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Sign language, like spoken language, promotes object categorization in young hearing infants

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ABSTRACT

The link between language and cognition is unique to our species and emerges early in infancy. Here, we provide the first evidence that this precocious language-cognition link is not limited to spoken language, but is instead sufficiently broad to include sign language, a language presented in the visual modality. Four- to six-month-old hearing infants, never before exposed to sign language, were familiarized to a series of category exemplars, each presented by a woman who either signed in American Sign Language (ASL) while pointing and gazing toward the objects, or pointed and gazed without language (control). At test, infants viewed two images: one, a new member of the now-familiar category; and the other, a member of an entirely new category. Four-month-old infants who observed ASL distinguished between the two test objects, indicating that they had successfully formed the object category; they were as successful as age-mates who listened to their native (spoken) language. Moreover, it was specifically the *linguistic* elements of sign language that drove this facilitative effect: infants in the control condition, who observed the woman only pointing and gazing failed to form object categories. Finally, the cognitive advantages of observing ASL quickly narrow in hearing infants: by 5- to 6-months, watching ASL no longer supports categorization, although listening to their native spoken language continues to do so. Together, these findings illuminate the breadth of infants' early link between language and cognition and offer insight into how it unfolds.

1. Introduction

Questions concerning the power and precision of the relation between human language and cognition are especially fascinating when approached from a developmental perspective: how, and how early, are language and cognition linked in the infant mind?

We know that infants as young as 3- and 4-months of age have already begun to build a link between human language and core cognitive processes (Ferguson & Lew-Williams, 2016; Ferry, Hespos, & Waxman, 2010, 2013). Evidence for this precocious link comes from a now-standard object categorization task that holds constant the objects infants view during a familiarization phase while systematically manipulating the acoustic information presented with these objects (see Fig. 1a) (Balaban & Waxman, 1997; Ferry et al., 2010, 2013; Fulkerson & Waxman, 2007; Perszyk & Waxman, 2019). In the task, infants are familiarized to a series of objects from a single category (e.g., fish). If infants detect the category-based commonalities among the familiarization objects, then during a test phase they should distinguish between a novel member of a novel-category (a dinosaur), and a novel member of the now-familiar-category (a new fish) (Aslin, 2007). For 3- and 4-month-old infants, listening to their native language during familiarization supports object categorization, and does so in a way that carefully-matched non-linguistic acoustic signals (sine-wave tone sequences, backward speech) do not (Ferry et al., 2010, 2013). Thus, this link between language and object categorization, which will ultimately serve as a foundation for acquiring meaning, is in place early enough to support infants' rapid acquisition of words, concepts, and the relations between them (Perszyk & Waxman, 2018; Yeung & Werker, 2009).

However, because investigations of this early language-cognition link have thus far examined infants' responses only to *acoustic* signals,

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a fundamental question remains unaddressed. Is this link reserved exclusively for language presented in the acoustic modality? Or is it sufficiently abstract to include language *writ large*, including sign language presented in the visual modality?

To address this, we modified the object categorization paradigm by pairing familiarization objects with sign language presented exclusively in the *visual*, rather than *auditory,* channel (See Fig. 1b). We tested 4- to 6-month-old hearing infants, who had not previously been exposed to sign language. We reason as follows: If infants' initial language-cognition link is reserved specifically for spoken language, then infants observing sign language should fail to form object categories. But if infants' initial link is sufficiently broad to include all human languages, then infants observing sign language, like those listening to spoken language, should successfully form object categories.

