

Acquiring a First Language in Adolescence:
The Case of Basic Word Order in American Sign Language

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Abstract

Previous studies suggest that age of acquisition affects the outcomes of learning, especially at the morpho-syntactic level. Unknown is how syntactic development is affected by increased cognitive maturity and delayed language onset. The current paper studied the early syntactic development of adolescent first language learners by examining word order patterns in American Sign Language, ASL. ASL uses a basic Subject-Verb-Object order, but also employs multiple word order variations. Child learners produce variable word order at the initial stage of acquisition, but later primarily produce canonical word order. We asked whether adolescent first language learners acquire ASL word order in a fashion parallel to child learners. We analyzed word order preference in spontaneous language samples from four adolescent L1 learners collected longitudinally from 12 months to 6 years of ASL exposure. Our results suggest that adolescent L1 learners go through stages similar to child native learners, although this process also appears to be prolonged.

Keywords: American Sign Language, Word Order, Age of Acquisition, Language Deprivation

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Introduction

One crucial observation about language acquisition is that it is age constrained (Lenneberg, 1967). Children usually acquire their first language (L1) early in life with little effort. By contrast, second language (L2) learners (Bongaerts, Mennens, & Slik, 2000; Coppieters, 1987; Lardiere, 1998, 2007) as well as L1 learners with early language deprivation (Fromkin, Krashen, Curtiss, Rigler, & Rigler, 1974; Grimshaw, Adelstein, Bryden, & MacKinnon, 1998; Mayberry, 1993) all seem to face difficulties developing native-like skills. In addition, early language deprivation results in a more disrupted learning outcome compared to delayed L2 learning (Mayberry, 1993; Mayberry & Lock, 2003). This contrast between increased cognitive maturity and decreased language acquisition ability suggests there may be a critical temporal window for successful language learning, and that missing this developmental window has negative effects on language development.

Research also suggests that not all linguistic structures are equally vulnerable to age of acquisition (AoA) effects for late L1 learners who suffer from early language deprivation. Previous studies have found that simple, mono-clausal structures that are acquired early by young children seem to be acquired at any age, while complex, multi-clausal structures are not (Boudreault & Mayberry, 2006; Curtiss, 1977; Newport, 1990). This parallel between child L1 milestones and late L1 outcomes seems to suggest that even when begun later in life, syntactic development still follows a set path similar to typical child L1 development. Studies on the initial stages of late L1 development also

suggest that, despite differences in cognitive skills and early language experience, late L1 learners tend to resemble native L1 learners in terms of initial lexical development and word combinations (Berk & Lillo-Martin, 2012; Ramírez, Lieberman, & Mayberry, 2013).

It remains unknown why late L1 learners fail to proceed to master more complex structures beyond basic mono-clausal structures. Thus far we have limited knowledge of what happens in-between initial child-like development and the ultimate non-native outcomes of late L1 learners. One way to fill in this gap is to investigate the developmental trajectory of late L1 syntactic development beyond the two-word stage.

Word order is a crucial linguistic device that maps thematic roles and grammatical relations in most languages, and the default word order is often acquired early in life (Brown, 1973; Pinker, 1989; Slobin & Bever, 1982). American Sign Language, ASL, uses a basic Subject-Verb-Object (SVO) order (Fischer, 1975), but also employs multiple word order variations under certain morphological and pragmatic conditions, such as sentence final pronominal subject copy (VS) and object topicalization (OV) (Fisher & Janis, 1990; Kegl, 1976; Liddell, 1980; Matsuoka, 1997; Padden, 1988; Pichler, 2001). ASL basic word order has been found to be generally intact in late L1 outcome with respect to comprehension and grammatical judgment tasks (Newport, 1990; Boudreault & Mayberry, 2006), but little is known about the use of word order in the ASL expression of late L1 learners. Previous literature has also documented ASL word order patterns at various stages in child L1 development (Berk, 2003; Hoffmeister, 1978; Pichler, 2001; Schick, 2002). Investigating the trajectory of word order development among late L1 learners offers us a unique opportunity to understand how syntactic development unfolds when the learners have more mature cognitive functions but reduced linguistic experience during childhood.

In the current study, we investigate the patterns of ASL word order preference by deaf adolescents with limited early language exposure. To do so, we first describe word order variations in ASL, how child native learners acquire these structures, and what we know about the effects of delayed language acquisition on syntactic development. Following this necessary background, we describe two studies. Study one investigates the longitudinal development of word order patterns in three adolescents acquiring language for the first time in the same linguistic environment. Study two investigates word order development in a fourth adolescent late L1 learner who was immersed in an entirely different ASL environment. The main goal of the studies is to describe in detail the word order patterns used by late L1 learners, to document changes over time in their development, and to compare their development with child L1 patterns available in the literature. The results indicate that adolescent L1 learners develop an increased preference for the basic SVO word order over time, which resembles that of child native learners. However, our findings also show that this process is prolonged in adolescent L1 learners compared with child L1 learners.

ASL Word Order and Acquisition

ASL word order

Languages utilize word order as the main method to mark grammatical relations and generate compositional meanings (Slobin, 1966). Word order usually refers to the relative order of a finite verb (V) and its nominal arguments, Subject (S) and Object (O). Most languages have a dominant word order (Greenberg, 1963), and typological studies show that SOV and SVO are the most common word orders across languages while other orders are relatively rare (Dryer, 2007; Tomlin, 1986). Many languages, such as Turkish, German, and Japanese, also have word order variations in addition to the default word

order, and these non-canonical word orders are usually conditioned by information structure with non-obligatory prosodic cues (Reinhart, 1995), and sometimes by lexical verb class as well (Bader & Häussler, 2010).

ASL is a natural language that employs the manual modality and demonstrates linguistic features similar to those of spoken languages (Klima & Bellugi, 1979; Stokoe, 1978). According to Fisher (1975), ASL demonstrates a basic SVO order (1a). Non-canonical word order patterns are mainly derived from the basic word order and constrained by certain grammatical rules. The most common variations include sentence-final pronouns (VS, as in 1b), pre-verbal objects (OV, as in 1c), and also the so-called ‘verb sandwiches’ structure (VOV, Fisher & Janis, 1990, as in 1d).¹

- (1) a. BOY LIKE ICECREAM
 ‘The boy likes ice cream.’
- b. SLEEP IX-3
 ‘He sleeps.’
- c. BALL HIT(handling: bat)
 ‘(Someone) hit the ball.’
- d. READ BOOK READ(aspect: continuative)
 ‘(Someone) kept reading the book.’

¹ As is standard, we use English glosses in uppercase to represent corresponding ASL signs. The English translation is given below in lowercase. Inflections on ASL verbs are specified in the brackets after the verb. ‘IX’ stands for the indexing pronoun in ASL, and the number following it stands for person. For example, ‘IX-3’ stands for the third-person singular pronoun.

Padden (1988) has explained the surface VS order as being a result of subject-pronoun copy with a null subject. ASL allows sentence-final subject pronouns to serve an emphatic function (2a), and this copied pronoun usually co-occurs with a null subject, rendering the surface structure non-canonical VS (2b).

(2) a. BABY SLEEP IX-3

‘The baby it sleeps.’

b. SLEEP IX-3

‘(As for the baby), it sleeps.’

As for the OV order, there is more than one trigger. First, ASL allows object topicalization, as shown in the following sentences. The underscore indicates the scope of the non-manual marker. The numbers represent the person alternations in verb agreement, with the subject person preceding the verb and the direct object following the verb. For example, 1_GIVE_3 means ‘I give (something) to him/her’.

(3) a. APPLE_{topic marker}, IX-1 EAT.

‘As for the apple, I eat it.’

b. BOOK_{topic marker} 1_GIVE_3

‘I give him/her the book.’

c. CANDY WANT_{yes-no question marker?}

‘Do you want candy?’

This non-canonical OV order is triggered by an object-prominent information structure, and also requires obligatory non-manual topic markers, usually raised eyebrows and chin (Aarons, 1996; Liddell, 1980). Topicalized OV order is common in verb agreement (3b) and yes-no questions (3c). Fisher (1975) suggests that word orders are more flexible when there is an agreeing verb, as the subject and the object are indicated by the agreement inflection, but the licensing conditions are less clear in the literature. Two deaf native signers we consulted confirmed that OV structure is very common with verb agreement but requires a topic marker on the fronted object.

OV structure is also grammatical when the verb is under certain modulated conditions. According to previous studies (Fisher & Janis, 1990; Hoffmeister, 1978; Kegl, 1976; Liddell, 1980; Matsuoka, 1997; Pichler, 2001), verb inflections that license the OV structure include aspectual inflection (4a), handling inflection (4b), and spatial inflection (4c).

- (4) a. TOMATO GIRL EAT(aspect: continuative)
'The girl keeps eating tomatoes.'
- b. BALL HIT(handling: bat)
'(He) hits the ball with a bat.'
- c. MONEY PUT(spatial: on the table)
'(He) puts money on the table.'

It is worth noting that not all ASL verbs are compatible with these three morphological modulations. Only a subset of verbs with corresponding properties can be morphologically marked, namely verbs that allow aspectual modulation, handling

verbs, as well as spatial verbs. Therefore, the OV structures listed above also depend on the specific verb type. However, it is less clear from the literature to what extent these OV orders are obligatory. According to our ASL consultants, canonical word order is still preferred even when the verbs are inflected, and the information structure plays an important role in deciding which order is used.

Another word order phenomenon is the ‘verb sandwich’ structure, when a verb is repeated at a sentence-final position. The second verb is usually morphologically modulated, but the modulation is not obligatory. An example is given below from Pichler (2001):

(5) SALLY TYPE PAPER TYPE(aspect: continuative)

‘Sally was typing and typing her paper.’

To conclude, ASL uses a basic SVO order but also several word order variants depending upon various constraints including a VS order that requires a pronoun copy, an OV order that requires object-prominent information structure and a mandatory non-manual topic marker, or an OV order that requires specific inflections that apply to different subsets of verbs. In addition, ASL allows null arguments (Lillo-Martin, 1986), which renders surface word orders even more diverse. This means that the full picture of ASL word order is complicated.

