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Word order in the context of extensional and intensional events in Austrian Sign Language (ÖGS)

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This study examines the impact of the semantics of events and their participants on syntax (word order) in Austrian Sign Language (ÖGS), replicating and extending findings on other sign languages (Napoli et al. 2017). We tested the hypothesis that in the visual modality, intensional and extensional events are preferentially expressed by different word orders: verbs expressing an intensional event are preferred before the object and verbs expressing an extensional event are preferred after the object. To test this pattern for ÖGS and whether animacy of the object argument contributes to these preferences, Deaf signers were asked to sign transitive relations involving extensional and intensional events in non-reversible and reversible contexts. Results indicate systematic differences between verb types. Subject-object-verb order (SOV), the basic ÖGS word order, was preferred for extensional events, while subject-verb-object order (SVO) was more prevalent with intensional events, which also showed more complex structures. Unlike prior research, we did not find a preference for SVO orders due to argument reversibility, which had been suggested to reflect iconicity in the visual modality. We reconsider how extensional/intensional are traditionally defined and suggest that while both are relevant to word order decisions in ÖGS, imputed iconicity loses any explanatory value it might have had if the stimuli more narrowly compared creation and non-creation verbs.

1. Introduction

This study investigates whether the semantics of verbs and properties of their arguments impact word order in Austrian Sign Language (ÖGS). We investigated the intensional-extensional event distinction reported for silent gestures and two other sign languages. The hypothesis arises from the correlation of extensional events with SOV orders and intensional events with SVO orders, and the possible contribution of argument animacy ('reversibility'). We provide background on word order, observations from silent gesture studies, and how event semantics is said to influence order. We then discuss intensionality/extensionality and their relation to cognition and iconicity, the context of sign languages, and word order in ÖGS.

1.1 Background information

1.1.1 Basic word order and its origin

Word order preferences can be approached from typological and evolutionary (i.e. historical evolution) perspectives. From the typological perspective, questions revolve around the basic word order (presumed to correlate with other syntactic features; Greenberg 1963) and factors that permit deviations from the basic order. From the evolutionary perspective, questions address how conventionalized orders may have emerged and whether they reflect cognitive biases or other evolutionary pressures (e.g. systemic simplicity). These perspectives intersect in the discussion of how a conventionalized order gains typological status and whether semantic preferences ('natural' orderings) must disappear or can coexist within a single language.

Typologically, basic order refers to subject (S), object (O) and verb (V) in simple clauses without required context ('all new information', Kratzer & Selkirk 2020). Typologically, six word orders are possible (SOV, SVO, VSO, VOS, OSV, OVS), of which SOV and SVO orders are the two most common, with SOV the single most common order cross-linguistically (Dryer 2013). Since Greenberg (1963; Cinque 2005), basic word order has been shown to correlate with other syntactic characteristics within a language, such as e.g. whether there are prepositions or postpositions (implicational universals). Nonetheless, languages show differing degrees of word order variation, involving factors such as animacy, information structure and dependency length. This has led to recent accounts that propose a less categorical, more gradient view of word order (e.g. Levshina et al. 2023).

The evolutionary issue is how word order conventions could have emerged (possibly overriding cognitive/semantic preferences) and what underlying cognitive biases might shape such preferences. One approach to studying possible origins rooted in cognitive biases is use of the silent spontaneous gesture task in which participants gesturally act out specific events (illustrated by pictures) without any speech (Schouwstra et al. 2019).[1] Note that the term 'word

[1] Theoretically this is without a conventional language system, but participants have language systems, namely their L1s and possibly additional L2s.

order' is used even in the context of silent gesture, which is communicative but not linguistic. The silent gesture studies reveal that participants produce SOV and SVO most frequently despite having different linguistic backgrounds (different L1s) (Goldin-Meadow et al. 2008; Gibson et al. 2013; Hall et al. 2013; Schouwstra & de Swart 2014; Meir et al. 2017).

1.1.2 The extensional-intensional distinction in silent gesture

Event semantics reportedly impacts the order in silent gesture experiments: SOV with extensional events, and SVO with intensional events (Schouwstra 2012; Schouwstra & de Swart 2014). In extensional events, the direct object presumably refers to an entity that exists independently of the event (e.g. a man swinging a guitar), whereas in intensional events, the direct object may not refer to a specific or existing object: for example, its existence may be dependent on the event denoted by the verb (creation: man knitting a sock, non-creation: man dreaming of a guitar). The differing orders for intensional and extensional events have been explained as a cognitive preference to convey specific, less relational information (entity information; agents/patients) before abstract, more relational information (actions; Gentner & Boroditsky 2001) leading to SOV. The direct object in intensional events may be considered more relational because it is not specific and may be dependent on the action (therefore following the action), leading to an SVO preference. Thus, in the silent gesture task participants appear to use a semantic basis to structure their productions, resulting in orders conveying different semantic interpretations (Schouwstra 2017).

Schouwstra et al. (2019) observed that participants also use silent gesture order as a comprehension cue for intensional versus extensional events. Although the strength of this effect was less pronounced than for production, participants were more likely to interpret gestured SVO orders (compared to SOV) as intensional events. Likewise, Motamedi et al. (2022) reported the difference between intensional and extensional events expressed by silent gestures in a forced choice decision task. They suggest that order preferences in both production and perception could be interpreted as evidence that they are likely rooted in general cognitive biases.

1.1.3 Speculations on how semantically-conditioned order yields to dominant syntactic order

With respect to emergence of dominant basic orders, researchers have tried to explain the connection between semantically-conditioned 'natural' order preferences in silent gesture and the regularized orders (with a 'dominant typological' order) by suggesting that using conventionalized order is *simpler* because it involves only one rule. In contrast, the use of semantically-conditioned 'natural' ordering involves two condition-dependent rules: If an intensional event is expressed, an SVO order is used, whereas if an extensional event is expressed, an SOV order is needed.

Schouwstra et al. (2020) examined conditions under which natural order might yield to conventional order. In their study a silent gesture system (involving extensional/intensional

events) was transmitted between 'generations' using a task that required observation of and participation in communication. They observed that communicative interaction and iterated learning (cultural transmission) both led to simplified (i.e. a dominant) order. SVO was the most dominant order, which was also the basic order of their participants' native language. Separately, they showed that SOV order can also conventionalize by manipulating the frequency of different semantic event types. They concluded that when there is a conflict between naturalness and regularity, naturalness will give way to regularity as word order becomes conventionalized through repeated usage (Schouwstra et al. 2020).

Motamedi et al. (2022) examined whether learning gestural descriptions (involving extensional/intensional events) with different frequencies of SOV and SVO would lead to a shift from natural ordering towards a single order for both event types. Using a forced-choice experiment in which participants select orders for different events, they observed reduced variability in the order patterns, suggesting that learning gestural descriptions with different order frequencies may play a role in shifting order preferences from natural to systematic. However, in addition to the single ordering across events, the natural order preference was observed to persist even after conventions appeared to be established.[2] The observation that natural ordering is used despite learning speaks against the assumption that once conventions are established, a preference for systematic languages would override natural ordering.

Using their data to model cultural transmission of order preferences over time, Motamedi et al. (2022) suggested that preferences for systematic as well as natural orderings are expected to persist over generations and that languages with unnatural orders will be strongly dispreferred. They hypothesized that semantically-conditioned order variability will continue to exist in at least some languages, whereby different ordering preferences may be evident in different contexts.

1.1.4 Re-evaluating this line of reasoning: possible role of arguments

It has been argued that the event properties are not the only factors affecting order, but that the semantic properties of the direct object referent also affect order. Silent gesture studies show a preference for SOV for non-reversible events (typically animate subject/agent and inanimate direct object/patient) (e.g. Goldin-Meadow et al. 2008). In contrast, for reversible events (typically two animate arguments) a preference for SVO or more variable orders have

[2] This was not observed for the unnatural condition (the most frequent order was the inverse of the natural condition, SVO for the extensional event and SOV for the intensional event), where the input frequencies were not learned well by participants. This suggests that the preference for natural ordering is associated with the mapping between event and order rather than with a general preference for consistent conditioned variation (Motamedi et al. 2022).

been observed (Meir & Lifshitz & Ilkbasaran & Padden 2010; Gibson et al. 2013; Hall et al. 2013; Futrell et al. 2015; Meir et al. 2017).

One account proposing to explain SVO orders in reversible events is the 'noisy channel' theory of Gibson et al. (2013), which suggests that speakers structure their message in a way that it can be perceived by their interlocutor even if some information is not appropriately transmitted due to noise. According to Gibson et al., SVO orders are more robust to noise, because even when information about one of the participants of a reversible event is missing, SVO would still be partly interpretable by the relative position of the remaining participant in relation to the verb (SV or VO). It is not clear that one would expect to see this effect in relatively noiseless experimental conditions, however.

