University of Haifa (haifaisr) IP: 132.74.189.192 On: Sat, 12 Aug 2023 07:06:09

Word order in simple sentences of tri-lingual tri-modal deaf students*

Rama Novogrodsky[1], Rose Stamp[2] and Sabrin Shaban-Rabah[1]
[1] University of Haifa | [2] Bar Ilan University

This study explores word order patterns produced by deaf students who use Israeli Sign Language (ISL) and Arabic. Nineteen students participated in a sentence elicitation task in which they retold events portrayed in 24 short videos in three language conditions: signed ISL, spoken Palestinian Arabic and written Modern Standard Arabic. A control group of 19 hearing students was tested in the two Arabic conditions. Results showed that SVO word order was the most frequent in both groups, and in all three languages. SOV word order, which is common in ISL but ungrammatical in Arabic, was produced only by the deaf group. Finally, unique word orders, specific to the signed modality were produced only in the ISL condition. The findings suggest that deaf students are sensitive to the syntactic structures of each language they use and show natural cross-linguistic interaction in their language use.

Keywords: bimodal bilingual, cross-linguistic interaction, word order, syntax, Israeli Sign Language, Arabic

1. Introduction

There is growing literature which supports the advantage of bilingual (signed[1] and spoken/ signed and written) educational approaches for good literacy outcomes for deaf students (e.g., Dammeyer 2014; Hoffmeister et al. 2022; Marschark et al. 2009; Mayberry et al. 2011; Novogrodsky et al. 2014; Strong & Prinz 1997). Yet, deaf students show difficulties in the acquisition of syntax (e.g., Friedmann

* The first and second authors declare equal contributions.

1. The term 'signed language' is used throughout the manuscript, unless we are referring to a specific signed language.

https://doi.org/10.1075/sll.22002.nov | Published online: 25 July 2023
Sign Language & Linguistics ISSN 1387-9316 | E-ISSN 1569-996X © 2023 John Benjamins Publishing Company

University of Haifa (haifaisr) IP: 132.74.189.192 On: Sat, 12 Aug 2023 07:06:09

et al. 2008; Tuller & Delage 2014; Wimmer et al. 2017), in spoken (e.g., Friedmann et al., 2008) and written language (Antia Reed & Kreimeyer 2005; Lederberg et al. 2019; Quigley & King 1980). This is often attributed to language deprivation (e.g., Henner et al. 2018; Hall, Levin, & Anderson 2017). The term language deprivation relates to the language acquisition conditions experienced by deaf children, due to reduced opportunities for incidental hearing (resulting from inconsistent spoken language input), and exposure to inconsistent signed language models. Note that most of these studies tested children from oral programs (those who do not use a signed language), who are therefore monolingual. Deaf children who use signed language are bilingual,[2] and therefore their language fluency is affected by several different factors including age of acquisition, home language, and amount of exposure (Hirosh & Degani 2018; Lederberg et al. 2019; Novogrodsky & Meir 2020a).

The current study investigates word order patterns in a unique population of multilingual deaf students who grow up in a diglossic Arabic language environment and additionally use Israeli Sign Language (ISL). The diglossic language under investigation in the current study is Arabic in which there are two varieties: Palestinian Arabic (hereafter, PA), which is used in daily interactions, and Modern, which is used in daily interactions, Standard Arabic (hereafter, MSA), which is used mainly for reading, writing and formal oral interactions (Saiegh-Haddad 2012). In the spoken variety, the dominant word order is Subject Verb Object (SVO) and, in contrast, in the written variety, MSA, the dominant word order is VSO, though SVO order is also grammatical and frequent (Attia 2008; Shlonsky 1997). In addition, the students who participated in the current study use ISL, which has a more flexible word order, influenced by a number of different factors (see section "Word order in signed languages" below).

With the aim to learn about **sensitivity to word order** by multilingual deaf students, we examined simple sentence productions by school-age deaf students in three languages and three modalities: ISL in the signed modality, PA in the spoken modality, and MSA in the written modality. The sentence responses in PA and MSA were compared to the responses produced by a control group of hearing students. Furthermore, within the deaf group, we compared the word orders produced across the three languages and tested for the effects of animacy[3] and child internal factors (e.g., hearing status, age, and language background in ISL).

---

2. Some deaf children who use a signed language acquire the surrounding spoken language only via the medium of reading and writing, and not through spoken communication. These children are also considered to be bilingual and bimodal (e.g., Hoffmeister & Caldwell-Harris 2014).

3. Animacy is a grammatical and semantic feature, expressing how sentient or alive the referent of a noun is (e.g., a child is animate and a ball is inanimate).

1.1 Word order in PA and MSA

The degree of exposure to each language is an important factor in the acquisition of syntax for multilingual children (Novogrodsky & Meir 2020b; Thorndyke 1977). For example, Thordardottir (2015) examined spontaneous language samples produced by typically-developing bilingual (English and French) and monolingual preschoolers and found that grammatical development in each language was strongly affected by the amount of same-language experience. Children with unequal exposure showed similarly unequal performance across languages and scored significantly lower than monolinguals in their weaker language. The findings emphasize the importance of understanding the language background of multilingual children.

In diglossic contexts, such as Arabic, there are two language varieties: one referred to as the Low variety and the other referred to as the High variety (Ferguson 1959). Typically, hearing children acquire the spoken language, the low variety, similarly to children acquiring any spoken language in a non-diglossic condition. MSA, the high variety, is used mainly in written texts and formal oral interactions (Saiegh-Haddad 2012). Linguistic differences between the two language varieties are present at all levels of the language (Saiegh-Haddad & Henkin-Roitfarb 2014); for example, 40% of the words are specific to each language variety. While children (both hearing and deaf) are exposed to MSA incidentally inside and outside of school, the syntactic structures of MSA are taught formally in school (Khamis-Dakwar Froud & Gordon 2012; Saiegh-Haddad & Spolsky 2014). For example, plural marking, WH-question forms and yes/no questions are taught in first grade, and the VSO word order is taught in third grade (Khamis-Dakwar Froud & Gordon 2012).

For the purpose of the current study, we focus only on the syntactic level. At this level, differences are found in terms of word order, negation and other syntactic features across the two language varieties. For Arabic speaking children, learning the unique syntactic structures of MSA is similar to learning the syntax of a new language. One prominent syntactic difference, which we examine here, is word order. SVO is the unmarked and most frequent word order in several different dialects of PA. In contrast, VSO is the unmarked word order in MSA (Shlonsky 1997), however, more freedom is allowed, thus word orders such as SVO, OVS and VOS are also possible in MSA, but are usually less frequent than VSO (Attia 2008; Parkinson 1981). Parkinson (1981) suggested that there is evidence of language change in terms of word order patterns, such that Arabic users produce more SVO sentences in MSA than is reported in the literature. In a study of written texts of MSA, Pashova (2003) showed more SV than VS word orders,

University of Haifa (haifaisr) IP: 132.74.189.192 On: Sat, 12 Aug 2023 07:06:09

University of Haifa (haifasr) IP: 132.74.189.192 On: Sat, 12 Aug 2023 07:06:09

suggesting that the use of SV in MSA is related to pragmatic aspects (e.g., SV order is more extensively used to mark the transition of the S from non-topic to topic).

Research shows that the syntactic discrepancy between PA and MSA has an effect on children's performance in different linguistic tasks, leading to an advantage in PA tasks (Faour 2019; Khamis-Dakwar Froud & Gordon 2012). In one study, school-age children scored higher on a syntactic judgment task including features specific to PA, compared with MSA, or features shared in both language varieties (Khamis-Dakwar Froud & Gordon 2012). In another study, Arabic-speaking children aged 5–6 produced longer stories in a retelling task in the PA-PA (told in PA, retold in PA) condition compared with the other two conditions, MSA-MSA or MSA-PA (Faour 2019). In addition, some syntactic structures which distinguish the two language varieties are shown to be easier in PA than in MSA (e.g., suffixes of object pronouns). Faour (2019) suggested that when children are young (e.g., 5–6 years), they are more proficient in PA than in MSA.

To summarize, for students, MSA is similar to the acquisition of an L2. In other words, they are more proficient in PA syntactic structures compared with MSA syntactic structures due their increased linguistic experience with PA.

