.22	83.97	87.19

Table 2. Percentage of correct answers per age group, children and adults (raw data)

Within the children's population, our constructed models revealed no main effect of AGE ($\chi^2(2)$=3.36, p = 0.18) and no interaction with any of the three other factors (p > 0.10). We

also did not find an age effect when sampled across children and adults ($\chi^2(3)=4.86$, $p = 0.18$). Put differently, children tend to produce a comparable ratio of targeted answers across conditions and groups. Factor AGE was then excluded from further analyses.

4.5.4. Children: A general model and estimated contrasts

The model fit to the children's sample data revealed a robust main effect of CONDITION ($\chi^2(2)=83.93$, $p < 0.0001$). Tukey's planned comparisons confirmed a significant difference between estimated responses on each of the three conditions involved ($p = 0.01$ for the pair Condition LP – Condition MP-Neg; $p < 0.0001$ for the other pairs). This factor thus emerges as a reliable predictor of the targeted responses. There was a marginal main effect of LANGUAGE ($\chi^2(1)=2.71$, $p = 0.09$). No main effect of GROUP was found ($\chi^2(1)=0.65$, *ns*). Furthermore, a significant three-way interaction of the factors CONDITION, LANGUAGE and GROUP was observed ($\chi^2(7)=109.65$, $p < 0.0001$). The three-way interaction model is summarized in Table 3 and illustrated in Figure 6.

Factors	Estimate	*SE*	*z*	*p*
(Intercept)	1.7271	0.2343	7.373	<0.0001
GROUPMONOLINGUAL	0.2805	0.3094	0.907	*ns*
LANGUAGESL	-0.1536	0.2437	-0.630	*ns*
CONDITIONConditionMP-Neg	-0.4929	0.2377	-2.074	0.03811
CONDITIONConditionMP	1.8060	0.3584	5.040	<0.0001
GROUPMONOLINGUAL:LANGUAGESL	0.3541	0.3799	0.932	*ns*
GROUPMONOLINGUAL: CONDITIONConditionMP-neg	-0.4415	0.2948	-1.498	*ns*
GROUPMONOLINGUAL: CONDITIONConditionMP	-1.3312	0.4133	-3.221	0.00128
LANGUAGESL:CONDITIONConditionMP-Neg	0.3207	0.3350	0.957	*ns*
LANGUAGESL:CONDITIONConditionMP	0.2609	0.5122	0.509	*ns*
GROUPMONOLINGUAL:LANGUAGESL: CONDITIONConditionMP-Neg	1.3316	0.4363	3.052	0.00227
GROUPMONOLINGUAL:LANGUAGESL: CONDITIONConditionMP	-0.6546	0.5856	-1.118	*ns*

Table 3. Summary of the three-way interaction model crossing GROUP, CONDITION and LANGUAGE factors based on the children data

