Polar response strategies across modalities: Evidence from German Sign Language (DGS)[1]

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Abstract

Response particles like *yes* and *no* fulfil two functions. They may indicate the truth of a previous utterance, i.e. affirm or reject it, or they may indicate that the response to the previous utterance has positive or negative polarity. The difference becomes relevant in responses to negative antecedents, where the two functions come apart, so that a particle response becomes ambiguous. Recent research has shown that languages may show preferences for one of the two functions but that there is no full disambiguation: dispreferred particles are often still quite acceptable. In view of recent advances in the study of multi-modal communication, the issue arises if the visual-gestural modality might be exploited for disambiguation. Sign languages are of particular interest in this context since they have conventionalized multiple articulatory channels, which they may simultaneously use to disambiguate a response. In this paper we present the first quantitative study on the response system of a sign language. We present data from a controlled open production study on German Sign Language (DGS) and give a representative picture of which response elements DGS signers use. The results indicate that DGS signers do not systematically exploit the simultaneous strategies available in sign languages to disambiguate their responses, but use disambiguation strategies that mostly do not depend on the visual-gestural modality. Still, the type of articulator (manual vs. non-manual) is relevant for the choice of a response element, as is the syntactic category of the element. Building on earlier theoretical proposals, we put forth an optimality-theoretic model and combine it with a new syntactic proposal to account for the role of articulator type, syntax, and disambiguation potential in the use of response elements in DGS. Overall, the study provides important cross-modal typological insights into response strategies in sign languages while improving our understanding of response strategies in language and visual communication in general.

Keywords: sign language, response particles, polarity, non-manuals, gesture

1. Introduction

The semantics and pragmatics of response particles have received increased attention in recent years. At first glance, the meaning of words like *yes* and *no* seems straightforward. As (1) illustrates, *yes* affirms the truth of the proposition introduced by the antecedent (a positive assertion

[1] Part of this research was published in Loos et al. (2020). There are some deviations from some of the numbers reported earlier because of the more detailed analysis of (potential) REs conducted for the current publication.

or polar question) and signals the positive polarity of the response clause (i.e., *he has*);[2] *no* rejects the truth of the antecedent proposition and signals the negative polarity of the response clause (i.e., *he hasn't*).

(1) *Antecedent:* Pete has won the race. / Has Pete won the race?
Response: a. **Yes**, he has. affirmation, positive polarity of response
b. **No**, he hasn't. rejection, negative polarity of response

Things get more complicated with negative antecedents. In (2)(a), *yes* affirms the negative proposition of the antecedent, while *no* signals that the response clause has negative polarity. In (2)(b), *yes* indicates the positive polarity of the response, while *no* rejects the negative proposition of the antecedent.

(2) *Antecedent:* Pete has **not** won the race. / Has Pete **not** won the race?
Response: a. **Yes/no**, he hasn't. *yes* = affirmation, *no* = negative polarity
b. **Yes/no**, he has. *no* = rejection, *yes* = positive polarity

Response particles thus serve two purposes: They either affirm or reject the truth of the antecedent proposition (truth-based system), or they signal the polarity of the response (polarity-based system) (Pope, 1976; Jones, 1999; Roelofsen & Farkas, 2015; and subsequent literature). In responses to negative antecedents, these functions do not coincide and *yes* and *no* become ambiguous.

Languages differ in their preferences for a truth- vs. a polarity-based system. Most languages exhibit a graded preference, but additional factors like prosody and co-speech gestures also play a role, as has been shown by experimental studies in various languages (e.g., Brasoveanu et al., 2013; González-Fuente et la., 2015; Meijer et al., 2015; Li et al., 2016; Claus et al., 2017; Goodhue & Wagner, 2015, 2018; Repp et al., 2019; Geist & Repp, i.p.). Furthermore, there seems to be considerable inter-individual variation: speakers of a language might have opposite preferences (Meijer et al., 2015; Claus et al., 2017; Repp et al., 2019; Geist & Repp, i.p.). Finally, some languages have particles encoding a specific combination of both functions. For instance, German *doch* and French *si* encode both rejection and positive polarity and are thus only appropriate in discourses like (2)(b).