Other verb meaning components interact with those of the direct object, providing a more nuanced understanding of reversibility. Schouwstra et al. (2022) showed that both the (in)animacy of the patient and the properties of the verb determine the reversibility of an event. They contrasted the silent gesturing of strongly non-reversible events (e.g. boy eats watermelon) with weakly non-reversible events (e.g. boy punches watermelon). Strongly non-reversible events are unlikely to ever occur in a reversible event: the agent is unlikely to be patient and the patient is unlikely to be agent. Thus, we cannot make these events reversible by changing one of the participants. Weakly non-reversible events are non-reversible events that can be made reversible by changing the participants in the event. The agent could plausibly be the patient (boy gets punched), but the patient is unlikely to be agent. They reported that weakly non-reversible events behave more like reversible events, displaying more SVO orders, whereas strongly non-reversible events displayed more SOV orders. They further report that when silent gesture is used for communicative interaction, the order became more consistent (SVO) over time, although this regularization is less pronounced for strongly non-reversible events. Such a regularization of order in a silent gesture task is not necessarily the basic order of gesturers' native language (e.g. Christensen et al. 2016; Schouwstra et al. 2020). Finally, full order consistency was not reached in Schouwstra et al.'s experiment, nor in order data on reversible vs. non-reversible events from natural languages (Schouwstra et al. 2022).

1.2 The sign language context

Previous work provides evidence for the extensional-intensional distinction at least for two sign languages, Brazilian Sign Language (Libras) and Nicaraguan Sign Language (NSL). The following sections will illustrate how the investigation of sign languages can contribute to the question of the origin of conventionalized basic order in languages.

1.2.1 Emerging sign languages

Another approach to investigate the emergence of word order is the study of young sign languages used by Deaf native signers for only two or three generations.[3] NSL is relatively young, emerging in the 1970s when the first Deaf school was founded in Managua. The first children attending school did not come from signing families, had no prior contact with a sign language, and used home sign systems to communicate with their families. When the children started to communicate with each other at the school, a signing system started to develop, and as subsequent cohorts of children acquired the new system from their older peers, the language developed and changed (Senghas et al. 2004). Such young sign languages can provide insight into the question of how a linguistic system emerges without any prior linguistic model, how social interaction and language experience impact the development of language, and – crucial for the present report – which orders are used in early stages of language development: emerging sign languages prefer SOV orders (Meir & Sandler & Padden & Aronoff 2010).

1.2.2 Established sign languages and the extensional-intensional distinction

The present report is focused on two factors affecting order: the semantics of the events involved, and the semantics of the event participants. With respect to the event semantics, the impact of the extensional-intensional distinction on order has not been observed for any spoken language so far, with the same order being used independent of event type. In contrast, this effect has been described for some sign languages. In Napoli et al. (2017) – which builds the base for the present experiment – signers of Libras, which has SVO as its basic order, were asked to express the same stimuli used in Schouwstra's gesture studies. They observed similar preferences to the silent gesture studies: extensional verbs prefer SOV and intensional verbs prefer SVO. They concluded that these order preferences reflected the iconicity and the visualization of events possible when event actions and participants are mapped to signs. Objects that are already present in a specific scene and are therefore visible before the verb is expressed tend to precede the verb (extensional), and objects whose existence are dependent on the verb and thus are not visible before the verb is expressed, follow the verb (intensional).[4] The same pattern was also observed for NSL, which has SOV basic order (Flaherty et al. 2018). For British Sign Language (BSL) a similar distribution was described: in sentences with affective verbs (verbs denoting an event that acts on something that

[3] Per convention *Deaf* with upper-case D refers to deaf or hard of hearing people who define themselves as members of the sign language community. In contrast, *deaf* refers to audiological status.

[4] A similar account based on iconicity was proposed by Christensen et al. (2016) who tested order preferences using a silent gesture task in the context of manipulation events (extensional events) vs. creation events (intensional events). They propose that order can iconically represent the structure of different events and reflect the temporal or conceptual structure of the events themselves. They argue that for extensional events the subject and direct object must be co-present for the event to take place, and for creation events, the event must take place for the direct object to exist.

already exists such as *break*), the object precedes the verb (OV), and with effective verbs (verbs denoting events that create/make something exist such as *bake*) the object follows the verb (VO) (Sutton-Spence & Woll 1999).

Napoli et al. (2017) note that their findings on Libras could also be explained by the fact that all of the extensional verbs they used were 'heavy' verbs, that is, all of these verbs were expressed by morphologically complex 'handling classifier' verbs (i.e. handshape showing handling of the object presumably by the agent). For a number of sign languages it has been reported that heavy verbs (i.e. classifier constructions, and lexical verbs marking aspect or agreement) affect word order, being produced sentence-finally (e.g. Napoli & Sutton-Spence 2014). Likewise for Libras, verb-final SOV order occurs with handling or classifier verbs (de Quadros 2003). Thus, the results reported by Napoli et al. (2017) could also be explained by the conflation of extensional and heavy verbs.[5]

Schlenker et al. (2024) point out that the extensional-intensional distinction and the analysis proposed by Napoli et al. (2017) have to be refined. Schlenker et al. observed order differences *within* the group of extensional events with respect to classifier constructions. Sign language classifiers are specific handshapes that are bound to verbs to express handling, motion and/or location of the referents (Frishberg 1975).[6] Schlenker et al. (2024) observed that for instance, *the crocodile ate up the ball* is preferentially expressed by an SOV order and *the crocodile spit out the ball* is preferentially expressed by an SVO order. This difference between eat-up-type verbs and spit-out-type verbs has been reported for American Sign Language (ASL; SVO basic order), Italian Sign Language (LIS; SOV basic order), and French (SVO basic order) pro-speech (=speech-replacing) gestures. In line with Napoli et al. (2017), Schlenker et al. (2024) propose the *Visibility Generalization* that object arguments are preferred to occur before the verb if their denotations are visible before the denoted action, and after the verb if their denotations are only visible after the denoted action. Interestingly, Schlenker et al. (2024) observed further variability with respect to order preferences. For LIS spit-out-type classifier constructions (where the ball is not seen until after it is spit out), they observed that SOV order can be used to express the target meaning when the object is signed in a neutral locus (non-specific), whereas SVO order, while acceptable, is degraded. A different pattern was observed for constructions in which the subject and object arguments are assigned loci in signing space (specific/definite). Their signers

[5] In Napoli et al. (2017), four of the intensional verbs were also expressed by a heavy verb (DRAW, BUILD, KNIT, SCULPT).

[6] Classifier handshapes can refer back to an already-mentioned referent using a pronominal form bound to the verb (Supalla 1986). Some classifier handshapes ("whole entity classifiers") reflect grammatically relevant semantic or physical features of noun referent classes (e.g. persons; animals; vehicles; Wilbur et al. 1985). Others ("handling classifiers") may also have an agentive interpretation, showing handling information about an object (e.g. picking up something small and round) (Benedicto & Brentari 2004). Although classifier constructions are highly iconic they are linguistically complex (Wilbur et al. 1985; Gökgöz 2024).

disagreed on acceptability and interpretation: one signer gets the target meaning ('x spit out y') with SOV, while for another signer, the SVO order yields the target meaning, but it is somewhat degraded (and the SOV order implies the meaning 'x spit something on y').

Additionally, Napoli et al. (2017) observed a difference in overall complexity between extensional and intensional verbs: while extensional events in Libras are syntactically simpler (a single clause), intensional events are expressed by more complex constructions (often multiple clauses). It seems that more transparent mapping is possible with concrete/extensional items in contrast to abstractions/intensions, such as dreams or thoughts.

Turning to the second factor, the semantics of the event participants, Napoli & Sutton-Spence (2014) report that in sentences with potentially reversible human subject and object arguments and verbs that are not inflected in signing space (i.e. plain verbs), SVO is the preferred ordering in most of the languages included in their survey. In their report they note that for Flemish Sign Language, more order variability (both SOV and OSV) was observed for reversible structures, whereas only SOV orders were observed for non-reversible structures (Vermeerbergen 1996; cited in Napoli & Sutton-Spence 2014).

1.2.3 An overlooked interpretation possibility

We want to point out a related possible explanation for the extensional-intensional order distinction. In addition to the existence of the object argument being potentially dependent on the action/event the verb expresses (as in creation verbs), the object is also the potential resultee of this action, or in Ramchand's (2008) terms, the holder of the Resultant State. To visually express the result of an action in a way that can be easily processed by the addressee, it would make sense that it follows a logical temporal ordering to first express the action that leads to this result, putting the V before the O. Thus, in intensional events the object argument could have a double status: it is not only the direct object argument but also holds the semantic function of the resultant/resultee, yielding preference for SVO (on resultative constructions in sign languages see Loos (2017) for German Sign Language, Rathmann (2005) and Kentner & Wilbur (2018) for American Sign Language, Kimmelman (2018) and Pasalskaya (2018) for Russian Sign Language). This contrasts with extensional events in which the object may be affected by the action but its existence is independent from the action expressed by the verb, allowing both SOV and SVO.

1.2.4 Aligning these investigations with the traditional definitions of extensional-intensional

As will become clear, our results indicate that we need to move away from the terminological use of extensional-intensional that has been used in the silent gesture studies, with its focus on iconicity or as Schlenker et al. suggest, the Visibility Generalization that the orders are related

to the visibility of the direct object entity before or after introduction of the action denoted by the verb. There are several reasons for this. One is that we will be working with a fully mature sign language rather than silent gesture or an emerging sign language. Another is that we will be demonstrating that the same result is achieved even when the factor of argument animacy is removed from the analysis, indicating that this does not contribute to the order difference. Rather it is the semantics of the verb, whether extensional or intensional, that accounts for the order preference. Hence, we can pivot back to the more traditional use of the extensional-intensional distinction, to which we now turn.

