



## SHORT REPORT

# Bilingualism changes children's beliefs about what is innate

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### Abstract

Young children engage in essentialist reasoning about natural kinds, believing that many traits are innately determined. This study investigated whether personal experience with second language acquisition could alter children's essentialist biases. In a switched-at-birth paradigm, 5- and 6-year-old monolingual and simultaneous bilingual children expected that a baby's native language, an animal's vocalizations, and an animal's physical traits would match those of a birth rather than of an adoptive parent. We predicted that sequential bilingual children, who had been exposed to a new language after age 3, would show greater understanding that languages are learned. Surprisingly, sequential bilinguals showed reduced essentialist beliefs about all traits: they were significantly more likely than other children to believe that human language, animal vocalizations, and animal physical traits would be learned through experience rather than innately endowed. These findings suggest that bilingualism in the preschool years can profoundly change children's essentialist biases.

### Research highlights

- Young children show essentialist reasoning, believing that many traits are innately endowed.
- We compared monolingual, simultaneous bilingual, and sequential bilingual 5–6-year-olds.
- Sequential bilinguals were more likely than other children to believe that human and animal traits are acquired from the environment rather than inherited.
- Second language learning reduces children's essentialist biases.

### Introduction

Young children show essentialist biases in their reasoning, believing that observable similarities between members of natural categories arise due to innate, hidden properties that are fixed at birth (Gelman, 2003, 2004). Essentialist reasoning can be readily observed in a switched-at-birth paradigm. For example, 4- and 5-year-olds judge that a baby born to cow parents but raised by pigs will have a straight tail and moo like a cow when he grows up (Gelman & Wellman, 1991), and that a human baby born to parents with white skin but raised

by parents who have black skin will have white skin when she grows up (Hirschfeld, 1995).

While children's early essentialist beliefs can be congruent with reality, essentialism sometimes leads to erroneous beliefs (Heyman & Gelman, 2000). For example, monolingual 5-year-olds believe that human language is inherited, expecting that a baby born to English parents but raised since birth by Portuguese parents will grow up to speak English (Hirschfeld & Gelman, 1997). Children show similar essentialist reasoning about other traits that are not inborn, such as clothing preferences (Solomon, 2002), hobbies (Taylor, Rhodes & Gelman, 2009), and non-racial ethnic identity (Diesendruck, Birnbaum, Deeb & Segall, 2013). Further, although the specific content of essentialist beliefs varies with age and culture, essentialism is a highly pervasive reasoning bias that persists across development (Atran, Medin, Lynch, Vapnarsky, Ucan Ek & Sousa, 2001; Diesendruck *et al.*, 2013; Diesendruck & Haber, 2009; Gelman, Heyman & Legare, 2007; Solomon & Johnson, 2000; Waxman, Medin & Ross, 2007).

Is there any type of experience powerful enough to alter preschool children's essentialist biases? We hypothesized that personal experience that languages can be learned, an experience inherent to early sequential

bilingualism, might change children's essentialist beliefs about language. Language affords a particularly stringent test, as children show strong language-related social preferences from early in life (Kinzler, Corriveau & Harris, 2010; Kinzler, Dupoux & Spelke, 2007; Souza, Byers-Heinlein & Poulin-Dubois, 2013), and there is evidence that early essentialist beliefs about language are stronger than those about race (Kinzler & Dautel, 2011).

Using a switched-at-birth paradigm, we compared monolingual, simultaneous bilingual, and sequential bilingual 5- and 6-year-olds' beliefs about the heritability of human and animal traits. We predicted that sequential bilinguals would be more likely than other children to understand that human language is learned through experience, but that all children would expect other traits such as animal vocalizations and physical traits to be innate.

## Methods

### Participants

Participants were 48 5- and 6-year-old children (28 girls, 20 boys;  $M_{age} = 5.7$  years,  $SD_{age} = 0.4$  years) living in the Montreal area, who were recruited from a database of interested families, and from kindergarten classes at local private schools. Children's parents completed a modified version of the LEAP-Q (Language Experience and Proficiency Questionnaire; Marian, Blumenfeld & Kushanskaya, 2007), which assessed children's exposure to different languages and their proficiency in each language.