Aside from *YES*- and *NO*-type particles,[3] response systems often include further elements. For example, English has expressions like *right*, *wrong, of course, exactly,* or *precisely*, which may be used to indicate the truth of the antecedent. English speakers also use the vocalizations *uh-huh*

[2] For polar questions, which in most semantic work are assumed to denote sets of propositions ($\{p, \neg p\}$ (Hamblin, 1973)), the relevant proposition is the one expressed in the surface form of the question, i.e. a positive proposition in the case of positive questions, and a negative proposition in the case of (unbiased) negative questions.

[3] When discussing response particles as a cross-linguistic phenomenon, we use italicized capitals for particles that are used like English *yes* and *no* after positive antecedents. Whether or not these particles are ambiguous after negative antecedents must be determined for each language individually.

(rising intonation) and *uh-uh* (falling intonation) with the same meaning as *yes* and *no* (Krifka, 2013). Another response strategy that languages use is to repeat or 'echo' lexical and syntactic material from the antecedent (Jones, 1999). Most commonly, the lexical verb or the copula is repeated, see (3)(a), but higher functional material such as sentential negators, aspectual markers, and modals can also be echoed, see (3)(b).

(3)	a.	nǐ **tóngyì** ma	**tóngyì**	bù **tóngyì**		Mandarin (Jones, 1999: 25)
		you agree Q	agree	NEG agree		
		'Do you agree?'	'Yes.'	'No.'		
	b.	tuan **mahu** jumpa	saya		**mahu**, encik	Malay (Jones, 1999:23)
		sir want meet	me		want ADDR	
		'Do you want to see me, sir?'			'Yes.'	

A description of the response system of a language thus ideally includes the available response particles as well as non-particle response strategies, and their preferred function(s). Furthermore, it should include an analysis of prosodic markers and (non-)manual co-speech gestures. Recent studies have shown that speakers of different spoken languages systematically use prosodic and gestural devices in multi-modal communication (for polar responses, see e.g., Li et al., 2016; González-Fuente et al., 2015; Esipova, 2021; for multimodal communication in general, see Goldin-Meadow & Brentari, 2017; Schlenker, 2018).

So far, almost all studies of response systems have investigated spoken languages and have focused primarily on their inventory of response particles. Little is known about response systems in the visual modality, including sign languages and co-speech gestures. Sign languages are particularly interesting in this context for two reasons: (i) They employ various independent articulators (e.g., hands, torso, head, and face) that can be used to realize different aspects of meaning simultaneously, and (ii) they may readily integrate manual and non-manual gestures in the grammatical system because sign languages have a gestural basis and both sign language and co-speech gesture share the same modality (Meier, 2002; Aronoff et al., 2005; Pfau & Steinbach, 2011; van Loon et al., 2014; Goldin-Meadow & Brentari, 2017). It might thus be the case that sign languages use the simultaneity of articulation to disambiguate responses to negative antecedents by mapping truth (i.e., affirmation/rejection) and polarity (of the response) to different articulators. Further, sign languages may systematically draw on (possibly grammaticalized) gestural devices such as specific head or brow movements to develop a complex system of response elements (REs). While we expect similar disambiguating functions for head and brow movements in spoken language co-speech gesture (see Section 3), no large-scale empirical study exists that investigates the semantic contributions and conventionalization of head movements in spoken-language response systems.

The present paper presents the first large-scale experimental study of response strategies in a sign language. We conducted an open production study on responses to assertions in DGS to determine the meaning and syntax of REs in this language. Open production allowed us to elicit a wide range of response strategies and thus to arrive at a representative picture of how DGS signers respond to assertions. The controlled experimental setting allowed for a systematic analysis which enabled us to evaluate general response preferences in DGS and also identify unexpected gaps. Where possible, the evaluation of the data elicited in the production study was complemented by data from the DGS corpus (Konrad et al., 2020a). Given the dearth of comprehensive studies on response systems in multimodal communication, the current work is a point of reference for future empirical and theoretical studies of response strategies in visual communication, i.e. in sign languages and in speech plus gesture. Starting these investigations with a sign language has the advantage that we can build on extensive studies of the form, function, and development of manual and non-manual elements exhibiting a greater degree of conventionalization and grammaticalization than they arguably do in co-speech gesture (for the general importance of formal semantic analysis of visual communication, see Schlenker, 2018).