The traditional definitions of 'extensional' and 'intensional' (e.g. Montague 1969; Heim & Kratzer 1998; Coppock & Champollion 2022) are somewhat different from the way they have been used in the gesture and word order work. Nonetheless, the order effect is correlated with the semantics: SOV for extensional verbs, SVO for intensional verbs. For the record, what are the traditional definitions?

A hallmark of intensional verbs is that they, unlike extensional verbs, may include reference to worlds other than the real world. For example, if someone 'dreams of/thinks about/hopes for world peace', the world they are thinking about is some potential future world. What IS in the 'here and now' world is dreaming, thinking, or hoping, which are the intensional verbs. We can contrast the extensional statement 'the child is eating ice cream' with the intensional one, 'the child is thinking about eating ice cream'. In the extensional example, eating is taking place in the real world, whereas in the intensional one, no eating is taking place in the real world (although it may at some time later) but in the possible world that the child is thinking about, eating is taking place. This distinction manifests itself in a variety of ways, most notably in how the truth value of the statement is computed (in the real world or not).

Our plan then is to first present our study following the existing literature and then to step back and approach it from this second angle. Before turning to our Methods, we introduce the sign language that our work is based on.

1.2.5 Word order in Austrian Sign Language (ÖGS)

For ÖGS the basic order is SOV (Skant et al. 2002; Wilbur 2002, 2005; Schalber 2015; Krebs & Fenkart 2024); this order is preferred over OSV and SVO orders, which are common but serve more specific pragmatic functions (Krebs & Wilbur in prep.). For instance, OSV orders occur in sentences with verbs that inflect in space, agreeing with the locations that are associated with argument referents (by movement and/or hand orientation towards specific locations, or by producing the verb at the associated locations; Krebs et al. 2018). OSV orders also occur with agreement markers, which are manual signs that spatially agree with subject and object arguments (similar to verbs) and which are another way to indicate argument structure (Krebs et

al. 2017). In constructions with the spatial relationship between referents expressed by classifier constructions, the locative object may precede the locative subject, yielding OSV (Krebs et al. 2021; Krebs & Fenkart 2024). Constructions in which arguments other than the subject function as the topic are grammatically licensed non-basic orders in ÖGS: topic arguments occur sentence-initially, are marked non-manually and are set apart from the rest of the sentence by a prosodic break (Krebs & Malaia & Wilbur & Roehm 2020; Krebs et al. in press). SVO order is also attested in ÖGS. However, so far it is unclear what factors may drive the use of SVO orders (Krebs & Wilbur in prep.).

Less is known about how animacy of the object affects word order preferences in ÖGS. Previous reports suggest that SOV is also the preferred order in sentences with reversible contexts (animate subject and animate object argument) (Krebs et al. 2018; 2019; Krebs & Fenkart 2024). The present study will shed further light on order preferences in ÖGS and the factors that may interact with it.

2. The present study

2.1 Study Design

Following the existing literature, the present study focuses on the factors suggested to affect order: event semantics and participant semantics. In experimental part 1 we tested whether the effect of the intensional-extensional event distinction would be reflected in order preferences in ÖGS, a well-established sign language. The hypothesis follows from Napoli et al. (2017) that the representation of the intensional-extensional distinction is grounded in iconicity and should be observable in sign languages in general. We use ÖGS, which contrasts with prior work on Libras (which has basic SVO order) because ÖGS has SOV basic order, as well as contrasting with prior work on NSL because ÖGS is a mature sign language while NSL is still emerging.

In experimental part 2 we test whether the effect of animacy in event participants would be reflected in order preferences in ÖGS. We do this because Napoli et al. (2017) investigated only sentences with inanimate objects, whereas we wanted to test both animate and inanimate objects. It may be that the same extensional-intensional distinction can be observed independently of the animacy of the object argument. However, it may also be that animacy overrides the effect of verb type such that SVO is preferred in sentences with animate arguments (Napoli & Sutton-Spence 2014).

However, in the present study we needed to rule out the possibility that the findings (partially) result from another factor, morphologically complex verbs (heavy verbs) because heavy verbs tend to appear in final position even in SVO languages like ASL. In order to eliminate the possibility that the heaviness of the verb might impact order preferences, we controlled for the heaviness of the verbs, avoiding those with aspectual marking or use of classifier handshapes.

2.2 Materials and Methods

The stimuli and procedure used in the present study differed from the Napoli et al. (2017) study, again to test for animacy effects and to avoid heavy verbs.

2.2.1 Materials

First, to test whether the extensional-intensional distinction can be observed in ÖGS and at the same time rule out the possibility that heaviness might influence order preferences in some way, we did not include concepts which may be expressed by a heavy (i.e. a morphologically complex) verb. In particular, we did not include events that would be likely to be produced with a handling classifier handshape, which express manipulation of the direct object, for example, an event in which the object argument gets moved in space (e.g. HANG (on a washing line)), or the body of the signer shows the action (e.g. CLIMB). Further, no stimuli describing a spatial relationship between the arguments were used because these are often complex classifier constructions (e.g. "A person is walking towards another person"; see **Figure 1**). Classifier signs were avoided because they potentially bias the order as they often appear sentence-finally in ÖGS (Schalber 2015). Likewise, no agreeing verbs were included because these also occur by default in sentence-final position (Krebs et al. 2018).

Second, to avoid additional descriptions of argument referents, we used simple subject arguments GIRL, BOY, WOMAN and MAN.

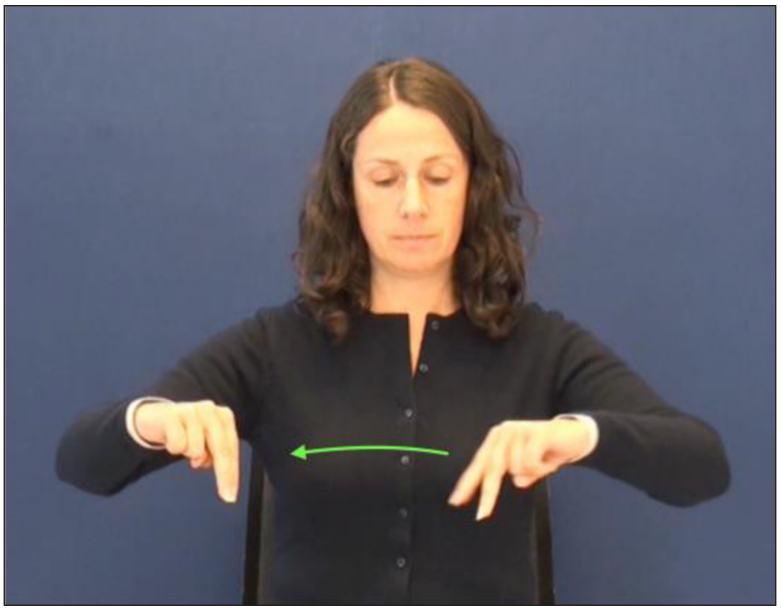

Figure 1: Classifier construction in ÖGS expressing the meaning "A person is walking towards another person".

Third, because the verbs we used could not be expressed clearly by a single picture (like those used by Napoli et al.) and because we wanted to ensure that the signers used the specific verbs we targeted, the verbs were presented in written gloss. Thus, the two arguments (e.g. a girl and a ring) were presented by two pictures respectively and the verb gloss (e.g. FIND) was presented below these pictures (see Appendix A for a list of the stimulus material).

2.2.2 Procedure

Participants were sent the powerpoint with the stimuli and an instruction video in ÖGS via an online link. They were asked to sign the content illustrated on the slides in ÖGS and to film themselves during signing. They were instructed that on each slide they would see two pictures which show the subject (active argument that is responsible for the action that the verb describes) and the object argument (passive argument that is affected by the action that the verb describes) of the sentence. The subject was illustrated in a picture with a frame and the object was illustrated in a picture without a frame (**Figure 2**).

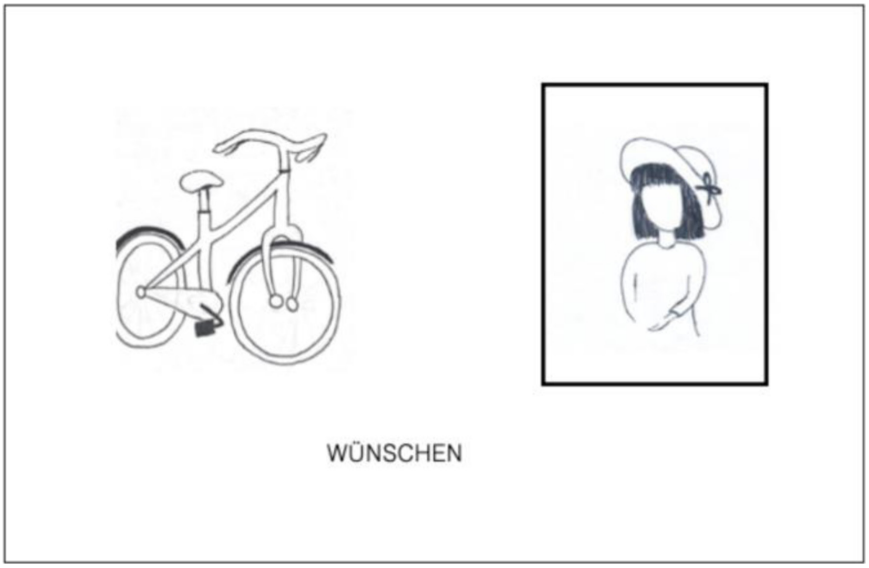

Figure 2: Illustration of a stimulus slide.