Participants were assigned to one of three groups – monolinguals, simultaneous bilinguals, and sequential bilinguals – based on how many languages they spoke, and their age of acquisition of each language. A sample size of 16 children per group was targeted prior to data collection, based on previous research using a similar paradigm (e.g. Kinzler & Dautel, 2011). Given evidence that autobiographical memory emerges between the ages of 1 and 5 (Nelson & Fivush, 2004), we reasoned that children who had acquired their language(s) before age 1 would be very unlikely to remember this experience (monolinguals and simultaneous bilinguals), but that children who had learned a new language at age 3 or older might have at least some implicit memory of language learning (sequential bilinguals). Because of the linguistic diversity of Montreal, a number of children in the bilingual groups were also exposed to a third language. However, we use the term *bilingual* consistently with Grosjean's (2010) definition of bilinguals as individuals who use two or more languages in their everyday lives.

Monolinguals had been exposed to either English or French from birth, and had no systematic exposure to any other language ( $N = 16$ ). Four monolinguals spoke English and 12 monolinguals spoke French.

Simultaneous bilinguals had regular exposure to both English and French that began within the first year of life, and had no exposure to another language after this age ( $N = 16$ ). Eight simultaneous bilinguals were English-dominant and eight were French-dominant. Simultaneous bilinguals had an average of 61% ( $SD = 11$ ) current exposure to their dominant language, and 33% ( $SD = 13$ ) exposure to their non-dominant language. These percentages do not add up to 100 because seven children had 10% or more current exposure to a third language, whose acquisition had begun within children's first year of life (i.e. these children were simultaneous trilinguals).

Sequential bilinguals had been regularly exposed to a new language beginning at age 3 or later, with an average age of exposure of 3.5 years ( $SD = .7$ ). They had an average of 61% ( $SD = 11$ ) current exposure to their first language, and 33% ( $SD = 12$ ) exposure to their new language. These percentages do not add up to 100 because eight children had 10% or more current exposure to a third language. The age of acquisition of this third language varied widely, from birth (e.g. children raised initially as simultaneous bilinguals who acquired a new language after age 3) to age 5 (e.g. children raised initially as monolinguals who acquired two new languages after age 3). Children were tested in their dominant language, 13 in English and three in French.

To ensure that children in the three groups would be able to understand the verbal information presented in the study, their comprehension proficiency in the language of testing was measured. Parents evaluated their children's proficiency in understanding on a scale of 0–10, where 0 is none, 5 is adequate, and 10 is perfect. Data on this question were not available for one monolingual and one simultaneous bilingual. Children in all three groups had very high reported levels of proficiency in the language of testing. Monolinguals averaged 9.3 ( $SD = 1.0$ ), simultaneous bilinguals averaged 9.7 ( $SD = .7$ ), and sequential bilinguals averaged 8.9 ( $SD = 1.6$ ). The proficiencies of the three groups did not differ significantly from each other,  $F(2, 43) = 1.50$ ,  $p = .24$ ,  $\eta^2 = .065$ .

An additional 10 children were tested but excluded from the final sample because their parents provided inconsistent or incomplete language background information (five children), they did not meet inclusion criteria for any of the groups (e.g. they were exposed to a second language after age 1 but before age 3; four children), or because they failed to understand the task (one child).

### Materials

Stimuli were photographs of human and animal couples paired with sound clips. Human couples included a male and female Caucasian adult. Animal couples included two animals of the same species (cats, ducks, pigs, cows, donkeys, lions, sheep, chickens, dogs, or owls). Sound clips of spoken language (human couples) and animal vocalizations (animal couples) were used to convey information about each couple. Human language clips were recordings of neutral sentences (e.g. 'I can wear sandals in the summer') either in the language of testing (English or French) or in a foreign language (Italian, Spanish, Serbian, Hindi, or Bulgarian). A different native language speaker produced each sentence. Animal vocalizations were recordings of real animals producing their characteristic vocalizations (e.g. a cow mooing, an owl hooting).

