

1 **How are signed languages learned as second languages?**

Chloe Marshall  
Sannah Gulamani  
Aurora Bel  
Gary Morgan

3

4 Key words: signed Language, second language acquisition, hearing learners

5 Running title: Learning signed languages

6

7

8

9 **Abstract**

10 This review addresses the question: How are signed languages learned by adult hearing learners?

11 While there has been much research on second language learners of spoken languages, there has  
12 been far less work in signed languages. Comparing sign and spoken second language acquisition  
13 allows us to investigate whether learning patterns are general (across the visual and oral  
14 modalities) or specific (in only one of the modalities), and hence furthers our understanding of  
15 second language acquisition (SLA). The paper integrates current sign language learning research  
16 into the wider field of SLA by focusing on two areas: 1. does 'transfer' occur between the  
17 spoken first language and signed second language, and 2. what kind of learning patterns are the  
18 same across language modalities versus unique to each modality?

19

20

21 **1. Introduction**

22 1.1 Second language acquisition as a field

23 Second-language acquisition (SLA) research deals with the process of learning other languages  
24 after one's native language (Epstein, Flynn, & Martohardjono, 1996). In addition, SLA research  
25 deals with the various strategies that exist for teaching and evaluating language learning in  
26 adults. An issue debated in the research on SLA is whether some of the properties or elements  
27 that characterize a learner's interlanguage (i.e., developing second language knowledge:  
28 Selinker, 1972) can be explained by influence from the first language (L1), or whether they are a  
29 by-product of developmental sequences that learners can be expected to move through regardless  
30 of different L1 backgrounds (VanPatten & Benati, 2015). This influence is known as language  
31 transfer and is argued to occur at all language levels, including phonology, syntax, pragmatics,  
32 and even the transfer of gestures from the learner's wider culture (Gullberg & McCafferty,  
33 2008). Transfer can result in errors (negative transfer), facilitation (positive transfer), avoidance  
34 (construction infrequency), redundancy or overgeneralization.

35  
36 SLA research on how learners acquire a new language spans a number of different disciplines  
37 (e.g. psychology, linguistics, pedagogy and sociology). Cognitive approaches to SLA research  
38 deal with the processes in the brain that underpin language acquisition, for example how  
39 language acquisition is related to short-term and long-term memory. Pienemann and Lenzing  
40 (2015) argue that second language (L2) learners acquire linguistic structures (i.e., negation,  
41 question formation) through predictable stages explained by domain-general processes.  
42 According to processability theory, instruction is constrained by these developmental stages as  
43 L2 learners follow a rigid route in the acquisition of grammatical structures. This approach

44 defines complexity in relation to language users: what is costly or difficult for language users is  
45 seen as complex. Complexity is thus identified with cost and difficulty of processing and  
46 learning (Miestamo, 2009). Such theories have uncovered patterns that appear to reveal an effect  
47 of universal principles of markedness, with a preference for simplification in the direction of less  
48 marked structures. For example, learners often learn a form or construction in one context and  
49 extend its application to other contexts e.g. ‘She bought a dress’ instead of using a less frequent  
50 (more marked) construction ‘bought’). Some SLA researchers have argued that simplification  
51 and overgeneralization can be used by L2 learners to reduce complexity and cognitive burden  
52 (Miestamo 2009). These selected domains of SLA research (transfer and learner patterns) are.....  
53 relatively broad ones that we to use to organise the current research literature on signed language  
54 acquisition. However, they are useful ones with which to describe the overall field before  
55 carrying out more in-depth studies of specific aspects of adults’ signed language acquisition of  
56 signed languages.

57

## 58 1.2 Signed languages

59 Signed languages are fully-fledged human languages (Pfau, Steinbach & Woll, 2012) that  
60 emerge naturally in deaf communities all over the world (e.g., American Sign Language: ASL;  
61 British Sign Language: BSL, etc.). Signed languages are considered ‘minority’ languages as  
62 deafness is a low incidence condition (1 in 1000 children are born deaf), and only around 10% of  
63 deaf children have deaf parents and are thus considered to be native signers (Mitchell &  
64 Karchmer, 2004). Signed languages are acquired as first languages by children of deaf adults  
65 following well-attested stages (Baker & Woll, 2009; Chamberlain, Morford & Mayberry, 2000;  
66 Chen-Pichler, 2012; Morgan & Woll, 2002; Petitto, 1997). In addition, some hearing parents use

67 a signed language with their deaf children and some hearing children of deaf adults (CODAs)  
68 acquire signed languages at a young age (Chen-Pichler, 2012). Signed languages are processed  
69 in the brain in traditional language centres, and users of signed languages comprehend and  
70 represent signs using similar cognitive processes proposed for users of spoken languages,  
71 including networks of lexical representations (Emmorey, 2002; Gutiérrez, Müller, Baus, &  
72 Carreiras, 2012; Orfanidou, Adam, Morgan, McQueen (2010).

73  
74 This review paper addresses a novel question in SLA research: How are signed languages  
75 learned by adult hearing learners? While there has been much research on L2 learners of spoken  
76 languages there has been less work in signed languages, despite signed languages being popular  
77 languages with adult learners. In 2009 in the UK, for example, there were an estimated 190,000  
78 hearing adults who had learned at least basic level BSL (Woll, 2012; for estimates of adult ASL  
79 learners see Smith & Davis, 2014). Hearing adults learn a signed language because they start  
80 working with deaf people, have a relative or friend who is deaf, plan to train as interpreters, or  
81 just develop an interest in learning a new language.

82  
83  
84 The paper is organised as follows: Section 2 overviews modality issues relevant for sign SLA,  
85 Section 3 reviews adult signed language learning with a focus on transfer and the existence of  
86 general learning patterns. The motivation for the focus on transfer and general learning patterns  
87 is that these represent two central areas of research in the SLA field. The exploration of SLA of  
88 signed languages provides a novel learning paradigm (cross-modality SLA) and can provoke  
89 new questions in the field. What transfer occurs between language modalities (spoken L1 to

90 signed L2)? Is SLA of signed languages constrained by domain-general processes or different  
91 processes unique to the visual-manual modality? If signed language SLA follows similar stages  
92 and evokes similar learner strategies and mechanisms as proposed for spoken language SLA (i.e.  
93 modality-similar SLA) it would confirm general patterns of SLA beyond the unitary modality  
94 (i.e., observed across signed and spoken languages). Finally, Section 4 draws together some  
95 conclusions and offers possible future directions for the field.