ASL Word Order Development in Young Children

As described above, ASL allows various word order patterns conditioned by verb inflections and mandatory information structure markers. This raises the question of whether variable adult ASL word order input complicates the learning situation for child

native learners. We now turn to research investigating the acquisition of both basic word order and word order variations in ASL by typically developing children.

At the initial stage of acquisition, when child native learners begin to produce multi-word combinations (around 2;0 - 2;6; years; months), several studies report similar findings, namely that deaf children produce a relatively high percentage of non-canonical word orders: 25%-36% VS; 41%-54% OV (Hoffmeister, 1978; Pichler, 2001; Schick, 2002). Also, the non-canonical word orders young children produce are mostly adult-like. Both Hoffmeister (1978) and Pichler (2001) observed that the subjects of non-canonical VS utterances produced by child native learners are almost always pronouns, which is compatible with the pronoun-copy rule. Still, Pichler did not find any statistically significant relationship between pronominal subjects and VS order, because young children mostly use pronouns even in the canonical subject position. Coerts (2000) also looked at the use of subject pronoun copy in Sign Language of the Netherlands (SLN), an SOV language, and found that young children were sensitive to this condition by age 2. As for OV utterances, adult-like, non-manual markers are generally missing in child ASL (Reilly, McIntire, & Bellugi, 1990). Still, Schick (2002) found that children tend to use OV order for certain verbs (e.g. EAT, SEE, DRINK, PUT-IN, LOOK-FOR, WANT, LIKE). Pichler (2001) confirmed this pattern in her data and further argued that most verbs found in child OV utterances are morphologically modulated, including aspectual, handling and spatial inflections. As described above, these verb inflections license OV order in adult ASL. One caveat in interpreting the results of these studies is that the types of verbs found in the OV utterances produced by the children were quite limited. It is unclear whether children at this stage have fully

acquired the licensing morphological rules, or have acquired certain patterns of specific verbs.

As for word order development beyond the initial two-word stage, Hoffmeister (1978) found that, in contrast to the high variability in word order at the earlier stage, deaf children from 3;2 to 5;7 consistently produce more than 80% of their utterances in canonical word order. Berk (2003) reported a similar trajectory for one child native learner who produced 43% canonical word order at age 2;0, and at age 2;9, increased production of canonical word order to 74%. Newport and Meier (1985) suggested that young children rely on fixed word order to mark grammatical relations. This pattern also echoes the early fixed word order preference of children observed for some spoken languages, such as Korean (Park, 1970) and Italian (Slobin & Bever, 1982). Interestingly, some of these studies also show a brief period of time in the earliest two-word stage (before 2;6) when young children use more word order variations (Slobin & Bever, 1982). These findings indicate a cross-linguistically similar developmental trajectory. When the language employs variable word order patterns, young children sometimes begin by using word order variations, but shortly thereafter show a preference for the canonical word order. Berk (2003) also reported that one native child learner at age 4;6 produced 63% canonical word order, slightly lower than the 74% at age 2;9. The literature reports variable word order in adult ASL (Aaron, 1996; Fisher, 1975; Liddell, 1980), but the exact frequencies of variable word order use remains unknown. Palmer (2015) analyzed three child-parent sessions between deaf native parents and their hearing bilingual bimodal children aged 1;8 to 3;4 with session durations ranging between 31 to 47 minutes, and found non-canonical VS order ranging between 11% to 24%, and non-canonical OV order ranging between 3% to 15%, suggesting that adult

input involves high percentage of canonical word order. Still, this limited language sample might not reflect the whole picture of adult use of variable word order.

Therefore, we do not know whether the percentage of canonical word order use by young children is adult-like or not, although children seem to use the same morphological rules as used in adult ASL.

In summary, studies to date indicate that young ASL learning children initially use more variable word orders in the early multi-word stage at around age 2;0 to 2;6, and that the non-canonical word orders they produce are mostly adult-like. Shortly afterward, children rely more on canonical SVO order. There is little information on word order preferences during later stages of ASL development and how this compares to adult ASL usage.

AoA effects on ASL Syntactic Development

Previous studies on late L1 language outcome suggest that late L1 learners are capable of acquiring simple structures, while showing more difficulties with linguistic structures with increased morpho-syntactic complexity, such as sentences with embedded clauses (Boudreault & Mayberry, 2006; Mayberry, 1993; Newport, 1990). In terms of basic word order, Newport (1990) found that, compared with other ASL morpho-syntactic structures, deaf adults with delayed L1 onset exhibit fewer problems comprehending basic SVO order in ASL. Boudreault and Mayberry (2006) also reported better performance with basic word order by late L1 learners in a grammatical judgment task, although they still performed slightly worse when compared to native signers. Hall, Ferreira and Mayberry (2015) found native and late learners to be equally syntactically primed by basic SVO structures in ASL. As for non-canonical word orders such as the topic-comment structure in ASL, no previous studies have explicitly

examined late L1 learner outcomes, but given the intricacies with various morphological, syntactic and discourse conditions, we would expect late L1 learners to show more difficulties based on their performance in other morpho-syntactically complex structures.

So far, developmental studies on late L1 development generally suggest a similar developmental trajectory when compared to young native learners, while also indicating a reduced rate of syntactic development as compared to lexical development. Ramírez, Lieberman and Mayberry (2013) examined the vocabulary development of three adolescent L1 learners, with an AoA of around 14 years, who were at the initial two-word stage of acquisition (1;0 to 2;0 years of exposure to ASL). They found few differences between adolescent late learners' vocabulary acquisition and early utterances compared with younger native learners reported in Anderson and Reilly (2002). Their findings suggest that adolescent L1 learners acquire lexical items in a fashion akin to younger native learners but at a faster rate.

Berk and Lillo-Martin (2012) examined the two-word stage of two deaf children with an AoA of 6 years old and observed a dissociation between linguistic and general cognitive abilities. Although the child late learners tended to produce more cognitively complex utterances, using mental verbs or more sophisticated semantic relations, they still used linguistic features similar to those of younger children at this stage, such as limitations in utterance length. Morford (2003) studied two deaf children with AoAs of 13;7 and 12;1, respectively, investigating their longitudinal development (2 to 31 months of exposure to ASL) of verb agreement and classifier constructions using picture description and elicited production. The adolescent L1 learners gradually improved production of these morpho-syntactically complex structures that use spatial features,

but their performance on comprehension tasks after 7 years of exposure still deviated significantly from that of native signers, consistent with the results of retrospective studies of ultimate attainment in adult, late L1 learners (Boudreault & Mayberry, 2006; Mayberry, 1993; Newport, 1990).

As for word order development, Lillo-Martin and Berk (2003) gathered naturalistic language data during the initial two-word stage from two deaf children whose language onset began at 5;9 and who had been exposed to ASL for 10 to 20 months. Adopting the same methodology as in Pichler (2001), they found that these late L1 learners were somewhat more canonical and made more inflectional mistakes with non-canonical orders compared with native child learners. Their findings suggest that non-canonical word orders in ASL pose difficulties for late learners. Longitudinal development of word order was studied for one of the children in Berk (2003). This child showed word order variation after 10 months of exposure with 61% canonical word order, which subsequently became even more canonical with a rate of 80% canonical word order after 3 years and 3 months of exposure. Thus, the trajectory of this late learner's ASL word order acquisition appears to be similar to that reported for young native learners. Berk also described this late L1 learner as showing a gradual increase in canonical word order use over three years, compared with the younger native learner in her study who displayed a rapid increase in canonical word order use within one year's time after initial two-word production.

Research Questions and Hypotheses

Previous studies suggest that late L1 learners of ASL show similar, and even faster development, in the very early stages of language acquisition compared with young native learners, but subsequently encounter difficulties with morpho-syntactically

complex structures. So far, the selectivity of AoA effects has yet to be explained, as few studies have looked at longitudinal syntactic development in late L1 learners after the two-word stage. The current study investigates the developmental trajectory of word order production in adolescent late L1 learners to deepen our understanding of AoA effects on syntactic development. To do so, we coded the word order patterns in their production of verb-noun combinations, calculated the percentage of canonical word order at each time point, examined their use of non-canonical word orders, examined the longitudinal changes in their word order patterns, and compared the results with findings on native, child L1 learners as reported in the literature. A key question is how late L1 learners might develop word order patterns in ASL given their cognitive maturity and early language deprivation.

With respect to the effects of cognitive maturity on syntactic acquisition, there are two possible outcomes. First, increased cognitive maturity may facilitate early syntactic development in fashion similar to its facilitation on early lexical development (Ramírez et al., 2013). If so, we would expect late learners to show faster syntactic development compared to native child learners. Alternatively, syntactic development may rely more on linguistic constraints than of cognitive maturity, as suggested in Berk and Lillo-Martin (2012). If this is the case, we would expect no facilitating effects from cognitive maturity, and the late L1 learners should develop word order patterns in a similar, if not slower, rate, compared to native L1 learners.

With respect to AoA effects, there are three possibilities. One possibility is that early syntactic development is unaltered by early language exposure. If this is the case, we would expect late learners to show a similar trajectory to that of native child learners, with a brief stage of variable order progressing to more canonical word order. In this

case, the late L1 learners should be sensitive to the various conditions that license non-canonical orders in early stages of acquisition. The second possibility is that early syntactic development is unaffected by early language deprivation, but only for basic word order. If so, we would expect late L1 learners to follow a similar trajectory in terms of the use of basic word order, but their use of non-canonical word orders might be random and not explained by the adult ASL grammar. Also, they might differ from native child learners in terms of when they begin to use basic word order. Finally, a late AoA might affect early syntactic development including basic word order. If so, late learners should show different patterns of word order development compared to native child learners. For example, they may rely on verb-specific patterns to produce word order and show no increase their use of the canonical word order over time.

To test these possibilities, we conducted two longitudinal studies of ASL word order acquisition by four adolescent L1 learners. The first study investigates the ASL word order acquisition of three deaf late L1 learners whose ASL environment was the same. The second study investigates the ASL word order acquisition of a fourth late L1 learner whose ASL learning environment was different.