Stimuli were presented on a 15-inch laptop computer screen using PowerPoint. On each slide, two couples were shown simultaneously on the screen. When clicked in turn, the image of each couple pulsated slowly while the corresponding sound clip played, so that children could clearly identify which couple was paired with which sound clip. On slides with human couples, one vocalization was always in the language of testing, and the other was always in a foreign language, with speaker gender held constant within trials. The pairing between human couples and languages was counterbalanced across children.

### Procedure

Children were tested by a bilingual female experimenter who was highly proficient in both English and French, and who spoke to children in their preferred language. Testing took place in a quiet room in the lab or at the children's school. The study used a switched-at-birth paradigm (Hirschfeld & Gelman, 1997). The experimenter told children they would hear stories and see pictures, and that they had to listen carefully in order to answer questions about the stories at the end. Children first completed two unrelated practice trials that had them point to each side of the screen (e.g. 'This family likes to eat cookies, and this family likes to eat cake. If I made a chocolate cake, which family do you think would like to eat it?'). Children were then shown five human trials and five animal trials, presented in a blocked order such that the first block (human or animal) was counterbalanced across participants.

During each trial, the experimenter told a story about a baby (human or animal) who was adopted at birth, for example:

This is an English mommy and an English daddy; they talk like this [play English clip]. This is an Italian mommy and an Italian daddy; they talk like this [play Italian clip]. Now the English mommy and English daddy had a little baby named Nicole. Right after Nicole was born, she went to live with the other mommy and daddy, the Italian mommy and the Italian daddy. Nicole grew up with the Italian mommy and Italian daddy, and she never saw another English person.

The wording of trials was carefully chosen so that human and animal trials would be as similar as possible. Animal trials were identical to human trials, except that parents were described as, e.g. 'a mommy lion and a daddy lion', parents were said to 'sound like this' rather than 'talk like this', the baby, e.g. 'never saw another lion', and animal vocalizations were played rather than human language clips. The name of the adopted baby varied on each trial. The side on which the sound clip was played first (birth vs. adoptive parents) was counterbalanced across and within participants.

After the story, two control questions assessed whether children understood and remembered the story (e.g. 'Who gave birth to Nicole?' and 'Who raised Nicole?'). The children answered questions either verbally or by pointing to the corresponding image. If the children answered either control question incorrectly, they were retold the story, and the questions were repeated. Children's initial answers to the control questions were correct on 95% of trials, and no children required more than one retelling of the story.

Next, children were asked the key experimental questions. On both human trials and animal trials, children were asked how the adopted child/animal would speak/sound when he/she grew up (e.g. 'When Nicole grows up, will she talk/make sounds like this [play English clip/lion vocalization], or will she talk/make sounds like this [play Italian clip/donkey vocalization]?'). The sound clip presented first (birth vs. adoptive parents) was counterbalanced both within and across children. On animal trials only, children were also asked what physical trait the baby would have when he/she grew up (e.g. 'When Nicole grows up, will she have sharp claws or flat hooves?'). Physical traits included curly tail versus straight tail (cow-pig), fur versus feathers (cat-duck), sharp claws versus flat hooves (lion-donkey), fluffy wool versus feathers (sheep-chicken), and running versus flying (dog-owl). Physical traits questions were not included on human trials for two reasons. First, it was not expected that children's language background would influence their reasoning about physical traits. Second, unlike the animals, the depicted human couples did not vary systematically in their physical traits, and

thus it would have been unfeasible to include such a question.