96

## 97 **2. Modality issues relevant for sign SLA**

98 When learners are exposed for the first time to a new language, they begin to perceive and store  
99 the sounds and sound patterns (phonological representations) of the target language. Learners of  
100 signed languages need to do the same. In this section we outline the phonological structure of  
101 signs, describe aspects of sign language linguistic organisation and the interface with wider  
102 communicative systems that are important for hearing second language learners. While some  
103 learners are deaf second sign language i.e. within the same modality (M1-L2) the current paper  
104 focuses on the L2 acquisition of a signed language by hearing learners thus between different  
105 modalities (M2-L2). For these learners, we describe the high amount of iconicity (i.e. motivated  
106 links between visual form and meaning) in signs, and how this drives the overlap of signs and  
107 gestures. We then document the possibility of expressing several grammatical elements  
108 simultaneously on different articulators (i.e. hands, face, and body). This section on signed .....  
109 languages covers several levels of linguistic organisation but is not exhaustive (see Pfau,  
110 Steinbach & Woll, 2012 for a comprehensive overview). These aspects are selected as they will  
111 be necessary to interpret the results of the signed language SLA research studies reviewed in the  
112 following sections.

113

## 114 2.1 Sign phonology

115 Phonology in spoken languages describes the systematic ways in which a limited set of  
116 meaningless sounds are combined to create a potentially unlimited set of meaningful words. In  
117 contrast to the sounds of language, signs are composed of four main phonological components  
118 (handshape, movement, hand orientation, and location - Brentari, 1999). For example, the BSL  
119 signs NAME and AFTERNOON (figure 1) constitute a minimal pair. Both have the same  
120 handshape, orientation and outwards movement, but differ in the location (the hand moves out  
121 from the forehead in NAME and from the chin in AFTERNOON).

122

123 Figure 1. Phonological minimal pair in BSL



128 NAME                      AFTERNOON

129

## 130 2.2 Iconicity

131 An important aspect of signed languages is the link between the visual form of the sign and its  
132 meaning, and this will be relevant for the following section on transfer. In spoken languages,  
133 words are traditionally argued to have an arbitrary form-meaning relationship e.g. the sounds in  
134 the English word 'dog', Spanish 'perro' and French 'chien' have no link to the concept of what a  
135 dog is or does (de Saussure 1983). However, spoken languages do have instances of sound

136 symbolism e.g. onomatopoeia, and this relationship is implicated in language learning  
137 (Deconinck, Boers & Eyckmans, 2017).

138  
139 Signed language vocabulary is richly influenced by visual properties of sign meanings (e.g.  
140 Friedman, 1976; Perniss & Vigliocco; 2015). Bellugi and Klima (1979) first described iconicity  
141 as being on a continuum across different signs e.g. in figure 2 the sign BOOK looks like an  
142 opening book, the less iconic TO-WORK in BSL looks like hitting your hands together and is  
143 related to the concept of making something. Finally, some signs are non-iconic e.g. SISTER in  
144 BSL is articulated with a hooked index finger tapping the bridge of the nose. It is also the case  
145 that many signs have lost their iconic motivation over time e.g. the index finger moving down  
146 the cheek in GIRL in BSL might have originally referred to the strap of a bonnet.

147  
148 Figure 2. Examples of signs in BSL that vary in iconicity



149  
150 BOOK WORK SISTER

151  
152  
153 As a result of this iconicity many signs resemble the conventional gestures used by non-signers.  
154 For example, TO-THROW and TO-SMOKE in BSL are visually similar to everyday  
155 conventional gestures used in wider British society to express these meanings.



156  
157 Indeed, some studies have reported that complete novices can correctly guess the meanings of  
158 many signs by using world knowledge and their experience with gestures (Ortega, Schiefner, &  
159 Ozyürek, 2019). In this study non-signing hearing adults exploited their implicit knowledge of  
160 gestures to guess correctly the meaning of iconic signs in Sign Language of the Netherlands  
161 (NGT) they had never seen before. When participants saw signs that had a strong visual overlap  
162 with gestural forms, they were able to guess the meaning based on their knowledge of those  
163 gestures. The implication of this study was that gestural knowledge can ease the interpretation of  
164 the meaning of novel signs. The authors went on to propose that iconic gestures that overlap in  
165 form with signs served as ‘manual cognates’ that help non-signing adults to break into a new  
166 language at first exposure (Ortega, Schiefner, & Ozyürek, 2019).

167  
168 Previous research suggested that the similarities between sign, silent pantomime and co-speech  
169 gesture are exploited during sign L2 learning (Casey & Emmorey, 2009; Chen-Pichler &  
170 Koulidobrova, 2015; Weisberg, Casey, Sevcikova Sehyr & Emmorey, 2020). In Casey and  
171 Emmorey’s (2009) study, a group of L2 signers were compared to participants with no  
172 knowledge of ASL. In an elicited narrative procedure, the L2 sign learners produced a greater  
173 number and type of iconic gestures, as well as a higher rate of such gestures, compared to non-  
174 signers. The authors argued that increased iconic gesturing by signers may reflect the iconicity  
175 present in lexical, phonological, and spatial aspects of sign languages. The authors further  
176 speculated that exposure to ASL influenced signers to visualize the narrative more vividly than  
177 non-signers (Casey & Emmorey, 2009).

178

179

180 2.3 Simultaneous articulation of several linguistic elements in sentences

181 Spoken languages generally express sentence-level meaning through a sequence of words or a  
182 sequence of morphemes in a word. Sign languages offer the possibility to express a number of  
183 meaningful elements simultaneously. This simultaneity can occur within a single sign (across  
184 different articulators); for example, Schönström and Mesch (2014) describe how the signer's  
185 mouth is able to function as an independent articulator parallel to the hand, allowing movements  
186 to add adverbial information to manual lexical signs. Simultaneity can also occur across multiple  
187 signs and articulators, i.e. the two hands, body, eyebrows, mouth, eyes and head (Sandler, 2012).  
188 One particular instantiation of the phenomenon is the use of classifiers in signing space.

189

190 An example is shown in figure 3 of a deaf BSL signer recounting a section of a story where a  
191 boy mistakenly climbs onto a deer's back and is carried away. The signer's head denotes the  
192 deer, his left hand forms the sign DEER and the right hand the position of the boy. The signer's  
193 face illustrates the discomfort of the boy.



194

195 Figure 3 THE BOY SITS UNCOMFORTABLY ON THE DEER'S HEAD

196 (example from Gulamani, Marshall & Morgan, 2020)

197

198 There is a relatively large amount of research concerning classifiers (see Morgan & Woll, 2007),  
199 with the main type investigated in sign SLA being handshapes that represent the shape of a  
200 referent class. Classifiers are particularly important as referring expressions. Reference and  
201 referring expressions are noun phrases or a surrogate for a noun phrase (e.g. a classifier) whose  
202 function in discourse is to identify some individual object. For example, in BSL a G-handshape  
203 (an extended index finger) can represent any long thin object e.g. PENCIL, TOOTHBRUSH or  
204 even TREE. Once the lexical sign for TREE is signed a subsequent mention of this referent can  
205 be tied to the classifier handshape (functioning as an anaphoric pro-form). Signers move or  
206 locate the classifier in space so as to express different meanings e.g. 'the tree was next to the  
207 river' or 'the tree was at the top of the hill'. Signers can also use classifiers in conjunction with  
208 other body parts and the face to express several meaning elements simultaneously. For example,

209 in BSL the V-handshape in figure 3 represents a person and how it moves and is located. Once  
210 the sign for BOY has been signed, a subsequent mention of this referent can be tied as an  
211 anaphor to the V-hand classifier handshape. Classifiers have been studied in only a handful of  
212 SLA contexts (e.g. Janke & Marshall, 2015) and the findings of this research will be reviewed in  
213 section 3.1.

