Language acquisition in hearing L2 learners of LIS: adapting to a different modality

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Abstract

The study examines the acquisition of LIS as a second language by adult hearing beginner students providing a qualitative analysis of the errors detected in the production of phonological parameters. LIS learners' errors pattern with those described in the literature for M2L2 learners of other sign languages, showing a hierarchy of difficulty with handshape being the most difficult and location the easiest parameter to master. Results are discussed against the major SSLA theoretical models.

Keywords

Italian sign language, phonology, Sign Second Language Acquisition, M2L2 learners, visual-manual modality.

1. Introduction

The paper presents an exploratory study on the acquisition of Italian Sign Language (LIS) as a second language (L2) by adult hearing first-year BA students, with no prior knowledge of LIS or other sign languages (SLs), in order to provide a preliminary qualitative analysis of the errors detected within the phonological domain.

Although in the shape of a preliminary research work, this is, to our knowledge, the first study investigating the acquisition of LIS as L2. Research on Sign Second Language Acquisition (SSLA) has been growing only recently, as a response to the increasing interest in learning SLs manifested by hearing and deaf students (see Schönström, Marshall 2022 for a recent overview). SSLA is particularly interesting to study from both a linguistic and pedagogical perspective: linguistically, it offers the opportunity to examine how L2 learners adapt to the visual-manual modality (M2) by reorganising their use of body, space, and facial expressions to convey linguistic meaning (Ortega, Morgan 2015; a.o.); pedagogically, it allows to identify M2L2 students' learning difficulties, thus supporting the development of proper teaching strategies.

The paper is organised as follows: § 2.1 provides a concise overview of the development of the phonological domain during SL acquisition by deaf L1 children, which constitutes a baseline for comparing L2 acquisition of hearing signers, addressed in § 2.2 along with the theoretical models advanced in the literature to account for the errors observed in this population. § 3 outlines the goals and the methodological details of the study. § 4 presents the results, while § 5 offers a discussion of the data. § 6 draws the conclusions.

2. The acquisition of sign language phonology across different populations of signers

The literature on the acquisition of SL phonology shows that the articulation of signs necessitates fine motor skills (Sandler 1989) and a precise ability to mentally rotate the sign produced by the interlocutor in order to interpret and reproduce it correctly from the signer's point of view (Emmorey 2002). These factors matter in both L1 and L2 sign language acquisition of the phonological domain, although to a different extent, as we shall address in what follows.

2.1 The development of the phonological domain in L1 deaf signers

The few studies on the L1 acquisition of the phonological domain argue that the location parameter is the first to be mastered because it does not involve the articulatory-motor complexity characterizing handshape and movement (see for ASL: Bonvillian, Siedlecki 1996; Conlin et al. 2000; for BSL: Morgan, Barrett-Jones, Stonehamet 2007).

Movement represents the second parameter to be acquired. Researchers find that L1 signers first produce path movements and then hand-internal movements (see for ASL: Marentette, Mayberry 2000; for BSL: Morgan, Barrett-Jones, Stonehamet 2007) and replace wrist and finger movements with movements more proximal to the trunk (see for ASL: Marentette, Mayberry 2000; a.o.).

Due to its complexity, handshape is the last parameter to be acquired, and the one recording the highest number of errors during early productions in L1 signers (see for ASL: Boyes-Braem 1990; Bonvillian, Siedlecki 1996; Conlin et al. 2000; a.o.). Boyes-Braem (1990) formalises handshape acquisition based on anatomical development and on a peculiar phenomenon called serial finger order, according to which handshapes involving adjacent finger positions are acquired earlier because they are simpler to produce. Conversely, handshapes requiring independent finger isolation are more complex and, therefore, acquired later. Boyes-Braem (1990) identifies four developmental stages: the first involves motorically simple handshapes (the unmarked handshapes), which are similar to children everyday spontaneous gestures (e.g., pointing or grasping); in the second stage, variants of previously produced handshapes begin to appear (e.g., finger spreading or bending); the third and fourth stages mark the emergence of more complex handshapes (the marked handshapes) that require finer motor control (e.g., the inhibition of movement in certain fingers or the coordination of non-adjacent fingers). The study shows that children tend to simplify more complex handshapes by replacing them with the ones acquired at the same stage or at an immediately preceding one.