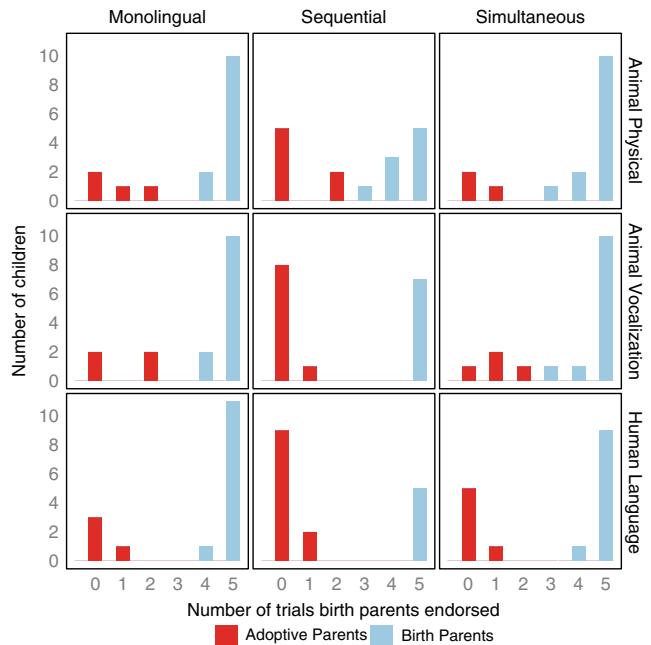
## Results

Children's responses were collapsed by group for each of the three traits: human language, animal vocalizations, and animal physical traits. For each trait, children were scored out of 5, reflecting the number of times they endorsed the birth parents as opposed to the adoptive parents. Thus, a high score reflected a belief that the trait is innate, while a low score reflected a belief that the trait is learned. Preliminary analyses indicated no effects of gender, trial order (human vs. animal first), or whether children in the bilingual groups were exposed to a third language,<sup>1</sup> so these factors were not included in subsequent analyses.

Figure 1 shows histograms of children's responses by group and trait. Because responses were not normally distributed, analyses examined both parametric *p*-values and non-parametric *p*-values obtained via permutation tests computed using the lmPerm package v1.1-2 (Wheeler, 2010) implemented in the R statistical language. Results obtained from these two approaches were similar, so only parametric values are reported.

A mixed between-within 3 (language background: monolinguals, simultaneous bilinguals, sequential bilinguals)  $\times$  3 (trait: human language, animal vocalizations, animal physical traits) ANOVA showed a near statistically significant main effect of language group,  $F(2, 90) = 3.72$ ,  $p = .051$ ,  $\eta^2 = .12$ . Post-hoc Fisher's LSD tests indicated that sequential bilinguals were significantly less likely than both monolinguals ( $p = .025$ ) and simultaneous bilinguals ( $p = .050$ ) to endorse the birth parents, but that monolinguals and simultaneous bilinguals did not differ significantly from each other ( $p = .76$ ). There was also a significant main effect of trait,  $F(1, 45) = 4.50$ ,  $p = .014$ ,  $\eta^2 = .091$ . Fisher's LSD tests showed that children were somewhat less likely to endorse the birth parents when asked about human language than when

<sup>1</sup> Several preliminary analyses were conducted to investigate potential effects of trilingualism. There was no significant effect of trilingualism when children's percent exposure to a third language was entered as a covariate in the omnibus ANOVA,  $F(1, 44) = .24$ ,  $p = .63$ . Similarly, when trilingual was treated as binary variable and included in the omnibus ANOVA, there was no significant main effect of trilingualism,  $F(1, 43) = .041$ ,  $p = .84$ , nor any interactions with the trilingualism factor,  $p > .5$ . Finally, *t*-tests performed on each trial type found no difference between children exposed to two or to three languages,  $p > .40$ . Based on these extensive analyses, we feel confident that exposure to a third language did not play an important role in children's performance in this study.



**Figure 1** Histograms illustrating the number of trials, out of five, on which children responded that a baby would grow up to display the characteristics of its birth parents rather than its adoptive parents. Data are displayed by language group (monolingual, simultaneous bilingual, and sequential bilingual) and trait (human language, animal vocalization, and animal physical traits). Bars are shaded as a function of children's predominant response (i.e. more frequently endorsing the adoptive or the birth parents).

asked about animal vocalizations ( $p = .049$ ) or about animal physical traits ( $p = .014$ ), but that their endorsements on animal vocalizations and animal physical traits did not differ ( $p = .33$ ). The interaction between trait and language background was not significant,  $F(1, 90) = 1.04$ ,  $p = .39$ ,  $\eta^2 = .044$ .