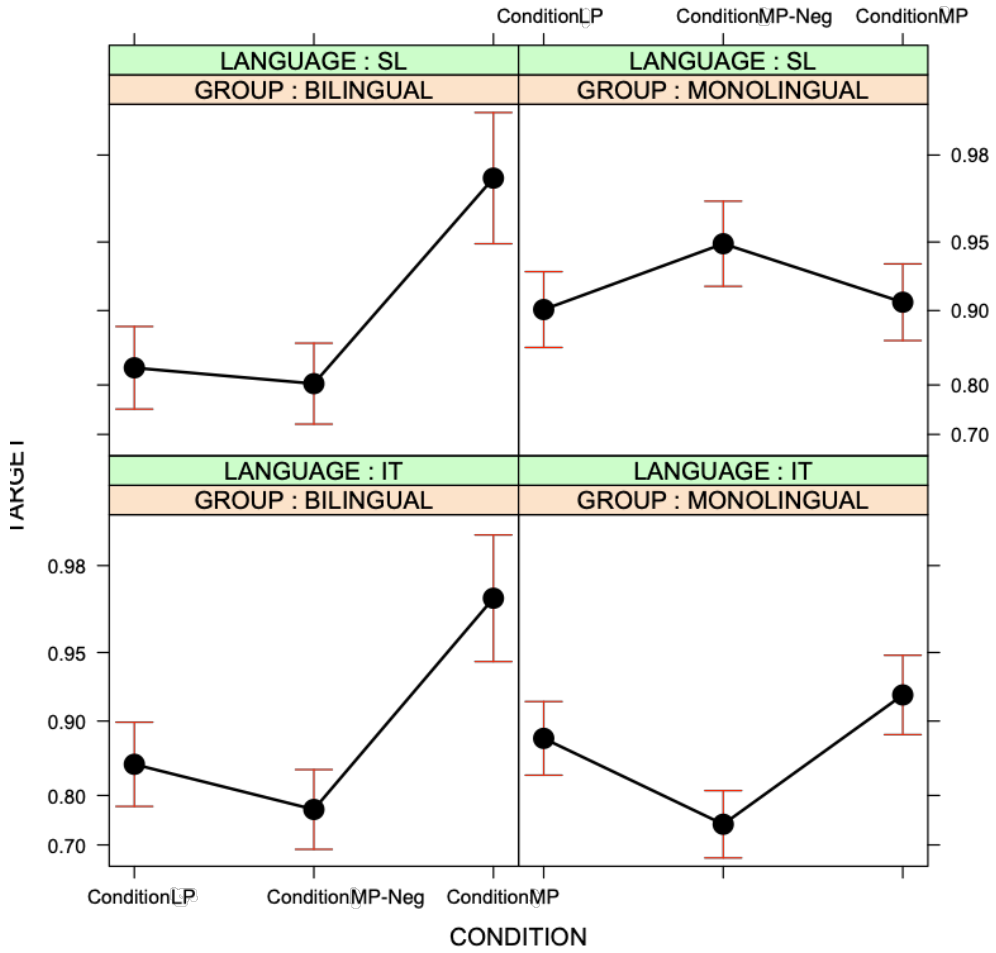

Figure 6. Interaction of GROUP, LANGUAGE and CONDITION based on the children data, given in estimated probabilities of correct answers

To better understand this interaction and specific loci of the effects in the three-way interaction term, we also constructed smaller two-way models. A significant interaction between GROUP and CONDITION was found across the language factor ($\chi^2(2)=45.30$, $p < 0.0001$). An examination of the respective model revealed that for the bilingual group, the odds ratio of giving a correct answer to Condition MP increase by factor 1.67 (84 %) compared to the monolingual group. Post hoc pairwise Tukey comparisons revealed that this decrease is significant ($\beta = -1.21$, $z = -3.881$, $p = 0.001$). In other words, bilinguals are more likely to give the targeted answer to Condition MP than monolinguals. In contrast, the odds of giving the targeted answer to Conditions LP and MP-Neg are not significantly affected by

bilingualism (Condition LP: $\beta = 0.45$, $z = 1.900$, *ns*; Condition MP-Neg: $\beta = 0.50$, $z = 2.137$, *ns*).

There was also a robust two-way interaction between LANGUAGE and CONDITION for monolinguals ($\chi^2(2)=58.28$, $p < 0.0001$), but not for bilinguals ($\chi^2(2)=0.93$, *ns*). Post hoc pairwise comparisons of the respective interaction term revealed that Condition MP-Neg was mostly responsible for the LANGUAGE effect, increasing the odds of giving the targeted answer to that condition by factor 1.64 (or 83% probability) if the language is Slovenian, compared to Italian ($\beta = 1.08$, $z = 5.070$, $p < 0.0001$). No significant contrasts were observed within Condition LP or Condition MP.

