

From visual language experience to lexical processing: The role of cognitive abilities in sign lexical decision performance

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Sign languages are both linguistic and visual-spatial, requiring encoding visuospatial information into linguistic representations. This process may recruit general cognitive abilities differently from spoken or written language, thereby providing a unique opportunity to explore how general cognitive abilities contribute to language processing. The present study investigated the relationship between sign language experience, general cognitive abilities, and language-related processes; specifically, we looked at how these cognitive and language measures predicted accuracy in a sign lexical decision task.

Three groups hearing native Spanish speakers with varying levels of Spanish Sign Language (LSE) knowledge — 25 native signers, 22 L2 signers, and 30 non-signers — completed a battery of general cognitive tasks (visual search, attention, working memory, biological motion perception, facial emotion recognition, IQ) and sign language-related tasks (lexical decision, verbal fluency, picture naming).

Compared with non-signers (see Table 1), the signing group (native and L2 signers combined) showed faster reaction times in biological motion perception ($t = -12.56$, $p < .001$), but slower reaction times in facial emotion recognition ($t = 2.61$, $p < .05$) and lower IQ matrix scores ($t = -2.04$, $p < .05$). Relative to L2 signers, native signers further exhibited faster reaction times in biological motion perception ($t = -22.27$, $p < .001$) and LSE lexical decision ($t = -27.24$, $p < .001$), but lower accuracy in LSE picture naming ($t = -4.19$, $p < .001$). Multiple linear regression with Bayes Factor (BF) evidence for the signing group (see Table 2) showed that sign lexical decision accuracy was significantly predicted by rapid visual information processing ($\beta = -0.01$, $t = -2.47$, $p < .05$; BF = 4.27) and LSE picture naming ($\beta = 0.02$, $t = 2.79$, $p < .01$; BF = 7.77), with a marginal effect of verbal IQ ($\beta = 0.01$, $t = 1.97$, $p = .055$; BF = 1.91); biological motion and facial emotion did not contribute ($ps > .05$; BFs < 1).

These findings suggest sign language experience impacts cognitive functions relevant for a visual language: biological motion and facial emotion recognition. For people who know sign language, lexical processing is primarily driven by knowledge of sign vocabulary and visual search abilities. Notably, higher visual search accuracy was associated with lower sign lexical decision accuracy; the visual search task involved detecting patterns in sequentially presented digits, whereas sign identification involves integrating information (handshape, location, movement) that is visible simultaneously. This study thus delineates a cognitive profile linking general cognitive abilities, language modality, and (sign) language processing.

Keywords: sign language experience, general cognitive abilities, sign lexical decision

Table 1: Descriptive statistics for all tasks across groups

Tasks	Measures	Native signers	L2 signers	Non-signers
<i>Visual search</i>				
rapid visual information processing task	A-prime reaction time (ms)	0.92 430	0.94 419	0.95 428
<i>Attention network</i>				
alerting effect	reaction time (ms)	39	37	32
orienting effect	reaction time (ms)	45	34	25
executive control effect	reaction time (ms)	85	69	82
<i>Working memory in LSE</i>				
number and word sorting task	correct recall	24.8	24.2	---
number rehearsal task	correct recall	15.0	15.2	---
<i>Biological motion perception</i>				
biological motion decision task	accuracy reaction time (ms)	0.96 963	0.97 1121	0.96 1091
<i>Facial emotion recognition</i>				
facial emotion recognition task	accuracy reaction time (ms)	66.4 1616	70.3 1522	67.5 1315
<i>IQ (Kaufman Brief Intelligence Test, KBIT)</i>				
KBIT-verbal knowledge	score	117	118	121
KBIT-matrices	score	113	116	118
<i>LSE lexical decision</i>				
sign lexical decision task	accuracy reaction time (ms)	0.90 1291	0.91 1599	--- ---
<i>LSE verbal fluency</i>				
semantic verbal fluency task	total correct responses	11.6	10.6	---
phonologic verbal fluency task	total correct responses	5.1	5.9	---
<i>LSE picture naming</i>				
picture naming task	accuracy	0.81	0.91	---

Note. --- indicates that the measures were not calculated for non-signers.

Table 2: Multiple Linear Regression (MLR) and Bayes Factor (BF) evidence for sign lexical decision accuracy

Predictors	MLR β	MLR t	MLR p	BF
Rapid visual information processing	-0.01	-2.47	0.018*	4.27
Biological motion perception	0.01	1.35	0.185	0.85
Facial emotion recognition	0.00	0.68	0.502	0.48
KBIT-verbal knowledge	0.01	1.97	0.055†	1.91
LSE picture naming	0.02	2.79	0.008 *	7.77

Note. * $p < 0.05$, † $0.05 < p < 0.1$.