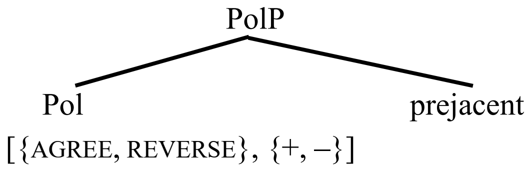
The paper is structured as follows. Section 2 introduces a theoretical approach to response particles in spoken languages which builds on the distinction of truth- vs. polarity-based systems but is an important advancement regarding the phenomenon of graded preferences: Roelofsen & Farkas's feature model (Roelofsen & Farkas, 2015; Farkas & Roelofsen, 2019). Section 3 discusses previous studies of response strategies in the visual-gestural modality for sign languages and for non-manual co-speech gestures. Section 4 presents our research questions, hypotheses, and methodology. The results are presented and discussed in Sections 5 to 7. Section 5 examines the syntax and semantics of the individual (non-)manual REs and their implications for existing theories of polar responses. Section 6 examines modality-specific simultaneous RE combinations and the grammaticalization of gesture. Section 7 discusses sequential combinations of REs. Section 8 summarizes and concludes.

2. The syntax and semantics of response particles

Theories of response particles fall into two camps: anaphora and ellipsis accounts. Anaphora accounts view response particles as propositional anaphors (Krifka, 2013; Roelofsen & Farkas, 2015; Farkas & Roelofsen 2019). Ellipsis accounts treat them as remnants of elided response clauses (Kramer & Rawlins, 2011; Holmberg, 2013, 2015). In this paper, we adopt an anaphora account, namely Roelofsen and Farkas's feature model, which builds on the classic truth vs. polarity distinction (Roelofsen & Farkas, 2015; Farkas & Roelofsen, 2019); see Claus et al. (2017) for a discussion of other anaphora and ellipsis accounts.

The feature model treats response particles as the morphological expression of two types of presuppositional polarity features that are hosted by a polarity head, Pol, see (4). Pol selects a clausal complement, the *prejacent*, which can be (partially) omitted. In bare-particle responses, the prejacent is fully elided.

(4)



The first type of polarity features are the *absolute polarity features* [+] and [–]. They presuppose that the polarity of the proposition denoted by the prejacent is positive [+] or negative [–]. The second type are the *relative polarity features* [AGREE] and [REVERSE]. They presuppose the existence of a unique salient proposition in the immediately preceding discourse whose denotation and polarity are identical with (i.e., [AGREE]) or the opposite of (i.e., [REVERSE]) that of the prejacent proposition. Pol contains one of four possible combinations of a relative and an absolute polarity feature, which reflects the type of discourse in which the response occurs, e.g., [AGREE, +] for a response that affirms the antecedent and has positive polarity, or [REVERSE, +] for a response that rejects the antecedent and has positive polarity.

A response particle realizes one or both of the features on Pol in line with distributed morphology (Halle & Marantz, 1993), where morphological vocabulary insertion rules insert lexical items, here polarity particles, that realize these features. Which feature(s) a particular particle realizes is determined by language-specific *feature-mapping rules*. For instance, a language may map [+] onto *YES*, another language may map [+] and [AGREE] onto *YES*, and yet another may map the combination [REVERSE, +] onto a particle (like German *doch*). Gradient preferences are modelled via optimality-theoretic constraints. The more recent version of the feature model (Farkas & Roelofsen, 2019) is couched in linear optimality theory, where constraints are weighted and the degree of well-formedness of a structure is the weighted sum of the constraint violations that it incurs so that non-optimal candidates are dispreferred to various degrees rather than ungrammatical (Keller, 2000). We discuss the account here in abbreviated form. (5) lists all relevant constraints.

(5) *Optimality-theoretic constraints in the feature model* (Farkas & Roelofsen, 2019)

MAXIMIZE RELATIVE:	Maximize the realization of relative polarity features.
MAXIMIZE ABSOLUTE:	Maximize the realization of absolute polarity features.
MAXIMIZE MARKED:	Maximize the realization of marked polarity features or feature combinations.
EXPRESSIVENESS:	Maximize the expression of feature content.

The constraints MAXIMIZE RELATIVE and MAXIMIZE ABSOLUTE specify that relative and absolute features, respectively, have a high realization need, i.e., must be expressed by a response particle. Linking back to the truth vs. polarity distinction, in a truth-based system MAXIMIZE RELATIVE has a great weight: features are preferably expressed that signal agreement with or rejection of the antecedent proposition. In a polarity-based system MAXIMIZE ABSOLUTE has a great weight: features are expressed that signal whether the response clause is positive or negative.