1.2 Word order in signed languages

Word order in signed languages is relatively flexible. Of the six possible word orders (when describing a transitive event that takes an agent/subject (S), object (O) and relation/verb (V)) – SVO, SOV, OSV, OVS, VSO and VOS – all six are observed in at least some of the world's languages (Dryer 2013).[4] Despite this, there is a strong preference towards certain word orders in signed languages; SOV and SVO are most common (Dryer 2013; Meir et al. 2017; Napoli & Sutton-Spence 2014). In their review study, Napoli and Sutton-Spence (2014) compared the dominant word order in 42 signed languages and concluded that SV is dominant in intransitive sentences (see example 1 below), and SOV (example 2) or SVO (example 3) are dominant for transitive sentences. Examples of SVO signed languages include American Sign Language, Brazilian Sign Language, and Hong Kong Sign Language. Examples of SOV signed languages include German Sign Language, Japanese Sign Language, and Italian Sign Language. Note that verbs show agreement with their arguments and this partially contributes towards the

4. Dryer uses the term 'dominant word order' for the most frequent word order, which we adopt here, rather than the term 'basic word order'.

flexibility in word order (Meir 2002).[5] In a study comparing the word orders in three young signed languages (Israeli Sign Language, Kufr Qassem Sign Language, and Al Sayyid Bedouin Sign Language) and in three invented gestural systems (produced spontaneously by speakers of Hebrew, Arabic, Turkish), Meir and colleagues (2017) found more use of OSV word order and less use of SOV word order in clauses with human objects (versus inanimate objects). The authors concluded that human arguments are introduced before inanimate arguments ('human first') and that word order patterns vary depending on whether the subject and object are human.

(1) BOY RUN[6] (ISL)
'the boy runs'

(2) GIRL BOX THROW (ISL)
'the girl throws the box'

(3) GIRL THROW BOX (ISL)
'the girl throws the box'

Other word orders have also been reported, which seem to be specific to signed languages, such as SVOV or SVSV. In some cases, this is described as a verb sandwich, in which the two verbs produced indicate the same action (4) (Fischer et al. 1990; Matsuoka 1999; Napoli & Sutton-Spence 2014). Typically, as mentioned by Napoli and Sutton-Spence (2014), the first verb is produced with no inflections while the second one shows aspectual marking. In other examples, the two verbs may be different and represent two perspectives of the same action, as in (5). These particular constructions have been noted in ISL (Meir et al. 2017) and in Nicaraguan Sign Language (NSL) (Flaherty 2014).

(4) GIRL TEAR PAPER TEAR (NSL)
'the girl tears the paper'

(5) BOY RIDE GIRL CRAWL (ISL)
'the boy rides and the girl crawl'

5. However, see Kimmelman (2012) – in Russian Sign Language, he found that for sentences with plain and agreeing verbs, SVO word order was used, while with sentences using classifier constructions, SOV order was used.

6. Lexical signs are presented with English glosses shown in small capital letters. The gloss is the nearest equivalent English word to represent the sign's meaning. For example, the gloss BOY refers to a specific sign that represents the concept of a 'boy'. Some lexical signs can be viewed at the following website: https://asl-lex.github.io/isl-lex/index.html (for an overview of the website see Morgan et al. 2022).

University of Haifa (haifaisr) IP: 132.74.189.192 On: Sat, 12 Aug 2023 07:06:09

University of Haifa (haifaisr) IP: 132.74.189.192 On: Sat, 12 Aug 2023 07:06:09

A number of factors affect word order in signed languages. We focus here on the effect of animacy of the object (e.g., 'the boy pushes the girl' vs. 'the boy pushes the chair'), which is one variable in the current study. Meir et al. (2017) showed that sentences with animate objects are more often produced in SVO order and sentences with inanimate objects are more often produced in SOV order. Production of gestures by hearing participants supports this claim (Hall et al. 2013; Meir et al. 2010). Hearing sign-naïve participants produced SOV word order when the object presented to them was inanimate (and they had to gesture the concept to another participant) and SVO word order when the object presented to them was animate. In a study, using a similar stimulus for elicitation to the current study, Morgan (2020) investigated word order in Kenyan Sign Language. She found that the subject was most often produced in first position (91.6%), similar to Meir et al.'s study (2017). Furthermore, in simple transitive sentences with one person and one inanimate object, SOV was most frequent, and in simple transitive sentences with two people (representing animate objects), SVO and SOV were produced in equal proportions. She also explored ditransitive sentences (with verbs that take two internal arguments, see examples 8 and 9 in the Methods section). In sentences with two people, one in subject position and one in object position, and an additional object, the animate objects were produced after the verb while the inanimate objects were produced before the verb, leading to an SOVO word order. This animacy effect has been attributed to the fact that in animate sentences the positioning of the verb disambiguates the direction of the action, which is otherwise understood in inanimate sentences through the semantics (e.g., 'the dog eats a bone' is unlikely to be confused with 'the bone eats the dog' and therefore either SVO or SOV word orders are acceptable).

The choice of word order in signed languages has been attributed to language contact by some scholars (Gell-Mann & Ruhlen 2011; Givón 1987; Vennemann 1975). In a study of a signed language used in Providence Island, Colombia, deaf signers showed a preference for verb-final with no consistent order between agents (S) and patients (O). Hearing signers with deaf family members favored the verb in final position (SOV) (64%) more than those without deaf family members (23%) (Washabaugh 1986). It was suggested that signers in this case were influenced by the word orders of the surrounding spoken and written languages (Meir et al. 2017; Washabaugh 1986).

In sum, signed languages tend to have flexible word orders, although two dominant word orders exist: SOV and SVO. Their use is not random, and is subject to language internal effects, such as animacy of the object and verb class, as well as language external effects, such as contact with spoken or written languages.

1.3 Acquisition of word order by deaf children

The acquisition of word order patterns in signed languages is claimed to follow the same acquisition path as those found in spoken languages (Chen Pichler 2002; Lillo-Martin & Henner 2020). For example, deaf children between the ages of 20–30 months acquire various word orders in simple sentences in American Sign Language (Chen Pichler 2002). Similarly, deaf children exposed to the Sign Language of the Netherlands from birth master different word orders from around the age of 25 months (Coerts et al. 2000; Coerts & Mills 1994). In a recent study on ISL, native signing toddlers aged 8–36 months moved through the developmental trajectory from one-sign productions to simple and complex sentence productions, and by 36 months toddlers had acquired a range of word orders common to ISL (Novogrodsky & Meir 2020b). During school years, children acquire more complex sentences including topic structure and WH-questions with duplication of the WH signs (Peer et al. 2023). With age, children's sensitivity to word order increases. For example, in a task including both simple and complex sentences representing different word orders in American Sign Language (including topicalization, complement, relative clause, verb agreement, negation, conditionals, WH-questions, and rhetorical questions) children's performance improved with age (Novogrodsky et al. 2017).

In spoken language studies, it was shown that school-age deaf children experience difficulties in the acquisition of syntax, specifically complex sentences with non-canonical word order (e.g., Friedmann at el. 2008; Tuller & Delage 2014; Wimmer et al. 2017). This is shown also for deaf school-age Arabic-speaking children both in sentence comprehension and production tasks (Daoud & Novogrodsky 2023; Friedmann et al. 2010) and in narrative tasks, in both PA and MSA (Kawar et. al. 2019; Novogrodsky & Maalouf-Zraik 2022).

Finally, the influence of spoken and written languages on the word order patterns in signed languages has been discussed in a number of studies (e.g., Fischer 2014; Meir et al. 2017; Washabaugh 1986). Importantly, language interaction like this is bidirectional, such that signed language may influence children's production in spoken and written languages, and spoken and written languages may influence children's production in signed languages (Stamp et al. 2021; Wolbers et al. 2014). For example, deaf and hard of hearing adolescents showed transfer of American Sign Language lexical and syntactical features into their English writing (Wolbers et al. 2014). The degree of cross-linguistic transfer is also dependent on a range of different factors, including the amount of language overlap (e.g., Austin 2007; Haznedar 2007; Hulk & Müller 2000), the domain of transfer (e.g., syntactic; Argyri & Sorace 2007; Haznedar 2007), language dominance (e.g., Foroodi-Nejad & Paradis 2009; Kidd et. al. 2015), and the child's age (e.g., Döpke 1998;

University of Haifa (haifaisr) IP: 132.74.189.192 On: Sat, 12 Aug 2023 07:06:09

University of Haifa (haifasr) IP: 132.74.189.192 On: Sat, 12 Aug 2023 07:06:09

Müller & Hulk 2001; Paradis & Genesee 1996). For age, included as a variable in this study, the results have been contradictory. Some studies show that the effects of cross-linguistic transfer decrease with age (e.g., Döpke 1998; Müller & Hulk 2001; Paradis & Genesee 1996), while others show that cross-linguistic influence is part and parcel of being bilingual and therefore, there is no relationship between the effect size of cross-linguistic transfer and age (van Dijk et al. 2022).