Finally, there was an interaction between GROUP and LANGUAGE, again confined to Condition MP-Neg ($\chi^2(1)=17.48$, $p < 0.0001$). There was no significant interaction within Condition LP or Condition MP (all $p > 0.10$). Post hoc pairwise comparisons revealed that Slovenian was the language in which the odds of giving a felicitous judgment were lower by factor 1.63, or 84% probability, for bilinguals than for monolinguals. In contrast, within Italian, felicitousness was not affected by bilingualism. These results are summarized in Table 4. Note that this essentially replicates the pattern observed across the Slovenian and Italian adults (Section 4.4.2).

contrast	estimate	SE	z.ratio	p.value
BILING,IT - MONO,IT	0.1680530	0.3370723	0.4985665	*ns*
BILING,IT - BILING,SL	-0.1910149	0.2463003	-0.7755367	*ns*
BILING,IT - MONO,SL	-1.8249548	0.3808254	-4.7921034	<.0001
MONO,IT - BILING,SL	-0.3590679	0.3404821	-1.0545865	*ns*
MONO,IT - MONO,SL	-1.9930077	0.3634549	-5.4835079	<.0001
BILING,SL - MONO,SL	-1.6339398	0.3823466	-4.2734516	0.0001

Table 4. Pairwise comparisons within the GROUP and LANGUAGE interaction term, Condition MP-Neg.

4.6. Discussion

4.6.1 Adult controls

We start the discussion with an interpretation of the results obtained from the adults who provide the comparison frame for children's pragmatic knowledge. The null hypothesis is that both Italian and Slovenian-speaking participants perform at ceiling on the lexical presupposition Condition LP and MP-related Condition MP. As for Condition MP-Neg, under the hypothesis that Neg-raising is available in Italian and not in Slovenian (cf. Section 2.4), we predicted that Slovenian speakers provide a comparable amount of target answers on Conditions MP-Neg and MP since both these conditions test sensitivity to MP. On the other hand, the alternatives in Condition MP-Neg in Italian are not truth-conditionally equivalent when a participant interprets the *pensare ('think')*-sentence with a negated embedded rather than matrix predicate. Under such interpretation of the neg-raising verb *pensare*, the choice between *pensare*- and *sapere*- alternatives is not affected by MP and, therefore, no prediction within our set of assumptions is possible. The results reported in Section 4.5.2. confirm the prediction that both groups will perform at ceiling on Conditions LP and MP. Our predictions regarding Condition MP-Neg were also borne out. The rate of target answers on Condition MP-Neg was comparable to that of Condition MP for the Slovenian speakers. In Italian, participants provided significantly less target answers to Condition MP which is in line with the hypothesis that neg-raising dissociates the task in Condition MP-Neg from MP.

There is, however, one unexpected result in the adult's set of data. Although we observed very high rates of success (above 90%) on Condition LP in both groups, we also observed a significant difference in favour of the Slovenian participants. At this stage, we do not have an explanation of this fact, and must leave that for future research.

4.6.2. Child participants

4.6.2.1. Factor Age

Turning to the interpretation of the results from our child participants, recall that Experiment 1 revealed that age affects sensitivity to MP only as long as it affects knowledge about the factivity of *know*. Moreover, at the age of 7, children demonstrated adult-like knowledge of both lexical presupposition of *know* and adherence to MP. On the hypothesis emerging from Experiment 1 that age cannot be expected to affect the success in providing targeted responses across conditions and across groups we expected no main effect of the factor age and no interaction with the other factors (Group, Condition and Language). In line with this prediction, the results in Section 4.5.3 revealed no main effect of age and no interaction with any additional factor.

4.6.2.2. Factor Group

In Section 1 we argued that adherence to MP requires competence about competition resolution and linked that competence to the general cognitive function of inhibition. On the hypothesis that bilingualism positively affects parts of the executive control system which are also relevant to language processing, we predicted that bilingualism will interact with the factor Condition. More specifically, we expected an advantage for the bilingual participants in their success rates with respect to Condition MP which tests sensitivity to MP. The results confirmed that prediction (cf. Figure 6). The difference between bilingual and monolingual responses on Condition MP was significant. As for Condition MP-Neg which also tested sensitivity to MP, we make a prediction only about the Slovenian data, given the difference between Slovenian and Italian with respect to Neg-raising. Similarly to Condition MP, we predict that bilingualism will positively affect performance on Condition MP-Neg. However, the prediction was not borne out. In fact, monolingual Slovenian participants performed

significantly better than bilingual participants in Slovenian on Condition MP-Neg. We suggest an interpretation of this result in the General discussion below.