MAXIMIZE MARKED expresses the general pressure to realize marked over unmarked features (Horn, 1984); [–] and [REVERSE] are considered marked features. The markedness of [–] is motivated by the assumption that negative sentences are more difficult to process than positive sentences. [REVERSE] is more marked than [AGREE] because the complement relation is more complex than the identity relation and because disagreeing is a dispreferred conversational move. The feature [+] is marked in the feature combination [REVERSE, +] because it contrasts with the polarity of the antecedent.

EXPRESSIVENESS maximizes the amount of information that a form encodes, so that response particles expressing feature combinations are preferred over particles expressing only one feature. Finally, Farkas and Roelofsen assume that it is pragmatically advantageous to avoid ambiguous expressions, but do not include the relevant constraint in their model.

Let us illustrate the mapping rules and application of the optimality-theoretic constraints for English and German. For both languages, quantitative data are available from experimental studies, which are roughly summarized in Table 1 (Brasoveanu et al., 2013; Claus et al., 2017; Goodhue & Wagner, 2018; Repp et al., 2019).

Table 1. Acceptability judgements for English and German response particles (for positive antecedents, there is no ambiguity, so only one particle is listed).

Antecedent	**Speech act**	**Features to be realized**	**Acceptability ranking**	
			English	**German (majority of speakers)**
positive	affirmation	[AGREE, +]	*yes*	*ja*
	rejection	[REVERSE, –]	*no*	*nein*
negative	affirmation	[AGREE, –]	*no > yes*	*ja > nein (> doch)*
	rejection	[REVERSE, +]	*yes > no*	*doch > nein > ja*

The feature-particle mapping for English and German is the following (Roelofsen & Farkas, 2015). In both languages, [AGREE] and [+] map onto *YES*, [REVERSE] and [–] map onto *NO*. In German, the combination [REVERSE, +] maps onto *doch*. The constraint ranking (with corresponding relative weights) in the two languages is as follows (non-effective constraints are suppressed):

(6) English: MAXIMIZE ABSOLUTE >> MAXIMIZE MARKED (Repp et al. 2019)
German: EXPRESSIVENESS >> MAXIMIZE RELATIVE >> MAXIMIZE MARKED (Farkas & Roelofsen, 2019, cp. Claus et al., 2017)

These constraint weightings reflect a preference for polarity-based responses in English and for truth-based responses in German. To see the impact of the constraint weightings, first consider an affirmation of a negative antecedent, e.g., (2)(a) from Section 1, *Pete hasn't won the race*. – *Yes/No he hasn't*. Here, *YES* can be used because it encodes [AGREE], and *NO* because it encodes [–]. In English, *no* is preferred over *yes*: *no* realizes absolute and marked [–], which is favored by both constraints (weighting irrelevant), whereas *yes* realizes relative and unmarked [+]. In German, the majority of speakers find *ja* 'yes' more acceptable than *nein* 'no'; for these speakers the realization of relative features has a higher weight than the realization of marked features.

For rejections of negative antecedents like (2)(b) from Section 1, *Pete hasn't won the race*. – *Yes/No he has*, the English *yes*-over-*no* preference is accounted for because *yes* realizes absolute, unmarked [+], whereas *no* realizes relative, marked [REVERSE], and in English the realization of absolute features has a higher weight than the realization of marked features. In German, EXPRESSIVENESS has the highest weight, which accounts for the preference of *doch* (expressing the combination [REVERSE, +]) over *nein* over *ja*: *nein* and *ja* express fewer features than *doch*. Furthermore, *nein* is better than *ja* because *nein* realizes relative, marked [REVERSE], whereas *ja* realizes the absolute, unmarked [+], and in German relative and marked features have a high realization need.