The Israeli deaf community,[7] which is under investigation in the current study, is in contact with multiple spoken languages. In general, deaf children in Israel are exposed to the spoken languages of their community (Hebrew or PA) in spoken and written forms to varying degrees. Deaf signing students from Arabic-speaking communities are exposed to three languages: ISL, PA and MSA. Specifically, deaf children are exposed to MSA through the media and literacy input, with limited exposure due to their lack of hearing. In addition, deaf children learn Hebrew and English to varying degrees of proficiency during their school years.

Language interaction is a complex process. For example, the type of language model to which children are exposed can affect it. In the Methods section, we describe the language background of our participants (see Table 1), however the real language situation is far more complex.

The current study explored word order patterns in simple sentences produced by deaf trilingual students who use ISL, PA, and MSA. First, we compared word order patterns produced by deaf and hearing students in the following two language varieties: PA and MSA. We predicted that hearing students would produce more SVO sentences in PA than in MSA, and more VSO sentences in MSA than in PA. We further predicted that deaf students might not show the same preference. Note that the students in the current study were upper elementary (third grade and older), which is the age VSO is formally taught in school. Second, for our deaf group who produced ISL sentences, we expected to find an animacy effect, showing a preference for SOV word order in inanimate sentences and SVO word order in animate sentences, as well as word orders unique to ISL. Finally, in our deaf group, we explored examples of language interaction, focusing on how word order preference in one language may affect word order preference in another language. Specifically, we looked at the presence of word orders unique to ISL, such as SOV, SVOV, and SVSV, in their productions of PA and MSA.

7. Most use ISL, however, there are smaller communities who use village sign languages in Israel (Meir and Sandler 2007), including those in Kufr Qassem, Al Sayyid, Abu Kaf and Ein Mahil.

2. Methods

2.1 Participants

Thirty-eight students were recruited from the North of Israel; they all used the same dialect associated with the area around the city of Nazareth. They were recruited through personal connections and parents provided signed informed consent for participation.

Deaf students. Nineteen tri-lingual[8] and tri-modal school-age congenitally deaf students (11 males, 8 females), ranging in age from 11:08–21:00 participated in this study. They all attend special classes for deaf children, and they use ISL and PA for daily communication and MSA mainly in its written form in school-related activities. All students use bilateral hearing devices, either hearing aids, cochlear implants or a combination of the two. Thirteen students came from families with deaf relatives, most of them first-degree relatives (see Table 1 for students' characteristics).

Hearing students. Nineteen bilingual (PA and MSA) students (8 males, 11 females), ranging in age from 8–14, participated in this study. They all have typical hearing and no reported developmental disorders, based on parental reports. In atypical acquisition studies, language delay is observed (Novogrodsky & Kreiser 2015) and thus the hearing group included a younger age range compared to the deaf group, however, age was not found to be significant across groups (see Results section).

In addition, 20 hearing Palestinian Arabic-speaking adults participated in this study and served as a control group for typical adult production. The Ethics Committee at the University of Haifa approved this study.

Table 1. Characteristics of the deaf students ($n = 19$)

Age (years: months)	Gender F/M*	Hearing-Loss	Hearing device for each ear*	Deaf relatives
11:08	M	Profound	CI+CI	None
12:04	M	Severe	HA+HA	Parents & brothers
12:04	M	Severe	HA+HA	Second-degree relatives
13:03	M	Severe	HA+HA	Second-degree relatives
13:04	M	Profound	CI+CI	None

8. We explored ISL, PA and MSA but note that these students learn also Hebrew and English in school, thus the most appropriate term to describe their language situation is multilingual.

University of Haifa (haifaisr) IP: 132.74.189.192 On: Sat, 12 Aug 2023 07:06:09

Table 1. *(continued)*

Age (years: months)	Gender F/M*	Hearing-Loss	Hearing device for each ear*	Deaf relatives
13:10	M	Profound	CI+CI	Brother
13:10	M	Severe	HA+HA	None
14:04	F	Profound	CI+CI	Father and sister
15:04	M	Severe	CI+CI	Brother
15:06	F	Severe	HA+HA	None
16:03	M	Severe	HA+HA	Brother
18:09	M	Profound	CI+CI	Brother
19:03	F	Severe	HA+HA	Brother
19:09	F	Severe-Profound	CI+HA	Father and brother
20:00	F	Profound	CI+HA	Sister
20:00	F	Profound	CI+HA	Sister
20:03	M	Profound	CI+CI	None
20:04	F	Severe	HA+HA	Brother
21:00	M	Severe	HA+HA	None

* F=female, M=male; CI=Cochlear-Implant; HA=Hearing Aid;

University of Haifa (haifaisr) IP: 132.74.189.192 On: Sat, 12 Aug 2023 07:06:09

2.2 Materials

The stimuli consisted of 24 short videos in which one event occurs. All target sentences could be described using a simple sentence with an accusative verb (a verb that describes an event and takes one or two arguments). Eight sentences described an event with two arguments (examples 6 and 7) and sixteen described an event with three arguments (8 and 9). Of the sentences with two arguments (8 sentences), 4 included animate objects, e.g., 'girl' (example 6) and 4 included inanimate objects, e.g., 'paper' (example 7), and of the sentences with three arguments (16 sentences), 8 sentences included one animate object, e.g., 'man' and one inanimate object, e.g., 'shirt' (example 8) and 8 included two inanimate objects, e.g., 'ball', 'closet' (example 9). Examples of the target sentences are shown below:

(6) A boy combs a girl's hair[9] (two arguments, animate object).

(7) A girl tears a piece of paper (two arguments, inanimate object).

9. Note that in Arabic, the object is produced as a single word, 'girl' and in ISL as GIRL-HAIR.

(8) A woman gives a shirt to a man (three arguments, inanimate object + animate object).

(9) A boy puts a ball in a closet (three arguments, two inanimate objects).

2.3 Procedure

Students watched 24 short videos and after each one, they were asked to describe what they saw. The order of clips was initially randomized and the same order was kept across students and tasks. Three language modalities were tested: signed ISL, spoken PA and written MSA. Instructions were given in PA for all three tasks by a researcher who is a native PA speaker (students could also rely on speechreading, which was accessible to all students). The use of PA in the instructions may result in more influence from PA in the students' responses than any of the other languages. This is one limitation of the study; however, it was important to provide the instructions in the most accessible language to the students. Students were familiar with the person who gave the instructions; she is a speech and language therapist with nine years of experience with ISL.

The responses for the signed and spoken tasks were video-recorded and the responses for the MSA task were written down by the students in a notebook. Deaf students were tested in two separate meetings, in the first meeting they were tested in ISL and in the second one, in PA and MSA. The aim of this procedure was to avoid the effect of Arabic (MSA and PA) on the signed modality. Hearing students were tested in one meeting in both PA and MSA. In both groups, the ordering of these two conditions was counterbalanced across participants, half of the students started with PA and half started with MSA. This ensured that the ordering effect, or priming of one language on another, was not the same for all participants and therefore any differences found could not be attributed to this.

2.4 Coding schema

Since the focus of the current study is on word order, we excluded any sentences which were incomplete. These included sentences missing the subject, object, or verb (see Stamp Novogrodsky & Shaban-Rabah 2021 for more information on argument omissions). The third author of the paper, who is a native speaker of PA, coded the PA and MSA productions. ISL productions were coded by the second author, a linguist who studies ISL. These judgments were confirmed by three deaf native ISL signers (one of them is an Arabic speaker and the other two are Hebrew speakers). We coded the order of signs/words in terms of the Subject, the Object, and the relation between them (Verb), as they appeared in the

University of Haifa (haifaisr) IP: 132.74.189.192 On: Sat, 12 Aug 2023 07:06:09

University of Haifa (haifaisr) IP: 132.74.189.192 On: Sat, 12 Aug 2023 07:06:09

productions describing the events of the videos. The responses varied in terms of how each child interpreted the event, some were more detailed than others, for example. We followed Meir and colleagues' (2017) coding system for word order analysis in signed languages and replicated the system in MSA and PA. Direct and indirect objects were coded as objects regardless of the nature of the object. This method was used because it is not clear whether the distinction between direct and indirect objects should be based on semantic or syntactic criteria and the syntax may differ from one language to another (Kimmelman 2018; Meir et al. 2017). When students produced more than one response to describe a video clip, we analysed the word order of the first response. When self-corrections occurred (that is, when the first response was partial), the subsequent response was analyzed only.