There is reason to suspect that hearing infants may indeed initially link any language – be it spoken or signed – to cognition. At birth, infants are prepared to acquire any human language, whether in the visual or auditory modality (Bavelier, Newport, & Supalla, 2003; Meier & Newport, 1990; Petitto, Holowka, Sergio, Levy, & Ostry, 2004; Pichler, 2011). Within the first six months, hearing infants who have had no exposure to sign language are sensitive to its linguistic features (Baker, Idsardi, Golinkoff, & Petitto, 2005; Palmer, Fais, Golinkoff, & Werker, 2012; Stone, Petitto, & Bosworth, 2018). Moreover, at 6 months, hearing infants successfully distinguish linguistic signing from non-linguistic hand gestures; within months, their sensitivity to the distinction wanes (Krentz & Corina, 2008). This developmental narrowing mirrors the narrowing observed as infants tune to the specific linguistic features of their native spoken language(s) (Kuhl & Rivera-Gaxiola, 2008; Maurer & Werker, 2014; Shultz, Vouloumanos, Bennett, & Pelphrey, 2014; Werker & Tees, 1984).

These findings, interesting in themselves, raise an intriguing new question: Does infants' sensitivity to the linguistic elements of sign language have downstream cognitive consequences, as evidenced in spoken languages (Ferry et al., 2010; Fulkerson & Waxman, 2007)? That is, do infants with no prior exposure to sign language successfully form object categories in the context of observing sign language? If observing sign language does indeed boost infant object categorization, it will be important to identify the developmental trajectory of this link and to ascertain whether this boost is driven by the *linguistic* elements of sign language per se (handshape, movement location, orientation, and non-manual behaviors, including mouth gestures and mouthing, Brentari, 1998, 2019, and references therein), or by *extra-linguistic* communicative cues, such as pointing and eye gaze, cues that naturally accompany both spoken and sign languages (Cooperrider, Fenlon, Keane, Brentari, & Goldin-Meadow, 2021; Emmorey, 1999; Fenlon, Cooperrider, Keane, Brentari, & Goldin-Meadow, 2019; Goldin-Meadow & Brentari, 2017).

To address these questions, we compared infants' categorization performance in a Sign Language condition with performance in a Non-linguistic control condition. In the Sign Language condition, infants saw a native signer point to an object and refer to it using a sign label. In the Non-linguistic control condition, the same signer used only a point and gaze shift to the object. If linguistic information in ASL is instrumental to infants' (hypothesized) success, then infants in the Sign Language condition should successfully form object categories, but those in the Non-linguistic Control condition should not.

2. Materials and methods

2.1. Participants

113 full term hearing infants ranging from 3.98–6.99 months were assigned randomly to either the Sign Language Condition (n = 57, 29 females, M_{age} = 5.4 months; 20 four-month-olds, 20 five-month-olds, 17 six-month-olds) or the Non-Linguistic Control Condition (n = 56, 22 females, M_{age} = 5.4 months; 20 four-month-olds, 20 five-month-olds, 16 six-month-olds). Twenty-one additional infants (12 in Sign Language condition, 9 in Control condition) were tested but then excluded due to fussiness (3 in Sign Language, 4 in Control); insufficient attention during familiarization (less than 2 SD from the mean: 2 in Sign Language, 2 in Control); looking to only one test object: (1 in Control), or equipment malfunction (7 in Sign Language, 2 in Control). Families received either $10 or a book and t-shirt for participation. Participants were from predominantly white, college-educated middle-class families.