The existing literature does not report observations regarding children's errors in the orientation parameter, except for the preference to produce palm orientation towards themselves rather than towards the neutral space (see for ASL: Siedlecki, Bonvillian 1993).

With respect to the acquisition of NMMs, children produce affective NMMs during their first year, then they begin to master grammatical NMMs (see for ASL: Reilly, McIntire, Bellugi 1990, a.o.; for LIS: Pizzuto 2002). The later acquisition of grammatical NMMs might result from the children's difficulty in identifying facial and body expressions as linguistic aspects and in articulating them simultaneously with the manual components of signs.

2.2 The development of the phonological domain in L2 hearing signers

The literature on SSLA is quite scarce if compared to L1 acquisitional studies, however, interesting parallels with respect to the order of acquisition of the phonological parameters emerge. Location seems to be the parameter that is most accurately mastered and reproduced, as detected by Jissink (2005), Ortega, Morgan (2015) and Bochner et al. (2011) across M2L2 signers of Sign Language of the Netherlands (NGT), British Sign Language (BSL) and ASL, respectively. These studies also show that the movement parameter is more difficult to master than location, but easier than handshape. Moreover, Mirus, Rathmann, Meier (2001) show that, when asked to reproduce isolated unfamiliar signs, ASL M2L2 adult signers frequently articulate the proximalisation of movements by replacing the sign canonical movement with one closer to the torso. They also show that handshape is particularly difficult to master for M2L2 learners, especially when producing iconic rather than arbitrary signs through repetition tasks (see Ortega 2013 for BSL; Chen Pichler 2009; 2011 for ASL).

As for orientation, the studies provide mixed results placing it between the acquisition of location and movement or handshape.

Finally, with respect to NMMs, Mesch, Schönström (2021) administer a retelling task to L2 learners of Swedish Sign Language (STS) and observe a high frequency of mouthings in the students' productions.

A further study worth mentioning is Rosen (2004). Rather than discussing the order of acquisition of the phonological parameters, he provides a detailed description of ASL M2L2 learners' errors collected through a longitudinal study. He detects errors based on motor dexterity (i.e., the ability to control the coordination of hands and movements, the alignment of fingers and facial expressions to correctly produce signs), and errors based on perception (i.e., the visual processing and attention to phonological features of the input signs produced by someone else, e.g., the teacher). The types of errors observed are illustrated in Table 1.

	Dexterity	**Perception**
Handshape	Incomplete formation Substitutions Displacements Switches	/
Location	Wrong placement of the point of contact between fingers or hands	Mirrorisations[1] Addition or deletion in compound signs
Movement	Incomplete movement Switches Displacements	Mirrorisations
Orientation	Switches	Parallelisations
NMMs	Substitution	Absence

Table 1. Rosen's (2004) errors typologies for each parameter

In order to explain the patterns detected across M2L2 learners, researchers working in the framework of SSLA have advanced different theoretical proposals, which can be grouped into three categories depending on the factors considered relevant. We shall briefly address each in turn.

In the first category, we find the transfer model (or Cross-linguistic influence, CLI model), which, in the spoken SLA literature, refers to the phenomenon whereby learners adopt the strategies of their L1 during L2 acquisition (Odlin 1989). In the context of SLs, this model is advocated by Chen Pichler (2009; 2011) and Ortega (2013), who account for the lower accuracy detected in the production of iconic signs by assuming that M2L2 learners transfer the use of the gestures related to their L1 spoken language culture into the L2 SL. The use of gestures from spoken languages constitutes an example of negative transfer, since L1 features negatively interfere with the correct production of L2 SL structures. The transfer hypothesis is also adopted by Mesch, Schönström (2021) in their analysis of the errors observed in L2 STS learners, as the use of mouthings during STS productions is likely to be the result of transfer from the students' L1, Swedish, into their L2, STS.