To directly investigate whether children showed essentialist reasoning, the number of times children endorsed the birth parents on each trait was compared to chance (2.5 out of 5 trials). The number of individual children (out of the 16 children per group) who endorsed the birth parents more often than the adoptive parents was also tallied. Under the binomial theorem, 12 or more children out of 16 showing more frequent endorsement of the birth parents would be significantly different from chance, and evidence for an essentialist bias.

Monolingual children endorsed the birth parents significantly more often than the adoptive parents on human language [ $M = 3.8$ ,  $SD = 2.1$ ,  $t(15) = 2.37$ ,  $p = .03$ ,  $d = .62$ ; 12/16 children], animal vocalizations [ $M = 3.9$ ,  $SD = 1.8$ ,  $t(15) = 3.02$ ,  $p = .009$ ,  $d = .78$ ; 12/16 children], and animal physical traits [ $M = 3.8$ ,  $SD = 1.90$ ,  $t(15) = 2.76$ ,  $p = .015$ ,  $d = .69$ ; 12/16 children].

Simultaneous bilingual children did not perform significantly differently from chance with regard to human language [ $M = 3.1$ ,  $SD = 2.4$ ,  $t(15) = 1.05$ ,  $p = .31$ ,  $d = .25$ ; 10/16 children], but endorsed the birth parents significantly more often than the adoptive parents with regard to animal vocalizations [ $M = 3.8$ ,  $SD = 1.8$ ,  $t(15) = 2.92$ ,  $p = .011$ ,  $d = .89$ ; 12/16 children] and animal physical traits [ $M = 3.9$ ,  $SD = 1.9$ ,  $t(15) = 2.96$ ,  $p = .01$ ,  $d = .74$ ; 12/16 children].

Sequential bilingual children's behavior was not different from chance with respect to human language [ $M = 1.7$ ,  $SD = 2.3$ ,  $t(15) = -1.40$ ,  $p = .18$ ,  $d = -.35$ ; 5/16 children], animal vocalizations [ $M = 2.3$ ,  $SD = 2.5$ ,  $t(15) = -.40$ ,  $p = .70$ ,  $d = -.080$ ; 7/16 children], or animal physical traits [ $M = 2.8$ ,  $SD = 2.1$ ,  $t(15) = .47$ ,  $p = .64$ ,  $d = .12$ ; 9/16 children].

Finally, Pearson's correlations were computed between children's responses on different traits to examine the extent to which their beliefs cohered, that is whether children who believed that one trait was innate were likely to believe that another trait was innate. Table 1 displays correlations computed within each group, as well as across all children. Correlations were very high, ranging from .57 to .94,  $p < .05$ , indicating that individual children's responses were highly consistent across traits.

## Discussion

Previous research has suggested that children show pervasive essentialist reasoning about many natural categories, believing that physical and behavioral traits are innately endowed rather than learned from the environment. The current study examined whether sequential bilingual children – who have the experience of learning a new language from their environment – differ from monolinguals and simultaneous bilinguals in their beliefs about the innateness of such traits.

Five- and 6-year-old monolinguals and simultaneous bilinguals expected traits to be innate, replicating previous findings (e.g. Gelman & Wellman, 1991; Hirschfeld & Gelman, 1997). Both groups claimed that a baby born to duck parents and adopted by cats would quack and grow feathers, and monolinguals claimed that a baby born to English parents and adopted by Italian parents would grow up to speak English. We predicted that sequential bilinguals would better understand that human languages are learned, but like other children they would expect animal vocalizations and physical traits to be innate. Surprisingly, sequential bilingualism had a generalized effect on children's essentialist beliefs: sequential bilinguals were more likely than other children

**Table 1** Correlations between children's responses on different traits

All children	Human language	Animal vocalization	Animal physical
Human language	–	.77**	.71**
Animal vocalization		–	.84**
Animal physical			–
Monolinguals			
Human language	–	.94**	.93**
Animal vocalization		–	.93**
Animal physical			–
Simultaneous bilinguals			
Human language	–	.73**	.57*
Animal vocalization		–	.78**
Animal physical			–
Sequential bilinguals			
Human language	–	.61*	.62**
Animal vocalizations		–	.83**
Animal physical			–

Note \* $p < .05$ ; \*\* $p < .01$ .

to believe that human language, animal vocalizations, and animal physical traits are learned from the environment rather than innately endowed. These results provide a striking demonstration that everyday experience in one domain – language learning – can alter children's beliefs about a wide range of domains, reducing children's essentialist biases.