2.2. Stimuli

2.2.1. Familiarization

Familiarization stimuli included 8 line-drawn images of either

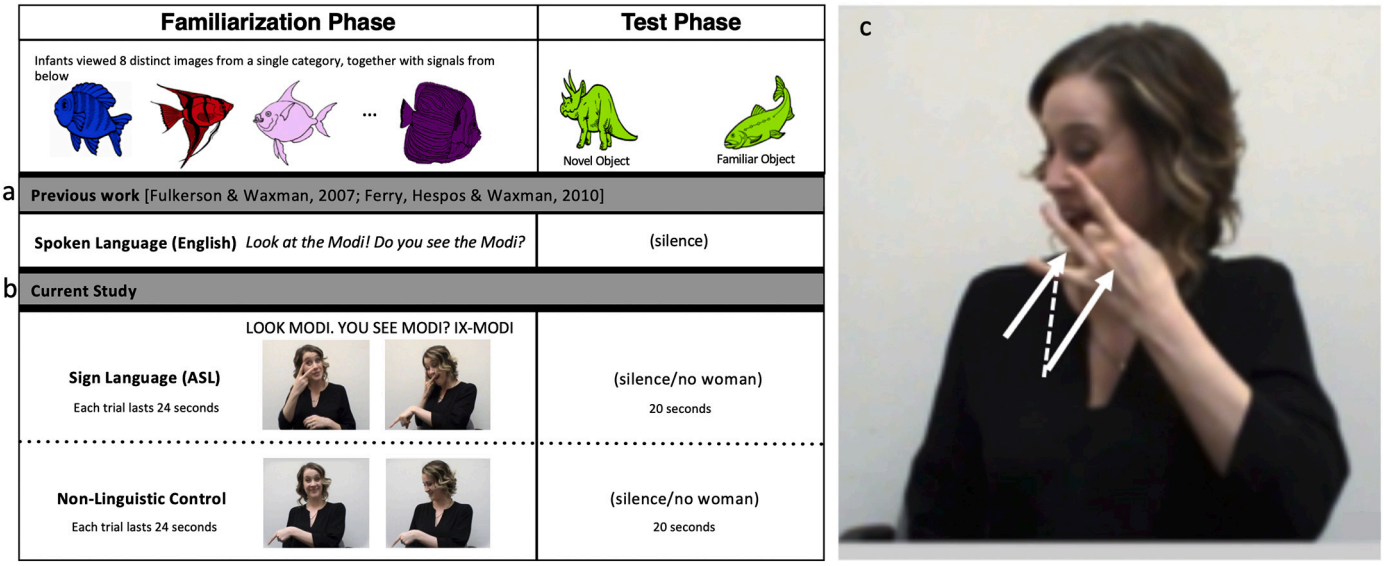

Fig. 1. Stimuli and design for all conditions. During Familiarization, infants viewed eight distinct visual images, presented sequentially. In previous work, *a,* (Ferry et al., 2010; Ferry et al., 2013), each image was accompanied by spoken English. In the current study, *b*, each image was accompanied by a woman who either produced ASL while pointing and gazing between the infant and the object (Sign Language condition) or produced only pointing and eye gaze cues (Non-Linguistic Control). The Pseudo-ASL sign for MODI is shown in *c*. Test trials were identical in all conditions. At test each infant viewed two images simultaneously in silence and with no woman present: a member of a novel category, and a novel member of the familiar category.

dinosaurs or fish. In each trial, a single image (e.g., a fish) appeared on the bottom right or left of the screen and a hearing native signer appeared in the center, clapping her hands to attract the infants' attention. From this point onward, the woman's activity varied as a function of condition. In the Sign Language condition, she produced a full comprehensive sign language phrase, using infant-directed ASL. She signed the phrase, "LOOK MODI YOU SEE MODI?", producing a pseudo-sign equivalent for MODI, shown in Fig. 1c. The pseudo-sign was a phototactically well-formed ASL noun (Supalla & Newport, 1978). It consisted of two short, straight movements with contact at the cheek, and with a single handshape throughout, in this case the "8"-handshape. While signing this phrase she glanced between the infant and object, and pointed to the object. The signer also produced mouth postures characteristic of ASL (these differ importantly from the silent mouthing of hearing speakers). This was intentional: Mouthing is inherent to sign language and is especially prominent in infant-directed signing (Masataka, 2000; Reilly & Bellugi, 1996). Indeed, non-manual behavior (phonological material on the face and body) is one of five parameters of sign language (other parameters are handshape, palm orientation, movement, and location) (Boyes Braem & Sutton-Spence, 2001; Brentari, 1998, 2019). In the Non-linguistic control condition, the woman pointed at the object and shifted her gaze as in the Sign Language condition, but did not produce any manual ASL signs, nor did she produce the accompanying mouth postures. For both conditions, the communicative episodes occurred twice within each 24 s familiarization trial. Examples can be viewed at https://osf.io/wzsj3/.