[1] Mirrorisation recalls the 'mirror effect', that refers to the learner's incapacity of producing the sign in a reversed fashion from the teacher input, thus copying the teacher (Rosen 2004).

With respect to the second category, we mention the Universal Grammar (UG) model, adopted by both Jissink (2005) and Mirus, Rathmann, Meier (2001) to account for the M2L2 order of acquisition of the phonological parameters and for the preference for proximal movements matching the data reported in the literature on L1 sign language acquisition in NGT and ASL respectively (§ 2.1).

The third category includes proposals building on the role played by modality specific features of SLs. Bochner et al. (2011) and Ortega, Morgan (2015) attribute the phonological difficulties faced by beginners to the perception and intrinsic complexity of sign structures, rather than to issues connected to transfer or UG. Along similar lines, Rosen (2004) argues that transfer models do not allow to capture L2 acquisitional patterns and errors because the phonological differences between the L1 spoken language and the L2 SL may make it difficult for L2 sign language learners to rely on their spoken L1. Although ASL M2L2 acquisitional patterns are in line with those exhibited by ASL L1 signers, he argues that the errors of M2L2 signers cannot be compared to that of L1 children, as the latter stem from the ongoing anatomical development, an explanation inapplicable to adult learners. To capture the observed errors (lack of accuracy in sign perception and poor motor articulation in sign production) in a unified model, Rosen (2004) proposes the Cognitive Phonology Model (CPM), according to which M2L2 learners exploit cognitive strategies, such as control of the alignment and coordination of the hands, to learn, remember and articulate signs. Both sign perception accuracy and dexterity in sign articulation are costly cognitive processes which may lead to errors across novice learners, who may lack the cognitive readiness necessary for a full mastery of sign perception and articulation.

3. The present study

The present study aims at analysing the first four months of the acquisition of LIS by M2L2 novice learners in order to provide a preliminary description of production errors (if any) in the domain of phonology. We developed a qualitative investigation to address the following research questions: i) is the process of learning LIS as L2 characterised by phonological errors in production? ii) Are the phonological error types identified similar to those detected for L2 learners of other SLs?[2] iii) Do errors provide evidence for the models of transfer and UG, or are they better captured through cognitive models such as the CPM (Rosen 2004)?

3.1 Participants

The paper draws on the data collected by one author for the purposes of her master's degree thesis (Digiorgio 2024). The study involved 62 (5 men, 57 women) L1 Italian students of LIS as L2 aged 18-21, attending the first-year of a BA course during the a.y. 2023/2024. Before taking part in the study, participants gave their written informed consent to be recorded during classes and to appear in papers or conference presentations for data illustration purposes. A short questionnaire was used to collect information about their knowledge of SL and contact with the deaf community. Participants were selected based on their lack of knowledge of LIS or other SLs prior to university enrollment.

3.2 Methodology

[2]Recall that the phonological inventories of SLs can differ from one language to another (Brentari 1998). We will approach the cross-linguistic comparisons proposed in our work with caution.

3.2.1 Data collection

Data were collected during the first year of LIS language practices, taught by a deaf native LIS lecturer. LIS language practice classes are organised as annual courses divided into two semesters. In order to focus on the initial phase of LIS learning, we chose to observe only the first semester, whose program is focused on fingerspelling exercises and production of simple dialogues. Consequently, the types of errors we report reflect this initial phase and concern the production of fingerspelling and a limited set of lexical signs, given the simplicity of the sentences produced. Students were observed by one of the authors during production exercises proposed by the teacher, no specific test was administered to elicit the data. Students' linguistic interactions (among them or with the teacher) were also recorded to allow for a more detailed subsequent analysis. We used two digital video cameras placed in the classroom: one capturing a general view of the students during the lesson, and the other one positioned on the teacher's desk in front of the students in order to record them when they were invited by the teacher to stand up and get closer to the teacher's desk for linguistic productions. Students were observed once a week between September and December 2023, for a total of 21 hours of lesson recordings.