The feature model shows well how different constraint weightings can explain different acceptability patterns for response particles expressing the relevant polarity features. In Section 1, we mentioned that response systems may comprise other elements than particles, for instance, adverbs (*exactly*), vocalizations (*uh-uh*), echoic verbs, co-speech gestures, etc. We will see that the same applies to DGS, as the open production method that we employed elicited not only response particles but also alternative response strategies. Roelofsen & Farkas (2015) do not discuss non-particle REs and alternative response strategies but they suggest that absolute features can also be realized by the prejacent, potentially in truncated form as in echoic responses. For some discourses, like [REVERSE, +] contexts in English or Romanian, an explicit prejacent is even obligatory. This means that the candidates for the optimality-theoretic evaluation in the feature model are not just particles on their own but entire response clauses. Note, however, that Roelofsen & Farkas do not specify how their constraint system ensures that a response clause is overtly expressed. Also note that from a syntactic point of view, it is not clear how a response clause can 'realize' a feature: an explicit response clause is not an instance of morphological vocabulary insertion in the narrow sense. Finally, it is not clear how multiple realizations – by a particle and a response clause – and gestural strategies can be enforced in the system. We will take up the issue of non-particle REs again in Section 4, where we introduce our study in greater detail.

3. Responding in the visual-gestural modality

As already mentioned, sign languages integrate gestural elements in the linguistic system, but spoken languages also make systematic use of co-speech gesture in face-to-face communication. In this section we discuss findings on response particles in sign languages and on gestural aspects of response strategies in sign languages.

To our knowledge, response particles in sign languages have only been studied by Gonzalez et al. (2019), who investigate responses to negative questions in American Sign Language (ASL). They report that the manual sign NO (typically accompanied by a headshake) can either mark the polarity of the response ((7)(a)), or reject the truth of the antecedent ((7)(b)). In both discourse types, NO is preferred over YES. In terms of the feature model, [–] and [REVERSE] map onto NO, and MAXIMIZE MARKED has a higher weight than MAXIMIZE ABSOLUTE or MAXIMIZE RELATIVE: In affirmations, NO encodes marked, absolute [–] (vs. YES expressing unmarked, relative [AGREE]); in rejections, NO encodes marked, relative [REVERSE] (vs. YES expressing unmarked, absolute [+]). Note that these data show that ASL differs from its ambient spoken language English.

(7) *Amy*: ASL (Gonzalez et al., 2019: 4)

____hs
ZOE PLAY VIDEO-GAMES NEVER[4] *Context*
'Zoe never plays video games.'

Ben to Zoe:

____br
IXZoe NEVER *Negative antecedent*
'You never play video games?'

Zoe's possible answers:

_____hs
(a) NO, IX*Zoe* NEVER *Negative polarity* [–]
'No, I never play video games.'

_hs
(b) NO, IX*Zoe* ONCE-IN-A-WHILE *Rejection:* [REVERSE]
'No, I play video games once in a while.'

Turning to (co-speech) gesture in polar responses, head movements have received most attention. They have been claimed to (almost) universally encode affirmation and rejection (for head nods and -shakes, see Jakobson, 1972; for headshakes, see Kendon, 2002; Pfau, 2015; Bross, 2021). Head nods are cross-culturally common conventionalized gestures with affirmative meanings such as approval, (re)assurance, understanding, and agreement. For instance, Puupponen et al. (2015) found that in spontaneous conversation in Finnish SL head nods most frequently perform affirmative functions. Headshakes often signal negative meanings including disapproval,

[4] Signs are represented by translation equivalents from the ambient spoken language in small caps (English for ASL, German for DGS). DGS examples further contain an English gloss. With the exception of the REs discussed here, whose form is detailed on OSF (https://osf.io/k2h9f/), DGS glosses are taken from the DGS Corpus. Numbers following those glosses indicate lexical variants. For ease of representation, phonological variants are not indicated. Non-manual components are marked on a line above the signs with which they co-occur. Abbreviations for the notational conventions are listed at the end of the document.

disbelief, rejection, and negation (Pfau, 2015; Puupponen, 2019). For English, Fusaro et al. (2011) report that 20-months-old toddlers shake their heads when affirming a negative statement, suggesting an association between negative polarity and the headshake. Kendon (2002) mentions adult English speakers accompanying negative statements with a headshake. Another function of head movements in spoken and signed languages is backchanneling. Finally, in DGS, like in other sign languages, head movements fulfil various other syntactic and information-structural functions.[5]

Experimental studies on headshakes and nods as REs in spoken languages exist for Mandarin Chinese (Li et al., 2016), Catalan, and Russian (González-Fuente et al., 2015). These studies investigated verbal, prosodic, and gestural response strategies to assertions and questions in a discourse completion task with four speakers each. They found that nods are the most common head movement when rejecting a negative antecedent, which goes against the above-mentioned universal association of nods with affirmation. In fact, in Mandarin and Russian, more than half of the rejections, which invariably were realized by *NO* (or in Russian with an echoic strategy), were accompanied by a head nod. Thus, it seems that the auditory channel may express relative [REVERSE] simultaneously with the visual channel expressing absolute [+] in these languages.