4.6.2.3. Factor Language

Our results revealed that Factor Language had a marginal main effect and interacted with both Condition and Group. Given the Neg-raising distinction between the Slovenian and Italian counterparts of *think*, we predicted interaction between language and condition, with Condition MP-Neg being the source of this. We further predicted a higher rate of Slovenian targeted answers to Condition MP-Neg. The results confirmed that Language affects only results on Condition MP-Neg. Moreover, they supported the hypothesis about a significantly higher possibility of giving the targeted answer on Condition MP-Neg in Slovenian. However, this possibility was restricted only to monolingual participants. To sum up: two results regarding the role of language need further discussion – i) the significantly better performance of monolinguals compared to bilingual participants in Slovenian (as already mentioned in the discussion of factor Group), and ii) the comparable rate of Slovenian and Italian targeted answers given by bilingual participants. We postpone these answers for the General Discussion section.

4.6.2.4. Factor Condition

The results reveal a robust main effect of the factor Condition and interactions with Group and Language. Most of the predictions that our study makes about these interactions and the corresponding results have already been systematised in Sections 4.6.2.2. and 4.6.2.3.: i) in line with prediction, bilingual participants perform significantly better on Condition MP in comparison to their monolingual peers; ii) in line with prediction, monolingual Slovenian speakers perform at ceiling on Condition MP-Neg unlike monolingual Italian speakers; iii) contrary to predictions, bilingual speakers perform significantly worse than monolinguals in

Slovenian on Condition MP-Neg, and iv) contrary to predictions, bilinguals speakers give a comparable amount of targeted answers to Condition MP-Neg in both of their languages.

Given the results of Experiment 1 which suggested adult-type knowledge on the factivity of *know* and MP, tested with Conditions LP and Condition MP, respectively, at the age of 7, we expected Experiment 2 participants to demonstrate comparable knowledge on all three conditions, modulo the Italian part of Condition MP-Neg. This expectation was borne out with respect to Condition MP and part of Condition MP-Neg (related to the performance of the monolingual Slovenian participants) where all groups achieved above 90% of success on choosing the targeted response. However, the results of performance on Condition LP, which contributed to the main effect of Condition that we observed, were unexpected. In both languages, all groups gave a comparable amount of targeted answers on Condition LP, approximating 90% from below, but this rate was significantly lower than the success rate for Condition MP. This result is puzzling in view of two facts: i) the much higher success rate on Condition LP of 7-year olds who were tested on the same material in Experiment 1 (99%), and ii) the fact that knowledge of factivity of *know* is a prerequisite for adherence to MP, hence participants cannot be expected to perform worse on Condition LP in comparison to Condition MP.

We speculate that the difference between the mode of presentation of Experiments 1 and 2 could have affected the achieved results. In view of the participant's age in Experiment 1, the verbal testing material was read to each child by an experimenter (a native speaker of Slovenian). In Experiment 2, participants read that material out loud themselves. It is possible that the intonation employed by the experimenter has facilitated the intended interpretations of compared alternatives. It is worth pointing out, however, that if this was the case, it should also have affected the outcome from Condition MP in experiment 2 and Condition MP in Experiment 1 which used the same material. We cannot validate such a prediction by statistical means. We observe, however, that the 7-year old participants in Experiment 1 (all

of whom were monolingual) achieved a slightly higher rate of success in targeted answers to the MP condition in comparison to each of the monolingual Italian and Slovenian groups of 9 to 13 olds in Experiment 2.

5. General discussion: *Maximize presupposition* and pragmatic abilities in children

In the beginning of this article, we formulated two research questions pertaining to 1) the influence of age on children's adherence to MP, and 2) the hypothesis that bilingualism enhances sensitivity to MP due to its acclaimed potential to enhance aspects of the executive control system that are also relevant in processing constraints like MP. We begin with addressing the first question in light of our findings.