3.2.2 Analyses

The researcher attending LIS classes wrote down the fingerspelled sequences and lexical signs exhibiting phonological deviations from the target production. Successively, SL dictionaries such as Spreadthesign (https://www.spreadthesign.com/) were used to check whether the detected recorded deviations actually differed from the correct articulation of LIS fingerspelling and from the signs' citation forms, and, if so, they were annotated in an Excel spreadsheet as errors pertaining to the different parameters. An in-depth qualitative analysis allowed to categorise the 116 tokens (24 fingerspelling and 92 lexical signs) into distinct error typologies for each phonological parameter. Finally, the collected data were processed to calculate the frequency of occurrence for both the affected parameters and the identified error types.

4. Results

Overall, the annotated data show that errors of substitution, reversion and internal assimilation are found for the following phonological parameters: handshape, movement, orientation and NMMs. No errors occur in the parameter of location. Interestingly, the same types of error substitution and reversion are detected for both fingerspelling and lexical signs, thus they are discussed together. The analysis delineates a hierarchy of difficulty, with handshape emerging as the most difficult parameter, followed by movement, orientation, and finally NMMs. In Table 2 below, we summarise errors' frequency and distribution across the detected typologies pertaining to each parameter.

Handshape		**Movement**		**Orientation**		**NMMs**	**Others**[3]
Handshape substitution	Handshape internal assimilation	Reversed movement	Movement internal assimilation	Reversed orientation	Orientation substitution	NMMs absence	
58%	3%	15%	3%	10%	5%	3%	

[3] This category includes only two items pertaining to the following error types: addition of non-dominant hand in one-handed sign and body contact (where no contact was required).

Total: 60%	Total: 18%	Total: 16%	Total: 3%	Total: 2%

Table 2. Percentage of errors distribution and frequency

In the remainder of this section, we address each phonological parameter in turn by describing the typologies of errors detected in students' productions, along with the percentages of errors' occurrence and distribution. Descriptions are supported by figures. The canonical forms of LIS signs are illustrated through examples taken from Spreadthesign, in which the left-handed signer is the LIS teacher who taught the first-level LIS course we considered. Pictures illustrating students' errors are real screenshots from our recordings.[4] For the correct interpretation of the results, it should be noted that all students are right-handed.

4.1 Handshape

Our analysis reveals that handshape records the highest percentage of errors (60%), distributed between handshape substitution (58%) and handshape internal assimilation (3%).

i) Handshape substitution. In one-handed signs, some students replaced  ,  ,  and  with  or  . This is illustrated through the LIS sign TO_BE_FAMILIAR_WITH,[5] standardly produced with  [fig 1], realised instead with  [fig 2].

Figure 1. TO_BE_FAMILIAR_WITH

Figure 2. Student production of TO_BE_FAMILIAR_WITH

Other instances concern the substitution of  ,  ,  ,  with  , as in the sign SURNAME [fig 3] modified as in Figure 4.

[4] In a few cases (e.g., fig 4), for privacy reasons figures do not feature original student footage but rather represent reconstructions of the original data.

[5] In this paper, the glosses for signs are given in small capitals following standard SL transcription conventions.

Figure 3. SURNAME

Figure 4. Student production of SURNAME

We also observe the substitution of  and  with  , as in the sign TO_BE_BORN, provided in Figure 5 and Figure 6, respectively.