214  
215 A second issue related to gesture and iconicity is that speakers sometimes move their hands  
216 around to express location and movement of objects in their co-speech gesture for referential  
217 purposes (Permiss & Ozyürek, 2015). Permiss & Ozyürek (2015) compared German co-speech  
218 gesture and German Sign Language (DGS) in this domain and found qualitative similarities and  
219 differences between sign language and co-speech gesture for reference tracking in discourse. The  
220 authors argued that similarities were driven by the shared affordances of the visual modality.  
221 Thus, the visual modality requires hearing L2 learners to re-use already present communicative  
222 resources in order to learn how signed language classifiers function. Up to this point we have  
223 described simultaneity as an aspect of expressive language competence. There is an additional  
224 role in learning however for receptive competence. When a signer sees a sign produced by  
225 another person it is visually reversed from the point of view of their own production of the same  
226 sign. For example when perceiving the sign BOOK in figure 2 a signer sees the back of the  
227 hands while in production they see the palm of the hands. Shield and Meier (2018) point out that  
228 this has implications for how learners represent a sign they have learned. Shield and Meier  
229 (2018) showed that sign language learners improved their ability at mentally reversing a visual  
230 representation when compared to non-signers suggesting sign exposure has an impact on  
231 cognitive visual-spatial skills. Non-signers made significantly more perspective-taking errors in

232 their imitation of gestures than either intermediate or advanced signers. In a related study,  
233 Watkins and Thompson (2017) provided evidence that both left- and right-handed participants  
234 identified signs produced by right-handed models more quickly because both left and right-  
235 handed signers are required to comprehend right-handed signing more than left-handed signing.  
236 Thus sign language learners will require some degree of visual perspective taking ability (Shield  
237 & Meier, 2018).

238  
239 In summary, sign language learning by hearing adults offers a range of opportunities and  
240 challenges for the learner related to the switch in modality it entails. On the one hand, sign  
241 meanings might be easier to guess and remember because of their close form-meaning  
242 relationship and similarities with learners' own gestures. On the other hand, the articulation of  
243 language across different parts of the body and in space is very different to how spoken  
244 languages are used. This section has highlighted those areas of the linguistic organisation of  
245 signed languages which are relevant for interpreting SLA research. As described at the end of  
246 section 1, the exploration of SLA of signed languages provides a novel learning paradigm with  
247 respect to the existence of transfer and domain-general processes. In the next section we describe  
248 a range of studies of signed language SLA in these two domains.

249

### 250 **3. Sign language learning: transfer and general learner patterns**

#### 251 3.1 Transfer

252 A common feature of SLA is the influence of the native language, i.e. transfer (Gass & Selinker,  
253 2008). How does transfer work in the SLA of signed languages? Hearing L2 learners of a  
254 signed language have to master a novel phonological system perceived in the visual and

255 produced in the manual modality. In comparison, learners of L2 spoken languages adjust their L1  
256 phonological repertoire to include the L2 sounds that partially overlap, as well as master sounds  
257 that are not in their language, and this can lead to a foreign accent. Some researchers have argued  
258 that because phonology from the L1 cannot transfer across modalities it is not possible for a  
259 hearing adult learner of signed languages to have a foreign ‘accent’ (Rosen, 2004). However,  
260 mastering the intricacies of sign phonology will bring to bear other demands, e.g. fine motor  
261 control (Mirus, Rathmann & Meier, 2001). More specifically, Mirus et al. (2001) found that sign  
262 hearing adult language learners used more proximal joints (i.e. those closer to the body) when  
263 attempting to sign and also that they signed more slowly. Thus it is possible that while a sign  
264 learner may not have a recognisable foreign (i.e. other) language accent, their difficulties in  
265 initial articulation of signs may identify them as being ‘hearing’ or ‘learner’ (i.e. non-native)  
266 signers.

267  
268 During the process of learning of sign languages, L2 signers usually adopt certain features, such  
269 as word orders of their L1, and even use the spoken L1 and signed L2 at the same time. If the  
270 learner’s L1 is English then this is known as Sign Supported English (SSE) or ‘learner signing’  
271 (Chen-Pichler & Koulidobrova, 2015). Signing and speaking at the same time is uniquely  
272 possible in sign SLA because each language is articulated in a different modality. While signed  
273 languages are independent from the spoken languages used around them, they do borrow from  
274 them. For example, many signed languages have a system of manually articulated letters in order  
275 to visually ‘fingerspell’ on the hands a word used in the surrounding spoken language e.g. ‘CAR  
276 v-o-l-v-o’. Here the BSL sign CAR is followed by the brand word ‘Volvo’ spelt on the hands of  
277 the signer: fingerspelling would be used in a situation where signers lack an agreed sign for this

278 particular make of car. Thus BSL and English can be used together by learners during attainment  
279 of fluency (Sevcikova Sehyr, Giezen & Emmorey, 2018). For example, a beginner hearing adult  
280 learner of BSL in Smith et al.'s (2010) study transferred an English expression 'to miss  
281 something' (i.e. emotionally long for) by signing this straight into English fingerspelling as YOU  
282 m-i-s-s u-s-a ('Do you miss the USA?') rather than using the sign TO-MISS. More research is  
283 required that describes the influence of spoken languages on SLA of signed languages both in  
284 diverse learning situations and in longitudinal studies.

285  
286 Another example of transfer in sign learning at the lexical level is the use of 'invented signs'.  
287 When a spoken L2 learner has a lexical gap, it is common for them to code-switch back to the  
288 L1. This switching is interesting in L2 sign learners, because if the shift meant using their L1  
289 then this would have to happen across modalities (i.e. back to their spoken L1). Smith et al.  
290 (2010) showed a group of beginner level BSL learners 40 pictures of objects and actions and  
291 asked them to name them with signs. It was expected that beginner learners would have lexical  
292 gaps and so would be forced to code-switch to speaking. In fact, the learners stayed in the  
293 manual-visual modality (i.e. they did not speak) and code-shifted by using gestures with  
294 appropriate meanings for over 80% of the items. These pantomimic gestures were very similar in  
295 form to lexical signs in BSL, e.g. for a picture of a CAMERA, all 20 learners demonstrated  
296 taking a photograph with a camera. Thus sign language learners transfer co-speech gesture  
297 system into pantomimes at the earliest stages of sign learning (Ortega & Özyürek, 2013).

