Bilingual Exposure Improves Use of Contrastive Prosody in Fast Mapping

Isabelle Lorge and Napoleon Katsos

Children growing up in a multilingual environment are confronted with a linguistic input of fundamentally higher complexity at every level (i.e., lexicon, grammar, phonology and prosody). In addition to this, they may face higher cognitive demands due to the need to inhibit and switch between languages (Green, 1998). They also face particular communicative challenges, such as the need to monitor speaker’s linguistic abilities and preferences, as well as higher risks of communicative failures (Paap and Greenberg, 2013). Finally, they have to learn a high number of words in a limited amount of time, which usually (though not always) results in temporary lower vocabulary levels in each language compared to monolinguals in early childhood (Bialystok et al., 2010; Pearson et al., 1993) but a greater total vocabulary (Junker and Stockman, 2002; Umbel et al., 1992; De Houwer et al., 2014). This greater amount of total words is particularly impressive, given that bilingual children appear to be less able to rely on some strategies and assumptions commonly used by monolinguals for learning words. For example, a common assumption in word learning is mutual exclusivity, or the assumption that a new word refers to a new object rather than a familiar one: e.g., if presented with an unknown object and a familiar object (such as an apple) and told to ‘pick up the dax’, both children and adults will tend to assume that the new word refers to the new object, various reasons of which have been hypothesised (Markman and Wachtel, 1988; Clark, 1987; Golinkoff et al., 1992). However, because of the need to acquire two words for many concepts from the very beginning this strategy seems to be relaxed in bilingual children (Davidson et al., 1997; Houston-Price et al., 2010), an effect which correlates with number of languages in the environment (Byers-Heinlein and Werker, 2009) and knowledge of translation equivalents (Byers-Heinlein and Werker, 2013).

High variability input has been shown to increase attention levels in language acquisition (Graf Estes and Hurley, 2013; Shneidman et al., 2009). Similarly, in the past decade there has been suggestions that bilingual upbringing led to improvements in general cognitive ability and executive control (Bialystok et al., 2004), although these improvements do not always replicate and are subject to controversy (Paap and Greenberg, 2013). Researchers have also postulated that bilinguals might benefit from enhanced theory of mind (Goetz, 2003), perspective-taking (Greenberg et al., 2013; Rubio-Fernandez and Glucksberg, 2012) and pragmatic skills either as a strict numeric advantage (Siegal et al., 2009) or relative advantage (Antoniou and Katsos, 2017; Veenstra et al., 2017). This

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would be the result of their more challenging communicative environment and, in the case of pragmatics, possibly to compensate for the inability to rely on tools such as mutual exclusivity (Byers-Heinlein, 2017). Furthermore, given that many of the challenging aspects related to multilingualism (i.e., variable input, communicative challenges and switching in comprehension, passive vocabulary knowledge, etc.) apply in any case of regular exposure to more than one language, there is growing evidence that at least some of these effects will be found in bilingually exposed children regardless of level of productive use in both languages (Fan et al., 2015; Liberman et al., 2017).

A bilingual learning environment might thus both create a stronger need for social and pragmatic skills in order to overcome these challenges as well as nurture these skills. For the reasons mentioned above, these skills might be particularly called for and evident in fast mapping (i.e., novel word referent resolution from a one-time exposure). Research indicates that bilinguals might indeed have an advantage in using speaker cues for reference resolution of a novel word. Studies so far have focused on the use of social (e.g., eye gaze, pointing) or prosodic cues where these are pitched against other types of cues: semantics (Yow and Markman, 2015), mutual exclusivity (see de Marchena et al., 2011, for a discussion on the non-pragmatic account of mutual exclusivity), object similarity (Colunga et al., 2012) and object salience (Yow et al., 2017).