Study One: Adolescent L1 acquisition within a group home environment

Participants

The participants of the first study were three individuals who, due to varying circumstances, acquired little or no language prior to being immersed in ASL around the age of 14 in the same environment. The adolescents lived in a group home for deaf adolescents where they were fully immersed in ASL. The staff consisted of proficient signers who used ASL exclusively with the adolescents daily. The participants resided together at the group home for four years along with other deaf adolescents who were

proficient signers. Before joining the group home, each participant was in a circumstance that prevented him or her from learning language.

Carlos lived with his hearing and non-signing family members in another country until he was 11 years old. He briefly enrolled in a local deaf school but soon stopped attending. He then immigrated with some of his family members to the United States and was first placed into a classroom for cognitively impaired children. He was later placed in the group home for deaf children at age 13;8. According to the staff, he knew no spoken language and very few ASL signs upon his initial placement, and mainly used pointing and gestures to communicate.

Before his placement, Cody lived with one hearing, non-signing guardian. He attended school at age 5 and was misdiagnosed as cognitively impaired. The school he attended used very limited sign language. Upon his placement in the group home at age 14;8, he knew only a few basic ASL signs. Similar to Carlos, Cody knew no spoken language and was observed to mainly use pointing and gestures to communicate.

Shawna lived with her hearing and non-signing guardians and was reported to have been kept at home until age 12. She attended several schools, both deaf and mainstream, for a total of 16 months. Upon joining the group home at age 14;7, she was reported to know no spoken language and rely primarily on behavior and limited use of gestures to communicate. She produced no ASL signs.

The adolescent L1 learners' lexical development and initial utterances are reported in Ramírez et al., (2013). Their vocabulary size, vocabulary composition, utterance length as well as complexity were similar to that of younger, deaf native ASL learners with a comparable length of ASL exposure (Anderson & Reilly, 2002).

Data Collection

In total, three sessions of spontaneous language samples were collected over a 3.5-year period. All three adolescent L1 learners participated in the first two sessions, which were filmed at their group home while they were having dinner with some deaf peers and deaf professionals. These filming sessions each lasted for about 50 minutes. During each filming session, the participants signed with different interlocutors on various daily topics. Instead of signing to each other, the participants mostly conversed with one to two proficient signers with whom they were familiar. The last session was filmed at the lab of the research team, and only Carlos and Shawna were filmed. During this filming session, each participant signed with a hearing researcher as well as with a deaf adult while they were having lunch. Both interlocutors were very proficient signers, and the participants were familiar with them. They conversed on various daily topics. Each participant was filmed for about 20 minutes. Table 1 shows their age and years of exposure to ASL at each filming session.

[Table 1]

The videos were transcribed using the annotation system ELAN (Crasborn & Sloetjes, 2008) by a hearing researcher who is highly skilled in ASL. All of the transcriptions were re-examined for accuracy by a deaf researcher who is a native signer.

Analysis procedures

The first step of the analysis was to select all verb phrases that were associated with at least one argument. Next, we coded word order information. All previous studies of ASL word order acquisition have separated subject-verb and verb-object

combinations in their analyses. Following this procedure makes it easier to compare the present results with previous findings. This is also because most utterances (87.44%, 181 out of 207) produced by the adolescent L1 learners were associated with either subject only or object only, and only 12.56% utterances (26 out of 207) had both subject and object. It is potentially interesting to analyze the word order patterns of those utterances with more than one argument, but for the purposes of the present study we do not have enough data points to perform such an analysis, as we only found around 3 such utterances per subject per session. Therefore, utterances that were associated with more than one argument, such as an SVO order, would be coded twice under the current coding scheme. For example, I LIKE DOG would be coded twice, first I LIKE as SV for the subject-verb combination, and also LIKE DOG as VO for the object-verb combination.

We first coded the relative order in subject-verb combinations. We tagged all verb phrases that were associated with a nominal subject, and then coded the relative word order between the subject and the verb. We then coded the relative order in verb-object combinations. We used all verb phrases that were intelligible and unambiguous. We tagged all nominal objects in each verb phrase, if there were any, and then coded the word order according to the relative linear order. Utterances with pointing gestures, such as pointing at a person or an entity in a picture, were excluded from the analyses. Nominal, adjectival, and classifier predicates were excluded from the analyses. Complement verbs, which take verb phrases as complements, such as WANT in I WANT EAT ICE-CREAM ('I want to eat ice-cream'), were analyzed as involving no nominal object, because the internal argument is an embedded verb phrase instead of a noun phrase, which did not meet our criteria. Auxiliary verbs such as FINISH in I FINISH

COOK MEAL ('I finished cooking a meal') were analyzed in a similar way. Embedded verb phrases and coordinated verb phrases, although very uncommon in the current data set, were analyzed independently.

Application of these criteria yielded our word order data set, summarized in Table 2. Our language sample for analysis is relatively small because the adolescent L1 learners were relatively taciturn and not particularly talkative. Also, perhaps due to being in the initial stages of ASL development, they produced more verb-only utterances and rarely used overt subjects or objects.

[Table 2]

Next, we classified the coded word orders according to whether they were canonical or not. A word order is canonical if the subject precedes the verb, or if the object follows the verb, otherwise it is considered to be non-canonical. According to Pichler (2001), VSV order is a variant of non-canonical VS order, with the verb repeated at the end of the utterance. Similarly, OVO is a variant of the non-canonical OV structure when the object is repeated for emphasis at the end, and is counted as OV. Another possible word order is the verb-sandwich order VOV, where the second verb is a copy of the first verb. We followed Pichler (2001) and analyzed VOV as a variant of VO. For the very occasional ditransitive verb phrase with both direct and indirect objects (1.72%, 4 utterances in total), we counted the word order as VO only if both direct and indirect object follow the verb, otherwise we counted the word order as OV.

After coding the relevant word order information, we analyzed the subject-verb combinations and verb-object combinations separately, following the analysis used in

previous studies to facilitate later comparison. Each analysis consisted of two parts. First, we examined the trajectory of word order preference over time. We specifically made the following computations: 1) the proportion of canonical word orders and non-canonical word orders in the initial stage of acquisition, as reflected in the first filming session, 2) the proportion of word orders in later stages as reflected in the second and third (if applicable) filming sessions, 3) the trajectory of word order preferences over time within and across the participants, and finally 4) the characteristics of the participants' trajectory relative to that of native child learners reported in the literature. Second, with the help of two deaf, native ASL consultants, we examined the participants' use of non-canonical word orders and compared them to those produced by child native learners. The following results are presented according to the analyses procedures outlined above. First, we turn to the relative word order between the verb and the subject and then to the relative word order between the verb and the object.

Results

Relative order between verb and subject. Recall that SV is the canonical word order in ASL and that non-canonical VS order is also allowed if the subject is a pronoun, according to the pronoun-copy rule. Fig. 1 shows the late L1 learners' preference for the relative order between a subject and a verb.

[Figure 1]

All the participants generally preferred canonical word order SV across all filming sessions (Fig. 1). In addition, they produced more non-canonical VS orders in earlier sessions (both first and second sessions for Carlos and Shawna, the first session for

Cody). All three participants tended to become more canonical with more ASL exposure. By the time of their last filming sessions (after 5;6 years of ASL exposure for Carlos, 4;6 years of exposure for Shawna, and 3;2 years of exposure for Cody), all three participants used only SV order. We note that Shawna produced more non-canonical word order VS in her second filming session (38.46%, 5 out of 13) compared to her first filming session (18.18%, 2 out of 11). As she had less ASL exposure compared with Carlos and Cody during her second filming session, this indicates her continued preference towards variable word order during her early developmental stages.

The percentage of non-canonical VS order the adolescent L1 learners used is comparable to that reported for child native learners, both in the initial stage around ages 2;0 to 2;6 (25% in Hoffmeister, 1978; 34% in Schick, 2002; 36% in Pichler, 2001), and also in the later stages beyond age 3;2 (8% - 14% in Hoffmeister, 1978). Both child native learners and adolescent L1 learners share the ASL word order characteristic of becoming more canonical over time, although the adolescent learners are more conservative and use only canonical SV order with a longer ASL exposure period compared with deaf native children.

Next, we take a further look at the non-canonical VS structure produced by these participants. All the subjects produced by Carlos and Shawna in VS structures were pronouns. Two examples are listed below, (6) produced by Carlos during the second filming session, and (7) produced by Shawna during the first filming session.

- (6) COOK IX-1.
'I cooked.'

(7) BRING FOOD IX-3.

‘She brought food.’

We compared the proportion of pronominal subjects in SV and VS structures to determine if Carlos and Shawna showed a tendency to use sentence-final pronouns. For Carlos, 64.71% of the subjects in SV structures (34 in total) were pronouns, while 100% of the subjects in his VS structures (4 in total) were pronouns. This difference is not significant according to a Fisher’s Exact test ($p = 0.287$) and suggests that the consistent use of pronoun in those VS utterances by Carlos may be a mere coincidence. The difference is more obvious for Shawna, as only 39.29% of her subjects in SV structures (28 in total) were pronouns, while 100% of her VS structures (7 in total) had pronominal subjects, which was a significantly different use of pronouns in SV and VS structures (Fisher Exact test $p = 0.008$). This suggests that Shawna consistently used pronominal subjects in the VS structure but less so in the SV structure.

By contrast, for Cody we found only 1 pronominal subject in the VS structure (8a). The other 3 VS utterances he produced all used the same noun, MOM, as the subject. One example is shown in (8b). This use of VS order is not adult-like, and could not be a copied form from adult input. He also used MOM several times in SV orders, as shown in (8c). This indicates that he is not consistently adopting VS order for this specific noun, MOM, but instead shows more random patterns in his production.

(8) a. FORGET IX-1 FORGET

‘I forget.’

b. BUY MOM.

‘Buy mom.’

Intended meaning: ‘Mom buys (something).’

c. MOM BUY DOG.

‘Mom bought the dog.’

To summarize the results thus far, similar to child native learners, all three late L1 learners produced more non-canonical VS order in the initial stage of ASL acquisition after 1 to 2 years of exposure and became more canonical at a later stage after 3 or more years of exposure, although their percentage of initial non-canonical VS order was slightly lower compared to child native learners. Two late L1 learners, Carlos and Shawna, consistently produced adult-like non-canonical VS orders with pronominal subjects, while Cody appeared to be more random in his production of the VS order. Next, we examine word order preference in verb-object combinations.