Below is a detailed description of the coding scheme:

A. Multiple consecutive signs/words within a clause referring to the same referent or action were treated as belonging to the same constituent. In the following example for a video in which a girl feeds her father, the signs glossed as GIRL SMALL GIRL were coded as Subject:
[GIRL SMALL GIRL]$_S$ [FEED]$_V$ [FATHER POSS:HER]$_O$ (produced in ISL)
'A small girl feeds her father.'

   Signs/Words denoting locations (such as SOFA, ROOM) or function signs/words (such as HIS, HER, WITH, IN) were not counted.

B. In multiple clause productions, we coded and analysed the word orders of each clause separately (see Table 2 below). For example, in the video showing 'the girl takes the book from the boy', some students produced this as two clauses with a conjunction:
Il-walad ʔiri: li-kta:b, w-il-binit ʔažat ʔaxad^{h}atu minnu (produced in PA)
[the-boy]$_S$ [read]$_V$ [the-book]$_O$ [and-the-girl]$_S$ [take-it]$_{VO}$ [from him]$_O$

   The first clause was coded as SVO and second clause as SVOO.

C. A response that contained a verb referring to both an animate human object and an inanimate object was analysed twice, once for each object. For example, in the video showing 'the boy throws a box to a girl' each object was coded separately:
BOY BOX THROW GIRL (produced in ISL)
'The boy throws the box to the girl.'

   The response was coded as SVO for the animate human object [BOY]$_S$ [THROW]$_V$ [GIRL]$_O$, ignoring the 'box' and as SOV for the inanimate object: [BOY]$_S$ [BOX]$_O$ [THROW]$_V$, ignoring the 'girl'.

D. In responses containing two verbs:
   - If the two verbs were identical (GIVE-GIVE) or semantically related (partial synonyms, as in TAKE-GRAB); it was analysed as SVOV:
     $[\text{GIRL}]_S\ [\text{TAKE}]_V\ [\text{BOOK}]_O\ [\text{GRAB}]_V$ (produced in ISL)
     'The girl takes the book.'
   - If each entity sign denoted the agent of the action, yet there was no prosodic break,[10] it was analysed as SVSV:
     $[\text{BOY}]_S\ [\text{RIDE}]_V\ [\text{GIRL}]_S\ [\text{CRAWL}]_V$ (produced in ISL)
     'The boy rides on the the girl's back.'

Because of the scarcity of these word orders ($n=39$), they were collapsed into a single category, SVXV, following Meir and colleagues (2017). While it may be interesting in future studies to consider the distribution of each of these word orders, this was beyond the focus of this study.

3. Results

Two word orders (OSV or VOS) were not found in our study. The remaining word orders were found in the data:

- SVO (e.g., [the-man read the-book] produced in PA).
- SOV (e.g., [MAN COAT WEAR] produced in ISL).
- VSO (e.g., [wash the-guy the-dishes] in MSA).
- SVXV (e.g., [BOY RIDE GIRL CRAWL] produced in ISL, meaning 'A boy rides a girl', and they were divided according to whether the object referred to animate (human) or inanimate argument. Because only a small number of tokens of SVOV and SVSV were found, the two categories were conflated into SVXV.

For each student, we counted the total number of responses produced with animate and inanimate arguments with each of our four word orders.

The distribution of word orders in the three languages is shown in Table 2. Note that in PA and MSA, hearing students produced more multiple clauses than deaf students, which were coded and counted separately in both PA and MSA (see Coding schema B above). This finding is shown in Table 2 in higher total scores

10. Prosodic breaks in ISL were determined based on manual signals, such as pauses, holds and reduplications (Nespor & Sandler 1999).

University of Haifa (haifaisr) IP: 132.74.189.192 On: Sat, 12 Aug 2023 07:06:09

(across the different word orders) for the hearing group compared with the deaf group in PA and MSA.

Table 2. Raw frequency of word orders, by language and hearing status

Hearing status	Language	SVO	SOV	VSO	SVXV	Total
Hearing	PA	556	0	35	0	591
	MSA	573	0	66	0	639
	Total	**1129**	**0**	**101**	**0**	**1230**
Deaf	PA	494	34	0	1	529
	MSA	516	30	0	0	546
	ISL	322	120	0	38	480
	Total	**1332**	**184**	**0**	**39**	**1555**

University of Haifa (haifaisr) IP: 132.74.189.192 On: Sat, 12 Aug 2023 07:06:09

Two statistical analyses were conducted, one with the data from our deaf and hearing students together to explore their productions in PA and MSA, since both groups completed the same tasks. A second analysis explored the word orders produced in ISL, PA and MSA for our deaf group alone. For both analyses, to investigate the relationship between word order (SVO, SOV, VSO, SVXV) and language (ISL, PA, MSA), animacy (animate, inanimate), hearing status (deaf, hearing), and age (as a continuous variable, with each individual age), we carried out multivariate statistical analyses of the data using Rbrul. We ran the data in four separate analyses, each with the dependent variable of word order: (1) SVO (vs. SOV+VSO+SVXV), (2) SOV, (3) VSO, and (4) SVXV respectively. In addition, we included participants and stimulus items as random effects. The inclusion of these two variables enabled us to account simultaneously for student-specific and stimuli-specific variability. Table 3 presents the results, including the log-odds, number of tokens analysed, percentage of sentences produced in this particular word order and the centred weight for each factor (with each word order as the application value). Results with a positive log-odd and a factor weight over 0.5 indicate that this factor results in an increased likelihood that this word order will be present (highlighted in bold in Tables 3 and 4) while a negative log-odd and a factor weight below 0.5 indicate decreased likelihood that this word order will be present in the data.

In the first analysis, including deaf and hearing students, we looked at their word orders produced in the PA and MSA tasks. Of the 2305 tokens analysed, 2139 (93%) were SVO, 64 SOV (3%), 101 VSO (4%), and 1 SVXV (0%). For SVO, we found significant main effects of animacy ($p = .0143$) and language ($p = .0404$). The findings showed that SVO word order was more likely in the PA condition (fac-

tor weight 0.574). Moreover, SVO word order was more likely for sentences with animate objects for all three languages (0.607) (e.g., for the video 'A girl feeds *a man*'). For SOV (SOV vs. SVO+VSO+SVXV), the findings showed the opposite effect ($p = .00829$). SOV word order was more likely with inanimate objects in all three languages (0.628) (e.g., for the video 'a girl tears *a paper*'). SOV was also preferred in our deaf group (> 0.999) more so than in our hearing group (< 0.001). Finally, language was a significant predictor of VSO word order ($p < 0.001$). VSO word order was preferred in the MSA condition (0.88) more so than the PA condition (0.12). The SVXV word order was not analyzed here as there was only a single token produced. Age was not significant in any of the analyses.

Table 3. Rbrul Results: Word order preferences as produced by deaf and hearing students

Dependent	Factor	Factor group	Tokens	Percentage	Log odds	Factor weight
SVO	Animacy	Animate	753	93.2%	0.434	0.607
		Inanimate	1552	92.6%	−0.434	0.393
	Language	PA	1120	93.8%	0.296	0.574
		MSA	1185	91.9%	−0.296	0.426
SOV	Animacy	Inanimate	1552	3%	0.522	0.628
		Animate	753	2.3%	−0.522	0.372
	Hearing status	Deaf	1075	6%	11.416	>0.999
		Hearing	1230	0%	−11.416	<0.001
VSO	Language	MSA	1185	5.6%	1.994	0.88
		PA	1120	3.1%	−1.994	0.12

Only the deaf students completed the task in the ISL condition and so this was analysed separately from the hearing group, however, in order to look at language interaction effects, we looked at all three language conditions produced by our deaf group. A total of 1,555 tokens were analyzed in our second analysis (see Table 4). Our findings revealed that language ($p < 0.001$) and animacy ($p < 0.001$) were significant predictors of SVO word order. SVO was preferred in MSA (factor weight 0.73) and PA conditions (0.68) compared to ISL and in animate sentences for all three languages (0.721) compared to inanimate sentences. Likewise, for SOV, language ($p < 0.001$) and animacy ($p < 0.001$) were significant predictors of this word order, in the reverse pattern. SOV was preferred in the ISL condition (0.78) compared to PA and MSA conditions and with inanimate sentences in all three conditions (0.731) compared to animate sentences. Finally, language ($p < 0.001$) and age ($p = 0.0365$) were significant predictors of SVXV word order;

University of Haifa (haifaisr) IP: 132.74.189.192 On: Sat, 12 Aug 2023 07:06:09

SVXV was preferred in ISL (>0.999) and PA (0.983) more so than in MSA (<0.001) and the presence of SVXV word order decreased with age.