Because these paradigms always involved inhibiting an irrelevant cue in order to focus on the (relevant) socio-pragmatic cue, the results in these studies might have been driven by more general cognitive abilities such as inhibitory control rather than by pragmatic competence per se. Another possibility could be that bilingualism increases attention to speaker or social cues (or preferential weighting of them compared to other types of cues) but not the ability to reason about communicative intentions and informativeness.

True pragmatic inference distinguishes itself from other types of inference in that it requires not only recognition of the cue provided but also reasoning about the speaker’s reasons or intentions for providing the cue. Contrastive inference for example is a type of pragmatic inference where the reason for providing a certain cue (e.g., an adjective) is assumed to be for informative purposes (i.e., to distinguish one potential referent from another). For example, listeners presented with an array of four objects and asked to ‘Pick up the tall...’ will typically start shifting their eye gaze towards the tall glass (which has a small glass counterpart) before hearing the noun rather than towards competitors which could also be described as ‘tall’ (a cup and a brush) but have no counterparts, assuming that the adjective is being used contrastively (Sedivy et al., 1999). Emotional affect (expressed via positive or negative intonation), on the other hand, is a type of socio-pragmatic cue which, like eye gaze and pointing, could potentially be used directly to identify a particular referent (that has a positive or negative characteristic) without the need to reason about why the speaker provided the cue. In this scenario, the affect (or point, or gaze) will shift the child’s attention towards the target object, raising its probability as a candidate for the novel word without any processes involving theory of mind taking place (Frank, 2014). This can to a certain extent be related to Grice (1975)’s dichotomy between natural
meanings (which can be used directly) and non-natural meanings (which require the understanding of a communicative intention).

Better performance in socio-pragmatic fast-mapping in the studies mentioned could be the result of a bilingual advantage in general cognitive abilities (and inhibition of irrelevant information) and/or to increased attention towards speaker cues, or they could result from increased ability to reason about speaker’s intentions in providing the cue. The current study sought to provide evidence for the latter by testing monolingual and bilingual exposed children’s performance on two different word learning/fast-mapping paradigms in the absence of conflicting information (i.e., where success could not be obtained by ignoring an irrelevant cue): a contrastive inference task and an emotional affect task.

1. Method
1.1. Participants

The study was approved by the Cambridge Psychology Research Ethics Committee and parents in participating schools were sent information about the study along with a form allowing them to opt-in or opt-out depending on the school’s policy. In total, 270 children aged 4-6 years old were recruited through schools in Cambridge and London. Demographic and language information was obtained through parental forms for 74 children, while the information for the remaining participants was obtained through school staff and proved to be highly reliable (over 98% match with the 74 questionnaires) when compared to available parental information. Of the 270 children, 138 (66 females, 72 males, mean age=5;2, sd=6.9 months) had been exposed daily to a second language for at least a year, including children in French immersion program (n=26), children identified through parental forms as sequential bilinguals (n=18) or as simultaneous bilinguals (n=26) and identified as bilingual by their teachers (for these children the school described the child as having English as additional language (EAL; n=68) which is a technical term used in the UK educational setting to signify children whose dominant language is not English). The remaining 132 children (62 females, 70 males, mean age=5;5, sd=8.2 months) had had no regular exposure to a language other than English. The average percentage of free school meals (FSM) in each of the participating schools was used as a proxy for socio-economic status (see Hobbs and Vignoles, 2007, for a discussion on the use of FSM for this purpose). Languages other than French (immersion and home, n=34) were Hindi (n=15), Gujarati (n=13), Tamil (n=10), Romanian (n=10), Urdu (n=6), Polish (n=6), Arabic (n=5), Pakhto (n=3), Portuguese (n=3), German (n=3), Cantonese (n=2), Czech (n=2), Somali (n=2), Slovak (n=2), ESL (n=2), Albanian, Bahasa, Farsi, Greek, Hungarian, Italian, Lithuanian, Malayalam, Mandarin, Punjabi, Persian, Russian, Serbian, Sindhi, Sinhala, Swahili, Swedish, Thai, Turkish and Vietnamese (all n=1). 75 monolingual adult participants were recruited through Prolific Academic for piloting purposes and to uncover any developmental effects. Adult participants completed the study online for a reward of 0.87.
1.2. Contrastive inference task

The paradigm we used was similar to Gelman and Markman (1985) with the difference that these authors used the word ‘one’ and familiar objects (in Study 1) and novel adjectives and objects (in Study 2) (e.g., ‘The red one’ or ‘the fep one’) instead of novel nouns as we did.