Relative order between verb and object. The issue of verb-object order in ASL is more complicated than that of subject-verb order. Recall that the most common word order in ASL is the canonical VO order. A non-canonical OV order is also possible. There are basically two conditions that license OV order. One is topicalization, which requires a clear non-manual marker, and the other is when the verb is morphologically modulated, with spatial, handling, or aspectual inflection. As mentioned above, despite morphological modulation, agreement inflections are more related to topicalized structures, and non-manual topic markers on the object are required for OV orders with agreement verbs.

Fig. 2 shows the proportion of different word order patterns produced by the adolescent learners during each session.

[Figure 2]

At the first filming session after 1 to 2 years of exposure to ASL, all participants showed more flexible word order patterns and produced more than 40% of their utterances using non-canonical order. During the second session, Shawna continued to produce more flexible word order after 2 years and 8 months of exposure, while Carlos and Cody, each with more than 3 years of exposure to ASL, showed a clear increase in their use of canonical word order. Cody especially produced no OV order at all after 3 years and 2 months of exposure to ASL. During the third session after 4 to 5 years of exposure to ASL, both Carlos and Shawna produced fewer than 20% utterances in non-canonical OV order. These results indicate that the adolescent L1 learners were quite similar in becoming more canonical over time.

For the late L1 learners, their percentage use of the non-canonical OV order in the initial stage after 1 year to 2 years and 8 months of exposure (more than 40%) was relatively close to what is reported for child native ASL learners at age 2;0 to 2;6: 41% (Hoffmeister, 1978); 44% (Schick, 2002); and 54% (Pichler, 2001). This also held true for the later stages after more than 3 years of exposure. According to Hoffmeister (1978), the percentage of non-canonical OV order produced by native child learners beyond age 2;9 ranged from 12% to 20%. Therefore, native child learners and late L1 learners appear to share a similar trajectory and become more canonical over time. It is less clear when Carlos and Cody shifted to the more canonical word order pattern, given the long intervals between their first and second sessions. However, Shawna continued to use varied word order patterns at her second session, after 2 years and 8 months of

exposure. Given the fact that these late L1 learners started producing multi-word utterances very early on (Ramírez et al., 2013), her use of varied word order pattern seems to have lasted for more than at least two years, which differs from that of the child native learners described in Berk (2003) and Hoffmeister (1978), who entered this stage only 9 months to 1 year after beginning to produce multi-word utterances.

Next we take a closer look at the adolescent learners' utterances with both canonical word order and with word order variations to determine if they were similar to child native learners in producing non-canonical word orders with OV-prominent structures. To do so, we grouped their utterances into six categories. The first three categories were verb inflections that allow OV order, namely, aspectual, spatial and handling inflection (Pichler, 2001). The fourth category was agreement verbs, which are commonly associated with topicalization and require the object to be marked by an eyebrow-raising non-manual marker. The fifth category was yes-no questions, which is also common in OV order in adult ASL. Similar to native child learners (Reilly et al., 1990; Pichler, 2001), late L1 learners rarely produce the non-manual eyebrow-raising marker, making it hard to detect any obvious topicalization structure in their production. This means that their production of agreement verbs and yes-no questions were less adult-like due to the lack of an appropriate topic marker. Nevertheless, given that verb agreement structures and yes-no questions are more often associated with topicalization, we would expect these structures to be OV prominent as well. Thus, the five categories listed above are considered to be OV-prominent in adult ASL. Other utterances that did not fit in the above categories were grouped into the 'other' category. While it is still possible that OV utterances that fall into the 'other' category are actually topicalized and conditioned by information structure, we have insufficient evidence to

examine such a possibility from our data set, due to the lack of non-manual discourse markers among late L1 learners.

Table 3a summarizes the different conditions that were sensitive to word order variations in non-canonical OV utterances produced by the late L1 learners over time, while Table 3b shows the distribution in their canonical VO utterances.

[Table 3a]

[Table 3b]

As shown in Table 3a, we observed individual differences in sensitivity to OV-prominent structures. In addition, Carlos seemed to be more sensitive to the topic-prominent conditions, especially with agreement verbs, but he also produced a few OV utterances with the handling inflection. In contrast, Shawna produced more OV orders with adult-like verb inflections, including aspectual, spatial and handling, during both the first and the second sessions. By comparing Table 3a with Table 3b, we observe that in the first session, Carlos produced more OV-prominent types in his OV utterances than in his VO utterances (Fisher Exact test $p = 0.008$). This is also observed in Shawna's second session (Fisher Exact test $p = 0.019$), but not in her first session (Fisher Exact test $p = 0.183$). Cody also produced two OV utterances with agreement verbs in the first session, but no preference for OV-prominent types is found in his OV utterances (Fisher Exact test $p = 0.266$). The numbers of OV utterances produced by Carlos in the second and third session, Shawna in the third session, and Cody in the

second session were too few to perform a meaningful test. In general, all three late learners produced very few unaccounted (“Others”) OV utterances.

Notably, we also observed that the OV utterances the adolescent L1 learners produced during the first session were always associated with a small set of verbs. For example, Carlos produced 8 OV utterances with 3 agreement verbs, namely PAY (9a), SEND (9b) and SHOW (9c).

(9) a. COACH FIRST PAY_3.

‘(I) first pay the coach.’

b. MY SISTER IX-3 SEND_3 EMAIL_3.

‘(I) send my sister (something), I email (her).’

c. CD IX-1 SHOW_2 FAMILY MANY FAMILY

‘I show the CD (to you), family, many (photos), family.’

During the first filming session, Carlos also produced the same verb PAY in canonical word order several times. Also, although his production of PAY often associates only with one object, either the direct object (e.g. COACH) or the indirect object (e.g. MONEY), it seems that neither is associated with a fixed word order pattern. Therefore, it seems that when producing utterances associated with this specific ditransitive verb, Carlos was random in his production.

Similarly, all the OV utterances Shawna produced with spatial and aspectual inflection were always associated with a certain verb for each inflection type, namely spatial BRING (10a) and aspectual SEARCH (10b).

(10) a. FOOD BRING(spatial: there)

‘(I) brought food.’

b. BATTERY SEARCH(aspectual: durative).

‘(I) searched for the battery.’

These patterns suggest that, instead of mastering the underlying rules, it is possible that the late L1 learners are initially learning whole phrases as a constructional template.

Compared with child native learners, we found that although Carlos and Shawna used more OV-prominent verbs in their OV utterances, there still seemed to be a difference between child and adolescent L1 learners in terms of the types of OV-prominent utterances they produced. According to Pichler (2001), most of the OV orders produced by young children are associated with the handling inflection as well as the spatial inflection; only a few utterances are associated with the aspectual inflection, and very few are licensed by the agreement inflection. In contrast, OVs with the handling inflection as well as with the spatial inflection were less common in the adolescent L1 learners’ productions, especially for Carlos and Cody, but all the adolescent L1 learners produced some OV utterances associated with agreement verbs. Because the adolescent L1 learners are much older and cognitively mature, we might speculate that agreement verbs are conceptually more difficult for child native learners compared with adolescent L1 learners who may be able to link experience with home sign or gesture to the spatial modulation of such verbs.

At the same time, we also note that adolescent L1 learners and child native learners share the use of certain verbs in OV utterances, such as WANT and LIKE. As

discussed earlier, adults commonly use these two verbs in yes-no questions with topicalization. This suggests that both adolescent L1 learners and child native learners are sensitive to the adult input for specific verbs.

In sum, these results indicate that adolescent L1 learners are similar to child native learners in terms of word order preferences and developmental trajectory. Also, there is some evidence that they may enter the canonical stage later compared to child native learners.

Although highly informative, there are some limitations of the present study that weaken these implications. First, the language samples we collected from the adolescent L1 learners were relatively small, which means that the patterns we found across three participants could be due to chance, although this is unlikely. The limited sample size also makes it difficult to directly compare results found at different time points, as the set of verbs being produced might influence word order choice as well. Also, with the present dataset, it is difficult to interpret the change in word order preference, given the few tokens of non-canonical utterances produced in the later filming sessions. Finally, because all three participants were living in the same group home, it is difficult to exclude the possibility that the word order patterns we found were prompted by mutual influence among the adolescent L1 learners. More utterances from other adolescent L1 learners acquiring ASL in different environments are required to confirm these findings. In study 2, we analyze the word order development patterns of a fourth adolescent L1 learner of ASL who met these criteria.

Study Two: Adolescent L1 acquisition in a family environment

Participant

The L1 learner in the second study has the pseudonym Chris. Chris was born and grew up until the age of 12 in Indo-China. He was the only deaf person in his hearing family who used no sign language. He attended no school until he moved to North America at the age of 12;10. Upon his arrival, Chris was illiterate and could neither speak nor lip-read. He was placed into a foster home with foster parents who were fluent signers, one of whom was deaf, where he was exposed to accessible language for the first time. He was also enrolled in a deaf residential school, where he was exposed to both ASL and English. Chris was thus fully immersed in an ASL environment at home and school. According to his foster parents, when they first met him, Chris mainly used gestures, facial expressions and loud vocalizations to communicate.

Data Collection

Two sessions of spontaneous language samples were collected from Chris. The first session occurred when Chris was aged 15;9, 2 years and 11 months after he was first exposed to ASL. The language samples were collected during spontaneous conversations about various daily topics between Chris and a deaf native ASL signer. The filming took place in a university laboratory. The second session was filmed when he was aged 18;8, which was 5 years and 10 months after his first exposure to ASL. Similar to the first filming session, Chris conversed with the same deaf native ASL signer about various topics in a university laboratory. The videos were first transcribed by a native deaf signer, and later checked by a hearing researcher who is highly skilled in ASL and coded using the Child Language Data Exchange System (CHILDES, MacWhinney, 2000).

Analysis Procedures

We used the same analysis procedures as those described in Study 1. Table 4 shows the number of analyzable argument-verb combinations we found in the spontaneous language samples.

[Table 4]

Compared with the data available for analysis in Study 1, significantly more data was available for analysis in Study 2. This is because the filming sessions with Chris consisted of several conversations throughout an entire day, while in Study 1 only one conversation was filmed for each session during one meal. Also, Chris was more talkative than the adolescent L1 learners who participated in Study 1.