To avoid additional extraneous material in the productions (which brings with it the difficulty to determine where a sentence begins and ends), we instructed the participants to describe what they see by the simplest and shortest answer.

The participants filmed themselves at home and provided their videos per online link. They signed an informed consent in written form and filled out a written demographic questionnaire.

Participant questions during and after were discussed via video chat, which was available from the time they received the powerpoint slides. The experimenter who conducted the interviews is fluent in ÖGS (completed an interpreter program and worked as an interpreter).

The powerpoint presentation contained 84 slides, including the stimuli of the two experimental parts described here (12 items/experiment; total 24 critical items), and filler material (60 items) which was structured in the same way as the critical stimuli and also aimed to investigate order in ÖGS (although participants were not informed about the study aims). Stimuli were presented in pseudo-randomized order (4 different lists). Each list contained all stimuli and thus each participant produced all of the stimuli in ÖGS.

Experimental part 1: intensional and extensional events with non-reversible arguments:

All of the sentences involved an animate subject and an inanimate object argument. The inanimate objects included the signs SCHOOLBAG, TEDDY BEAR, CAR, BALL, BICYCLE, HOUSE, RING, NEWSPAPER, BOOK and CERTIFICATE. Six extensional verbs (FIND, READ, REPAIR, COPY, HIDE, STORE) and six intensional ones (THINK-OF, WANT, DREAM-OF, LOOK-FOR, WISH, IMAGINE) were tested. The critical material comprised 12 of the 84 slides.

Experimental part 2: intensional and extensional events with potentially reversible arguments:

All of the sentences involved an animate subject and an animate object argument. The animate objects included the signs BOY, WOMAN, GIRL, MAN and FRIEND. Six extensional verbs (FIND, GREET, WARN, REGISTER, INSULT, ARREST) and six intensional ones (THINK-OF, WANT, DREAM-OF, LOOK-FOR, WISH, IMAGINE) were tested. The critical material comprised 12 of the 84 slides.

2.3 Participants

8 Deaf participants (5 female) took part in the study with a mean age of 48.75 years (SD: 10.83 years; Range: 32–62 years). They acquired ÖGS at different times in life: two native signers acquired ÖGS from birth from their Deaf parents; four acquired ÖGS early, between the age of 4 to 7 years; and two were native signers of a different sign language from birth and learned ÖGS at the age of 33 (16 years of ÖGS usage) and at the age of 34 (1 year of ÖGS usage). Data analysis was run with these L2 signers (because they are fluent in ÖGS) as well as without these L2 signers (because their language circumstances are also different from the others).

2.4 Data analysis and results

Signed sentences were glossed and coded according to the order of the verb V and its subject S and object O arguments. A summary of the results of experimental part 1 and experimental part

2 is presented in **Tables 1–4**. Each table contains 48 cells representing the orderings that each participant produced for each verb: eight participants signed orderings with six extensional verbs and six intensional verbs, first with nonreversible arguments (**Tables 1** and **2**) and then with potentially reversible arguments (**Tables 3** and **4**). In some cases, participants produced multiple responses for a stimulus; these are included in our analysis. Omitted from the tables are index signs (used for referencing arguments in space), occurrences of PALM-UP outside of wh-clefts, and extraneous material (e.g. modifying signs).[7]

The data collected for experimental parts 1 and 2 were each subjected to three general analyses. To relate our findings to previous results on Libras, in data analysis 1 we approached the data in line with the hypothesis based on Napoli et al. (2017). In particular, the cells are coded to reflect order expectations based on Napoli et al. (2017): white for expected order, dark grey for unexpected order, and light grey if the expected order was produced as well as any additional order(s). In the first analysis cells containing the expected order (white and light grey cells) were summed up.

In data analysis 2 the data was approached from a different perspective reconsidering the original hypothesis. The light grey cells were revisited and 'unexpected' orders of the light grey cells were also included summed up with the orders in the dark grey cells.

In line with the study on Libras, the chi-square test was used for data analysis 1 and 2. Reflecting recent statistical developments, we also used logistic mixed-effects regression for data analysis that accounts for random subject and item effects (more detailed information is presented below).

Stepping further away from Napoli et al. (2017), in data analysis 3 we calculated the number of SOV and SVO orders per participant and per verb for all four conditions (extensional inanimate, intensional inanimate, extensional animate, intensional animate). The total number of SOV and SVO orders per condition and percentages of SOV and SVO orders were computed. Data analysis 3 excluded the L2 signers.

2.4.1 Data analysis 1

2.4.1.1 Experimental part 1: Extensional and intensional events with nonreversible arguments

A summary of the results of experimental part 1 is presented in **Tables 1** and **2**.

Of the 48 cells in **Table 1**, 47 cells were included in the analysis. The item excluded was an occurrence of the verb HIDE, because it was signed only in a wh-cleft, that is, a structure which was analyzed separately (see Appendix B). As some participants produced multiple responses for a stimulus, a total of 52 sentences were produced in this condition (excluding the wh-clefts). Nonetheless, for analysis 1, each cell was counted only once.

[7] Sometimes participants used arguments with a more specific meaning, using TEACHER or MOTHER instead of WOMAN or a specific sign name instead of BOY.

Extensional event and inanimate object							
Participant	**AOA**	**FIND**	**READ**	**REPAIR**	**COPY**	**HIDE**	**STORE**
01	native	SOV	<u>SOV</u>	SOV	SOV	SOV	**SOV_1V_2**
02	native	SOV	SOV	SOV *Wh-clefts:* *S V WHAT – O* *O V WHO – S*	SOV	*Wh-cleft(?):* *S PALM-UP* *– OVV*	SOV *Wh-cleft:* *OV* *WHO – S*
03	4–7 years	SOV	SOV	SOV	SOV	SOV	SOV
04	4–7 years	SOV / SVO *Wh-cleft:* *SV* *WHAT-O*	SVO	SOV	SOV	SOV	SOV
05	4–7 years	SOV	SOV	SOV / SVO	SOV / SVO	SOV	SOV / SVO
06	4–7 years	SOV	SOV	SOV	SOV	SOV	SOV
07	since age 33; 16 years	SVO	**SOV_1V_2**	SOV	SOV	SOV	SOV
08	since age 34; 1 year	SVO	SVO	SVO	SOV / SVO	SOV	SOV

Table 1: Order results of extensional events with nonreversible arguments (inanimate object). AOA = age of acquisition of ÖGS. SOV is the expected order (in white cells). Productions containing SOV and additional orderings are in light grey cells; productions other than SOV are in dark grey cells. Complex orders with additional material are underlined. Orders with multiple verbs are in bold. Wh-clefts are shown where they occurred.

A simple count of orders produced in the 47 cells shows a preference towards SOV. 35 sentences were signed only as SOV and 2 more had SOV_1V_2 (=37 white cells showing expected SOV); 5 additional productions were signed with both SOV and SVO (=5 light grey cells, which were counted as expected SOV order), resulting in 42 extensional events that were signed by the expected SOV order (for an example see **Figure 3**). In contrast, 5 extensional events were signed only by the unexpected SVO order (=5 dark grey cells).

Two of the above productions contained more than one verb in a sentence (SOV_1V_2 orders) and one of the above productions (SOV order) also contained a modifying phrase that did not affect the word order; these were included in the 42 count of expected SOV. And 4 events were signed (additionally) with a wh-cleft (see Appendix B).

Figure 3: Example of an expected SOV order with extensional event and inanimate object.

Intensional event and inanimate object							
Participant	**AOA**	**THINK-OF**	**WANT**	**DREAM-OF**	**LOOK-FOR**	**WISH**	**IMAGINE**
01	native	SOV / SVO	**SV_1V_2O**	SOV *Wh-cleft: SV PALM-UP – O*	SOV	SOV / SVO *Wh-cleft: SV PALM-UP – O*	**SOV_1V_2**
02	native	SVO / OSV	SOV / OSV	OSV *Wh-cleft: SVV WHAT – O*	SOV Wh-cleft: *SV WHAT – O*	SOV *Wh-cleft: SV WHAT – O*	SVO / OSV
03	4–7 years	SOV	SOV	SOV	SOV	SOV	SOV
04	4–7 years	SVO	SVO	SVO	SVO	SVO	SVO
05	4–7 years	SVO	SVO	SOV / SVO	SOV / SVO	SOV / SVO	SOV / SVO
06	4–7 years	SOV	SOV / SVO	SOV	SOV / OSV	SOV	**SV_1V_2O**
07	since age 33; 16 years	SVO	SVO	**SV_1V_2O**	SVO	**SV_1OV_2**	**SOV_1V_2**
08	since age 34; 1 year	SVO	SVO	SVO	SOV / SVO	SVO	SVO

Table 2: Order results of intensional events with nonreversible arguments (inanimate object). AOA = age of acquisition of ÖGS. SVO is the expected order (in white cells). Productions containing SVO and additional orderings are in light grey cells; productions other than SVO are in dark grey cells. Complex orders with additional material are underlined. Orders with multiple verbs are in bold. Wh-clefts are shown where they occurred.