1.2.1. Stimuli

Stimuli were 12 pictures each with four unknown aliens, two of which were of the same kind (e.g., two type A aliens, one type B alien, one type C alien). Pictures for the critical conditions contained a target and distractor featuring the target property (e.g., a wet type A alien and a wet type B alien) and a counterpart which did not feature the property (e.g., a dry type A alien) (see figure 1). Pictures for the control condition contained only one alien featuring the target property. The properties were chosen so that they could be described by common adjectives, would be accidental/non-intrinsic (so that one alien could feature the property while its counterpart did not) and could be used to describe modified or unmodified creatures (e.g., a wet alien or dry alien) to account for the potentially increased salience of modified aliens. Colours were avoided because of the confusion often displayed by children around that age in reliably recognising and naming them (Bornstein, 1985).

Figure 1: example stimulus contrastive inference

1.2.2. Procedure

For adult participants stimuli were presented using the Qualtrics platform. For children participants stimuli were implemented and presented on a touchscreen laptop using Superlab version 5.0 (Cedrus, San Pedro, CA). Clicks were recorded as raw X and Y pixel coordinates of the point where the screen had been touched and answers were subsequently coded by matching the coordinates to the corresponding answer area among the four possible choices on the picture. Children were tested in a quiet room at their school. They were introduced through the computer to Mr. Puppet, who had recently made some alien friends
and lent them some toys which he now needed to get back. They were then asked if they would like to help Mr. Puppet find the ‘wet gloop’ and ‘dirty gloop’ (feedback provided) before proceeding to the task. There were four trials of each type (12 total): non-stressed condition (e.g., ‘Touch the wet gorp’), stressed condition (‘Touch the WET gorp’) and control (similar instructions to the non-stressed condition but only one alien had the target feature). Instructions were recorded by a female native English speaker using a Sennheiser ME 64 cardioid microphone connected to a Tascam HD-P2 Compact Flash Audio Recorder. Recordings were made in 24bit mono with a sample rate of 44.1kHz. Experimental design was within-subject, with 4 target features/adjectives (‘wet’, ‘dry’, ‘clean’ and ‘dirty’) and 12 novel words (gorp, pitack, rapook, lep, plonk, yubba, moozie, ral, flurg, dinkoo, patam and tweep). There were two lists of items counterbalanced for word/alien pairings and target position. Trials were randomised.

1.3. Receptive vocabulary task

Children also completed a computerised version of the BPVS-3 (Dunn and Dunn, 2009) implemented on the touchscreen laptop to test receptive vocabulary. This is a picture-matching task in which children are asked to point to one of four pictures that matches the word uttered. The items are arranged in blocks of 12, and the test continues until children have made 8 or more mistakes in a block. Children received two warm-up trials. Raw scores rather than standardized were used in the analyses as they indicated both vocabulary and developmental levels. Receptive vocabulary scores are also a more direct measure of the impact of socioeconomic factors on language development (the issue of interest here) than SES indices such as maternal education or household income. Instructions were recorded by a female native English speaker.