Table 4. Rbrul Results: Word order preferences as produced by deaf students only in all three conditions

Dependent	Factor	Factor group	Tokens	Percentage	Log odds	Factor weight
SVO	Language	**MSA**	**546**	**94.5%**	**0.993**	**0.73**
		PA	**529**	**93.4%**	**0.755**	**0.68**
		ISL	480	67.1%	−1.748	0.148
	Animacy	**Animate**	**528**	**91.9%**	**0.95**	**0.721**
		Inanimate	1027	82.5%	−0.95	0.279
SOV	Language	**ISL**	**480**	**25%**	**1.266**	**0.78**
		PA	529	6.4%	−0.539	0.368
		MSA	546	5.5%	−0.727	0.326
	Animacy	Animate	528	4.2%	−1.002	0.269
		Inanimate	**1027**	**15.8%**	**1.002**	**0.731**
SVXV	Language	**ISL**	**480**	**7.9%**	**8.536**	**>0.999**
		PA	**529**	**0.2%**	**4.084**	**0.983**
		MSA	546	0%	−12.620	<0.001
	Age	+1			−0.21	

Finally, since both hearing and deaf students did not produce VSO word order in the written modality as predicted, we tested 20 hearing adults, using the same task. Interestingly, we found that adults also produced predominantly SVO word order in the spoken modality (92% SVO, 8% VSO), and also in the written modality (73% SVO, 27% VSO). See Table 5 for raw frequencies of word orders produced by hearing adults.

Table 5. Raw frequency of word orders produced by twenty hearing adults

Language	SVO	SOV	VSO	SVXV	Total
PA	232	0	21	0	253
MSA	169	0	61	0	230
Total	**401**	**0**	**82**	**0**	**483**

University of Haifa (haifaisr) IP: 132.74.189.192 On: Sat, 12 Aug 2023 07:06:09

4. Discussion

The findings showed that SVO word order was preferred in both groups and in all three languages. Note that MSA was tested in the written modality and all students were of an age in which VSO word order is already taught formally in school (Khamis-Dakwar Froud & Gordon 2012). Although hearing students used VSO very minimally (66 occurrences in MSA and 35 occurrences in PA), they used it more in the written condition, indicating that they associate MSA with VSO word order. The adult group, who we recruited after this surprising result, also showed an overall preference for SVO in the written condition, although similarly, they produced more VSO word order in the written modality than in the spoken modality. An explanation for this finding might be attributed to methodological limitations – all participants, adults and students, were asked to respond in a written modality, however, there was no explicit instruction to use formal language (MSA). Thus, it could be that our participants used PA in a written modality in this condition. Alternatively, the findings might support claims about language change in Arabic word order, suggesting that Arabic users produce more SVO sentences in MSA than is reported in the literature (Pashova 2003; Parkinson 1981).

Unlike the hearing group, the deaf students in our study did not use VSO in their Arabic productions (PA and MSA).[11] This might be attributed to differences in curriculum between deaf and hearing students. According to Khamis-Dakwar et al. (2012), hearing students are taught VSO word order in third grade. However, the same curriculum is not used in special education with deaf students. Our findings might reflect the fact that our deaf group received limited formal teaching of MSA syntax including VSO word order. In a study that explored the acquisition of signed language syntax, the effect of age of entering a school for the deaf (in which American Sign Language is used) correlated positively with students' scores on the syntactic measure in signed language (Henner et al. 2016). This finding supports the importance of language exposure as a predictor of the acquisition of syntactic structures. In addition to the curriculum of deaf students, teachers of the deaf should receive knowledge of second language acquisition, understanding the relations between the signed language and the spoken language and integrating it in their teaching. Specifically, in the case of Arabic, this is true for all students learning the spoken language and MSA, regardless of signed language.

Future studies should explore the effect of MSA exposure and its formal teaching on the performance of deaf students in MSA. Studies suggest that deaf children with signed language as a first language can acquire a second language

11. Note that Clause-initial Vs were not expected in ISL as they are infrequent in most signed languages (Napoli & Sutton–Spence, 2021).

University of Haifa (haifaisr) IP: 132.74.189.192 On: Sat, 12 Aug 2023 07:06:09

University of Haifa (haifaisr) IP: 132.74.189.192 On: Sat, 12 Aug 2023 07:06:09

via the medium of print alone (e.g., Hoffmeister & Caldwell-Harris 2014). This suggests that deaf children who acquire ISL may acquire MSA via formal teaching. Importantly, in the process of language assessment of deaf students, the findings of cross-linguistic interaction should be taken into account (see also Holcomb & Lawyer 2020).

Another difference found between the two groups relates to the use of multiple clauses in PA and MSA. The hearing group produced many examples of sentences with multiple and complex clauses (e.g., coordinate sentences), which were counted as two separate clauses, and led to a higher number of clauses in the hearing group than in the deaf group in both PA and MSA (see Table 2). The effect of formal teaching on word order patterns and production of complex sentences among deaf students awaits future studies.

Here we focus on the unique word order patterns found in ISL which were used exclusively by our deaf group. In the second analysis, exploring word order within our deaf group, the results revealed that most sentences (86%, see Table 2) were produced in SVO word order (across all three languages). These findings suggest that at school age, deaf students prefer SVO word order, similar to hearing students. The results further support the assumption that SVO is the dominant word order in PA and is common in MSA (Parkinson 1981; Shlonsky 1997). For ISL, the findings follow previous studies suggesting that the dominant word order of ISL is SVO (Meir et al. 2017). Part of the dominance effect of SVO in ISL may be attributed to interaction with the spoken language (Meir et al. 2017), which is also SVO word order in PA. Meir et al. (2017) found that bilingual deaf signers who use ISL and Hebrew (Hebrew has SVO word order) preferred SVO word order more so than signers who show less interaction with the surrounding spoken language. The current finding supports the presence of language interaction effects in multilingual children (Koulidobrova 2017; Lillo-Martin et al. 2010; Stamp et al. 2021; van den Bogaerde & Baker 2006). In a recent study (Stamp et al. 2021), it was found that argument omissions in one language were attributed to acceptable argument omissions in the child's second or third language. More specifically, deaf students who acceptably omitted an object in their ISL productions also showed object omissions in their spoken and/or written Arabic productions.

SOV word order was produced only by our deaf group. Note that this word order is common in ISL, but it is ungrammatical in Arabic (in both PA and MSA). This word order was preferred in ISL (65%) compared to PA and MSA, which suggests that our deaf group is able to distinguish between the three languages, and they know which word order to use in each language context. That said, students do show effects of cross-linguistic transfer from ISL into Arabic; deaf students used SOV word order in PA and MSA (e.g., 'boy picture give girl' for the target sentence 'the boy gives a picture to the girl'). This falls in line with other

University of Haifa (haifaisr) IP: 132.74.189.192 On: Sat, 12 Aug 2023 07:06:09

studies that explored language interaction in the domain of syntax (Stamp et al. 2021; Kupisch 2007; Komeili & Marshall 2013; Washabaugh 1986). It is important to distinguish between language interaction phenomena and atypical acquisition when studying language acquisition in deaf populations (Henner et al. 2018). Specifically, when researchers, educators, and clinicians test deaf students who use ISL, the use of SOV word order in their other languages supports typical language interaction processes, in line with language development of bilingual children who use two spoken languages (for an overview see Novogrodsky & Meir 2020a). Together with previous findings, the current results support the idea of cross-linguistic and cross-modal interaction in the domain of syntax.

Support for the typical acquisition account of SOV word order comes from the effect of animacy found in the current study. Deaf students not only preferred SOV word order in ISL compared to PA and MSA, they also preferred this word order in sentences with inanimate objects compared to sentences with animate objects, in line with previous studies which explored signed and spoken languages and animacy effects (Meir et al. 2017; Nice & Dietrich 2003; Prat-Sala et al. 2000; Napoli et al. 2017). The characteristic of the object: animate (e.g., 'a boy who combs a **girl's hair')** versus inanimate (e.g., 'a man wears a **coat**') affected the preference of word order in the deaf group and specifically in ISL. When the object is animate, the word order, SVO, distinguishes and disambiguates the two animate arguments (e.g., a boy and a girl), the subject and the object which can cause ambiguity (Volterra et al. 1984). With inanimate objects, word order is not required to disambiguate meaning and can be more flexible, allowing the two arguments, subject and object, to occur next to one another. The current findings suggest that deaf students demonstrate animacy effect in the word order of the sentences they produce.