Figure 5. TO_BE_BORN

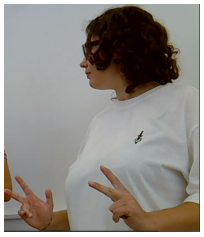

Figure 6. Student production of TO_BE_BORN

This type of error is also attested in two-handed asymmetrical signs, where students replaced the handshape of the non-dominant hand with a different one, usually  . For example, the asymmetrical sign BILL, which selects  for both hands in its citation form [fig 7], was articulated with  in the non-dominant hand [fig 8].

Figure 7. BILL

Figure 8. Student production of BILL

The data show the occurrence of handshape substitution within fingerspelling as well. For instance, some students substitute E  with A  .

ii) Handshape internal assimilation. Some students in our corpus applied this phonological process to the two-handed asymmetrical sign for the number SIX, which, in its canonical form, is produced with  on the non-dominant hand and  on the dominant hand [fig 9]. In the students' production, the handshape of the non-dominant hand mirrors the handshape of the dominant hand [fig 10].

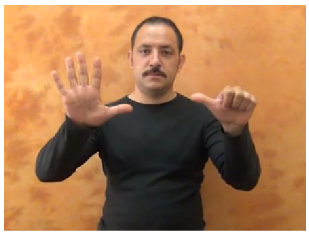

Figure 9. SIX

Figure 10. Student production of SIX

No errors of this type are identified in fingerspelling.

4.2 Movement

In our data, movement follows handshape in the hierarchy of difficulty, with 18% of error occurrence. Movement error types can be grouped into reversed movement (15%) and movement internal assimilation (3%).

i) Reversed movement: this error is observed for the sign VENICE, a two-handed symmetrical sign produced with a forward circular movement [fig 11]. Students produced the sign with an inward circular movement, thus reversing the movement articulation [fig 12].

Figure 11. VENICE

Figure 12. Student production of VENICE

The same error of reversing the movement articulation is observed for signs and fingerspelling displaying a sideward path movement. For instance, the one-handed sign NAME [fig 13] and S-S [fig 15], both displaying an ipsilateral movement, were produced with a movement towards the opposite direction, the contralateral side [fig 14; fig 16].

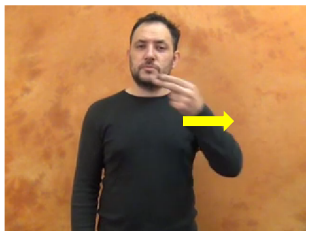

Figure 13. NAME

Figure 14. Student production of NAME

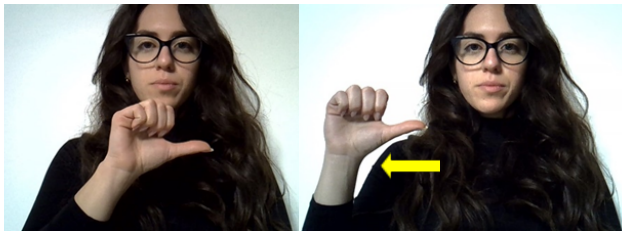

Figure 15. S-S

Figure 16. Student production of S-S

ii) Movement internal assimilation: when producing asymmetrical two-handed signs, some students copied the movement of the dominant hand on the non-dominant hand, thus producing a wrong version of the target sign. This is the case of the sign SEVEN_HUNDRED [fig 17], whose citation form consists of  on the dominant hand, also displaying fingers bending, and  on the non-dominant hand. As a result of the assimilation of the dominant hand internal movement, students produced bending of the fingers on the non-dominant hand as well [fig 18].

Figure 17. SEVEN_HUNDRED

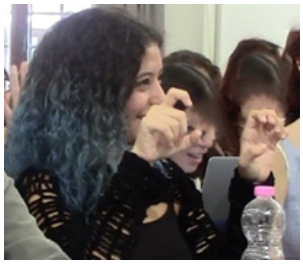

Figure 18. Student production of SEVEN_HUNDRED

No errors of this type are identified in fingerspelling.