298  
299 It has been argued that iconicity also influences the accuracy of sign production in L2 learners  
300 through transfer of iconic gestures from the larger culture of the L1. Ortega and Morgan (2015)

301 used a sign repetition task in which beginner learners had to imitate as accurately as possible a  
302 set of iconic and non-iconic signs (viewed with English translations and balanced for sign  
303 language phonological complexity). Contrary to expectation, it was found that iconic signs were  
304 articulated less accurately than arbitrary signs. For example, after seeing the sign TO-WRITE  
305 learners repeated the sign but changed the handshape and movement and instead articulated what  
306 they did when they actually write (See figure 4).

307

308 Figure 4 Iconic sign repetition



315 Target: TO-WRITE           Learner: Handshape and movement error

316 (example from Ortega and Morgan, 2015)

317

318 Ortega and Morgan (2015) argued that iconicity afforded learners direct access to the meaning of  
319 a sign, which led them to focus less on the exact phonological form. The beginner learners still  
320 produced a sign with the same meaning (via its iconic motivation) but not necessarily with the  
321 same phonological form as the target. In contrast, when they repeated non-iconic signs, learners  
322 had to focus more on forms, because they could not be linked to meanings via iconicity, and this  
323 led to increased accuracy. An alternative but not mutually exclusive explanation is that learners



324 produced iconic signs less accurately because of their access to gestures. As iconic signs and  
325 iconic gestures often resemble one another, learners may have retrieved the gesture rather than  
326 the sign.

327  
328 Other researchers have reported similar negative effects in sign articulation where some of the  
329 learners' errors can be traced back to their gestures (Ortega & Özyürek, 2013). There is general  
330 consensus among researchers that spoken language transfer is more likely to occur at lower  
331 levels of proficiency (Odlin, 1989; Poulisse & Bongaerts, 1994). Following this assumption,  
332 presumably once further sign learning has taken place, iconicity can be used but without it  
333 transferring via gestures. Nevertheless, as Odlin (1989) points out, certain types of transfer in  
334 spoken language, such as cognate vocabulary use, occur even at high levels of proficiency.  
335 Although evidence of this type of transfer comes from spoken language data, we cautiously  
336 suggest that even learners with good command of a signed language might transfer gestures  
337 when attempting to describe constructions that involve elements of both sign and gesture (for  
338 example, the classifier system; Marshall & Morgan, 2015).

339  
340 A final example of transfer is seen in the acquisition of classifiers signs where both Woll (2012)  
341 and Janke and Marshall (2017) argue that beginner L2 learners may recruit gesture and  
342 pantomime. Smith et al. (2010) reported many errors in the selection and orientation of  
343 handshapes to denote objects by BSL learners in spontaneous conversation involving classifiers.  
344 Learners were able to produce hand formations to stand in for objects in space (i.e., a fist for a  
345 car, a flat hand for a person) which looked 'sign-like' but not the accepted handshapes for these  
346 referents in BSL.

347  
348 Marshall and Morgan (2015) measured experimentally the difficulties that intermediate-level  
349 learners (1-3 years of exposure) face with classifiers and also asked whether learners' pre-  
350 existing repertoire of gesture and ability to understand iconicity could, as Woll (2012) suggested,  
351 facilitate their acquisition. Marshall and Morgan (2015) focused on spatial relationships, which  
352 in sign languages are represented in a very iconic way using the hands, and which one might  
353 therefore predict to be easy for adult learners to acquire. In a test of matching classifier sentences  
354 in BSL with pictures, learners were indeed highly accurate in understanding handshape, location  
355 and orientation information. More surprisingly, Marshall and Morgan (2015) reported the same  
356 pattern of high comprehension in sign-naïve participants (adults with no prior knowledge of a  
357 signed language). The authors argued that the sign-naïve participants were able to bring their  
358 general visuo-spatial abilities to the task of understanding BSL classifiers. This type of transfer  
359 would not be available to assist understanding grammatically complex constructions in spoken  
360 languages.

361  
362 As Smith et al. (2010) had suggested, Marshall and Morgan (2015) went on to ask whether  
363 visual-spatial skills aid the production of classifiers. The same intermediate level learners were  
364 asked to describe spatial arrays in pictures using BSL, and their productions were compared to  
365 those of native deaf signers. The question was whether the different components of the classifiers  
366 – handshape, location and orientation – would be produced equally well. Hearing intermediate  
367 level learners produced an interesting set of constructions. This group of learners knew that they  
368 should use their hands to represent objects and were highly accurate at signing location and  
369 orientation information, but they had more difficulty choosing the same handshapes as the native

370 signer targets. Marshall and Morgan (2015) concluded that gesture knowledge was partially used  
371 by sign learners to produce classifier sentences but lengthy exposure to BSL was required in  
372 order to go beyond this first stage and acquire the full complexity of the language. Some authors  
373 have indicated that for any pre-existing experience to transfer it is important that the learner goes  
374 through a reanalysis stage in which previous gesture knowledge is processed as being  
375 linguistically meaningful (Taub, Galvan, Piner & Mather, 2008).

376  
377 Janke and Marshall (2017) subsequently argued that learners have to converge on the  
378 conventionalised classifier system that forms part of the grammar of the language being learned  
379 by selecting from all the handshapes they are physically able to articulate. In this study 30 sign-  
380 naïve hearing adults were tested on Marshall and Morgan's task. All used some handshapes that  
381 were different from those used by native BSL signers and the intermediate learners, but there  
382 was a lot overlap also. However, the sign-naïve hearing adults had much less consistency e.g.  
383 using 4-5 different handshapes to represent the same object across the different trials in the task,  
384 whereas fluent signers used just a single handshape. The findings suggest that a key challenge  
385 when learning classifiers might be reducing from a very large set of gestural resources, rather  
386 than supplementing a restricted one. An interesting observation on the use of classifiers and  
387 potential transfer effects is that if we distinguish between production and comprehension there  
388 seems to be a negative transfer (e.g., wrong handshapes) in production and a positive transfer of  
389 gesture knowledge in comprehension.

390  
391 The studies reviewed in this section report transfer from L1 to L2. Much more research is  
392 required on transfer as this is an important process in SLA of signed languages. Similarly, it will

393 be necessary to carry out studies on larger numbers of learners, as well as combine observational  
394 and experimental data. There is an additional area of research which should be pursued, namely  
395 that acquisition of a new language (L2) affects the first (L1). Casey, Emmorey and Larrabee  
396 (2012) reported that learning a signed language influenced co-speech gesture that accompanied  
397 the learners' spoken L1. Learners of ASL felt that they gestured more when they were speaking  
398 English, and a longitudinal study confirmed this perception. The sign learners produced more  
399 iconic gestures in their co-speech gesture, and they also used a greater number of differing  
400 handshapes when gesturing.