1.3.1. Results

Final results can be seen in Table 1. Data from eleven monolingual children were excluded from final analyses because of experimenter’s error or child fussiness or failing to complete the task. We first conducted analyses with target and distractor responses only (removing errors where the character selected did not semantically match the instruction, e.g., children chose a dry character in response to a prompt for a ‘wet gorp’) to be able to set chance performance at 0.5 and examine each group’s performance in each condition (chance with four choices would otherwise technically have been set at 0.25). In the regression model raw scores (including all types of errors) were used to allow comparison with performance in control condition. The first set of analyses showed that adults were significantly above chance in both stressed (m=0.66, sd=0.47, t = 3.19, df = 350, p= 0.001) and non-stressed condition (m=0.58, sd=0.49, t = 6.35, df = 345, p<0.0001). Children, on the other hand, were significantly above chance in the stressed condition (m=0.56, sd=0.49, t=4.06, df = 947, p<0.0001) but not in the non-stressed condition (m=0.51, sd=0.50, t=0.59,
df=927, p=0.55). This pattern applied to both monolinguals (non stressed=0.50, p=ns; stressed=0.58, t=3.66, df = 489, p=0.0003) and bilinguals (non stressed=0.52, p=ns; stressed=0.55, t=2.06, df=457, p=0.04). Preliminary analyses revealed that, compared to the monolinguals, the bilingual group was on average significantly younger (5;1 vs. 5;5, t=2.63, df=364.9, p=0.009), had significantly lower English vocabulary (British Picture Vocabulary raw scores 76 vs. 68, t = 6.3, df=377.75, p <0.0001) and significantly lower SES (as calculated through averaging free school meal percentages previously normalised using national average and standard deviation, -3.00 vs. -2.51, t = -3.95, df=372.32, p<0.0001). These were then entered as covariables in our regression model. As all these variables, chronological age, SES and general vocabulary proficiency in the language of testing are known to independently have an effect on performance on linguistic tasks, they were then entered with gender (also shown to have an effect on pragmatic performance, cf. Stiller et al., 2015) as a logistic regression mixed model (Bates et al., 2014) with items and participants as random effects and starting with all design-relevant fixed effects as random slopes, i.e., a maximal random effects model. Following a procedure used in cases of over-parameterisation (Horowitz et al., 2018; Cane et al., 2017), random effects were removed only when they led to non-convergence. Because age and raw BPVS scores were highly correlated, only BPVS scores were retained as they proved to be a better predictor of performance. The final model included gender, normalised BPVS scores, normalised FSM percentages, bilingual status, condition and their interaction as fixed effects, and subject intercepts as random effects. The control condition was used as the reference level. Performance was significantly correlated with higher vocabulary scores (est=0.23, se=0.04, z=5.45, p<0.0001), lower FSM percentage (est=-0.16, se=0.04, z=-4.35, p <0.0001), bilingual status (est=-0.71, se=0.21, z=-3.39, p=0.0007) and gender (est=0.22, se=0.09, z=-2.46, p=0.01), with monolinguals and females performing better. Performance was significantly lower in both stressed (est=-2.26, se=0.19, z=-11.93, p <0.0001) and non stressed condition (est=-2.62, se=0.19, z=-13.83, p=0.0001) compared to control. In addition, there was a significant interaction between condition and bilingual status, with bilinguals performing significantly better than expected from their control performance compared to monolinguals in both stressed (est=0.49552, se=0.24059, z=2.060, p=0.04) and non stressed condition (est=0.70183, se=0.24063, z=2.917, p=0.003). We conducted further analyses on a subset of children including only those who had a maximum score on the control task. However, as this meant the removal of data from over a hundred children, and given that the contrastive inference effect had proven to be weaker than expected, it led to the bilinguals average score of 0.55 in both conditions no longer being significantly above chance, which meant comparison with monolingual performance was not possible with this subset of data.