4.3 Orientation

As for palm orientation, errors occur in 16% of the instances, either as reversed orientation (10%) or orientation substitution (5%).

i) Reversed orientation: this error is observed with some signs whose palm is oriented toward the signer in their citation form. Students tend to change the palm orientation by facing it outwards. An example is the one-handed sign NOVEMBER [fig 19] represented in the modified version in Figure 20.

Figure 19. NOVEMBER

Figure 20. Student production of NOVEMBER

The data show the same error type in some students' fingerspelling production. For instance, some students produced Y  with the palm facing inward, i.e., toward the signer [fig 21], rather than outward.

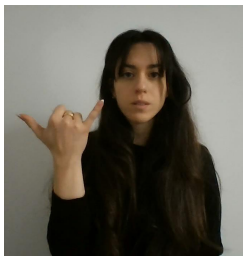

Figure 21. Student production of Y

ii) Orientation substitution: it refers to the students' tendency of replacing the sign orientation with a wrong one. Some students failed in articulating the sign YOU [fig 22], a one-handed sign produced in the neutral space with  and the palm facing the contralateral side. The modified version was produced by some students with the palm facing downwards [fig 23].

Figure 22. YOU

Figure 23. Student production of YOU

The same error is detected in the production of the fingerspelled B  . Some students substituted the target contralateral palm orientation with the palm facing outward [fig 24].

Figure 24. Student production of B

4.4 NMMs

A low percentage of error occurrences characterise NMMs (3%).[6] We find only one error type: LIS first-year students tend to omit phonological NMMs, specifically we observe the omission of mouth gestures (lexically specified in the phonological structure of some signs and thus compulsory in LIS (Ajello, Mazzoni, Nicolai 2001)). We provide an illustrative example of the sign SOFT, obligatorily produced in LIS with protruded lips, puffed cheeks and lowered eyebrows [fig 25], which are absent in the student's production [fig 26].

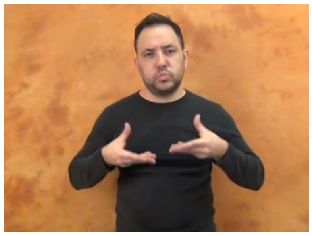

Figure 25. SOFT

Figure 26. Student production of SOFT

5. Discussion

With this study, we aimed at investigating whether novice LIS M2L2 learners' productions are characterised by the same phonological errors attested in the literature on M2L2 learners of other SLs, and providing a qualitative analysis of the detected errors. A further goal was to try to account for the data by identifying which SSLA model best captures our results.

As outlined in § 4, we observe errors in all phonological parameters except for location. Specifically, the data show that handshape is the most difficult parameter to master with an error

[6] We will treat the low error percentage in NMMs with caution, as it may be due to the limited number of signs with phonological NMMs produced by students during classes, rather than to a lower level of difficulty with this parameter.

occurrence of 60%, followed by movement (18%), orientation (16%) and NMMs (3%). The results are consistent with other studies on M2L2 learners (Mirus, Rathmann, Meier 2001; Jissink 2005; Ortega, Morgan 2015; Bochner et al. 2011). Several types of phonological errors have been detected in the students' productions: substitution, reversion and internal assimilation. In what follows, we discuss the phonological errors detected in both lexical signs and fingerspelling against the SSLA models illustrated in § 2.2, noting that some errors support the transfer model, others align with the UG model, and yet others are better accounted for by Rosen's (2004) CPM.

The transfer model seems to capture orientation substitutions in lexical signs involving the substitution of the target orientation with a wrong one. Specifically, the orientation error in the sign YOU (produced by some students with the palm facing downwards) recalls the findings by Ortega (2013) and Chen Pichler (2009; 2011) regarding iconic signs (§ 2.2), as the downward orientation is characteristic of the Italian gesture for the second singular person, thus we analysed it as a negative transfer.