As shown in Table 4, Chris generally produced more subjects than objects, especially during the second filming session. But this bias does not affect our analyses as we separate the verb-subject combinations from the verb-object combinations when calculating the percentages.

Results

Fig. 3 shows the proportion of canonical and non-canonical word order patterns produced by Chris during each session.

[Figure 3]

Considering the relative order between verb and subject, Chris preferred canonical SV order in both the first filming session (79.27%) and the second filming session (87.26%), using slightly more SV order in the second filming session. This is

similar to the results from Study 1. One pattern to note is that Chris appeared to show less change over time, but this pattern is more apparent than real considering the fact that he had nearly three years of ASL exposure in the first filming session compared with the one and one and a half years of experience for Shawna and Cody respectively and the two years of exposure for Carlos during their first filming session.

In Chris' first filming session, we found 76% of the subjects in utterances with VS order to be pronouns, higher than the proportion in utterances with SV order, which was 59.04%, but the difference was not significant (Fisher Exact test $p = 0.159$). In the second filming session, there were 84.61% of pronoun subjects in VS utterances, while in SV utterances the percentage was 74.86%; the difference was again not significant (Fisher Exact test $p = 0.333$). Therefore, although Chris produced more pronouns in his VS utterances, there is no clear evidence that he was sensitive to the pronoun-copy rule in ASL.

Similar to Study 1, only 12.71% utterances (15 out of 118) in the first filming session and 11.21% utterances (23 out of 205) in the second filming session were produced with both subject and object. In the first filming session, only 40% followed the canonical SVO word order. In the second filming session, 65.21% utterances followed the canonical SVO order. This increase is not statistically significant (Fisher Exact test $p = 0.185$), but might indicate an increased preference of canonical word order even when the utterance has more than one argument.

Next, we examined his relative order pattern between verb and object. The general pattern was again similar to our results from Study 1. During the first filming session, Chris showed more variation in his word order patterns, with 64.71% canonical VO order. In the second filming session, the proportion of canonical word order

increased to 76.06%. Similar to Shawna in Study 1, Chris already had 2 years and 11 months of exposure to ASL at the time of the first filming session, but he still showed a relatively varied word order pattern. This again may suggest a prolonged development of late L1 learners compared to native child learners.

Chris also produced a number of OV utterances in his second filming session, which enables us to analyze changes in the distribution of his OV production over time. Table 5 summarizes his use of each category of verb-object combinations in the first (T1) and second (T2) filming sessions.

[Table 5]

As Table 5 shows, in the first filming session, Chris showed a slight tendency to prefer OV-prominent categories in his OV utterances (33.33%) than in his VO utterances (9.09%), and this difference is marginally significant (Fisher Exact test $p = 0.052$). In the second filming session, we observe an increased use of OV-prominent categories in his OV utterances (58.82%), which is significantly different (Fisher Exact test $p < 0.001$) from the low percentage in his VO utterances (14.81%).

These results suggest that instead of applying the canonical word order to all verbs, Chris shows an increased sensitivity to OV-prominent conditions in ASL. Therefore, it appears that Chris continued to learn the specific rules that allow non-canonical word order in ASL, but increased his use of canonical word order in other utterances. Nevertheless, the non-canonical OV utterances produced by Chris in the second filming session are also associated with a small set of verbs, such as ASK and SEND, similar to the patterns found in Carlos and Shawna's data.

Despite different childhood backgrounds and ASL learning environments, we found that Chris showed a developmental trajectory similar to those of Carlos, Shawna and Cody. We next summarize the results across all four adolescent L1 learners, and examine word order preferences over time.

Word Order Preferences as a Function of Length of ASL Exposure

To further explore the relation between years of ASL exposure and word order preference, we plotted word order preferences as a function of years of exposure for each participant at each language sampling session allowing us to compare findings across the two studies.

[Figure 4]

All four late L1 learners display a similar learning trajectory of word order acquisition as shown in Fig. 4. For the verb-subject combinations, the late L1 learners tended to use more canonical word order from the beginning of ASL acquisition, becoming more canonical with increased years of exposure. For the verb-object combinations, the late L1 learners produce more variable word orders during the earlier stage of acquisition, and after two to three years of exposure to ASL converge on a more canonical word order pattern over time.

These patterns are very similar to the findings reported for child native learners (Berk, 2003; Hoffmeister, 1978), although there is some evidence, as discussed in previous studies, that adolescent L1 learners tend to spend more time using variable word order despite their early production of two-word utterances after approximately one year of ASL exposure (Lillo-Martin & Berk, 2003; Ramírez et al., 2013). It seems

that late L1 learners may require up to 2 years from the initial two-word utterance stage to proceed to the canonical word order stage, more than twice the time child native learners need to enter this stage from their first multi-word utterances, around 9 months to 1 year.

We do observe some individual differences, however. Shawna produced only 61.54% canonical SV order in her second filming session after two years of ASL exposure, which differed from other participants. We speculate that this may be because Shawna, unlike other late L1 learners, tended to restrict the use of pronominal subject to the sentence-final position during this stage, as described above in Study 1. Also, Cody showed an earlier stage of canonical word order preference after 3 years and 2 months of exposure to ASL, while other three adolescent L1 learners, Shawna, Carlos, and Chris, showed more variability with similar years of exposure. Cody had attended school prior to being exposed to ASL. Although he showed little evidence of language acquisition from this schooling, it may have had an effect on his subsequent language acquisition. He also showed faster vocabulary development compared to Carlos and Shawna (Ramírez et al., 2013), and faster lexical development is related to an earlier onset of early morpho-syntactic development in English speaking children (Marchman & Bates, 1994). This may explain why he entered the canonical stage earlier than other adolescent L1 learners.

Discussion

In two studies, we found that for both verb-subject combinations and verb-object combinations, adolescent L1 learners showed word order variation in the initial stage of ASL acquisition, after 1 year to 2 years and 11 months of exposure to ASL (first session for Carlos, Cody and Chris, and both first and second sessions for Shawna). This result is

highly consistent with those reported for child native learners who also produce more flexible word order at this stage with similar amounts of ASL exposure, at ages 2;0 to 2;6 (Hoffmeister, 1978; Pichler, 2001; Schick, 2002). We also found that adolescent L1 learners became more canonical after about three years of language exposure. This second finding again parallels the word order patterns observed for young native children beyond age 2;6, when they also show a preference for canonical word order (Berk, 2003; Hoffmeister, 1978). In addition, like young child L1 learners, the adolescent L1 learners seldom produced unaccountable non-canonical utterances. That is, they often used pronominal subjects in the sentence-final position, and also showed sensitivity to the various object-first conditions. Together these results indicate a similar developmental trajectory of ASL word order acquisition for adolescent and child L1 learners. However, there is some evidence that adolescent L1 learners take longer to progress to the canonical stage.

For our main research question, we asked about the effects of cognitive maturity and early language deprivation on syntactic development. First, we did not observe faster acquisition by adolescent L1 learners in early syntactic development, suggesting that cognitive maturity does not facilitate syntactic development. The trajectory of word order acquisition in ASL thus appears to be constrained by the learning mechanisms of grammatical structure for the first time rather than by cognitive maturity. One thing we noticed is that compared to native L1 learners, late L1 learners produced more utterances with cognitively more complex verbs, for example agreement verbs, early in their syntactic development. They also showed some sensitivity to the OV-prominent features of these verbs, along with other types of verbs, similar to native L1 learners. These findings extend previous findings for the initial stages of adolescent L1 lexical

acquisition (Ramírez et al., 2013) and the two-word stage in child late L1 learners (Berk & Lillo-Martin, 2012), confirming that the content and trajectory of early language development is not altered by increased cognitive maturity.

As for AoA effects, we considered three possibilities: no effects, effects on non-canonical orders only, and effects on both basic and non-canonical word orders. According to our results, late L1 learners showed a developmental trajectory similar to that of child, native L1 learners with varied word order in the beginning and more canonical word order later on. Also, they seem to show sensitivity to the various syntactic conditions that trigger non-canonical word orders, such as sentence-final pronominal subjects and various verb-specific object-first conditions. Similar to child native L1 learners, from very early on, adolescent L1 learners seldom produce unaccountable non-canonical word orders. Among the late L1 learners, Chris showed increased sensitivity to non-canonical conditions over time. In this sense, these findings seem to favor the first prediction, that early language deprivation does not affect early syntactic development in general.

However, we also garnered some evidence suggesting a prolonged developmental stage for basic word order for late L1 learners. Although the mechanisms underlying early syntactic development appear to be intact when language acquisition is delayed until adolescence, the developmental duration of syntactic acquisition appears to be significantly prolonged relative to the fast rate observed for their early lexical development (Ramírez et al., 2013).

Previous studies on native L1 grammatical development (Pinker, 1989; Brown, 1973; Slobin & Bever, 1982), emerging sign languages (Sandler, Meir, Padden, & Aronoff, 2005), early language deprivation (Boudreault & Mayberry, 2006; Curtiss,

2014; Newport, 1990), and gestural communicative systems developed by deaf children without sign language (Goldin-Meadow & Mylander, 1998), have all suggested that simple form-meaning mappings, such as unit combinations with basic constituent order, are salient to children, even when environmental input is varied, insufficient, severely delayed, or absent. Our findings confirm that basic word order is relatively resilient from the effects of late language exposure from a developmental aspect.

The present study was an initial attempt to fill the gap between the native-like developmental trajectory shown by the adolescent L1 learners in previous studies (Berk & Lillo-Martin, 2012; Morford, 2003; Ramírez et al., 2013), and the morpho-syntactic and complex syntax deficits observed in ultimate attainment studies of delayed L1 acquisition (Boudreault & Mayberry, 2006; Newport, 1990). Our findings suggest that the trajectory of syntactic development is not altered when it starts later in life, but the learning process is likely to be significantly slowed, even for the most common structures such as basic word order. It is also important to note that crucial morphological markers, such as the non-manual topic marker, were always missing from late learners' utterances. Thus, it appears that ultimate language outcomes are likely affected by selective learning difficulties at the morpho-syntactic level of language structure. A protracted rate of word order development may be one symptom that the underlying mechanisms of grammatical learning are adversely affected by a late start to the language acquisition process. Future studies are required to determine whether such learning difficulties cause representational differences in language outcome, or rather indicate increased processing difficulties that affect their task performance, as proposed by Morford (2003).