5.1. Knowledge of MP and developmental effects

Both experiments in this study tested sensitivity to MP. For older participants the design was enriched also with a negative MP-condition. The general conclusion that follows from this work is that from the age of 7 onwards, children have adult-like knowledge about MP. Earlier, we argued for a parallelism in processing the two pragmatic constraints: Maxim of Quantity and MP. Our results, then, seem to contradict the suggested parallel-acquisition view that knowledge of the Maxim of Quantity and consequently scalar implicatures that arise due to it, involve a developmental trajectory (cf. Noveck 2001, Papafragou and Musolino 2003, etc.). The conflict, however, rather disappears if we mention some important points about the protocol used in this study. Specifically, we use a Felicity Judgment Task (cf. Gualmini et al 2001) which only probes for sensitivity to MP. Sensitivity to MP does not automatically ensure acquisition of implicatures due to the application of the principle. It is likely that a different protocol targeting the processing of implicated presuppositions, like the Truth Value Task, would yield poorer results. A relevant example from the domain of the Maxim of Quantity and scalar implicatures is Foppolo et al (2012) which reports 42% success rate for

scalar implicature comprehension of 5-year olds tested with a Truth Value task in Experiment 1 vs 95 % success rate at sensitivity to the Maxim of Quantity of 5-year old participants tested with a Felicity Judgment Task for group in Experiment 5. A related point is that the literature on scalar implicatures identified a number of factors affecting the success rate in pragmatic tasks. In particular, it has been demonstrated that children as young as our older participants in Experiment 1 already show adult-like knowledge of scalar implicatures (Guasti et al 2005, Pouscoulous et al 2007, a.o.). Among these factors are the availability of training, the availability of visual context accompanying the verbal material, the choice of implicature-triggering lexical items, etc. It is very likely that all of these would also be relevant in acquisitional studies on MP and implicated presuppositions.

Some of the results pertaining to Condition MP-Neg in Experiment 2 need further discussion in the context of our participants' sensitivity to MP. Recall that both Slovenian-speaking adults and Slovenian monolingual child participants performed at ceiling with respect to Condition MP-Neg, as expected under the Neg-raising hypothesis. Italian adult and monolingual speakers, on the other hand, provided considerably less targeted answers on that condition. However, we are in need of explanation about the fact that in Slovenian, bilingual participants' responses revealed an unexpected tendency. In both of their languages bilingual speakers demonstrated a consistent linguistic behaviour with respect to Condition MP-Neg, namely, they gave a comparable amount of targeted answers in each language. That rate was also similar to the rate of targeted answers on Condition MP-Neg provided by monolingual Italian child and adult participants, but different from monolingual Slovenian participants who gave a significantly higher rate of such responses. This suggests that our bilingual speakers analyzed both of their translational equivalents of *think* as neg-raising verbs, consistent with Italian. This conclusion is strengthened by the fact that bilinguals showed the highest success rate on Condition MP among all tested groups, thus disproving a potential hypothesis that they lack sufficient knowledge of MP. We tentatively suggest that Experiment 2 has revealed

a case of what is known in the literature on bilingual acquisition as syntactic transfer, a phenomenon in the process of bilingual language acquisition a morphosyntactic feature is transferred from one language to another if it has different values in the acquired languages (cf. Jarvis and Pavlenko 2008 for an overview and discussion). Negation and neg-raising are syntactically encoded, and, furthermore, Slovenian and Italian differ with respect to the neg-raising parameter (see Section 2.4). It is therefore conceivable, that bilingual speakers may wrongly assume, at least in some cases, that Slovenian is a neg-raising language on the basis of transfer of the relevant part of their knowledge of Italian. Clearly, more research is needed to show that a syntactic transfer from Italian to Slovenian can occur in the domain of bilingual language acquisition of *think*-type predicates and the potential influence of other factors concerning language dominance, proficiency etc. At the same time, the results we have obtained in this study are intriguing and consistent with the suggested possibility.