It is relevant to consider what specific aspect of bilingual children's experience affected their beliefs. Unlike monolinguals, neither simultaneous nor sequential bilinguals reliably responded that human language is innate. This raises the possibility that bilingualism, whether simultaneous or sequential, could have a circumscribed influence on essentialist reasoning about human language. On the other hand, omnibus analyses revealed an overall difference between sequential and simultaneous bilinguals' essentialist beliefs, and only sequential bilinguals showed reduced essentialist beliefs about animal vocalizations and physical traits. This indicates that reduced essentialism in sequential bilinguals stems, at least in part, from experience unshared with simultaneous bilinguals. We propose that sequential bilingual children's personal, everyday experience with acquiring a new language alters their beliefs about the heritability of human and animal traits. However, another complementary possibility is that caregivers of bilingual children discuss language acquisition with their children more often than parents of

other children, which could also lead to belief change. Future research is needed to test each of these possibilities.

Interestingly, not all sequential bilingual children believed that traits are acquired from the environment: a minority showed essentialist reasoning. Children's beliefs were nonetheless coherent and positively correlated across different traits (see also Gelman *et al.*, 2007, for contrasting results). An important direction for future research will be to further understand how individual differences play out across different components of early essentialism, for example by investigating children's beliefs about heritability in conjunction with their inductive inferences about natural categories (Gelman & Markman, 1986, 1987).

The current study contributes to mounting evidence that early bilingualism systematically alters children's cognition. Previous studies have linked bilingualism to advantages in executive functioning, metalinguistic awareness, and theory of mind (Akhtar & Menjivar, 2012; Bialystok, Craik & Luk, 2012). Uniquely, our results demonstrate that bilingualism can also affect children's naïve theories.

Because our main findings were unexpected, they raise several important considerations for future research. First, our study did not test children's beliefs about the heritability of human physical traits. Future studies could investigate sequential bilinguals' essentialist beliefs about a wider variety of traits, including human physical traits. Second, while we counterbalanced whether children encountered the animal trials or the human trials first, within the animal trials the vocalization question always preceded the traits question. Future studies should counterbalance all question types. Third, our bilingual groups included both children exposed to two and to three languages. While our analyses did not find any effect of trilingualism, some previous research has found developmental differences between these two groups (Byers-Heinlein & Werker, 2009). Future work could directly compare samples of bilingual and trilingual children to better understand how different types of multilingual experience affect essentialist beliefs. Fourth, given the unexpectedly pervasive influence of second language learning on essentialist beliefs, future studies of essentialism will need to more carefully consider participants' language background. For example, Israeli children (Jewish and Arab) who attended ethnically integrated schools had reduced essentialist beliefs about ethnicity compared to children who attended mono-cultural schools (Deeb, Segall, Birnbaum, Ben-Eliyahu & Diesendruck, 2011). While the results were interpreted in terms of children's exposure to different ethnicities, our findings raise the

possibility that second language experience at the integrated schools (where instruction was provided in both Hebrew and Arabic) might have also affected children's essentialist beliefs.<sup>2</sup>

Finally, understanding the development and malleability of essentialism has important social implications (Rothbart & Taylor, 1992). Research has shown that adults who hold stronger essentialist beliefs are more likely to endorse stereotypes (Bastian & Haslam, 2006) and prejudiced attitudes (Haslam, Rothschild & Ernst, 2002). Our finding that bilingualism reduces essentialist beliefs raises the possibility that early second language education could be used to promote the acceptance of human social and physical diversity.

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<sup>2</sup> We thank an anonymous reviewer for this suggestion.

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