Esipova (2021) claims that head movements are equivalent to response particles in encoding polarity features. On the basis of single intuitions, she suggests for Russian that co-speech head nods encode [AGREE] and [+] while headshakes encode [REVERSE] and [–]. However, when used as a stand-alone gesture (without simultaneous speech), nods only encode [AGREE]: in sequential combinations of response elements, the nod is restricted to affirmations; in [REVERSE, +] discourses, the nod cannot precede *net* 'no', which encodes the relative feature [REVERSE]. Esipova puts this down to a constraint DISAGREE FIRST. Overall, she suggests that the nod fills a gap in the Russian response paradigm, which has no particle encoding [+]. Note, however, that the inability of nods to encode [+] without a particle simultaneously encoding [REVERSE] poses interesting theoretical questions concerning the realization of features by single REs vs. RE combinations.

Other gestural elements in polar responses that have been investigated are head tilts, eyebrow raises, eyebrow furrowing, movement of the corners of the mouth and shoulder shrugs (González-Fuente et al., 2015; Li et al., 2016). Overall, such gestural elements are more frequent in responses than they are in control sentences. Furthermore, rejections of negative antecedents are marked by gestures more frequently than affirmations of positive antecedents, which seems to corroborate the assumption that disagreeing as a dispreferred conversational move receives specific marking.

To summarize, gestural elements in general and head movements in particular are frequent in polar responses, with rejections showing the most gestural accompaniments. Head movements seem to take different functions in spoken languages, and even to express different polarity features than simultaneous verbalizations. Still, the empirical basis for the description of the use of the

[5] For instance, repeated short headshakes contribute to the marking of implicit *wh*-questions (Happ & Vorköper, 2014). Head nods can mark perfective aspect, contrastive and information focus (Happ & Vorköper 2014; Lillo-Martin & Quadros, 2008; Wilbur, 2012), the consequent of conditionals and adverbial clauses (Paulus, 2019).

visual-gestural modality in responses is small, and for sign languages there is almost no representative empirical research available. Nevertheless, the data that we discussed suggest that in addition to head movements, brow movements might be used in sign languages. Like head movements, they have been analyzed as grammaticalized gestures that fulfill various grammatical and pragmatic functions, including marking topics, polar interrogatives, the antecedents of conditional clauses, and also salience (Janzen, 1999; Pfau & Steinbach, 2011; Wilbur & Patschke, 1999). Their use in polar interrogatives suggests a relation to polarity in sign languages. Finally, a specific element used in many sign languages are mouthings (Boyes Braem & Sutton-Spence, 2001). In DGS, mouthings accompany up to half of manual signs in spontaneous conversations (Ebbinghaus & Hessmann, 1996), so they may be expected to be used in combination with or as replacements of manual and nonmanual REs in polar responses, too.

4. The present study

4.1. Research questions

The goal of the current study is to start closing the research gaps identified in the previous sections. We pursue this goal by addressing two major research questions.

(8) **Research question 1**
Which REs are attested in DGS and how can their distribution be modelled theoretically?

This two-part question is motivated by our aims (i) to overcome the general lack of systematic empirical descriptions of response systems in sign languages; and to gain a better understanding (ii) of the application of theoretical analyses of response elements beyond particles, and (iii) of the specific role of the visual-gestural modality and gestural aspects of visual communication in response systems, as discussed in the previous sections.

We know from the literature that DGS has at least one *YES*-type manual sign (JA) and one *YES*-type non-manual (head nod), as well as the corresponding *NO*-type manual (NEIN) and non-manual (headshake) (Konrad et al., 2020; Papaspyrou et al., 2008; Pfau and Quer 2002, 2007). In our study, we investigate the feature mappings attested in DGS and explore the realization preferences for these REs. Furthermore, we investigate potential preferences of the manuals vs. the non-manuals as stand-alone REs, an issue that must be addressed when discussing a system that can use multiple articulators simultaneously to express different grammatical and pragmatic features. Finally, we discuss the gestural origins and the degree of grammaticalization of certain manual and nonmanual REs and thus broaden our current understanding of response strategies in visual communication.