All 48 cells in **Table 2** were included in the analysis. As some participants produced multiple responses for a stimulus, a total of 60 sentences were produced in this condition (excluding the wh-clefts). Nonetheless, for analysis 1, each cell was counted only once.

A simple count of orders produced in the 48 cells shows a preference for SVO order. 16 events were signed with SVO order and 3 events were signed by an SV_1V_2O order (=19 white cells showing expected SVO order); 10 additional productions included SVO and an additional order (8 additional SOV; 2 additional OSV) (=10 light grey cells), resulting in 29 productions with expected SVO order (for an example see **Figure 4**). 13 intensional events were signed only with SOV, 2 more had SOV_1V_2 order, one event had OSV, one with an SV_1OV_2 order[8] and 2 more were signed with SOV and OSV order (=19 dark grey cells), resulting in 19 intensional events with unexpected orderings.

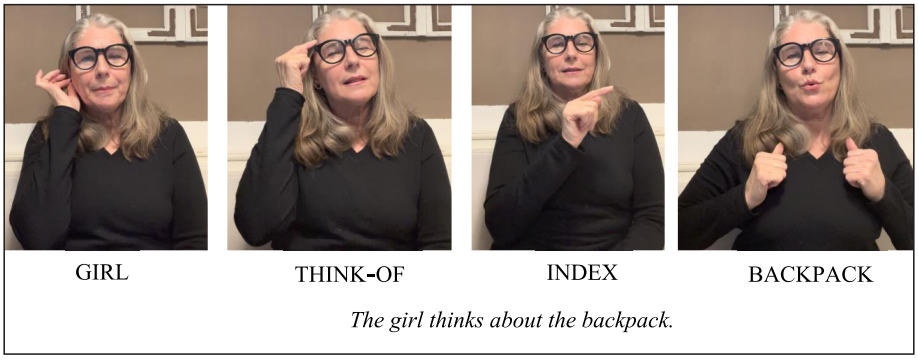

Figure 4: Example of an expected SVO order with intensional event and inanimate object.

Six of the above productions contained more than one verb: three with SV_1V_2O, two SOV_1V_2 and one SV_1OV_2. Six of the above productions contained a modifying phrase (three SVO and one SV_1V_2O which were counted as expected; one SOV_1V_2 and one OSV in the unexpected group). And 5 events were signed with a wh-cleft.

2.4.1.2 Experimental part 2: Extensional and intensional events with potentially reversible arguments

A summary of the results of experimental part 2 focusing on extensional and intensional events in the context of an animate object is presented in **Tables 3** and **4**. In some cases, participants produced multiple responses for a stimulus; these are included in our analysis.

[8] The SV_1OV_2 order contains the verb WISH two times with the second occurrence showing aspectual reduplication (a heavy verb).

Extensional event and animate object							
Participant	**AOA**	**FIND**	**GREET**	**WARN**	**REGISTER**	**INSULT**	**ARREST**
01	native	SO AGRM V	SO AGRM V	S AGRM OV	SO AGRM V	S AGRM OV	S AGRM OV
02	native	S AGRM OV	S AGRM OV	**S AGRM OV_1V_2**	S AGRM OV	S AGRM OV *Wh-cleft: OV WHAT – S AGRM*	S AGRM OV
03	4–7 years	SOV	SOV	SOV	SOV	SOV	SOV
04	4–7 years	SVO	S AGRM OV	SVO	SOV	S AGRM OV	S AGRM OV
05	4–7 years	SOV / SVO	SOV / SVO	SOV / SVO	SOV / SVO	SOV / SVO	SOV
06	4–7 years	SOV	SOV	S AGRM OV	S AGRM OV	S AGRM O V	S AGRM OV
07	since age 33; 16 years	SVO	S AGRM OV	S AGRM OV	S AGRM OV	**S AGRM OV_1V_2**	**S AGRM OV_1V_2**
08	since age 34; 1 year	SVO	SV AGRM O	SVO AGRM / SO AGRM V	SVO	SVO AGRM	SVO AGRM

Table 3: Order results of extensional events with potentially reversible arguments (animate object). AOA = age of acquisition of ÖGS. AGRM = agreement marker. SOV is the expected order (in white cells). Productions containing SOV and additional orderings are in light grey cells; productions other than SOV are in dark grey cells. Complex orders with additional material are underlined. Orders with multiple verbs are in bold. Wh-clefts are shown where they occurred.

All 48 cells in **Table 3** were included in the analysis. As some participants produced multiple responses for a stimulus, a total of 55 sentences were produced in this condition (excluding wh-clefts). Nonetheless, for analysis 1, each cell was counted only once.

A simple count of orders produced in the 48 cells shows a preference for SOV. 31 events were signed only with SOV (some contained an additional agreement marker sign, labeled AGRM) and three sentences were signed with SOV_1V_2 orders (with agreement markers) (=34 white cells,

which counted as the expected order); an additional 6 were signed with SOV as well as SVO (=6 light grey cells), resulting in 40 events that were signed with expected SOV order (for an example see **Figure 5**). 8 events were signed with the unexpected SVO order (some with an agreement marker) (8 dark grey cells).

Three of the above productions contained multiple verbs: S AGRM OV_1V_2 orders. One of these S AGRM OV_1V_2 orders contains a modifying phrase. And one event was additionally signed with a wh-cleft.

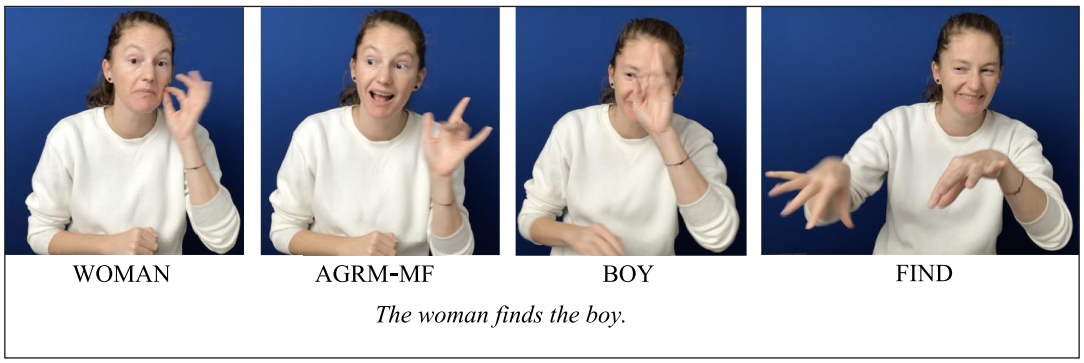

Figure 5: Example of an expected SOV order with extensional event and animate object.

Of the 48 cells in **Table 4**, 45 were included in the analysis. Excluded were one item for one participant (the verb WISH) and two items from a second participant (the verbs DREAM-OF and WISH), because these were signed only using a wh-cleft (see Appendix B). As some participants produced multiple responses for a stimulus, a total of 54 sentences were produced in this condition (excluding wh-clefts). Nonetheless, for analysis 1, each cell was counted only once.

A simple count of orders produced in the 45 cells shows a preference for SVO. We observed 23 sentences signed only with SVO (some with agreement marker) (=23 white cells displaying the expected SVO order); an additional 7 were signed with SVO and an additional order (4 SOV; 1 SOV and SV_1V_2O orders; 1 OSV; 1 SV_1V_2O and OSV_1V_2) (=7 light grey cells), resulting in 30 productions with expected SVO order (for an example see **Figure 6**). 11 productions were signed with SOV (some with agreement marker; one was signed additionally with OSV AGRM), one was signed with S AGRM OV_1V_2, one was signed with OSV_1V_2O, and two with SV_1OV_2 (one with and one without agreement marker; SVO AGRM V)[9] (15 dark grey cells), resulting in 15 productions with unexpected orderings.

[9] The SV_1O AGRM V_2 order contained the verb DREAM-OF two times. The other SV_1OV_2 order expressing the event *to wish* contained the verb WANT and a sign glossed as DA (GIRL WANT FRIEND DA). The sign DA is a possessive/existential/locative marker in ÖGS and can occur either before or after the object (Skant et al. 2002; also Chen Pichler et al. 2008). Because the same expression can be signed without DA (as signed by the other signers) we assigned this order also to the SVO order class.

Intensional event and animate object							
Participant	**AOA**	**THINK-OF**	**DREAM-OF**	**LOOK-FOR**	**IMAGINE**	**WISH**	**WANT**
01	native	SV AGRM O	SOV / SVO *Wh-cleft: SV PALM-UP – O*	SOV	SV AGRM O / SO AGRM V	*Wh-cleft: SV PALM-UP – O*	SVO
02	native	S AGRM O AGRM V AGRM / OSV AGRM	*Wh-cleft: SV WHAT – O V*	SVO / OSV	**SV_1V_2O** / **OSV_1V_2**	*Wh-cleft: SV WHAT – O*	**OSV_1V_2O** *Wh-cleft: SV WHAT – O*
03	4–7 years	SOV	SOV	SOV	SVO	SOV	SOV
04	4–7 years	SV AGRM O	SVO	SVO	SVO	**SV_1OV_2**	SVO
05	4–7 years	SVO	SV AGRM O	SOV / SVO	SOV / SVO	SVO	SVO
06	4–7 years	S AGRM OV	S AGRM OV	S AGRM OV	**SV_1V_2O** / S AGRM OV / **S AGRM V_1V_2O**	SOV	SVO
07	since age 33; 16 years	SV AGRM O	**SV_1O AGRM V_2**	SV AGRM O	**S AGRM OV_1V_2**	SVO	SV AGRM O
08	since age 34; 1 year	SVO AGRM	SVO AGRM	SVO	SVO AGRM	SVO	SVO

Table 4: Order results of intensional events with potentially reversible arguments (animate object). AOA = age of acquisition of ÖGS. AGRM = agreement marker. SVO is the expected order (in white cells). Productions containing SVO and additional orderings are in light grey cells; productions other than SVO are in dark grey cells. Complex orders with additional material are underlined. Orders with multiple verbs are in bold. Wh-clefts are shown where they occurred.