The nature of longitudinal studies of a less-studied language (ASL) of a special population (adolescent L1 learners) poses several limitations. First of all, given our limited knowledge of adult ASL patterns, it is difficult to determine if the relatively high proportion of canonical word order use observed in the later sessions of the present studies are adult-like or not. It remains possible that late L1 learners as well as child native L1 learners rely on canonical word order more than necessary due to a failure to fully acquire more complex morphological and syntactic structures. More longitudinal data is necessary to determine whether and when late L1 learners and child native L1 learners start to produce adult-like word order patterns. The lack of this information does not affect the interpretation of our present findings, however, as we only compared late L1 learners with native L1 learners in the early stages of syntactic acquisition. More information on adult input patterns would greatly increase our understanding of late L1 syntactic acquisition.

Another caveat regarding our findings is that, because the non-canonical OV orders in ASL are often associated with a subset of verbs in ASL, we do not know if the OV utterances expressed by the late L1 learners are generated by morphological rules, or instead are acquired on a verb-specific basis. For example, most of the non-canonical OV utterances produced by Carlos, Shawna and Chris were always associated with a small set of agreement verbs or morphologically modulated verbs. This was also true for the morphologically modulated verbs observed in Pichler (2001). Experiments involving less common verbs with similar morphological features would clarify this question.

We do not know the complexity of the home sign systems these learners may have used before their exposure to ASL. Studies on home sign systems (Goldin-Meadow & Feldman, 1977; Goldin-Meadow & Mylander, 1998) suggest that deaf children without

natural sign language input usually develop their own gesture systems, and they demonstrate certain patterns in their two gesture combinations, such as constituent expression and ordering as a function of argument type. Because all four late L1 learners showed similar word order acquisition patterns despite their different cultural backgrounds and ASL learning environments, it seems likely that the task of learning ASL grammar itself overrides any pre-existing differences in the late L1 learners' use of homesign.

Finally, when analyzing the available spontaneous data, it was not always easy to interpret the late learners' intended information structure to determine how change in information prominence might have affected their word order preference. Answering this question would require careful control of information structure using experimental designs, which would be a fruitful direction for future research.

In sum, the current studies find that adolescent late L1 learners show a developmental trajectory in their ASL word order production similar to what has been observed for child native ASL learners. The present results also show that the process of word order acquisition when language acquisition begins for the first time at or after the age of 13 is significantly prolonged. Importantly, the present findings suggest that initial syntactic development follows a similar trajectory even with delayed language onset and increased cognitive maturity. These results confirm previous findings that L1 AoA effects are selective: simple syntactic structures are relatively more resilient to perturbations in the age-onset of language acquisition than morpho-syntactically complex structures. These findings also suggest that the learning process of early morpho-syntactic development appears to be sensitive to the age-onset of language acquisition unlike early lexical development. More research is required to discover

precisely how a late onset of language exposure affects the mechanisms of syntactic acquisition and processing.

References

- Aarons, D. (1996). Topics and topicalization in American Sign Language. *Stellenbosch Papers in Linguistics*, 30, 65-106.
- Anderson, D., & Reilly, J. (2002). The MacArthur communicative development inventory: normative data for American Sign Language. *Journal of deaf studies and deaf education*, 7(2), 83-106.
- Bader, M., & Häussler, J. (2010). Word order in German: A corpus study. *Lingua*, 120(3), 717-762.
- Berk, S. B. (2003). *Sensitive period effects on the acquisition of language: A study of language development* (Unpublished doctoral dissertation). University of Connecticut, Storrs, CT.
- Berk, S., & Lillo-Martin, D. (2012). The two-word stage: Motivated by linguistic or cognitive constraints?. *Cognitive psychology*, 65(1), 118-140.
- Bongaerts, T., Mennen, S., & Slik, F. V. D. (2000). Authenticity of pronunciation in naturalistic second language acquisition: The case of very advanced late learners of Dutch as a second language. *Studia Linguistica*, 54(2), 298-308.
- Boudreault, P., & Mayberry, R. I. (2006). Grammatical processing in American Sign Language: Age of first-language acquisition effects in relation to syntactic structure. *Language and Cognitive Processes*, 21(5), 608-635.
- Brown, R. (1973). *A first language: The early stages*. Cambridge, MA: Harvard.
- Coerts, J. A. (2000). Early sign combinations in the acquisition of Sign Language of the

- Netherlands: Evidence for language-specific features. *Language acquisition by eye*, 91-109.
- Coppieters, R. (1987). Competence differences between native and near-native speakers. *Language*, 544-573.
- Crasborn, O., & Sloetjes, H. (2008). Enhanced ELAN functionality for sign language corpora. In *6th International Conference on Language Resources and Evaluation (LREC 2008)/3rd Workshop on the Representation and Processing of Sign Languages: Construction and Exploitation of Sign Language Corpora* (pp. 39-43).
- Curtiss, S. (1977). *Genie: A psycholinguistic study of a modern-day "Wild Child"*. New York: Academic Press.
- DeKeyser, R. M. (2000). The robustness of critical period effects in second language acquisition. *Studies in Second Language Acquisition*, 22(04), 499-533.
- Dryer, M. S. (2007). Word order. *Language Typology and Syntactic Description*, 1, 61-131.
- Ellis, R. (1994). *The study of second language acquisition*. Oxford: Oxford University Press.
- Fisher, S. D. (1975). *Influences on word-order change in American Sign Language*. In C. Li, (Ed.), *Word order and word order change* (pp 1–25). Austin, TX: University of Texas Press.
- Fisher, S., & Janis, W. (1990). Verb sandwiches in American Sign Language. In S. Prillwitz & T. Vollhaber (Eds.), *Current trends in European sign language research: Proceedings of the third European Congress on Sign Language*

- Research* (pp. 279-294). Hamburg: Signum Verlag.
- Fromkin, V., Krashen, S., Curtiss, S., Rigler, D., & Rigler, M. (1974). The development of language in genie: a case of language acquisition beyond the "critical period". *Brain and Language, 1*(1), 81-107.
- Goldin-Meadow, S., & Feldman, H. (1977). The development of language-like communication without a language model. *Science, 197*, 401-403.
- Goldin-Meadow, S., & Mylander, C. (1998). Spontaneous sign systems created by deaf children in two cultures. *Nature, 391*(6664), 279-281.
- Granena, G. (2012). *Age differences and cognitive aptitudes for implicit and explicit learning in ultimate second language attainment*. University of Maryland, College Park.
- Granena, G., & Long, M. H. (2013). Age of onset, length of residence, language aptitude, and ultimate L2 attainment in three linguistic domains. *Second Language Research, 29*(3), 311-343.
- Greenberg, J. H. (1963). Some universals of grammar with particular reference to the order of meaningful elements. *Universals of Language, 2*, 73-113.
- Grimshaw, G. M., Adelstein, A., Bryden, M. P., & MacKinnon, G. E. (1998). First-language acquisition in adolescence: Evidence for a critical period for verbal language development. *Brain and Language, 63*(2), 237-255.
- Hoffmeister, R. (1978, September). Word order in the acquisition of ASL. Paper presented at the Third Annual Boston University Conference on Language Development, Boston, MA.
- Johnson, J. S., & Newport, E. L. (1989). Critical period effects in second language

- learning: The influence of maturational state on the acquisition of English as a second language. *Cognitive Psychology*, 21(1), 60-99.
- Kegl, J. (1976). Pronominalization in ASL. *Manuscript, MIT, Cambridge, MA.*
- Kidd, E. (2012). Implicit statistical learning is directly associated with the acquisition of syntax. *Developmental psychology*, 48(1), 171.
- Klima, E., & Bellugi, U. (1979). The sign of language. *Cambridge, MA: Harvard University Pres.*
- Lardiere, D. (1998). Dissociating syntax from morphology in a divergent L2 end-state grammar. *Second Language Research*, 14(4), 359-375.
- Lardiere, D. (2007). *Ultimate attainment in second language acquisition: A case study.* Mahwah, NJ: Lawrence Erlbaum.
- Lenneberg, E. H. (1967). The biological foundations of language. *Hospital Practice*, 2(12), 59-67.
- Liddell, S. K. (1980). *American sign language syntax.* The Hague: Mouton.
- Lillo-Martin, D. (1986). Two kinds of null arguments in American Sign Language. *Natural Language & Linguistic Theory*, 4(4), 415-444.
- Lillo-Martin, D., & Berk, S. (2003). Acquisition of constituent order under delayed language exposure. In B. Beachley, A. Brown & F. Conlin (Eds), *Proceedings of the 27th Annual Boston University Conference on Language Development* (Vol. 2, pp. 484-495). Somerville, MA: Cascadilla Press.
- MacWhinney, B. (2000). *The CHILDES Project: Tools for analyzing talk. Third Edition.* Mahwah, NJ: Lawrence Erlbaum Associates.
- Marchman, V. A., & Bates, E. (1994). Continuity in lexical and morphological

- development: A test of the critical mass hypothesis. *Journal of Child Language*, 21, 339-339.
- Matsuoka, K. (1997). Verb raising in American sign language. *Lingua*, 103(2), 127-149.
- Mayberry, R. I. (1993). First-language acquisition after childhood differs from second-language acquisition: The case of American Sign Language. *Journal of Speech, Language, and Hearing Research*, 36(6), 1258-1270.
- Morford, J. P. (2003). Grammatical development in adolescent first-language learners. *Linguistics*, 41(4), 681-722.
- Newport, E. L. (1990). Maturation constraints on language learning. *Cognitive Science*, 14(1), 11-28.
- Newport, E. L., & Meier, R. P. (1985). *The acquisition of American Sign Language*. In D. Slobin (Ed.), *The cross-linguistic study of language acquisition: The data* (Vol. 1, pp. 881-938). Hillsdale, NJ: Lawrence Erlbaum Associates.
- Padden, C. (1988). *Interaction of morphology and syntax in American Sign Language*. New York: Garland.
- Palmer, J. L. (2015). *ASL word order development in bimodal bilingual children: Early syntax of hearing and cochlear-implanted Deaf children from signing families* (Unpublished doctoral dissertation). Gallaudet University, Washington, D.C.
- Park, T. Z. (1970). Language acquisition in a Korean child. *Unpublished manuscript*. Psychological Institute, University of Bern, Switzerland.
- Pichler, D. C. (2001). *Word order variation and acquisition in American Sign*