Finally, the SVXV word order was produced only by the deaf group and only in ISL (excluding one occurrence in PA) and this word order decreased as students aged. Though only 12% of the sentences included this word order, it offers us a window into the syntactic knowledge of deaf students. This structure included SVSV and SVOV, both verb final. The SVSV word order was produced in the current study for events in which two consecutive contrastive viewpoints could be shown, the first from a point of view of one character and the second from a point of view of the other character (e.g., BOY RIDE GIRL CRAWL, for an event describing 'A boy rides a girl'). This structure has been noted in other signed languages and studies (Flaherty 2014; Kocab et al. 2015; Meir et al. 2017). Note that these word orders were not produced by the deaf students in PA and MSA. This suggests that deaf students in the current study are sensitive to the syntactic structures available in ISL. In sentences with SVOV word order with a repeated verb (e.g., GIRL TEAR PAPER TEAR), the first verb was produced with no inflections and the second

one with aspectual marking (Fischer et al. 1990; Matsuoka 1999; Napoli & Sutton-Spence 2014). In our study, we found a significant relationship between age and the use of verb-final word order, with a decrease as age increased. Some studies claim that with sufficient language exposure, cross-linguistic transfer reduces with age (e.g., Döpke 1998; Müller & Hulk 2001; Paradis & Genesee 1996), however, other studies show that cross-linguistic transfer is part and parcel of being bilingual and therefore should occur at any age (van Dijk et al. 2022). In this study, we claim that the decrease in verb-final word order can be attributed to increased literacy and interaction with the surrounding spoken language, leading to a reduction in the use of word orders unique to ISL. Meir et al. (2017) found differences between signers of ISL, Al-Sayyid Bedouin Sign Language and Kufr Qassem Sign Language. In their study, the effect of literacy played a significant role in word order, with a reduction of SOV and OSV word orders for ISL signers, who were influenced by the SVO word orders common in Hebrew and Arabic.

5. Conclusion

To conclude, the findings suggest that deaf students are sensitive to the word orders of the languages they use. In addition to the SVO word order which was found as the most frequent word order in all three languages, students showed a preference for word orders which are unique to ISL in the ISL condition. Furthermore, language interaction phenomena in the domain of syntax (e.g., word order) showed cross-modality and cross-linguistic interaction, suggesting that this process is not specific to one modality of communication and is part of the syntactic acquisition process of tri-lingual trimodal students.

University of Haifa (haifaisr) IP: 132.74.189.192 On: Sat, 12 Aug 2023 07:06:09

Funding

This research was supported by the ISRAEL SCIENCE FOUNDATION (grant No. 1068/16). During the writing of this manuscript, Rose Stamp was funded by the ISRAEL SCIENCE FOUNDATION grant (number 2757/20).

Acknowledgements

The authors thank Debi Menashe, Ora Ohanin, and Nida Abu-Amneh for their ISL expertise. Special thanks go to the parents and deaf students who were involved in our study. Finally, we would like to dedicate this paper to Irit Meir, our colleague and dear friend, who developed the project together with us and who passed away in February 2018.

References

Antia, Shirin D., Susanne Reed & Kathryn H. Kreimeyer. 2005. Written language of deaf and hard-of-hearing students in public schools. *The Journal of Deaf Studies and Deaf Education* 10(3). 244–55.

Argyri, Efrosyni & Antonella Sorace. 2007. Crosslinguistic influence and language dominance in older bilingual children. *Bilingualism: Language and Cognition* 10(1). 79–99.

Attia, Mohammed. 2008. *Handling Arabic morphological and syntactic ambiguity within the LFG framework with a view to machine translation (Vol. 279)*. Manchester: University of Manchester PhD dissertation.

Austin, Jennifer. 2007. Grammatical interference and the acquisition of ergative case in bilingual children learning Basque and Spanish. *Bilingualism: Language and Cognition* 10(3). 315–31.

Bogaerde, Beppie van den & Anne Baker. 2006. Code mixing in mother-child interaction in deaf families. *Sign Language & Linguistics* 8(1–2). 153–76.

Chen Pichler, Deborah. 2002. Language acquisition. In Roland Pfau, Bencie Woll & Marcus Steinbach (eds.), *Sign language. An international handbook*, 647–686. Berlin: De Gruyter Mouton.

Coerts, Jane. 2000. Early sign combinations in the acquisition of Sign Language of the Netherlands: Evidence for language-specific features. In Charles Chamberlain, Jill Morford & Rachel Mayberry (eds.), *Language acquisition by eye*, 91–109. Mahwah, NJ: Lawrence Erlbaum.

Coerts, Jane & Anne Mills. 1994. Early sign combinations of deaf children in Sign Language of the Netherlands. In Inger Ahlgren, Brita Bergman & Mary Brennan (eds.), *Perspectives on sign language structure: Papers from the Fifth International Symposium on Sign Language Research*, 69–88. Durham, UK: ISLA.

Dammeyer, Jesper. 2014. Deafblindness: A review of the literature. *Scandinavian Journal of Public Health* 42(7). 554–62.

Daoud, Heba & Rama Novogrodsky. 2023. The relations between speech perception and language abilities of Palestinian-Arabic speaking school age children with hearing impairment. In Tova Most & Rachel Gali Cinamon (eds.), *Living with diversity: Research and application in working with the population of deaf and hard of hearing*. Tel Aviv: Mofet. (in Hebrew)

Döpke, Susanne. 1998. Competing language structures: The acquisition of verb placement by bilingual German-English children. *Journal of Child Language* 25(3): 555–84.

Dryer, Matthew S. 2013. Determining dominant word order. In Matthew S. Dryer & Martin Haspelmath (eds.), *The World Atlas of Language Structures Online*. Leipzig: Max Planck Institute for Evolutionary Anthropology. https://wals.info/chapter/s6

Faour, Rula. 2019. '*The Effect of Diglossia on the Comprehension and Production of Syntactic Structures among Typically Developing Children (TLD) and Children with Developmental Language Disorder (DLD)*.' Bar Ilan University thesis dissertation.

Ferguson, Charles A. 1959. Diglossia. *Word* 15(2). 325–40.

Fischer, Susan D. 2014. Constituent order in sign languages. *Gengo Kenkyu* 146. 1–12.

University of Haifa (haifair) IP: 132.74.189.192 On: Sat, 12 Aug 2023 07:06:09

Fischer, Susan D. & Wynne Janis. 1990. Verb sandwiches in American Sign Language. In Siegmund Prillwitz & Thomas Vollhaber (eds.), *Current Trends in European Sign Language Research* 9, 279–93. Hamburg: Signum Verlag.

Flaherty, Molly. 2014. *The emergence of argument structural devices in Nicaraguan Sign Language*. Chicago, IL: University of Chicago PhD dissertation.

Foroodi-Nejad, Farzaneh & Johanne Paradis. 2009. Crosslinguistic transfer in the acquisition of compound words in Persian-English bilinguals. *Bilingualism: Language and Cognition* 12(4). 411–27.

Friedmann, Naama, Rama Novogrodsky, Ronit Szterman, & Omer Preminger. 2008. Resumptive pronouns as a last resort when movement is impaired: Relative clauses in hearing impairment. In Sharon Armon-Lotem, Gabi Danon & Susan Rothstein (eds.), *Current Issues in Generative Hebrew Linguistics*, 267–290. Amsterdam: John Benjamins.

Friedmann, Naama, Ronit Szterman & Manar Haddad-Hanna. 2010. The comprehension of relative clauses and wh-questions in Hebrew and Palestinian Arabic hearing impairment. In Ana Castro, João Costa, Maria Lobo & Fernanda Pratas (eds.), *Language acquisition and development: Generative approaches to language acquisition*, 157–69. Newcastle, UK: Cambridge Scholars Press.

Gell-Mann, Murray & Merritt Ruhlen. 2011. The origin and evolution of word order. *Proceedings of the National Academy of Sciences* 108(42). 17290–17295.

Givón, Talmy. 1987. *On understanding grammar*. New York: Academic Press.