Eight of the above productions (both SVO and SOV, as well as OSV) contained more than one verb: two SV_1V_2O, one SV_1OV_2, one SV_1O AGRM V_2, one S AGRM V_1V_2O; one S AGRM OV_1V_2; one OSV_1V_2 and one OSV_1V_2O. Ten of the above productions contained a modifying phrase (four SVO, one SV AGRM O, one SV_1V_2O, one OSV, one OSV_1V_2, one OSV_1V_2O, and one S AGRM OV_1V_2). 5 events were signed with a wh-cleft.

Figure 6: Example of an expected SVO order with intensional event and animate object.

2.4.1.3 Statistical analysis

To further examine the relation between verb type and word order, in line with the study on Libras, chi-square tests of independence were performed, separately for a) the data from the extensional and intensional verbs in non-reversible contexts, in **Tables 1** and **2,** b) the data from the extensional and intensional verbs in reversible contexts, in **Tables 3** and **4**, and c) the data summarizing the extensional and intensional verbs in non-reversible and reversible contexts, in all four Tables.

For calculating these chi-square tests, based on the hypothesis of Napoli et al. (2017) that extensional events tend to be expressed by SOV orders and intensional events tend to be expressed by SVO orders in sign languages, the expected (white and light grey cells) and unexpected orders (dark grey cells) were summed up for each of the three data sets described above (a-c) respectively. In particular, for extensional events all the cells with an expected SOV order (either only SOV or SOV and any additional order(s); white and light grey cells) and all the cells with unexpected SVO only (dark grey cells) were summed up. For intensional events all the cells with an expected SVO order (either only SVO or SVO and any additional order(s); white and light grey cells) and all the cells with unexpected SOV only (dark grey cells) were summed up. Data from cells which include either only a wh-cleft or only an OSV or SV_1OV_2 order (i.e. no SOV and no SVO order) was excluded from analysis.

To further analyze participants' word order productions regarding extensional and intensional events in the context of non-reversible and reversible constructions, we used logistic mixed-effects regression using the lme4 package (Bates et al. 2015) in R (R Core Team 2018). For this analysis, data from both experimental parts were combined. We defined a model that included an interaction between the factor Verb type (extensional vs. intensional) and the factor Animacy (inanimate vs. animate) as fixed effects. The random effects structure consisted of by-participant and by-item random intercepts. Sum coding was used for main effects testing.[10]

[10] coded in R as glmer = glmer(Word order ~ Verb type*Animacy + (1|Participant) + (1|Item)).

SOV orders were encoded as 1 and SVO orders were encoded as 0 in the dependent variable; thus positive regression coefficients can be interpreted as the (log) odds ratio in favor of SOV orders, whereas negative coefficients reflect (log) odds ratio in favor of the SVO orders. *p*-values were assessed using the lmerTest package; *p*-values were obtained by using maximum likelihood estimators.

The chi-square tests and the linear mixed model analyses were run with and without the two L2 signers.

2.4.1.3.1 Testing and supporting Napoli et al.'s hypothesis: extensional SOV, intensional SVO

With the modifications mentioned in the Methods section, we attempted to replicate and extend Napoli et al.'s (2017) finding that a natural sign language shows semantically conditioned word order when the event arguments are non-reversible (inanimate object). The relevant data from signers of ÖGS is shown in **Tables 1** and **2**; the sums for this condition are presented in **Table 5**.[11]

Non-reversible events			
Verb type/Word order	**SVO**	**SOV**	**Total**
Extensional	5	42	47
Intensional	29	17	46
Total	34	59	93

Table 5: Data used for performing the chi-square test of independence with respect to non-reversible events.

The chi-square test of independence revealed that the relation between verb type and word order is significant [X^2 (1, N = 93) = 25.31, $p < .001$]. SOV order is more prevalent with extensional events and SVO order is more prevalent with intensional events. This finding replicates and supports Napoli et al. (2017).

2.4.1.3.2 Extending the hypothesis to potentially reversible arguments (animate objects)

We also added stimuli to determine if the hypothesis of semantically conditioned word order would be supported when the event arguments are potentially reversible (animate object), itself a novel investigation. The relevant data from signers of ÖGS is shown in **Tables 3** and **4**; the sums for this condition are presented in **Table 6**.[12]

[11] Data from one cell including only a wh-cleft (observed for the extensional events) and from one cell including only an OSV order and a wh-cleft (observed for the intensional events) were excluded from analysis.

[12] Data from three cells including only a wh-cleft and from one cell including only an OSV_1V_2O order and a wh-cleft (observed for intensional events) were excluded from analysis.

Reversible events			
Verb type/Word order	**SVO**	**SOV**	**Total**
Extensional	8	40	48
Intensional	30	12	42
Total	38	52	90

Table 6: Data used for performing the chi-square test of independence with respect to reversible events.

A chi-square test of independence was performed to examine the relation between verb type and word order. The relation between these variables is significant [X^2 (1, N = 90) = 25.34, $p < .001$]. SOV order is more prevalent with extensional events and SVO order is more prevalent with intensional events. Thus, we can see that semantic conditioning of word order extends beyond non-reversible contexts in ÖGS.

2.4.1.3.3 Further analysis for a separate question: Is argument type really relevant?

We have focused on two conditioning factors believed to affect order: (1) event type represented in the verb, and (2) event participants represented by the arguments of the verb. This focus was determined by the existence of prior work on event type with non-reversible arguments (inanimate direct object) and the non-existence of prior work on event type in the context of potentially reversible arguments (animate direct objects), a new result which we have just presented. There are two ways that this situation might be cognitively modeled. In one, the signer must consider the event type (extensional/intensional) and the argument type (reversible/non-reversible) in order to determine the order that seems most appropriate. On the other hand, if argument type is not needed, then the signer need only consider the event type, which would appear to be a simpler process. Our data suggests that at least for an established sign language (as opposed to silent gesturing), this latter model is supported. When the data from **Tables 1–4** are summed to consider only extensional/intensional without the argument type factor (**Table 7**), a chi-square test for event type can be calculated.

Reversible and non-reversible contexts			
Verb type/Word order	**SVO**	**SOV**	**Total**
Extensional	13	82	95
Intensional	59	29	88
Total	72	111	183

Table 7: Data used for performing the chi-square test of independence for event type without argument type.

The relation between event type and word order is significant [X^2 (1, N = 183) = 52.29, p < .001]. SOV order is more prevalent with extensional events and SVO order is more prevalent with intensional events. The simpler model would appear to be supported.

The mixed-effects model for participants' productions regarding extensional and intensional events also revealed a significant main effect of Verb type (Estimate: 2.586; Standard error: .5197; p < .001) indicating that extensional events were more likely than intensional events to be signed by an SOV order. The analysis did not show a significant effect of Animacy (**Table 1** in Appendix C).

Chi-square tests of independence excluding the two L2 signers also revealed that the relation between verb type and word order is significant [non-reversible events: X^2 (1, N = 70) = 20.23, p < .001; reversible events: [X^2 (1, N = 67) = 23.65, p < .001; reversible and non-reversible events combined: X^2 (1, N = 137) = 45.89, p < .001]. The mixed-effects model for participants' order productions regarding extensional and intensional events excluding the two L2 signers likewise revealed a significant main effect of Verb type (Estimate: 4.010; Standard error: 1.312; p = .002) indicating that extensional events were more likely than the intensional events to be signed by an SOV order.

2.4.2 Data analysis 2

2.4.2.1 Reconsidering the original hypothesis

The finding that the word order difference appears to be independent of the argument type suggested one further analysis. Instead of looking at the productions in terms of whether they were expected or not (as per Napoli et al. 2017), as we have done above, we approached the data from a different perspective, looking only at how often each order was produced with each verb type (independent of whether it was expected or not). To do this, we revisited the grey cells in each table, which contained an expected order along with other orders. We looked at the 'other' orders to see if the unexpected order was among them, and if yes, we counted that occurrence and added it to the 'unexpected' orders in the dark grey cells. This resulted in the following **tables (Tables 8** to **10**), based on token count and not just cell count.

Non-reversible events			
Verb type/word order	**SVO**	**SOV**	**Total**
Extensional	10	42	52
Intensional	29	25	54
Total	39	67	106

Table 8: Data used for performing the chi-square test of independence with respect to non-reversible events.

Reversible events			
Verb type/word order	**SVO**	**SOV**	**Total**
Extensional	14	40	54
Intensional	30	17	47
Total	44	57	101

Table 9: Data used for performing the chi-square test of independence with respect to reversible events.