401

### 402 3.2 Domain generality

403 In investigating how signed languages are learned as second languages we turn to general  
404 learning patterns seen across modalities. In the general SLA literature difficulties can occur for  
405 learners because of proposed processing costs (Miestamo, 2009) that lead to errors, as well as  
406 conscious/intentional strategies on the part of the learner. Two important aspects which can be  
407 studied in SLA of signed language are the following:

- 408 • Simplification: Learners often use simpler forms and constructions instead of more  
409 complex ones. E.g. the use of simple present 'John eats' instead of the present perfect  
410 continuous 'John has been eating' (Trudgill, 2011).
- 411 • Over-redundancy: Learners can over-use a lexical form or construction to avoid  
412 ambiguity or decrease cognitive load e.g. 'The lady bought a dress. The lady bought  
413 some shoes' (Sorace, Serratrice, Filiaci, & Baldo, 2009).

414 Documenting how sign languages are learnt might reveal similar general L2 learner patterns.

415

416 A well-documented feature of SLA is phonological simplification processes. For example,  
417 marked sounds like [θ, ð] are replaced by more common ones like [t, d], and consonant clusters  
418 are reduced. In sign learning this can be seen in changes made to the sub-lexical organisation.  
419 For example, the handshape required in the BSL sign SHEEP involves a fist with an extended  
420 pinkie finger. Adult L2 learners often produce this sign with a fist but omit the pinkie finger, thus  
421 simplifying the articulation. In seminal work, Mirus, Rathmann, and Meier (2001) and Rosen  
422 (2004) examined production errors in ASL phonology made by beginning L2 adult learners due  
423 to poor motor dexterity. Although adults have a fully developed motor system to perform  
424 complex movements with their arms and hands, the particular types of movements required for  
425 signing are initially unpractised and lead to errors (Woll, 2012). These were proximalisation  
426 (making signs with joints closer to the body than in the target), substitutions of handshapes,  
427 displacements of signs to the wrong locations, additions of extraneous ‘practice’ movements and  
428 deletions of movements. Production errors were also tied to difficulties in visually perceiving  
429 signs, include the mirroring of hand movements (producing signs as perceived in the input i.e. on  
430 the wrong side of the body), addition and deletion of parts of the sign difficult to see (e.g. on top  
431 of the head).

432

433 Smith et al. (2010) reported one of the few examples of longitudinal data for BSL sign  
434 phonology in L2 acquisition. Learners were asked to articulate a list of 20 signs at the beginning  
435 of the BSL course (after 2 hours of exposure) and at the end (after 24 hours of exposure).  
436 Beginner learners found handshape most difficult to produce accurately, followed by movement  
437 and location, and during learning accuracy across all these parameters improved from 36% to  
438 79% (Smith et al., 2010). A second methodology used in the sign language learning literature is

439 to ask learners to copy signs with different levels of phonological difficulty and observe what  
440 errors they make. Signs are not all equal in phonological complexity e.g. in the number of hands  
441 with which they are articulated (1 or 2), the number of movement components they include, and  
442 the motoric complexity of the handshape (Brentari, 1999). See figures 5 and 6 of BSL signs with  
443 the simplest to the most complex phonological structure

444 Figure 5.



448 I/ME ALLOW YEAR

449 I/ME, one- handed sign, one handshape, one location, no movement;

450 ALLOW, double-handed sign, symmetrical, one handshape, one location, movement in both  
451 hands;

452 YEAR, two-handed sign, two different handshapes, movement in the dominant hand.

453

454

455 Figure 6.

456

457

458 PROMISE

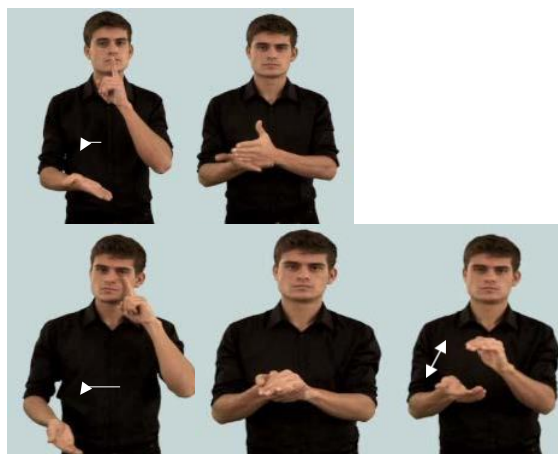
459

460

461 LOOK-AFTER

462

463



464 PROMISE, two-handed sign, two different handshapes, one handshape change in the dominant

465 hand, movement in the dominant hand;

466 LOOK-AFTER, one handed sign to start with then changes to double-handed, two different

467 handshapes occur during the production of the sign, handshape change in the dominant hand,

468 movement in the dominant hand: movement is different in the one-handed compared to the

469 double-handed sign.

470

471 Ortega and Morgan (2015) asked sign learners to copy different signs. They found that two-

472 handed signs (ALLOW, YEAR, PROMISE & LOOK-AFTER) were articulated less accurately

473 than one-handed signs (I/ME), and two-handed signs in which both hands have symmetrical

474 movements (ALLOW) were executed more accurately than two-handed signs in which both

475 move independently (PROMISE & LOOK-AFTER). Furthermore, and with respect to location,

476 signs that were performed in the signing space in front of the learner were articulated less

477 accurately than signs which make some contact with the body. It is possible that the

478 proprioceptive feedback of a sign that requires contact on the body eased learner cognitive load  
479 when producing the location parameter. The authors concluded that the more phonological  
480 constituents a sign has, the more difficult it will be for learners to process and articulate  
481 accurately, and this findings follows patterns reported in the wider SLA literature (Epstein,  
482 Flynn, & Martohardjono, 1996).

483

484 Williams and Newman (2016) reported differences in ASL phonological accuracy based on both  
485 learners' proficiency and input variability (input from a learner or a native signer). This study  
486 adds another level of complexity to previous accounts of accuracy in learners by describing some  
487 differences, especially for handshape perception (described as the most difficult parameter to  
488 master in previous research), based on learner and target properties. Learners made more  
489 movement errors for sentences signed by other learners relative to those by the native signer.