Hall, Matthew L., Rachel I. Mayberry & Victor S. Ferreira. 2013. Cognitive constraints on constituent order: Evidence from elicited pantomime. *Cognition* 129(1). 1–17.

Hall, Wyatte C., Leonard L. Levin & Melissa L. Anderson. 2017. Language deprivation syndrome: A possible neurodevelopmental disorder with sociocultural origins. *Social Psychiatry and Psychiatric Epidemiology* 52. 761–776.

Haznedar, B. 2007. Crosslinguistic influence in Turkish-English bilingual first language acquisition: The overuse of subjects in Turkish. In Alyona Belikova, Luisa Meroni & Mari Umeda (eds.), *Proceedings of the 2nd Conference on Generative Approaches to Language Acquisition North America (GALANA)*, 124–134. Somerville, MA: Cascadilla Proceedings Project.

Henner, Jonathan, Rama Novogrodsky, Jeanne Reis & Robert Hoffmeister. 2018. Recent issues in the use of signed language assessments for diagnosis of language disorders in signing deaf and hard of hearing children. *Journal of Deaf Studies and Deaf Education* 23(4). 307–16.

Henner, Jonathan, Catherine L. Caldwell-Harris, Rama Novogrodsky & Robert Hoffmeister. 2016. American Sign Language syntax and analogical reasoning skills are influenced by early acquisition and age of entry to signing schools for the deaf. *Frontiers in Psychology* 7(1982).

Hirosh, Zoya & Tamar Degani. 2018. Direct and indirect effects of multilingualism on novel language learning: An integrative review. *Psychonomic Bulletin & Review* 25(3). 892–916.

Hoffmeister, Robert J. & Cahterine L. Caldwell-Harris. 2014. Acquiring English as a second language via print: The task for deaf children. *Cognition* 132(2). 229–242.

Hoffmeister, Robert J., Jonathan Henner, Catherine L. Caldwell-Harris & Rama Novogrodsky. 2022. Deaf children's ASL vocabulary and ASL syntax knowledge supports English knowledge. *The Journal of Deaf Studies and Deaf Education* 27(1). 37–47.

University of Haifa (haifaisr) IP: 132.74.186.192 On: Sat, 12 Aug 2023 07:06:09

Holcomb, Leala & Gloshanda Lawyer. 2020. Assessments to evaluate bilinguals: The overdue discussion of the deaf and hard of hearing student population in the United States. *Psychology in the Schools* 57(3). 426–42.

Hulk, Aafke & Natascha Müller. 2000. Bilingual first language acquisition at the interface between syntax and pragmatics. *Bilingualism: Language and Cognition* 3(3). 227–44.

Kawar, Khaloob, Joel Walters & Jonathan Fine. 2019. Narrative production in Arabic-speaking adolescents with and without hearing loss. *The Journal of Deaf Studies and Deaf Education* 24(3). 255–69.

Khamis-Dakwar, Reem, Karen Froud & Peter Gordon. 2012. Acquiring diglossia: Mutual influences of formal and colloquial Arabic on children's grammaticality judgments. *Journal of Child Language* 39(1). 61–89.

Kidd, Evan, Angel Chan & Joie Chiu. 2015. Cross-linguistic influence in simultaneous Cantonese-English bilingual children's comprehension of relative clauses. *Bilingualism: Language and Cognition* 18(3). 438–52.

Kimmelman, Vadim. 2012. Word Order in Russian Sign Language. *Sign Language Studies* 12(3). 414–445.

Kimmelman, Vadim. 2018. Basic argument structure in Russian Sign Language. *Glossa* 3(1). 116.

Kocab, Annemarie, Jennie Pyers, & Ann Senghas. 2015. Referential shift in Nicaraguan Sign Language: A transition from lexical to spatial devices. *Frontiers in Psychology* 5(1540).

Komeili, Mariam & Chloë Marshall. 2013. Sentence repetition as a measure of morphosyntax in monolingual and bilingual children. *Clinical Linguistics & Phonetics* 27(2), 152–162.

Koulidobrova, Elena V. 2017. Language interaction effects in bimodal bilingualism: Argument omission in the languages of hearing ASL-English bilinguals. *Linguistic Approaches to Bilingualism* 7(5). 583–613.

Kupisch, Tanja. 2007. Determiners in bilingual German-Italian children: What they tell us about the relation between language influence and language dominance. *Bilingualism: Language and Cognition* 10(1). 57–78.

Lederberg, Amy R., Lee Branum-Martin, Mi-Young Webb, Brenda Schick, Shirin Antia, Susan R. Easterbrooks & Carol McDonald Connor. 2019. Modality and interrelations among language, reading, spoken phonological awareness, and fingerspelling. *Journal of Deaf Studies and Deaf Education* 24(4). 408–23.

Lillo-Martin, Diane & Jonathan Henner. 2020. Acquisition of sign languages. *Annual Review of Linguistics* 7. 395–419.

Lillo-Martin, Diane, Ronice Müller de Quadros, Elena Koulidobrova & Deborah Chen Pichler. 2010. Bimodal bilingual cross-language influence in unexpected domains. In João Costa, Ana Castro, Maria Lobo & Fernanda Pratas (eds.), *Language Acquisition and Development. Proceedings of GALA 2009*, 264–275. Newcastle upon Tyne: Cambridge Scholars Press.

Marschark, Marc, Patricia Sapere, Carol M. Convertino, Connie Mayer, Loes Wauters & Thomastine Sarchet. 2009. Are deaf students' reading challenges really about reading? *American Annals of the Deaf* 154(4). 357–70.

Matsuoka, Kazumi. 1999. The lexical verb sandwich in American Sign Language and the hybrid feature. In Rebecca Daly & Anastasia Riehl (eds.), *ESCOL'99*, 142–148. Storrs: Cornell University.

University of Haifa (haifa) IP: 132.74.189.102 On: Sat, 12 Aug 2023 07:06:09

Mayberry, Rachel I., Alex A. del Giudice & Amy M. Lieberman. 2011. Reading achievement in relation to phonological coding and awareness in deaf readers: A meta-analysis. *The Journal of Deaf Studies and Deaf Education* 16(2). 164–88.

Meir, Irit. 2002. A cross-modality perspective on verb agreement. *Natural Language and Linguistic Theory* 20(2). 413–450.

Meir, Irit, Mark Aronoff, Carl Börstell, So-One Hwang, Deniz Ilkbasaran, Itamar Kastner, Ryan Lepic, Adi Lifshitz Ben-Basat, Carol Padden & Wendy Sandler. 2017. The effect of being human and the basis of grammatical word order: Insights from novel communication systems and young sign languages. *Cognition* 158. 189–207.

Meir, Irit, Adi Lifshitz, Deniz Ilkbasaran & Carol A. Padden. 2010. The interaction of animacy and word order in human languages: A study of strategies in a novel communication task. In Andrew D. M. Smith, Marieke Schouwstra, Bart de Boer & Kenny Smith (eds.), *The Evolution of Language. Proceedings of the 8th International Conference (EvoLang8)*, 455–456. Singapore: World Scientific Publishing.

Meir, Irit & Wendy Sandler. 2007. *A language in space: The story of Israeli Sign Language*. 1st edition. New York: Psychology Press.

Morgan, Hope, Wendy Sandler, Rose Stamp & Rama Novogrodsky. 2022. ISL-LEXv.1: An online lexical resource of Israeli Sign Language. In *Proceedings of the LREC2022 10th Workshop on the Representation and Processing of Sign Languages: Multilingual Sign Language Resources*, 148–153. Marseille: European Language Resources Association.

Morgan, Hope E. 2020. Argument structure and the role of the body and space in Kenyan Sign Language. *Sign Language & Linguistics* 23(1/2). 38–72.

Müller, Natascha & Aafke Hulk. 2001. Crosslinguistic influence in bilingual language acquisition: Italian and French as recipient languages. *Bilingualism: Language and Cognition* 4(1). 1–21.

Napoli, Donna Jo, Rachel Sutton-Spence & Ronice Müller de Quadros. 2017. Influence of predicate sense on word order in sign languages: Intensional and extensional verbs. *Language* 93(3): 641–70.

Napoli, Donna Jo & Rachel Sutton-Spence. 2014. Order of the major constituents in sign languages: Implications for all language. *Frontiers in Psychology* 5(376).

Napoli, Donna Jo & Rachel Sutton-Spence. 2021. Clause-initial Vs in sign languages: Scene- Setters. In Vera Lee-Schoenfeld & Dennis Ott (eds.), *Parameters of Fronting*, 192–220. New York: Oxford Academic.