Reversible and non-reversible contexts			
Verb type/word order	**SVO**	**SOV**	**Total**
Extensional	24	82	106
Intensional	59	42	101
Total	83	124	207

Table 10: Data used for performing the chi-square test of independence for event type without argument type.

With this new analysis, the chi-square test of independence for non-reversible events revealed that the relation between verb type and word order is significant [X^2 (1, N = 106) = 12.10, $p < .001$]. We continue to see that SOV order is more prevalent with extensional events and SVO order is more prevalent with intensional events.

This new chi-square test of independence for reversible events revealed that the relation between verb type and word order is significant [X^2 (1, N = 101) = 13.18, $p < .001$]. Again, SOV order is more prevalent with extensional events and SVO order is more prevalent with intensional events.

Finally, the chi-square test of independence for all events without consideration of the argument type revealed that the relation between verb type and word order is significant [X^2 (1, N = 207) = 26.09, $p < .001$]. Independent of argument type, SOV order is more prevalent with extensional events and SVO order is more prevalent with intensional events. This is a novel finding.

Likewise, the mixed-effects model for participants' productions regarding extensional and intensional events revealed a significant main effect of Verb type (Estimate: 1.270; Standard error: .2431; $p < .001$) indicating that extensional events were more likely than intensional events to be signed by an SOV order. The analysis did not show a significant effect of Animacy (**Table 2** in Appendix C).

Even when the two L2 signers are excluded, chi-square tests of independence again showed that the relation between verb type and word order is significant [non-reversible events: X^2 (1,

N = 81) = 8.70, p = .003; reversible events: X^2 (1, N = 77) = 10.83, p < .001; reversible and non-reversible events combined: X^2 (1, N = 158) = 20.56, p < .001]. The mixed-effects model for participants' order productions regarding extensional and intensional events excluding the two L2 signers revealed a significant main effect of Verb type (Estimate: 1.248; Standard error: .2613; p < .001) indicating that extensional events were more likely than the intensional events to be signed by an SOV order.

What this analysis tells us is that despite a strong bias for SOV word order overall, and clearly seen with extensional verbs regardless of argument type, the use of SVO is significant with intensional verbs *independent of argument type*. While iconicity may drive the order in silent gesture studies as observed in previous studies, it is not obviously a factor in word order decisions in a mature sign language like ÖGS because the semantic status of a verb as extensional or intensional can be determined from the lexical item alone without consideration of the co-occurring argument types. With argument type as irrelevant to the word order, any justification for considering the argument's animacy or (non)reversibility of an event is likewise irrelevant.

2.4.3 Data analysis 3

To provide more detailed information about the differences between individual participants, in a further step we calculated the number of SOV and SVO orders per participant for all four conditions (extensional inanimate, intensional inanimate, extensional animate, intensional animate) separately. Likewise, to provide more detailed information about the differences related to individual verbs, we calculated the number of SOV and SVO orders for each individual verb for all four conditions (see **Tables 3–10** in Appendix C). The maximum number an order (e.g. SOV) could be used in one of the four conditions was 36 (6 native/early signers used the specific order with all 6 verbs).

This analysis shows a clear separation between extensional and intensional events: in extensional contexts, 94.4% of the participants' responses are SOV, which is the typological basic order for ÖGS, independent of whether the object is inanimate or animate, and also independent of which verbs are involved. In intensional contexts, there is a split between SOV and SVO orders for both the inanimate (SOV 63.9%) and the animate (SOV 44.4%) object conditions, again independent of which verbs are involved. One difference that shows up in the intensional contexts is an increase in the number of orders other than SOV and SVO, such as OSV, wh-clefts and double items (frequently the verb), regardless of object (in)animacy.

3. Discussion

The present study aimed to investigate the preferred sign order in the context of intensional and extensional events and to test whether the extensional-intensional distinction observed in

silent gesture tasks and natural sign languages (Libras and NSL) also can be observed in ÖGS. Additionally, the influence of the animacy of the object argument was investigated.

Experimental part 1 revealed that with inanimate objects extensional events are preferentially expressed by an SOV order and with intensional events SVO is more prevalent in comparison to extensional events. Thus, a similar result was observed for ÖGS as reported for Libras, NSL and the silent gesture studies. These results may be interpreted as supporting the hypothesis of Napoli et al. (2017) that the extensional-intensional distinction is likely grounded in the visual modality used for the expression of extensional and intensional events.

The findings of the present study also lend support to the assumption of Napoli et al. that the prevalence for SOV observed in Libras in the context of extensional events is not due to the heaviness of the extensional verbs used for expressing the extensional events. The present study revealed an extensional-intensional distinction in ÖGS with stimuli controlled to exclude heaviness of the verb.

Experimental part 2, which tested the combination of extensional and intensional verbs with animate objects, revealed a similar pattern, namely a preference for SOV with extensional events and a higher prevalence of SVO with intensional events compared to extensional events. This finding contrasts with a generalization on word order in sign languages formulated by Napoli & Sutton-Spence (2014) that in reversible sentences with plain verbs (i.e. verbs that do not inflect in signing space) SVO is the preferred order. Our findings indicate that the higher prevalence of SVO orderings in the context of intensional events is caused by the event type (i.e. intensional event) rather than by the reversibility of (the participants of) the event. If the animacy of the object had led to the higher prevalence of SVO orders in the context of intensional events, it should also be observed in reversible contexts with extensional events, which was not the case.

The finding that in ÖGS SVO is not the required ordering in reversible contexts is in line with our previous observations that SOV is used in reversible sentences with plain verbs without any specific discourse context required (Krebs & Wilbur & Roehm 2020). Thus, two animate verbal arguments occurring in the sentence before the sentence-final plain verb (that is, SOV) do not lead to a role conflict in ÖGS. The two arguments can be temporally ambiguous with respect to their syntactic function (i.e. either could be interpreted as subject or object argument before the sentence-final verb is encountered) because there is no case marking on the argument NPs. In ÖGS sentence-initial arguments are preferentially interpreted as the subject of the sentence leading to a default SOV interpretation (i.e. subject preference). Under neurolinguistic experimental conditions when verb agreement marking or agreement markers resolve local ambiguity and reveal that the intended order is OSV, sentence reanalysis is observed (Krebs et al. 2018; 2019).

The only systematic difference that is observed as a result of object (in)animacy is the presence of the agreement marker AgrM in contexts with animate objects. It should be noted, however, that this AgrM occurred in various places: in SOV: S AgrM OV as well as SO AgrM V;

in SVO: SV AgrM O; in OSV: OSV AgrM. There is also one production of S AgrM O AgrM V AgrM (the same AgrM production each time), providing additional support for our previous claim (Krebs & Wilbur 2018) that the AgrM marking in ÖGS is very different in its linguistic behavior as compared to German Sign Language (DGS), even though both are basically SOV languages.

The present data is also in line with the observation of Napoli et al. (2017) that intensional events are signed by more complex constructions compared to extensional events. For intensional events, more wh-clefts, constructions containing multiple verbs, constructions with modifying phrases and additional linguistic material, OSV orders, and more PALM-UP signs (independent of wh-clefts) were observed.

That some verb types are associated with more complex linguistic structure compared to others was also shown for lexical telic verbs (which include a natural endpoint, e.g. arrive) vs. atelic verbs (which do not include a natural endpoint, e.g. run) (Wilbur 2003, 2008, 2009, 2010, 2011; Grose et al. 2007). Telic verbs involve a conceptual boundary for event segmentation and are assumed to trigger the extraction of an event template along with thematic roles inherent in it. The segmentation operation required for telics might require more effort at the point of being carried out but facilitates thematic role re-assignment (in the case of resolution of garden path sentences in English (Malaia et al. 2009, 2012, 2013)) or facilitates the participants' performance in an offline classification task later (Ji & Papafragou 2020; Krebs & Malaia & Wilbur & Roehm 2023; Krebs & Wilbur & Roehm & Malaia 2023).

3.1 'Natural' and systematic orderings in ÖGS

Moreover, the present data is in line with Motamedi et al. (2022) who hypothesize that languages should be able to evolve regular ordering patterns that are natural or systematic and that preferences for systematic as well as natural patterns persist over generations. The present study shows that ÖGS is another natural language which combines what Motamedi et al. consider to be 'natural' ordering (extensional-intensional distinction) and systematic ordering (SOV basic order for the majority of the sentences) in one and the same linguistic system. The factors that determine the use of conventionalized or natural order patterns in ÖGS is an open question.

That in sign languages natural orderings seem to be more apparent compared to spoken languages may be due to the visual modality in which sign languages are expressed. Sign languages are produced by manual (hands and arms) and non-manual (movement and position of head, shoulders, upper body, eye gaze as well as movement of eyebrows, mouth, lips, cheeks and nose) cues in the three-dimensional signing space, that is, the space in front of the signing person. Due to the visual modality sign languages allow for a higher degree of iconicity compared to spoken languages, that is, a transparent mapping between cognitive representation (semantics) and linguistic structure (form) on the phonological, lexical, semantic as well as syntactic level (although spoken languages also show iconic structures; e.g. Perniss et al. 2010).