2.2.2. Test

The test trial was identical to that used in prior work using this categorization task (Ferry et al., 2010, 2013; Fulkerson & Waxman, 2007). Infants in both conditions viewed two static novel images: one new image from the now-familiar category, and one image from the novel category. These images appeared side-by-side in silence for 20s; the woman was not present (See Fig. 1). Test trials lasted for 20s to give infants sufficient time to provide at least 10 s of looking.

2.3. Procedure

Infants sat on their caregiver's lap facing a large screen; a hidden video-camera recorded infants' eye movements. Caregivers wore opaque glasses and were instructed not to interact with their infants. Infants viewed a familiarization phase, followed by a test phase. The familiarization phase included eight trials. The familiarization category (fish, dinosaur) and side of first familiarization exemplar (right/left), as well as the location of novel and familiar images at test (right/left) were counterbalanced, resulting in eight unique orders.

2.4. Coding and analyses

Videos of infant attention were coded frame-by-frame by trained coders blind to the hypothesis and infants' age. On familiarization trials, coders determined whether infants were looking at the object or the woman. On test trials, coders determined whether infants were looking to the right or left object. As in all prior work using this method (Ferguson & Waxman, 2016; Ferry et al., 2010, 2013; Fulkerson & Waxman, 2007; Perszyk & Waxman, 2019; Woodruff Carr, Perszyk, & Waxman, 2021), we computed a novelty preference score for each infant (accumulated time looking to the novel test object / total accumulated time looking to both the novel and familiar test objects), calculated over infants' first 10 s of looking during test. For reliability, 23% of videos were re-coded; reliability was high during familiarization (proportion of looking to woman, Pearson's $r = 0.85$, $p < .001$, or object, Pearson's $r = 0.88$, $p < .001$) and test (novelty preference, Pearson's $r = 0.90$, $p < .001$).

Successful categorization was determined using two-tailed, one-sample *t*-tests comparing group-level novelty preferences against chance (0.5). Because preliminary analyses revealed no reliable effects of familiarization category, test image R/L position, or participant gender (all *p*'s > 0.3), further analyses collapsed across these factors. All statistical tests were conducted on arcsine root transformations of proportions, but figures and text present raw means for clarity. Comparisons between data from the current study and prior studies (Ferry et al., 2010; Fulkerson & Waxman, 2007) used Welch 2-sample t-tests to account for cross-experimental differences in sample size and standard deviation (Delacre, Lakens, & Leys, 2017).

3. Results

Infants were highly engaged in the task. Despite the fact that the Sign language condition incorporated more complex actions than the control condition, there were no reliable differences in infants' attention during familiarization as a function of condition ($M_{ASL} = 0.73$, SD =0.12; $M_{control} = 0.76$, SD =0.09, $\beta = 0.02$, SE = 0.02, $p = .37$) nor any effects of age ($\beta = 0.02$, SE = 0.01, $p = .25$). During familiarization, infants successfully divided their visual attention between the woman ($M_{ASL} = 0.59$, SD =0.08; $M_{control} = 0.59$, SD =0.10) and the familiarization objects ($M_{ASL} = 0.41$, SD =0.08; $M_{control} = 0.41$, SD =0.10). Here however, there was an effect of age ($\beta = 0.07$, SE = 0.01, $p < .001$). In both conditions, infants' attention to the woman increased (and consequently, their attention to the objects decreased) as they got older..[1] During test, there was also no difference across conditions in infants' total duration of attention.[2]

Infants' novelty preferences at test provide support for the prediction that infants' initial link to cognition is indeed sufficiently abstract to include sign language. A linear regression predicting infants' novelty-preferences revealed a significant effect of condition ($M_{ASL} = 0.52$, SD = 0.15; $M_{Control} = 0.50$, SD =0.16, $\beta = 0.49$, SE = 0.19, $p = .01$). Importantly, this main effect was qualified by a significant condition by age interaction ($\beta = 0.08$, SE = 0.03, $p = .01$) (See Fig. 2). There was no main effect of age: ($\beta = 0.02$, SE = 0.02, $p = .34$).[3] Following up on the interaction, we observed a significant, negative effect of age within the Sign Language Condition ($\beta = -0.06$, SE = 0.02, $p = .01$), but no effect of age in the Control condition ($\beta = 0.02$, SE = 0.02, $p = .34$).