1.3.2. Discussion

There was a developmental effect in that adults were above chance in both critical conditions but children in stressed condition only. This might be due to
the fact that the inference is relatively weak and is reinforced by the additional cue of prosodic focus which helps direct children’s attention towards the use of the modifier, making it more ostensive and raising its informative potential. Since vocabulary scores and SES were both shown to significantly impact target choices, it was unsurprising to find that the bilingual group (who were younger, with lower vocabulary scores and lower SES) was performing significantly worse in control than the monolingual group. However, when this delay in structural language (and potentially, given their young age, general attentional skills and ability to focus on the task) was accounted for by examining target answers in both critical conditions relative to performance in control, a significant interaction between bilingual status and condition was found, with bilingual children performing significantly better than expected from control (‘doing more with less’) compared to monolingual children. This means that, compared to the regular use of structural language and semantics for reference resolution in control, bilinguals were particularly sensitive to and efficient at using the pragmatic cue (i.e., the use of a modifier) to reason about the speaker’s communicative intentions in providing that cue. This shows that the differences in exerting pragmatic skills between bilinguals and monolinguals might go further than a simple ‘pragmatic bias’ whereby this particular type of cue is preferred to other types such as semantic content or object similarity. The closer-to control performance in bilinguals in the non-stressed task could simply be due to their worse performance in control combined with chance performance in critical condition, however this does not apply to the stressed condition given that both bilingual and monolingual groups were shown to be reliably above chance in selecting target in this condition.

1.4. Emotional affect task

1.4.1. Stimuli

The task was adapted from Berman et al. (2013). Stimuli were 12 pictures, each displaying two novel objects, one damaged object (i.e., dirtied or broken: mud splash, green splash, hole or dismantled parts, see figure 1) and one enhanced object (i.e., featuring flower, star or brightly lit up, see figure 2).

Figure 2: example stimulus emotional affect
1.4.2. Procedure

For adult participants stimuli were presented using the Qualtrics platform. For children participants stimuli were implemented and presented on a touchscreen laptop using Superlab 5.0 (Cedrus, San Pedro, CA). Clicks were recorded as raw X and Y pixel coordinates of the point where the screen had been touched and answers were subsequently coded by matching the coordinates to the corresponding answer area among the two possible choices (left or right). Children were tested in a quiet room at their school. The task was part of Mr. Puppet’s story and his meeting with aliens who played with strange new objects and damaged some of them but also made some of them ‘look prettier’. Children first completed two test trials, one mutual exclusivity trial (to ensure they paid attention to the linguistic information) and one to test their understanding of the task. In each trial they were presented first with the two novel objects in an unaltered state and prompted with ‘Oh! Look at these, have you seen these?’ then the altered objects along with an instruction of the type ‘Oh! Look at the nurmy, can you touch the nurmy?’ recorded with a positive, neutral or negative voice (emotional affect). The instructions were recorded by a female native speaker of English in a soundproof room using a Sennheiser ME 64 cardioid microphone connected to a Tascam HD-P2 Compact Flash Audio Recorder. Recordings were made in 24bit mono with a sample rate of 44.1kHz and checked for the prosodic and amplitude features characteristic of each type of affect (in addition to the adult study serving as control). Experimental design was within-subject with four trials in each condition (positive, neutral and negative, 12 in total). There were two lists of items counterbalanced for word/object pairings and target position. Trials were randomised.