490 An innovative study, building on the earlier studies of learner errors carried out by Mirus et al.  
491 (2001) and Rosen (2004), attempted to calculate learners' ability to produce accurate ASL  
492 signing using an instrumentation methodology. Hilger, Loucks, Quinto-Pozos and Dye (2015)  
493 investigated production variability and the development of motor control. Production variability  
494 was characterized through a Spatio Temporal Index (STI - Smith et al., 1995) which is a measure  
495 of stability and variability in kinematic movements. Motion capture apparatus was used to  
496 acquire wrist displacement data across eight target signs embedded in carrier phrases. The STI  
497 values of deaf fluent signers and beginner hearing learners at three different ASL experience  
498 levels were compared. As predicted, deaf fluent signers showed significantly lower STI values  
499 than the hearing learners and stability increased with increased language use as in spoken  
500 language accuracy measures. Future research using combined naturalistic and instrumentation



501 methods is required to add to these interesting initial studies. Future studies should control  
502 elicitation procedures and tasks, both from the production and comprehension perspectives.  
503

504 The wider SLA literature describes learners dropping or mis-ordering required elements during  
505 acquisition. In signed languages the face is an important non-manual marker of several  
506 grammatical functions. For example, one of the non-manual markers of questions is movement  
507 of the eyebrows. Research has found that the grammatical use of non-manuals is relatively  
508 limited among early and intermediate L2 learners (Schönström & Mesch, 2014). An example  
509 from their data is that L2 learners did not raise the eyebrows in order to indicate wh-questions  
510 non-manually but instead used the manual question signs WHAT etc. Unfortunately, the authors  
511 did not report quantitative statistics for this observation. The authors reported that learners  
512 largely focused on how to articulate manual signs while in fact not looking at the teacher.

513 Signing SLA learners have to become familiar with using facial expressions to convey particular  
514 grammatical contrasts that in spoken languages would be conveyed by changes in intonation and  
515 they have to learn how these non-markers work simultaneously with the manual lexicon. A  
516 possible reason why these non-manual elements are challenging is that learners cannot visually  
517 perceive their own faces whilst signing. Smith et al. (2010) reported timing difficulties with  
518 articulating the manual and non-manual part simultaneously, whereby the non-manual was  
519 articulated before the manual part when it should have occurred throughout the whole phrase.

520 Although we have included these as errors of simplification it is also possible that as  
521 grammatical markers expressed on the face are not part of the learners' L1 they are thus harder to  
522 learn.  
523

524 Finally, a common pattern in second language learning is the issue of ‘redundancy’ in the use of  
525 referring expressions e.g. ‘The lady bought a dress. The lady bought some shoes’.

526

527 L2 learners of pro-drop (null-subject) languages even with an advanced level command of the  
528 target language will produce overt subjects in contexts where native speakers would not have  
529 produced them (Sorace & Filiaci, 2006). There are now a small number of papers examining  
530 how hearing adult learners of sign learn to use referring expressions (Bel, Ortells & Morgan,  
531 2015; Frederiksen & Mayberry, 2019; Gulamani, Marshall & Morgan, 2020; Perniss & Özyürek  
532 2015). Bel et al.’s (2015) study involved 13 advanced adult learners of Catalan Sign Language  
533 (LSC) who were enrolled on a sign language interpreter training course and had experienced 600  
534 hours of formal exposure to LSC. Eleven deaf native LSC-signers acted as controls. Participants  
535 were required to view a three-minute silent film about conflicts at school and were subsequently  
536 instructed to tell a new story to camera about a similar experience they knew involving a friend  
537 or classmate during their childhood or teenage years. This task was devised to encourage  
538 participants to introduce third-person characters in their productions and make use of spatial  
539 locations. Bel et al. (2015) found, as has previously reported for spoken language studies, that  
540 the L2 signers had a tendency to oversupply overt arguments. Learners used overt pronouns more  
541 frequently than their native-signing comparison group, including in contexts of referent  
542 maintenance when a null pronoun would have sufficed. Thus Bel et al. (2015) argued that the  
543 complexity of the task was resolved by learner signers in modality-similar ways to that argued  
544 for spoken language L2 users. The added redundancy, while it seemed to free up cognitive  
545 resources, had the effect of reducing the sign learners’ fluency as judged by native signers.

546 **4. General conclusions and future directions**

547 The aims of this review were to describe sign language SLA research and begin to integrate these  
548 results into wider SLA theory and literature. We chose to do this by using two general and well-  
549 researched topics in SLA: transfer and general learner patterns. Although these domains are  
550 broad-ranging, they constitute fundamental topics in SLA research. We see that the sign learning  
551 research fits into these topics naturally and provokes several interesting issues worthy of further  
552 discussion. In general, we see that the research on SLA in sign is compatible with patterns and  
553 data previously reported solely in the spoken modality. While there are modality-specific issues  
554 e.g. transfer of gestures rather than phonemes/words, and visual reversals in perception and  
555 production of signs, by and large these appear to be about *how* general SLA mechanisms are  
556 instantiated.

557 The mechanisms we have reviewed in this paper centre around the reduction of processing cost  
558 (Miestamo, 2009) by SLA learners of sign through simplifications (Trudgill, 2011) and over-  
559 redundancy (Sorace, Serratrice, Filiaci, and Baldo, 2009). This supports our position that SLA  
560 across modalities is driven by some of the same language and learner component features.

561  
562 This review, while touching on a broad and central range of topics, illustrates that in many  
563 domains there is a clear need to carry out much more research to arrive at more informed  
564 patterns and mechanisms of signed language SLA. There are several areas of SLA research up to  
565 this point less tested on sign language learners. We point out some of these future directions.  
566 There is less research devoted to the development of signed language comprehension in adult  
567 learners than there has been on signed language production. For example, unlike learning new  
568 spoken words, signed language learners are required to use visual perspective-taking skills to  
569 perceive new signs as they see the visual reversal when looking at someone else produce a sign

570 compared to what they themselves produce (Shield and Meier, 2018). Future research in signed  
571 language SLA should look more at the relationship between expressive and receptive language in  
572 L2 sign acquisition, and how is it influenced by the visual-spatial modality. In other aspects of  
573 SLA there is also no work on how different types of exposure or learning setting (classroom  
574 versus incidental learning) influence SLA of sign. A similarly unexplored area is the age of the  
575 learner. While there is much debate about sensitive periods in the acquisition of spoken and  
576 signed languages there has been no work on whether age influences hearing adults SLA of sign  
577 language. It is our hope that future interaction between sign language and SLA research on these  
578 future topics will enrich both disciplines.  
579

## References

- 581 Baker, A., & Woll, B. (Eds.). (2009). *Sign Language Acquisition*. Amsterdam: John Benjamins  
582 Publishing.
- 583 Bel, A., Ortells, M., & Morgan, G. (2015). Reference control in the narratives of adult sign  
584 language learners. *International Journal of Bilingualism*, 19(5), 608–  
585 624. doi:10.1177/1367006914527186
- 586 Bellugi, U., & Klima, E. S. (1979). Two faces of sign: iconic and abstract. *Annals of the New  
587 York Academy of Sciences*, 280(1), 514–538. [https://doi.org/10.1111/j.1749-  
588 6632.1976.tb25514.x](https://doi.org/10.1111/j.1749-6632.1976.tb25514.x)
- 589 Brentari, D. (1999). *A prosodic model of sign language phonology*. Cambridge, MA: MIT Press.
- 590 Casey, S., & Emmorey, K. (2009). Co-speech gesture in bimodal bilinguals. *Language and  
591 Cognitive Processes*, 24(2), 290-312. doi: 10.1080/01690960801916188
- 592 Casey, S., Emmorey, K., & Larrabee, H. (2012). The effects of learning American Sign  
593 Language on co-speech gesture. *Bilingualism*, 15(4), 677-686.  
594 doi: 10.1017/S1366728911000575
- 595 Chamberlain C., Morford J. P., Mayberry R. I. (2000). *Language Acquisition by Eye*. Mahwah,  
596 NJ: Lawrence Erlbaum Associates.
- 597 Chen Pichler D. (2012). Language acquisition. In R. Pfau, B. Woll & M. Steinbach (Eds.),  
598 *Handbook of Linguistics and Communication Science: Sign Language* (pp. 647-686).  
599 Berlin: de Gruyter.