The UG model seems to explain the lack of errors in the location parameter (the first to be acquired by deaf children exposed to SL from birth) and the great difficulty with handshape (the last parameter acquired by L1 signers, § 2.1) in producing both lexical signs and fingerspelling. Moreover, the tendency to substitute the target handshape with an easier one in both lexical signs and fingerspelling, such as the substitution of marked handshapes ( ,  ,  ,  ,  ,  and ) with unmarked ones ( ,  or ), the substitution of handshapes like  ,  ,  ,  with  and the substitution of  with  recalls the acquisitional pattern according to which children acquiring a SL as L1 tend to replace target handshapes with the ones belonging to the same stage of acquisition or an immediately preceding one (§ 2.1). Similarly, the tendency of LIS M2L2 learners to initially omit the required phonological NMMs is in line with the first productions of L1 signers (§ 2.1). These data seem to suggest that L2 learning appears to be supported by the same Universal Grammar that is active during L1 acquisition.

Nevertheless, we agree with Rosen's (2004) claim that while L1 phonological errors may be explained in terms of an immature motor system, the errors detected across M2L2 LIS learners seem to be rather due to difficulties in employing the body for linguistic purposes, such as learning how to correctly select fingers, arrange hands and coordinate movements to produce signs. In other words, despite showing some of the universal trends of L1 acquisition, our data also seem to support the dexterity and perception predictions advanced by Rosen (2004) in his CPM, especially when considering instances of orientation substitution in fingerspelling, handshape internal assimilation and movement internal assimilation in lexical signs.[7] Furthermore, errors such as reversed movement and reversed orientation in both lexical signs and fingerspelling seem to correspond to those called by Rosen as movement mirrorisation and parallelisation of palm orientation. Specifically, movement mirrorisation in ASL learners is attributed to the fact that students reproduce the teacher's signs using a mirror effect (§ 2.2). In our study, however, the teacher is left-handed, while the students are right-handed. If the same mirror effect was present in our LIS students, we would have expected a faithful reproduction of the signs, yielding no reversed movement errors. Thus, regardless of the presence or absence of the mirror effect, learners may struggle to mentally rotate the sign produced by the teacher

[7]Since LIS fingerspelling is a one-handed system (Meir 2012), our data do not show handshape or movement internal assimilation within fingerspelling.

in front of them, and may opt for reproducing the sign from the teacher's perspective, rather than from their own, due to the cognitive cost required to correctly perceive and reproduce the sign.

From a crosslinguistic perspective, the typologies and frequencies of errors detected in this study replicate the patterns described for other SLs, suggesting that they may characterise the process of sign language acquisition in M2L2 students in general. Further in-depth research into the acquisition of SLs as L2 is needed in order to confirm these preliminary observations.

6. Conclusions

In this paper, we present a first exploratory study on the acquisition of LIS as M2L2 by first-level students. Although preliminary, the collected data has allowed us to contribute to the existing literature on SSLA at both the empirical and theoretical level.

At the empirical level, we provide a description of the error types detected for each phonological parameter (except for location) emerging during LIS M2L2 learners' productions, namely: substitution, reversion and internal assimilation. Errors' frequency shows that handshape is the most difficult parameter to master, while location is the most accurate. Interestingly, these results replicate the patterns attested in the literature for other SLs. At the theoretical level, we propose that in the context of M2L2 LIS acquisition, the transfer and UG models equally contribute to account for the observed error types. However, other factors strictly related to the process of learning a language in a new modality, such as fine motor skills involved in hand coordination and body movement, visual attention to phonological features, and mental rotation abilities, also seem to have a crucial impact on LIS L2 acquisition, thus aligning with Rosen's (2004) CPM. We conclude that our data provide evidence that learners' error types cannot be accounted for by a single model, but rather call for an integration of the three theoretical approaches proposed in the SSLA literature.

Future research is needed to deepen our understanding of the stages and error types involved in SLA in a different modality, potentially comparing M1L2 deaf learners with M2L2 ones. Research in the field of L2 sign language acquisition is crucial not only to foster theoretical knowledge, but also to feed educational programs for SL teachers.

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