- Language* (Unpublished doctoral dissertation). University of Connecticut, Storrs, CT.
- Ramírez, N. F., Lieberman, A. M., & Mayberry, R. I. (2013). The initial stages of first-language acquisition begun in adolescence: when late looks early. *Journal of Child Language, 40*(02), 391-414.
- Reilly, J. S., McIntire, M., & Bellugi, U. (1990). The acquisition of conditionals in American Sign Language: Grammaticized facial expressions. *Applied Psycholinguistics, 11*(04), 369-392.
- Reinhart, T. (1995). *Interface strategies - Reference-set computation*. Cambridge, MA: MIT Press.
- Rumelhart, D. E., & McClelland, J. L. (1986). On learning the past tenses of English verbs. In J. L. McClelland, D. E. Rumelhart, & the PDF Research Group (Eds.), *Parallel distributed processing: Explorations in the infrastructure of cognition: Vol. 2. Psychological and biological models* (pp. 216-271). Cambridge, MA: MIT Press.
- Saffran, J. R., Newport, E. L., Aslin, R. N., Tunick, R. A., & Barrueco, S. (1997). Incidental language learning: Listening (and learning) out of the corner of your ear. *Psychological Science, 8*(2), 101-105.
- Sandler, W., Meir, I., Padden, C., & Aronoff, M. (2005). The emergence of grammar: Systematic structure in a new language. *Proceedings of the National Academy of Sciences of the United States of America, 102*(7), 2661-2665.
- Schick, B. (2002). The expression of grammatical relations in deaf toddlers learning ASL. In B. Woll & G. Morgan (Eds.), *An international perspective on the*

acquisition of sign languages (pp. 143–158). Philadelphia, PA: John Benjamins.

Slobin, D. I. (1966). The acquisition of Russian as a native language. In F. Smith & G. A. Miller (Eds.), *The genesis of language: a psycholinguistic approach* (pp 129-148). Cambridge, MA: MIT. Press.

Slobin, D. I., & Bever, T. G. (1982). Children use canonical sentence schemas: A crosslinguistic study of word order and inflections. *Cognition*, 12(3), 229-265.

Snedeker, J., Geren, J., & Shafto, C. L. (2007). Starting over: International adoption as a natural experiment in language development. *Psychological Science*, 18(1), 79-87.

Stokoe, W. C. (1978). *Sign language structure*. Silver Spring, MD: Linstok.

Tomlin, R. S. (1986). *Basic word order: Functional principles*. London: Croom Helm.

Tables

Table 1: The participants’ age and years of exposure (YoE) to ASL at each filming session.

Participant	AoA^a	YoE^b at T1^c	YoE at T2	YoE at T3
Carlos	13;8	2;0	3;8	5;6
Shawna	14;7	1;0	2;8	4;6
Cody	14;8	1;6	3;2	NA

^a AoA: Age of Acquisition; ^b YoE: Years of Exposure to ASL; ^c Filming session: T1 - Time 1, T2 – Time2, T3 – Time 3.

Table 2: The number of verb-argument combinations produced in each filming session by each participant

Participant	Verb with Subject			Verb with Object		
	T1 ^a	T2	T3	T1	T2	T3
Carlos	12	17	9	31	13	11
Shawna	11	13	11	21	20	15
Cody	16	10	NA	14	9	NA

^a Filming session number: T1 - Time 1, T2 – Time2, T3 – Time 3.

Table 3a: Distribution of word order sensitive conditions in OV utterances – token number (type number)

Participant	Carlos			Shawna			Cody	
Session (Years of exposure)	T1 (2;0)	T2 (3;8)	T3 (5;6)	T1 (1;0)	T2 (2;8)	T3 (4;6)	T1 (1;6)	T2 (3;2)
Utterance Type								
Aspectual	0	0	0	3(1)	0	1	0	0
Spatial	0	0	0	3(1)	0	0	0	0
Handling	1	0	1	0	5(3)	0	0	0
Agreement	8(3)	0	0	1	1	0	2(2)	0
Yes-no question	2(2)	1	0	1	0	0	0	0
Others	1	2(2)	1	2(2)	2(2)	0	3(3)	0
OV total count	12(7)	3(3)	2(2)	10(6)	8(5)	1	5(5)	0

Table 3b: Distribution of word order sensitive conditions in VO utterances – token number (type number)

Participant	Carlos			Shawna			Cody	
Session (Years of exposure)	T1 (2;0)	T2 (3;8)	T3 (5;6)	T1 (1;0)	T2 (2;8)	T3 (4;6)	T1 (1;6)	T2 (3;2)
Utterance Type								
Aspectual	0	0	0	0	1	0	0	0
Spatial	0	1	0	1	1	1	4(2)	3(2)
Handling	3(1)	0	0	0	0	0	0	0
Agreement	5(1)	2(2)	0	3(2)	0	2(1)	3(1)	0
Yes-no question	0	0	0	1	0	0	0	0
Others	11(9)	7(7)	9(5)	6(2)	10(7)	11(6)	2(2)	6(6)
VO total count	19(11)	10(10)	9(5)	11(6)	12(9)	14(8)	9(5)	9(8)

Table 4: Number of argument-verb combinations produced by Chris during each filming session – token number (type number)

Type	T1 (2;11)^a	T2 (5;10)
Verb with Subject	77	146
Verb with Object	51	59

^a Filming session number: T1 - Time 1; T2 - Time 2. Years of exposure to ASL shown in the parentheses (Year; Month).

Table 5: Distribution of word order sensitive conditions in VO and OV utterances – token number (type number)

Session^a (Years of exposure)	T1 (2;11)		T2 (5;10)	
Word Order Utterance Type	VO	OV	VO	OV
Aspectual	0	0	0	1
Spatial	0	2(2)	2(1)	0
Handling	0	1	0	1
Agreement	2(2)	3(3)	2(2)	7(4)
Yes-no question	1	0	4(4)	1
Others	30(19)	12(11)	46(23)	7(5)
Total count	33(22)	18(17)	54(30)	17(11)

^a Filming session number: T1 - Time 1; T2 - Time 2.