5.2. The impact of bilingualism on sensitivity to MP

The second research question that we posed asked about the role of bilingualism in the context of MP. While we introduced two MP-relevant conditions in the design of Experiment 2, only Condition MP turned out to be informative due to the fact that a transfer effect was revealed in Condition MP-Neg and precluded the possibility to evaluate sensitivity to MP with the pair of attitude verbs under negation. The results in the positive condition (Condition MP) lend support to the hypothesis that bilingualism affects positively linguistic behaviours that require particular general cognitive abilities, and in particular that bilingualism affects positively adherence to MP. The observed factor interaction suggests that bilingual speakers are more likely to detect MP contexts than their monolingual peers and conform to linguistic demands in them. However, since all age groups, across languages, demonstrated adult-like knowledge of MP, we interpret these results to pertain to a bilingual advantage in performance between groups with equal competence.

This conclusion is in line with previous experimental evidence that links bilingualism to efficiency of the Executive Control System, as suggested in Section 1. It has been argued that executive functions (inhibition, flexible switching between tasks, working memory and monitoring attention control) contribute to a bilingual advantage in behavioural tasks (Bialystok et al 2012 and references therein; Costa and Sebastián-Gallés 2014 and references therein, Antoniou et al (2016), Garraffa et al (2015), among others). The necessity to manage (parts of) two or more language systems typical for bilinguals is commonly suggested in the literature to enhance executive functions, attentional and other types of cognitive control, conflict resolution and/or inhibition, and working memory. Indeed, in some obvious way, choosing a more informative, presuppositionally heavier, alternative out of semantically equivalent attitude reports constitutes a conflict resolution task, similarly to a Stroop or Simon task, that requires focus on relevant contextual cues. A further, rather straightforward, parallel can be drawn on children's performance on various false belief tasks. Such tasks usually involve conflicting mental representations that the child has to choose between: one regarding the actual state of affairs, and the other related to other people's beliefs about that state which can also be false. Similarly, the so-called Appearance and Reality tasks (A&R) where evaluated objects do not have a prototypical form which enhances a misleading perception are often recognized as false-beief tasks even without false-belief questions (Bialystok and Senman 2004, Carlson and Moses 2001, Carlson et al 2002). The bilinguals' better performance in these conflict-resolution tasks can also be interpreted in terms of enhanced inhibitory control. More specifically, such tasks could be construed as raising inhibitory demands because participants in such tasks have to inhibit the default belief that beliefs are usually true (cf. Kovács 2009). As such, false belief tasks are also competition-based tasks. Similarly, in the A&R tasks, bilinguals perform better at reality questions in which representational features have to be inhibited. Alternatively, or, perhaps, even complementary to the above, false belief tasks are argued by Kovács (2009) to parallel switching situations in

which participants have to switch among the actual and possible worlds describing a certain state of affairs in settling an appropriate mental state. From that perspective, bilinguals might exercise a larger degree of cognitive flexibility developed as a result of handling language switching situations. This reasoning can be extended to the MP task in the sense of a parallel demand for inhibition in deciding between the two competing propositions. The choice that a speaker must make between *know*-sentences and *think*-sentences in the relevant context is a choice between two true propositions. Given that speakers generally contribute in discourse only propositions in whose truth they believe (Quality Maxim of the Cooperative Principle of Grice 1989), none of these alternatives is to be discarded by default. However, in the presence of an overarching pragmatic principle like MP, the presuppositionally weaker *think*-alternative has to be inhibited.

6. Conclusion

In this study we provided experimental support for Heim´s (1991) pragmatic constraint *Maximize presupposition* being productively used both in monolingual and bilingual child populations. We found out that across ages, children between 7 and 13 years are able of complying with the constraint at ceiling. We also traced a potential bilingual advantage linked to performance in relation to this pragmatic constraint and thus provided new support for research on its impact on developing general cognitive abilities.

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