Nespor, Marina & Wendy Sandler. 1999. Prosody in Israeli Sign Language. *Language and Speech* 42(2–3). 143–76.

Nice, Kathy Y.V. & Rainer Dietrich. 2003. Task sensitivity of animacy effects: Evidence from German picture descriptions. *Linguistics* 41(5). 825–49.

Novogrodsky, Rama, Catherine L. Caldwell-Harris, Sarah Fish & Robert J. Hoffmeister. 2014. The development of antonym knowledge in American Sign Language (ASL) and its relationship to reading comprehension in English. *Language Learning* 64(4). 749–70.

Novogrodsky, Rama, Jonathan Henner, Catherine L. Caldwell-Harris & Robert J Hoffmeister. 2017. The development of sensitivity to grammatical violations in American Sign Language: Native versus nonnative signers. *Language Learning* 67(4). 791–818.

University of Haifa (haifais) | IP: 132.74.180.192 On: Sat, 12 Aug 2023 07:06:09

Novogrodsky, Rama & Varda Kreiser. 2015. What can errors tell us about Specific Language Impairment deficits? Semantic and morphological cuing in a sentence completion task. *Clinical Linguistics & Phonetics* 29(11). 812–25.

Novogrodsky, Rama & Natalia Meir. 2020a. Multilingual children with special needs in early education. In Mila Schwartz (ed.), *Handbook of Early Language Education*, 1–29. Berlin: Springer.

Novogrodsky, Rama & Natalia Meir. 2020b. Age, frequency, and iconicity in early sign language acquisition: Evidence from the Israeli Sign Language MacArthur-Bates Communicative Developmental Inventory. *Applied Psycholinguistics* 41(4). 817–45.

Novogrodsky, Rama, Nardeen Maalouf-Zraik & Irit Meir. 2022. Children with hearing impairment in a diglossic context – The case of Palestinian-Arabic speaking children. In Elinor Saiegh-Haddad, Lior Laks & Catherine McBride (eds.), *Handbook of literacy in diglossia and dialectal contexts*, 405–423. Cham: Springer.

Paradis, Johanne & Fred Genesee. 1996. Syntactic acquisition in bilingual children: Autonomous or interdependent? *Studies in Second Language Acquisition* 18(1). 1–25.

Parkinson, Dilworth B. 1981. VSO to SVO in Modern Standard Arabic: A study in diglossia syntax. *Al-'Arabiyya* 14(1–2). 24–37.

Pashova, Tsvetomira. 2003. The VS/SV alternation in modern written Arabic from a textual perspective. *Zeitschrift für Arabische Linguistik* 42. 7–40.

Peer, L., Doran Levy, Neta Haluts, & Nama Friedmann. in press. Research-based linguistic-educational policy: On the importance of input in signed language for deaf and heard of hearing children. In Tova Most & Rachel Gali Cinamon (eds.), *Living with diversity: research and aplication in working with the population of deaf and hard of hearing*. Tel Aviv: Mofet.

Prat-Sala, Mercé, Richard Shillcock & Antonella Sorace. 2000. Animacy effects on the production of object-dislocated descriptions by Catalan-speaking children. *Journal of Child Language* 27(1). 97–117.

Quigley, Stephen P. & Cynthia M. King. 1980. An invited article: Syntactic performance of hearing impaired and normal hearing individuals. *Applied Psycholinguistics* 1(4): 329–56.

Saiegh-Haddad, Elinor. 2012. Literacy reflexes of Arabic diglossia. *Current Issues in Bilingualism* 5. 43–55.

Saiegh-Haddad, Elinor & Roni Henkin-Roitfarb. 2014. The structure of Arabic language and orthography. In Elinor Saiegh-Haddad & Malatesha Joshi (eds.), *Handbook of Arabic literacy*, 3–28. Dordrecht: Springer.

Saiegh-Haddad, Elinor & Bernard Spolsky. 2014. Acquiring literacy in a diglossic context: Problems and prospects. In Elinor Saiegh-Haddad & Joshi Malatesha (eds.), *Handbook of Arabic Literacy: Insights and Perspectives*, 225–40. Springer: Dordrecht.

Shlonsky, Ur. 1997. *Clause structure and word order in Hebrew and Arabic: An essay in comparative semitic syntax*. (Oxford Studies in Comparative Syntax). Oxford: Oxford University Press.

Stamp, Rose, Rama Novogrodsky & Sabrin Shaban-Rabah. 2021. Argument omissions by deaf students in three language modalities. *First Language* 41(5). 646–670.

Strong, Michael & Philip Prinz. 1997. A study of the relationship between American Sign Language and English literacy. *Journal of Deaf Studies and Deaf Education* 2(1). 37–46.

University of Haifa (haifair) | IP: 132.74.189.192 On: Sat, 12 Aug 2023 07:06:09

Thordardottir, Elin. 2015. The relationship between bilingual exposure and morphosyntactic development. *International Journal of Speech-Language Pathology* 17(2). 97–114.

Thorndyke, Perry W. 1977. Cognitive structures in comprehension and memory of narrative discourse. *Cognitive Psychology* 9(1). 77–110.

Tuller, Laurice & Hélène Delage. 2014. Mild-to-moderate hearing loss and language impairment: How are they linked? *Lingua* 139. 80–101.

Van Dijk, Chantal, Elise van Wonderen, Elly Koutamanis, Gerrit Jan Kootstra, Ton Dijkstra & Sharon Unsworth. 2022. Cross-linguistic influence in simultaneous and early sequential bilingual children: a meta-analysis. *Journal of Child Language* 49(5), 897–929.

Vennemann, Theo. 1975. An explanation of drift. In Charles N. Li (ed)., *Word Order and Word Order Change*, 269–305. Austin: University of Texas Press.

Volterra, Virginia, Alessandro Laudanna, Serena Corazza, Elena Radutzky & Francesco Natale. 1984. Italian Sign Language: The order of elements in the declarative sentence. In Filip Loncke, Penny Boyes Braem & Yvan Lebrun (eds.), *Recent research on European sign languages*, 19–46. Lisse, NL: Swets & Zeitlinger.

Washabaugh, William. 1986. *Five Fingers for Survival*. Ann Arbor: Karoma.

Wimmer, Eva, Monika Rothweiler & Martina Penke. 2017. Acquisition of who-question comprehension in German children with hearing loss. *Journal of Communication Disorders* 67. 35–48.

Wolbers, Kimberly A., Lisa M. Bowers, Hannah M. Dostal & Steve Graham. 2014. Deaf writers' application of American Sign Language knowledge to English. *International Journal of Bilingual Education and Bilingualism* 17. 410–28.

University of Haifa (haifaisr) IP: 132.74.189.102 On: Sat, 12 Aug 2023 07:06:09

Appendix A. Descriptions of the video stimuli (total of 24 videos)

Three arguments	Two arguments
A boy puts a sock on his head	A boy combs the girl's hair
A man shows a picture to the girl	A girl feeds the man
A boy puts the ball in the locker	A man washes the dishes
A man throws the ball to the girl	A boy rides the girl
A girl gives a bottle of water to the man	A girl tears the paper
A girl hangs a picture on the wall	A girl pulls the man
A boy puts the book into his bag	A man puts on the jacket
A boy puts the hat on the girl	A girl drinks the milk
A girl puts the shoes under the table	
A girl takes the book from the boy	
A girl takes the shirt from the bag	
A boy throws the box to the girl	

Appendix A. *(continued)*

Three arguments	Two arguments
A girl gives a shirt to the man	
A boy puts an apple in the box	
A girl puts stickers on a man's face	
A girl puts the book on the table	

University of Haifa (haifaisr) IP: 132.74.102.192 On: Sat, 12 Aug 2023 07:06:09

Address for correspondence

Rose Stamp
Department of English Literature & Linguistics
Bar-Ilan University
Building 404
Room 203
Ramat Gan 5290002
Israel
rose.stamp@biu.ac.il
https://orcid.org/0000-0002-1993-559X

Co-author information

Rama Novogrodsky
University of Haifa
rnovogr1@univ.haifa.ac.il
ramanovo@gmail.com
https://orcid.org/0000-0002-9834-2388

Sabrin Shaban-Rabah
University of Haifa
sabora_sh32@hotmail.com

Publication history

Date received: 20 December 2021
Date accepted: 8 February 2023
Published online: 25 July 2023