1.4.3. Results

Final results can be seen in Table 1. A logistic regression mixed model with subject and items as random effects for adults showed that negative responses (i.e., dirty or broken object) were significantly above chance in control condition (reference level) \( m=0.61, sd=0.49, est=0.52, se=0.15, z=3.35, p=0.0008 \), significantly higher in negative than control condition \( m=0.71, sd=0.46, est=0.47, se=0.18, z=2.55, p=0.01 \) and significantly lower in positive than control condition \( m=0.36, sd=0.48, est=-1.19, se=0.18, z=-6.52, p <0.0001 \). The regression model for children was again a maximal random effects model adding all design-relevant effects as fixed and subject and item as random effects, random slopes being removed only when leading to non-convergence. Results showed that negative responses were above chance in control condition \( m=0.62, sd=0.48, est=0.69, se=0.20, z=3.46, p=0.0005 \) significantly higher in negative condition than control \( m=0.81, sd=0.39, est=1.18, se=0.28, z=4.11, p <0.0001 \) but not in positive condition \( m=0.59, sd=0.49, est=-0.05, se=0.28, z=-0.18, p=ns \). There was also a significant effect of vocabulary scores with higher scores leading to a negative bias in control \( est=0.20528, se=0.08591, z=2.389, p=0.0169 \). No other effects were significant.
There was a negative bias in the neutral affect control condition found in both children and adults whereby negative choices (i.e., dirty or broken objects) were preferred to positive ones (i.e., enhanced/decorated objects). This default preference for a negative interpretation or outcome is found in the literature and potentially results from a higher salience of negative versus positive events (Berman et al., 2013), which is why answers in the negative and positive conditions were compared to performance in the control condition rather than to chance performance in the regression model. There was also a developmental effect, with adults performing as expected in both critical conditions (i.e., making significantly more negative choices when hearing a new label uttered with negative than with neutral and positive affect, and significantly less negative choices when hearing a new label uttered with positive than with neutral and negative affect), whereas children were succeeding only in the negative condition and seemed to fail to perceive or use positive affect to direct their referent choices in the positive condition. This is again something that has previously been found and is potentially, like the negative bias mentioned above, the result of a higher salience of negative versus positive. Just as negative events appear to be more salient than positive ones, negative prosody or emotional affect might have higher salience than positive, which would lead to children being able to interpret and use it earlier (Nelson and Russell, 2011; Berman et al., 2010). The higher salience of negative events and affect appears rational from a biological/survival instinct point of view, since ignoring warning about bad outcomes might have dire consequences than ignoring good news.

No interaction between bilingual status and performance in critical condition relative to control condition was found this time. However, performance in this task relied entirely in being able to recognise and associate the specific valence of the cue (negative or positive) with the corresponding event (negative, i.e., damaged object or positive, i.e., enhanced object). Since the prompts always had the same linguistic form, there was no advantage of having a stronger vocabulary knowledge of modifiers as in the first task, and contrary to specific language exposure, there is no principled reason why bilingually exposed children should

### Table 1: summary of results

<table>
<thead>
<tr>
<th>Condition</th>
<th>Adults mean</th>
<th>Adults SD</th>
<th>Monolinguals mean</th>
<th>Monolinguals SD</th>
<th>Bilinguals mean</th>
<th>Bilinguals SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>contrastive (control)</td>
<td>0.92</td>
<td>0.29</td>
<td>0.92</td>
<td>0.27</td>
<td>0.83</td>
<td>0.38</td>
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<tr>
<td>contrastive (non stressed modifier)</td>
<td>0.54</td>
<td>0.49</td>
<td>0.47</td>
<td>0.50</td>
<td>0.44</td>
<td>0.49</td>
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<tr>
<td>contrastive (stressed modifier)</td>
<td>0.64</td>
<td>0.47</td>
<td>0.56</td>
<td>0.49</td>
<td>0.47</td>
<td>0.50</td>
</tr>
<tr>
<td>emotional (neutral affect)</td>
<td>0.61</td>
<td>0.49</td>
<td>0.65</td>
<td>0.48</td>
<td>0.60</td>
<td>0.49</td>
</tr>
<tr>
<td>emotional (negative affect)</td>
<td>0.71</td>
<td>0.46</td>
<td>0.84</td>
<td>0.36</td>
<td>0.78</td>
<td>0.41</td>
</tr>
<tr>
<td>emotional (positive affect)</td>
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<td>0.48</td>
<td>0.60</td>
<td>0.49</td>
<td>0.58</td>
<td>0.49</td>
</tr>
</tbody>
</table>

*Note: raw scores for the contrastive task include all types of errors, i.e., chance = 0.25*
have had more or less experience with or in interpreting different types of emotional affect. More importantly, unlike in the contrastive task, success in this task did not require reasoning about why the speaker was providing a certain cue since emotional affect, contrary to prosodic stress, has an intrinsic value or valence (negative or positive) which can be directly linked to the corresponding (damaged or enhanced) referent. We further develop this explanation in the general discussion.