Next, to permit comparisons to chance and to prior work, we divided infants into discrete age groups: 4-month-olds (age 3.98–4.99 month), 5-month-olds (5.0–5.99 months), and 6-month-olds (6.0–6.99 months) (See Fig. 3). In line with the prediction that infants' earliest link between language and cognition is *not* reserved exclusively for language presented in the acoustic modality, at 4 months, infants in the Sign Language condition displayed a significant preference for the novel test object ($M_{4\text{-ASL}} = 0.60$, SD = 0.15, $t(19) = 3.01$, $p = .007$, d = 0.67). Their novelty preference significantly exceeded that of 4-month-olds in the Non-linguistic Control condition ($M_{4\text{-control}} = 0.50$, SD = 0.19, $t(38) = 1.99$, $p = .05$, d = 0.63), who performed at chance ($t(19) = 0.37$, $p = .71$, d = 0.02). This pattern demonstrates that, at 4-months, infants in the

[1] Infants' attention in familiarization did not predict their novelty preferences at test (either for total looking during familiarization, $p = .85$, or for looking specifically to the objects during familiarization, $p = .31$).

[2] This was the case when calculated over the entire 20 s test phase ($M_{ASL} = 13.31$ s, SD = 3.64; $M_{Control} = 13.37$ s, SD =3.62, $p = .98$) and for the first 10 s of accumulated looking ($M_{ASL} = 9.6$ s, SD = 1.8; $M_{Control} = 9.73$ s, SD =0.69, $p = .49$)

[3] An analysis of infants' novelty preference across the entire 20 s test phase yielded the same pattern of results: there was no significant main effect of age ($\beta = 0.02$, SE = 0.02, $p = .38$), but there was a significant effect of condition ($\beta = 0.47$, SE = 0.19, $p = .02$), qualified by a significant age by condition interaction ($\beta = 0.08$, SE = 0.03, $p = .02$). We chose to focus our main analysis on the novelty preference scores from the first 10 s of looking, rather than the full 20 s segment, in order to be consistent with prior research using this method (e.g., Ferguson & Waxman, 2016; Ferry et al., 2010, 2013; Fulkerson & Waxman, 2007; Perszyk & Waxman, 2019; Woodruff Carr et al., 2021)

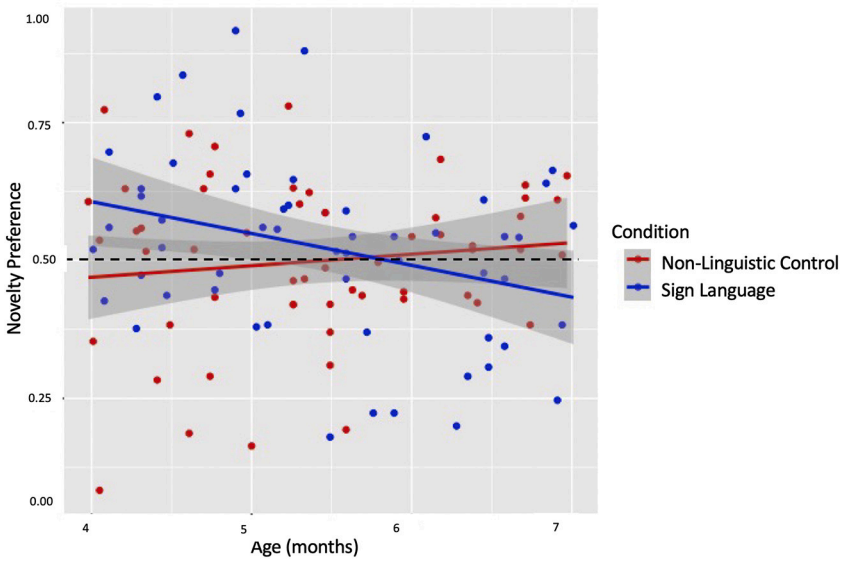

Fig. 2. Raw novelty-preference scores for each infant. 0.50 (dotted line) indicates chance performance.