- 600 Chen-Pichler, D. C., & Koulidobrova, H. (2015). Acquisition of sign language as a second  
601 language. In M. Marschark (Eds.), *The Oxford handbook of deaf studies in language:  
602 Research, policy and practice* (pp. 218-230). Oxford: Oxford University Press.
- 603 Deconinck, J., Boers, F. & Eyckmans J. (2017). Does the form of this word fit its meaning? The  
604 effect of learner-generated mapping elaborations on L2 word recall. *Language teaching  
605 research, 21*(1), 31–53.
- 606 Epstein, S. D., Flynn, S., & Martohardjono, G. (1996). Second language acquisition: Theoretical  
607 and experimental issues in contemporary research. *Behavioral and Brain Sciences, 19*(4),  
608 677-758. doi: 10.1017/S0140525X00043521
- 609 Emmorey K. (2002). *Language, Cognition, and the Brain: Insights from Sign Language  
610 Research*. Mahwah, NJ: Lawrence Erlbaum and Associates.
- 611 Frederiksen, A.T., & Mayberry, R.I. (2019). Reference tracking in early stages of different  
612 modality L2 acquisition: Limited over-explicitness in novice ASL signers' referring  
613 expressions. *Second Language Learning, 35*(2), 253-283.  
614 doi:10.1177/0267658317750220
- 615 Friedman L. (1976). *Phonology of a soundless language: Phonological structure of the  
616 American Sign Language*. (Unpublished doctoral dissertation). University of California,  
617 Berkeley.
- 618 Gass, S. M., & Selinker, L. (2008). *Second language acquisition: An introductory course*. (3rd  
619 ed.). New York, NY: Routledge.

620 Gulamani, S. Marshall, C. R., & Morgan, G. (2020). The challenges of viewpoint taking when  
621 learning a sign language: Data from the “frog story” in British Sign Language. *Second*  
622 *Language Research*. doi: <https://doi.org/10.1177/0267658320906855>

623 Gullberg, M., & McCafferty, S. G. (2008). Introduction to gesture and SLA: Toward an  
624 integrated approach. *Studies in Second Language Acquisition*, 30(2), 133-146.  
625 doi: <https://doi.org/10.1017/S0272263108080285>

626 Gutiérrez, E., Müller, O., Baus, C., & Carreiras, M. (2012). Electrophysiological evidence for  
627 phonological priming in Spanish Sign Language lexical access. *Neuropsychologia*, 50(7),  
628 1335-1346. doi: [10.1016/j.neuropsychologia.2012.02.018](https://doi.org/10.1016/j.neuropsychologia.2012.02.018)

629 Hilger, A. I., Loucks, T. M., Quinto-Pozos, D., & Dye, M. W. (2015). Second language  
630 acquisition across modalities: Production variability in adult L2 learners of American  
631 Sign Language. *Second Language Research*, 31(3), 375-388. doi:  
632 [10.1177/0267658315570648](https://doi.org/10.1177/0267658315570648)

633 Janke, V., & Marshall, C. R. (2017). Using the hands to represent objects in space: Gesture as a  
634 substrate for signed language acquisition. *Frontiers in Psychology*, 8:2007. doi:  
635 [10.3389/fpsyg.2017.02007](https://doi.org/10.3389/fpsyg.2017.02007)

636 Marshall, C. R., & Morgan, G. (2015). From gesture to sign language: Conventionalization of  
637 classifier constructions by adult hearing learners of British Sign Language. *Topics in*  
638 *Cognitive Science*, 7(1), 61-80. doi: [10.1111/tops.12118](https://doi.org/10.1111/tops.12118)

639 Miestamo, M. (2009). Implicational hierarchies and grammatical complexity. In G. Sampson, D.  
640 Gil & P. Trudgill (Eds.), *Language Complexity as an Evolving Variable* (pp. 80-97).  
641 Oxford: Oxford University Press.

642 Mirus, G., Rathmann, C., & Meier, R. P. (2001). Proximalization and distalization of sign  
643 movement in adult learners. In V. Dively, M. Metzger, S. Taub, & A.M Baer (Eds.),  
644 *Signed languages: Discoveries from international research* (pp. 103-119). Washington,  
645 DC: Gallaudet University Press.

646 Mitchell, R. E., & Karchmer, M. A. (2004). Chasing the mythical ten percent: Parental hearing  
647 status of deaf and hard of hearing students in the United States. *Sign Language Studies*,  
648 4(2), 138–163. doi: 10.1353/sls.2005.0004

649 Morgan G., & Woll B. (Eds.). (2002). *Directions in Sign Language Acquisition*. Amsterdam:  
650 John Benjamins Publishing.

651 Morgan, G., & Woll, B. (2007). Understanding sign language classifiers through a  
652 polycomponential approach. *Lingua*, 117(7), 1159-1168. doi:  
653 10.1016/j.lingua.2006.01.006

654 Odlin, T. (1989). *Language transfer: Cross-linguistic influence in language learning*.  
655 Cambridge: Cambridge University Press.

656 Orfanidou, E., Adam, R., Morgan, G., & McQueen, J. M. (2010). Recognition of signed and  
657 spoken language: Different sensory inputs, the same segmentation procedure. *Journal of*  
658 *Memory and Language*, 62(3), 272-283. doi: 10.1016/j.jml.2009.12.001

659 Ortega, G., & Özyürek, A. (2013). Gesture-sign interface in hearing non-signers' first exposure to  
660 sign. In *Tilburg Gesture Meeting* (pp. 1–5). Tilburg: Tilburg University.