1.5. General discussion

The goal of this paper was to investigate monolingual and bilingually exposed children’s use of pragmatic cues and prosodic cues for reference resolution of a novel word. Past literature had examined bilingual and monolingual children’s performance in reference resolution tasks which involved using a socio-pragmatic cue such as pointing, eye gaze or emotional affect and found bilingual children generally performing better than monolinguals (Yow and Markman, 2015; Yow et al., 2017). However, given that the experimental paradigms used required ignoring an irrelevant cue (e.g., semantic meaning, object similarity or object salience) in favour of the pragmatic one, it remained unclear whether these results were driven by attentional biases (i.e., more attention towards these types of cues or a preference over other types of cues) or by the activation of pragmatic reasoning per se (i.e., reasoning about speaker’s communicative intentions). To examine the latter hypothesis, we tested monolingual and bilingually exposed children aged 4 to 6 years old in two tasks using different types of prosodic cues for reference resolution of a novel word: contrastive stress (e.g., ‘Touch the WET gorp’) and emotional affect (e.g., ‘[sad tone] Oh look at the figoo, can you touch the figoo?’) where success did not rely on ignoring an irrelevant cue and could thus not be solely the result of better inhibitory control abilities.

We replicate previous findings that both adults and children are able to use negative affect to choose between damaged and enhanced referent for a novel label but young children around the age of five do not seem able to reliably make use of positive emotional affect for the same purposes (Berman et al., 2013). We demonstrate that prosodic stress does significantly modulate performance of a contrastive inference for novel word fast-mapping in children as well as in adults (an open question, cf. Kronmüller et al., 2014), with children appearing to be unable to reliably perform such an inference when the use of a contrastive modifier was not emphasised by contrastive stress. This is in line with previous work with adults demonstrating a facilitating effect of intonational focus for contrastive inference in referent resolution (Sedivy et al., 1999). We also find a gender difference, with males producing less pragmatic answers than females, an effect which has been documented before (Stiller et al., 2015).

We found bilingually exposed children to perform significantly better than expected in the contrastive stress task (i.e., close to monolingual performance despite being younger, with lower SES and vocabulary levels) but not in the emotional affect task (where the ability to overcome a negative bias was as expected from demographic variables in both groups). This indicates that
bilingual exposure enhances not only the attention to socio-pragmatic cues (as demonstrated in previous studies) but also the ability to reason about speaker’s communicative intentions in providing the cue. Indeed, the main difference between the two types of prosodic cues in our tasks was the following: while contrastive stress required pragmatic reasoning to be interpreted (since it had no intrinsic valence or meaning, i.e., the hearer will know that the modifier ‘wet’ has been emphasised but since there are two wet aliens this by itself will not be enough to resolve reference without asking why it was emphasised), emotional affect on the other hand intrinsically contained enough information for reference resolution by simple association (i.e., pairing negative emotion with negative event). As we have said, this can be related to Grice (1975)’s dichotomy between natural meanings and non natural meanings, the difference being the need to recognise a communicative intention. The absence of a number of significant effects found to impact performance in the first task (such as gender or SES) further emphasises that the two tasks involve different sets of skills. While the finding of a bilingual performance closer to control than monolinguals could be due to the former performing worse in control and at chance in the non stressed condition, we do not believe this is the case in the stressed condition, given that both bilingual and monolingual groups performed significantly above chance in this condition. Furthermore, a follow-up study on two ostensive teaching fast mapping tasks conducted with a different sample of children where SES and control performance were matched found bilingual children to display both a numerical and significant advantage (Lorge and Katsos, in prep.).

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