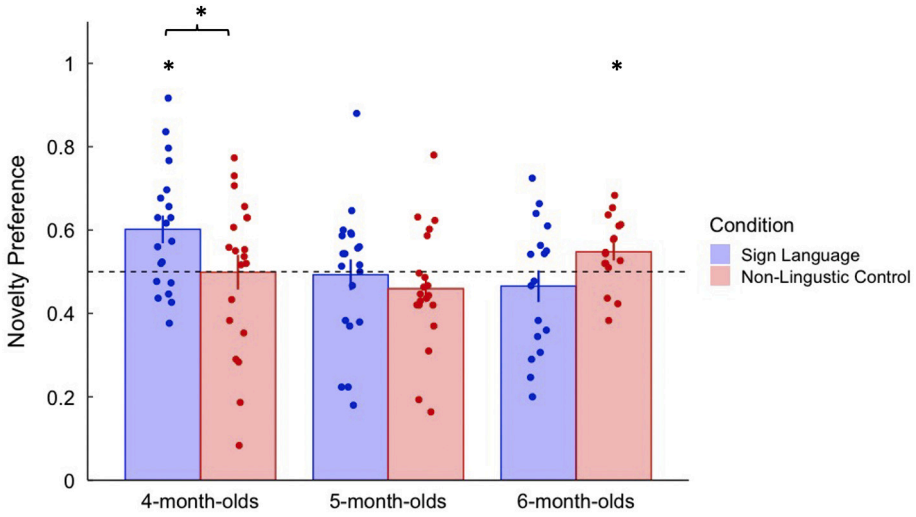

Fig. 3. Novelty Preference binned by age group and condition. Error bars represent ±1 SEM. Dotted line indicates chance performance and values above the dotted line indicate successful categorization. Asterisks indicate conditions in which novelty preferences are significantly above chance or in which novelty preferences are significantly different between conditions ($p < .05$).

Sign Language, but not Control, condition successfully formed the object category. Moreover, a subsequent analysis comparing infants in the Sign Language condition to previous work (Ferry et al., 2010) revealed that 4-month-olds formed object categories as successfully when observing ASL as when listening to their native spoken language (i.e., English) ($M_{4\text{-English}} = 0.64$, SD = 0.22, English vs. ASL: $t(15.90) = 0.71$, $p = .49$, hedge's g = 0.25).

Also as predicted on the basis of previous results, the cognitive advantage of observing sign language was short-lived. At 5 and 6 months, object categorization in the Sign Language condition did not differ from chance levels, ($M_{5\text{-ASL}} = 0.49$, SD = 0.19; $M_{6\text{-ASL}} = 0.47$, SD = 0.15), ($ts < 1$, $ps > 0.36$, d's < 0.22). At both ages, infants' novelty-preferences were significantly lower than those of 4-month-olds (4 vs 5: $t(38) = 2.18$, $p = .03$, d = 0.69; 4 vs 6: $t(35) = 2.73$, $p = .009$, d = 0.90). In a subsequent analysis, we compared 6-month-old infants observing ASL (here) to those listening to their native spoken English (reported in Fulkerson & Waxman, 2007). Infants observing ASL at 6 months were significantly less successful than those listening to spoken English ($M_{6\text{- English}} = 0.63$, SD = 0.19, English vs. ASL: $t(45.72) = 3.37$, $p = .002$, hedges g = 0.99.