661 Ortega, G., & Morgan, G. (2015). Phonological development in hearing learners of a sign  
662 language: The influence of phonological parameters, sign complexity, and iconicity.  
663 *Language Learning*, 65(3), 660-688. doi: 10.1111/lang.12123

664 Ortega, G., Schiefner, A., & Özyürek, A. (2019). Hearing non-signers use their gestures to



665 predict iconic form-meaning mappings at first exposure to signs. *Cognition*, 191, 103996.  
666 doi: [10.1016/j.cognition.2019.06.008](https://doi.org/10.1016/j.cognition.2019.06.008)

667 Perniss, P., & Ozyürek, A. (2015). Visible cohesion: A comparison of reference tracking in sign,  
668 speech, and co-speech gesture. *Topics in Cognitive Science*, 7(1), 36-60. doi:  
669 10.1111/tops.12122

670 Perniss, P., Özyürek, A., & Morgan, G. (2015). The influence of the visual modality on language  
671 structure and conventionalization: insights from sign language and gesture. *Topics in*  
672 *Cognitive Science*, 7(1), 2-11. doi: 10.1111/tops.12127

673 Perniss, P. & Vigliocco, G. (2014) The bridge of iconicity: from a world of experience to the  
674 experience of language. *Philosophical Transactions of the Royal Society B: Biological*  
675 *Sciences*, 369(1651), 20130300. doi: 10.1098/rstb.2013.0300.

676 Petitto L. A. (1997). In the beginning: on the genetic and environmental factors that make early  
677 language acquisition possible. In M. Gopnik (Ed.), *The Inheritance and Innateness of*  
678 *Grammars* (pp. 45-69). Oxford: Oxford University Press.

679 Pfau, R., Steinbach, M., & Woll, B. (Eds.). (2012). *Sign language: An international handbook.*  
680 *(Handbook of Linguistics and Communication Science)*. Berlin: De Gruyter Mouton.

681 Pienemann, M., & Lenzing, A. (2015). Processability theory. In B. VanPatten & J. Williams  
682 (Eds.), *Theories in second language acquisition: An introduction* (2nd edition) (pp. 159–  
683 179). New York, NY: Routledge.

684 Pizzuto, E., & Volterra, V. (2000). Iconicity and transparency in sign languages: A cross-  
685 linguistic cross-cultural view. In K. Emmorey & H. L. Lane (Eds.), *The signs of language*  
686 *revisited: An anthology to honor Ursula Bellugi and Edward Klima* (pp. 229–250).  
687 Mahwah, NJ: Lawrence Erlbaum Associates.

688 Poulisse, N., & Bongaerts, T. (1994). First language use in second language production. *Applied*  
689 *Linguistics*, 15(1), 36-57. doi: <https://doi.org/10.1093/applin/15.1.36>

690 Rosen, R. S. (2004). Beginning L2 production errors in ASL lexical phonology: A cognitive  
691 phonology model. *Sign Language & Linguistics*, 7(1), 31-61. doi:10.1075/sll.7.1.04beg

692 Sandler, W. (2012). The phonological organization of sign languages. *Language and Linguistics*  
693 *Compass*, 6(3), 162-182. doi: 10.1002/lnc3.326

694 de Saussure, F. (1983). *Course in General Linguistics*. Trans. R. Harris. Duckworth, London.

695 Schönström, K., & Mesch, J. (2014). Use of nonmanuals by adult L2 signers in Swedish Sign  
696 Language – Annotating the nonmanuals. In O. Crasborn, E. Efthimiou, E. Fotinea, T.  
697 Hanke, J. Hochgesang, J. Kristoffersen, & J. Mesch (Eds.), *Beyond the manual channel.*  
698 *Proceedings of the 6th workshop on the representation and processing of sign languages*  
699 (pp. 153–156).

700 Selinker, L. (1972). Interlanguage. *International Review of Applied Linguistics in Language*  
701 *Teaching*, 10(1-4), 209-232. doi: <https://doi.org/10.1515/iral.1972.10.1-4.209>.

702 Selinker, L., & Gass, S. (2008). *Second language acquisition*. Mahwah, NJ: Lawrence Erlbaum  
703 Associates.

704 Sevcikova Sehyr, Z., Giezen, M.R., Emmorey, K. (2018). Comparing semantic fluency in  
705 American Sign Language and English, *The Journal of Deaf Studies and Deaf Education*,  
706 23(4), 399–407. doi: 10.1093/deafed/eny013

707 Shield, A., & Meier, R. P. (2018). Learning an embodied visual language: Four imitation  
708 strategies available to sign learners. *Frontiers in psychology*, 9, 811. doi:  
709 <https://doi.org/10.3389/fpsyg.2018.00811>

710 Smith, D. H., & Davis, J. E. (2014). Formative assessment for student progress and program  
711 improvement in sign language as L2 programs. In D. McKee, D. & R. Rosen. (Eds.),  
712 *Teaching and learning signed languages* (pp. 253-280). Palgrave Macmillan UK.

713 Smith, N., Tsimpli, I., Morgan, G., & Woll, B. (2010). *The signs of a savant: Language against*  
714 *the odds*. Cambridge: Cambridge University Press.

715 Sorace, A., & Filiaci, F. (2006). Anaphora resolution in near-native speakers of Italian. *Second*  
716 *Language Research*, 22(3), 339-368. doi: 10.1191/0267658306sr271oa

717 Sorace, A., Serratrice, L., Filiaci, F., & Baldo, M. (2009). Discourse conditions on subject  
718 pronoun realization: Testing the linguistic intuitions of older bilingual  
719 children. *Lingua*, 119(3), 460-477. doi: <https://doi.org/10.1016/j.lingua.2008.09.008>

720 Taub, S., Galvan, D., Piñar, P., & Mather, S. (2008). Gesture and ASL L2 acquisition. In R. M.  
721 Quadros (Ed.), *Sign languages: Spinning and unravelling the past, present and future*  
722 (pp. 639-651). Petropolis, Brazil: Arara Azul.

723 Trudgill, T. (2011). *Sociolinguistic typology: Social determinants of linguistic complexity*.  
724 Oxford, UK: Oxford University Press

725 VanPatten, B., & Benati, A. G. (2015). *Key terms in second language acquisition*. Bloomsbury  
726 Publishing.

727 Watkins, F., & Thompson, R. L. (2017). The relationship between sign production and sign  
728 comprehension: What handedness reveals. *Cognition*, 164, 144-149. doi:  
729 10.1016/j.cognition.2017.03.019

730 Weisberg, J., Casey, S., Sevcikova Sehyr, Z., & Emmorey, K. (2020). Second language  
731 acquisition of American Sign Language influences co-speech gesture production.  
732 *Bilingualism: Language and Cognition*, 23, 473-482. doi:10.1017/S1366728919000208

- 733 Williams, J.T., & Newman, S.D. (2016). Phonological substitution errors in L2 ASL sentence  
734 processing by hearing M2L2 learners. *Second Language Research*, 32(3), 347-366. doi:  
735 10.1177/0267658315626211.
- 736 Woll, B. (2012). Second language acquisition of sign language. In A. C. Chapelle (Ed.), *The*  
737 *encyclopedia of applied Linguistics* (pp. 743-6). Iowa State University, USA.
- 738 Yu, L. & Odlin, T. (2016) *New perspectives on transfer in second language learning*. Bristol,  
739 UK: Multilingual Matters.