The suggestion we made earlier that events involve an action with a result and that therefore the object argument of an event can have double status, that is functioning as the direct object argument as well as the resultee of the event, is further supported by the word order pattern observed for wh-clefts. Wh-clefts can convey the resultant status of the object argument whereby the resultee (i.e. the new information) is presented in focus (sentence-final) sentence position, which means that the S and V must precede the focused O in the sentence. In the wh-clefts observed here for the intensional contexts the object appears in sentence-final position (in focus position; Wilbur, 1996) representing the result of the event and thus providing new information (10 wh-clefts with O in focus, that is, in all cases the Verb precedes the Object). In the wh-clefts observed for the extensional contexts the subject sometimes appeared in focus position indicating allowable options other than SVO (2 wh-clefts with O in focus, that is, with Verb before Object; 3 wh-clefts with S in focus; see Appendix B).

Also it has been suggested that the relatively younger age of sign languages and the structure of the sign language community might be possible factors influencing the linguistic structure of sign languages (Meir et al. 2012; see Napoli et al. (2017) arguing against a young language account regarding Libras). A young language account does not seem to hold for ÖGS. There is little known about the origin of ÖGS, however, it is known that ÖGS played an essential role at the beginning of Deaf education in Austria. The first Deaf institute (named the k.u.k. Taubstummeninstitut) was founded in 1779, more than 240 years ago – a language age which cannot be considered as young (Schalber 2015).

That the semantics of the event or the arguments can impact word order preferences in sign languages (other than the extensional-intensional distinction) has also been described, for instance, for sentences in which the spatial relationship between arguments is expressed (often called figure-ground constructions). In these sentences the bigger immobile/inanimate locative object (the ground) precedes the smaller mobile/animate locative subject (the figure). These figure-ground constructions have been described for several sign languages that differ in their basic order used in non-locative sentences (e.g. Liddell (1980) for ASL; Volterra et al. (1984) for LIS; Coerts (1994) for the Sign Language of the Netherlands (NGT); Leeson (2001) for Irish Sign Language (IrSL); Milković et al. (2006) for Croatian Sign Language (HZJ); Vermeerbergen et al. (2007) for South African Sign Language (SASL); Kimmelman (2012) for Russian Sign Language (RSL); Krebs & Fenkart (2024) for ÖGS).

3.2 Co-optation of iconic non-linguistic cognitive abilities into sign language systems

As sign languages have evolved, non-linguistic cognitive abilities or biases are assumed to have been co-opted into formal linguistic systems in an iconic way. For instance, the endpoint in telic signs is marked by a rapid deceleration to a stop at the end of the sign. Hearing non-

signers can accurately infer the lexical aspectual meaning from telic/atelic verb signs (Strickland et al. 2015; Kuhn et al. 2021; Krebs & Malaia & Wilbur & Roehm 2023; Krebs & Wilbur & Roehm & Malaia 2023) and neurally process these verb types differently (Malaia & Ranaweera & Wilbur & Talavage 2012; Krebs & Malaia & Wilbur & Roehm 2023; Krebs & Wilbur & Roehm & Malaia 2023). Changes in speed of individual objects are highly correlated with event boundary identification in non-linguistic visual action comprehension and thus might have been co-opted into the linguistic structure of sign languages (Zacks et al. 2001; 2006).

Likewise the natural ordering observed in silent gesture studies might have been co-opted into the linguistic system of sign languages. Note however, research on emerging sign languages suggests that an additional (prior) step seems to be involved in the evolution process of marking argument structure. In the initial stages of young sign languages (e.g. Nicaraguan Sign Language) when grammatical means to mark grammatical roles have not yet emerged, signers tended to express a transitive event by producing a sequence of two intransitive events, especially when the two arguments were human (Senghas et al. 1997; see also Meir et al. 2012 for similar data on two relatively young sign languages Israeli Sign Language (ISL) and Al-Sayyid Bedouin Sign Language (ABSL)). It is not implausible however, that hearing non-signers do not use two intransitive sentences for expressing a transitive event in silent gesture studies because these participants have a fully developed linguistic system (their spoken L1), contrary to the Deaf signers who use a young sign language or a home sign system which is their only linguistic system.

3.3 Verb semantics impacts word order in ÖGS

Crucially, although the visual modality of sign languages allows the use of natural orders to a greater degree than spoken languages do, they show conventionalized order patterns typical for linguistic systems. Thus, non-basic orders have to be grammatically or pragmatically licensed in some way. The present study confirms that SOV is the basic sign order of ÖGS (the majority of the sentences were signed by an SOV order), but also shows that there is licensed variation in order in that specific linguistic factors, such as verb semantics, may license non-basic orders. This observation supports the gradient approach to word order (Levshina et al. 2023).

The present findings give insight into the grammar of ÖGS. The results reveal that semantic properties of the verb (i.e. verb type) may be one factor that licenses SVO orders in ÖGS. Word orderings differing from the basic SOV order (SVO and OSV orders) were observed. Also, the expression of intensional events leads to more complex constructions compared to the expression of extensional events. In intensional contexts linguistic material was observed which might be interpreted as marking the irrealis indicating that the object is nonexistent. This linguistic material includes the sign WIE (“how”), the sign SO (“so/like this”), the sign combination FORM SO (“shape like this”), the THOUGHT-BUBBLE sign and eye gaze up.

3.4 Limitations of the present study

A limitation of this study is the relatively small number of participants resulting from the fact that the potential participant pool of Deaf ÖGS signers is limited. Another limitation is related to the possibility that the intensional events used in this study might be interpreted in two ways: either the verb is used intensionally containing a non-existing object (e.g. 'The girl is thinking about her dream schoolbag') or extensionally implying an existing object (e.g. 'The girl is thinking about her schoolbag (which is at home)'). This might explain why some intensional events were expressed by an SOV and an SVO order (SVO for intensional interpretation and SOV for extensional interpretation). Unfortunately, the present production data do not provide an answer to this question, and the potential ambiguity of intensional events was also present in previous studies on word order in intensional and extensional events. It is not clear whether this can be solved by experimental techniques or whether the answer ultimately lies in intensive linguistic fieldwork.

4. Conclusion

The present study investigates the effects of semantic properties of the event and participants on word order preferences in ÖGS. In line with previous work on Libras and NSL, the data show a differentiation between extensional and intensional events with respect to order, in that extensional events are preferentially expressed by SOV and intensional events show a higher prevalence for SVO. Also more complex constructions were observed in the context of intensional events. These findings suggest that verb semantics may impact the syntax in ÖGS.

Furthermore, ÖGS does not show the general preference towards SVO in reversible contexts, contrary to what has been described for a number of other sign languages (Napoli & Sutton-Spence 2014). Thus, in reversible sentences SOV is still the preferred order in ÖGS.

However, we would be remiss if we did not comment on the implications of our data for the assumption that iconicity is involved in the word orders we have observed. Our results indicate that the order preferences are primarily determined by the semantics of the verbs and not the semantics of the arguments, in contrast to what is reported for silent gesture. When the existence of the object argument is dependent on the action of the verb, which is the basis for the relevance of iconicity of visual representation to the decision to put the object after the verb, the verb is strictly speaking a 'creation' verb (Levin 1993). It is not clear at what point in the history of this line of research the term 'intensional' was applied to this group of verbs or the concept of the object dependency that is associated with this group of verbs. In any case, few of the concepts or verbs in the prior studies can be said to be actual creation verbs, and in our study, because of our avoidance of classifier verbs and other heavy verb types, none of our intensional stimuli are creation verbs. In this sense, the issue of iconicity and visual representation affecting word order is irrelevant to understanding our results. Yet we find a strong effect of extensional and intensional verb semantics affecting ÖGS word order. We need to consider why this is the case.

Schlenker et al. (2024) posit that the extensional-intensional distinction is not appropriate from a theoretical as well as from an empirical standpoint and instead propose an alternative account within pictorial semantics. They initially observed a difference in order within the group of extensional events expressed by classifier constructions, whereby arguments precede the verb if their denotations are typically visible before the action (their 'Visibility Generalization' is a form of iconic explanation).[13] They further noted that it was unclear how the prevalence for SVO orders observed for intensional events in other studies might be explained by their account. Again, it remains to be determined what impact pictorial display and verb semantics have on word ordering when the verbs being tested are clearly creation type compared to non-creation type.

The data we have presented provide important knowledge about word order in ÖGS, contribute to typological findings on order preferences in (sign) languages and provide evidence for order variability supporting the view of a gradient approach to the emergence of word order.

Which factors might determine the use of natural versus systematic orderings, as well as which additional (socio-)linguistic factors may influence order patterns in ÖGS (e.g. age of acquisition, bilingualism and contact with surrounding spoken or written language) remain to be investigated.

[13] We should note that verbs with classifier handshapes fall into the 'heavy' verb category and it is possible that this could have influenced their findings of V after O if these heavy verbs were in fact in final position.

Data availability

The datasets generated and analyzed for this study as well as the appendix is available at https://osf.io/e5xbj/?view_only=618e28ab484b4deeba2134f5efe9a9f2.

Ethics and consent

The study was approved by the research ethics committee of Purdue University at the time of data collection and subsequently received updated approval at the University of Salzburg (EK-GZ 10/2023).

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Competing interests

The authors have no competing interests to declare.

Authors' contributions

JK: Conceptualization, Methodology, Data collection, Analysis, Writing – original draft.

RBW: Conceptualization, Methodology, Analysis, Writing – review and editing.

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