Finally, infants in the Non-linguistic Control condition revealed a different developmental pattern from those in the Sign Language condition. At 5 months, like infants at 4 months, infants in the Non-linguistic Control condition performed at chance levels ($M_{5\text{-control}} = 0.46$, SD = 0.14, $t(19) = 1.25$, $p = .22$, d = 0.28), 4 vs 5: $t(38) = 0.51$, $p = .66$, d = 0.21). This pattern suggests that pointing and eye gaze do not, in the absence of linguistic information, support infant categorization. At 6 months, infants in the Control condition did exhibit a significant novelty preference ($M = 0.55$, SD = 0.08, $t(15) = 2.27$, $p = .04$, d = 0.57). However, this result must be interpreted with caution for several reasons. First, there was no reliable difference between 6-month-olds' performance in the Control condition and their (null) performance in the Sign Language condition ($t(31) = 1.87$, $p = .07$, d = 0.65). Second, a subsequent analysis revealed that 6-month-olds in the Control condition (reported here) were significantly less successful than 6-month-olds who listened to spoken English, $t(41.627) = 2.35$, $p = .02$, hedges g = 0.71) (data from Fulkerson & Waxman, 2007). Third, performance in the current Control condition showed no variation as a function of age as a

continuous measure ($\beta = 0.02$, SE = 0.02, $p = .34$).

4. Discussion

The current findings provide new insight into the initial breadth and increasing precision of infants' precocious link between language and the core cognitive capacity of object categorization. First, we discovered that infants' earliest link is sufficiently broad to include language presented exclusively in the visual modality. At 4 months, hearing infants – who had not previously been exposed to sign language – successfully formed object categories when images were presented in conjunction with ASL. Their success mirrored precisely the cognitive advantage conferred by listening to spoken English, their native language (Ferry et al., 2010). This constitutes the first evidence that infants' initial link between language and the fundamental cognitive capacity of object categorization is not constrained to spoken languages alone.

Second, we document that for hearing infants not exposed to sign language, the cognitive advantage conferred by ASL wanes between 4 and 6 months: In contrast to 4-month-olds, who successfully formed object categories in the Sign Language condition, infants at 5 and 6 months of age performed at chance levels. This outcome converges well with evidence that infants rapidly narrow the range of signals they will link to cognition (Ferry et al., 2013; Perszyk & Waxman, 2019). In future work, it will be important to assess whether observing sign language (like listening to their native spoken language) supports object categorization in younger infants (Ferry et al., 2010).

Third, we discovered that the cognitive advantage conferred by observing sign language at 4 months cannot be attributed to communicative signals, like pointing and eye gaze, alone. Although pointing and eye gaze are ubiquitous in infants' communicative environments, and are often produced in conjunction with spoken language (Bornstein, Tamis-LeMonda, Hahn, & Haynes, 2008; Carpenter, Nagell, Tomasello, Butterworth, & Moore, 1998; Conboy, Brooks, Meltzoff, & Kuhl, 2015; Rowe & Goldin-Meadow, 2009; Tomasello & Farrar, 1986), they did not, on their own, support object categorization. Only when produced in conjunction with linguistic information in ASL, and only at 4 months, did infants categorize successfully.

This outcome suggests that pointing, eye gaze, and language – all of which have been described as natural pedagogical cues (Csibra & Gergely, 2006, 2009; Csibra & Shamsudheen, 2015; Futó, Téglás, Csibra, & Gergely, 2010; Hernik & Csibra, 2015; Marno, Davelaar, & Csibra, 2014, 2016; Yoon, Johnson, & Csibra, 2008) – do not share equal status in supporting infant cognition. Neither do they all follow the same developmental path in the first months of life. Here, we document that, at 4 months, language (either spoken or signed) supports object categorization, and does so in a way that other pedagogical cues (pointing and eye gaze) do not. Moreover, we have shown here that between 4- and 6-months, hearing infants' responses to linguistic cues inherent in sign language traverse a different developmental path than their responses to the pedagogical cues found in pointing and eye gaze.

Additional work is required to specify more precisely which cues in ASL are instrumental in supporting infant cognition at which age(s). For example, it will be important to clarify the developmental fate of cues like pointing and eye gaze, both of which are used in ASL, on infant cognition. It will also be important to investigate the effect of the ASL mouthing postures, present in the Sign Language condition, but not in the Control condition. Mouthing postures, which are integral to sign languages (Boyes Braem & Sutton-Spence, 2001) and particularly salient in infant-directed signing (Masataka, 2000; Reilly & Bellugi, 1996), are produced only in conjunction with signing. For this reason, mouthing postures were absent in our Non-linguistic Control condition. This design feature permitted us to conclude that pointing and eye gaze, in the absence of linguistic information, were not sufficient to support object categorization.