Figures

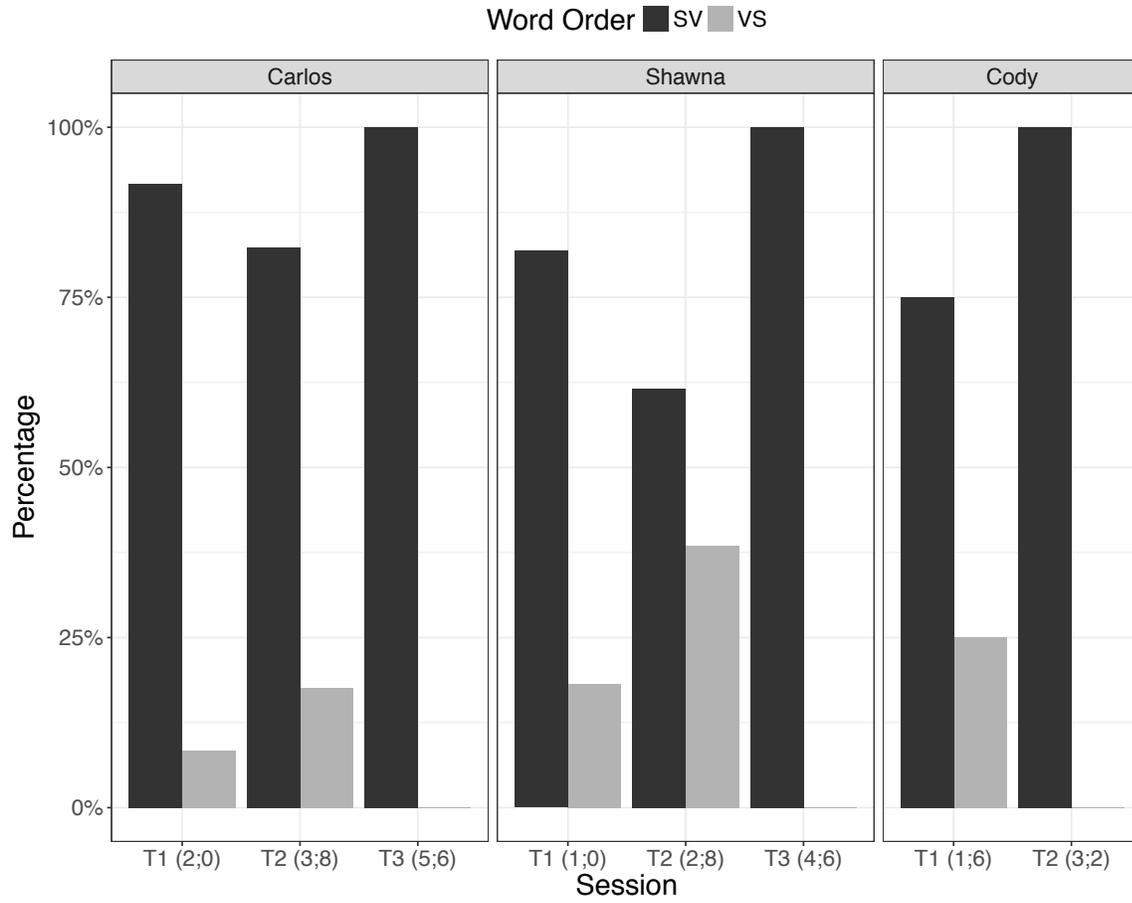


Figure 1

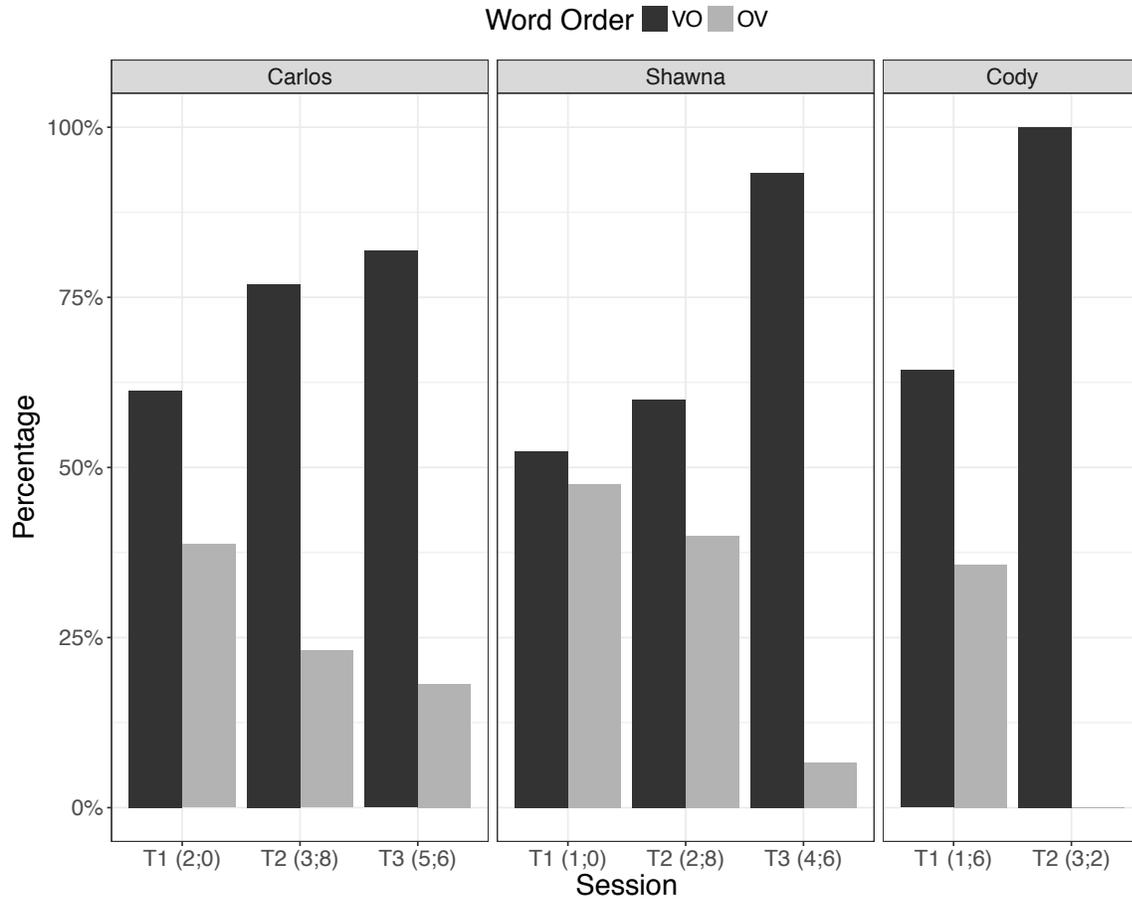


Figure 2

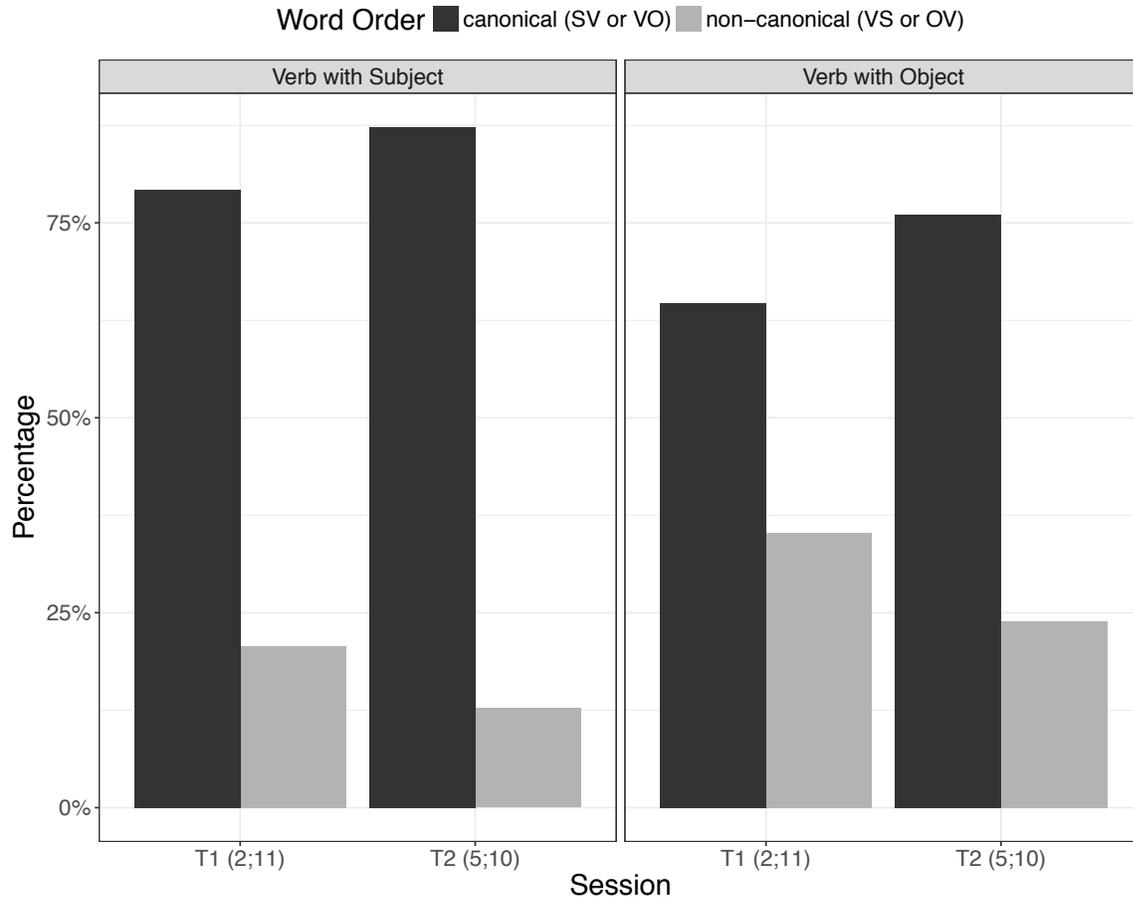


Figure 3

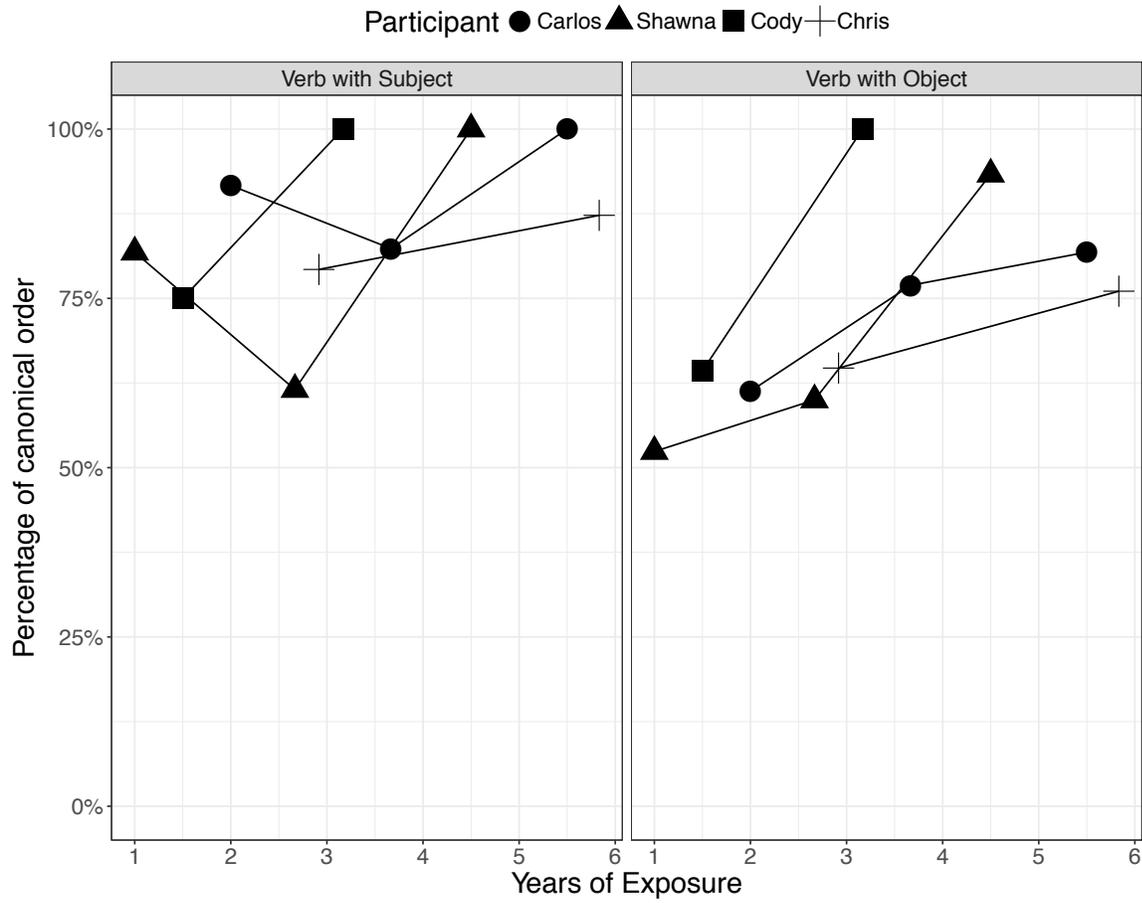


Figure 4

Figure captions

Figure 1: Percentage of canonical SV and non-canonical VS orders produced by the adolescent L1 learners during each session as a function of years of ASL exposure (shown in the parenthesis following the session number).

Figure 2: Percentage of canonical VO and non-canonical OV order produced by the learners during each session as a function of length of ASL experience (shown in the parenthesis following the session number).

Figure 3: Percentage of canonical (SV or VO) and non-canonical (VS or OV) utterances produced by Chris during each session as a function of length of ASL experience (shown in the parenthesis following the session number).

Figure 4: Percentage of canonical word order (SV or VO) produced by each participant as a function of years of ASL exposure.