What remains unresolved is the role, if any, that mouthing contributed to infants' performance in the ASL condition. These mouth postures, like others inherent in sign languages, differ from the mouth movements we produce when whispering a spoken language or producing it silently insofar as selected postures of each syllable are produced, not the whole word (Boyes Braem & Sutton-Spence, 2001). Nonetheless, there is considerable evidence that, at both 4 and 6 months, infants acquiring spoken languages rely upon visual speech information – information produced by the mouth – to process speech sounds (Patterson & Werker, 1999) and to discriminate among spoken languages (Weikum et al., 2007). If mouth movements are themselves generally sufficient to support infants' categorization, then infants at all ages should have succeeded in the Sign Language condition. Instead, only 4-month-old infants succeeded, suggesting that the mouthing postures of sign languages affect hearing infants differently than the mouthing gestures of spoken languages. This outcome may serve as a starting point for future investigations designed to assess which parameters of language, be they signed or spoken, are instrumental in engaging infants' cognition.

The current results amplify our understanding of the breadth of infants' earliest link to cognition and how it is tuned. At 3 and 4 months, language is not the only signal that supports infant cognition: listening to lemur vocalizations also promotes object categorization (Ferry et al., 2013). But by 6 months, infants have severed this link. Yet, if infants are exposed systematically to lemur vocalizations between 4 and 6 months, then lemur calls continue to support categorization at 6 months (Perszyk & Waxman, 2016). We expect that exposing hearing infants to ASL during this developmental window would have an equally powerful effect, permitting them to maintain the link between ASL and cognition. In future work, it will be important to specify how much exposure to sign language (compared to lemur calls) is required and whether the amount varies as a function of development.

It will also be important to consider how infants' perceptual tuning to their native language influences the developmental fate of non-native languages and their link to cognition. For hearing infants, the first year represents a period of rapid perceptual tuning to the sounds of their native language(s) (Werker, 2018), and this attunement is especially sensitive to rhythmic and other prosodic properties of spoken language (Gervain & Mehler, 2010). Moreover, this perceptual tuning has downstream cognitive consequences that extend beyond speech perception alone, setting constraints on *which* human languages infants will link to core cognitive capacities. Perszyk and Waxman (2019) demonstrated this by comparing English-acquiring infants' object categorization in the context of listening to two non-native languages: German (a language that shares rhythmic and prosodic properties with English) and Cantonese (a language that differs considerably from English in these suprasegmental properties). At 3 and 4 months, English-acquiring infants listening to German successfully formed object categories, but those listening to Cantonese did not.

The evidence reported here offers new insight into the process by which infants' early language-cognition is tuned. Because sign language does not engage infants' speech processing, it should not be subject to the same downstream constraints as those observed for non-native spoken languages. English-acquiring, four-month-old infants' success while observing Sign Language, but not while of listening to Cantonese Perzyk and Waxman (2019), is consistent with this prediction. This suggests that the downstream consequences of perceptual tuning on the language-cognition link may be modality specific.

What remains unknown is whether perceptual tuning among sign languages also has downstream consequences for their links to cognition. Consider young infants acquiring ASL. Are they more likely to retain a link to cognition when observing French Sign Language (a nonnative sign language that is historically linked to ASL, (Frishberg, 1975) than British Sign Language (a nonnative sign language that has no historical ties to ASL, (Sutton-Spence & Woll, 1999)? Resolving such questions, which require tracing infants acquiring sign language from birth, should clarify the developmental processes by which infants increasingly specify *which* human languages they consider as candidate links to cognition.

5. Conclusions

In sum, the current evidence illuminates, for the first time, the power of language – be it spoken or signed – on the core cognitive capacity of object categorization in very young infants. This work offers an intriguing glimpse into how linguistic visual communicative cues evolve in infants' first six months of life.

Declaration of Competing Interest

None.

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