In addition to the above REs, the DGS corpus lists further manual markers such as, e.g., STIMMT '(that's) right', GENAU 'exactly', and FALSCH 'wrong' (Konrad et al., 2020). Our study sheds light on the distribution of these manuals in comparison to and in combination with *YES/NO*-type particles. This comparison is relevant for two reasons. First, some of these signs are not particles but verbal or adjectival predicates, as we will argue below. This different syntactic status is relevant because in the feature model only the realization of polarity features by particles is modelled in any detail (Section 2). The syntax of verbal or adjectival predicates in relation to the Pol head hosting the polarity features is not specified. Note that Holmberg (2015) suggests for English responses like *true* or *right* (which he calls 'rejoinders' – they only occur after assertions[6]) quite a different analysis than for response particles: response particles occupy a Foc head in the left periphery of the clause whereas rejoinders take the proposition denoted by the assertion as an argument, roughly, e.g., ~~*That John skis is*~~ *true*. This analysis captures the predicate characteristic of rejoinders. It seems clear that such predicates must receive a different analysis than REs also in the feature model. It also seems clear that they cannot be analyzed as truncated prejacent clauses (echoic responses), for which Roelofsen & Farkas (2015) argue that they can realize absolute polarity features (see Section 2).

Second, the comparison of the *YES/NO*-type elements and other REs is important from a semantic-pragmatic perspective. REs like STIMMT or FALSCH intuitively are unambiguous, which is an issue that has not been discussed so far: they seem to signal only the truth or falsity of the antecedent, not the polarity of the response clause. This is a characteristic that we will verify in our study. If these REs are indeed unambiguous, this is highly relevant for the choice between REs after negative antecedents. Recall that although the feature model does not contain a dedicated constraint penalizing ambiguity, Roelofsen & Farkas (2015) acknowledge the avoidance of ambiguity as a general pragmatic principle. Hence, it might be the case that in ambiguous contexts, i.e., after negative antecedents, unambiguous REs are used more frequently than in unambiguous contexts. If this is so, a constraint like AVOID AMBIGUITY should be part of the theoretical model.

The second research question our study addresses is:

(9) **Research question 2**
What simultaneous and sequential combinations of REs are attested in DGS and what is their pragmatic function?

As laid out in Section 1, due to the systematic use of multiple articulators, sign languages may be expected to use the simultaneity of articulation to disambiguate responses by expressing truth (i.e., relative features) and polarity (i.e., absolute features) by different articulators. While we would not expect the simultaneous production of two manual articulators producing different REs for phonotactic reasons (Battison, 1978; Crasborn, 1995; Brentari, 1998; Becker, 2016), we may expect manual REs to co-occur with head and eyebrow movements as well as with mouthings. In Section 3, we saw that in some spoken languages, head movements are used to express absolute polarity [+] simultaneously with a verbal RE expressing relative polarity [REVERSE], thus

[6] In the DGS corpus (Konrad, 2020), at least STIMMT also occurs after questions.

potentially avoiding ambiguity. Note, however, that ambiguity avoidance indeed is only potential: the combination comprises ambiguous REs, so unless there is some conventionalization as to which articulator expresses which type of feature, ambiguity is not resolved. In our study, we therefore explore what types of simultaneous combinations there are, if any. We focus on head movements, mouthings and brow movements.

Sequential combinations of REs, which have been associated with various discourse functions (e.g., discourse cohesion, the pragmatic functions of hedging and face-saving; cp. Burridge & Florey, 2010; Guntly, 2021), might also have a potential disambiguating function. As just mentioned, combining a *YES*-type and a *NO*-type RE (e.g., *Yes, no, he didn't call*) still leaves open which RE realizes which feature. However, a cue for true disambiguation might be ordering regularities. For instance, REs realizing relative features might (have to) occur before REs realizing absolute features (recall Esipova's 2021 principle DISAGREE FIRST!). Of course, combinations might also contain unambiguous REs. This, however, is redundant because using only one unambiguous RE would be enough. Still, as we will see, such combinations are frequent. The question is, why: Combinations arguably are more effortful, and non-informative sequential combinations violate the Gricean Maxim of Manner (Grice, 1989), so should be avoided. We will argue that the overall frequency of individual REs might play a role here because ambiguous *YES/NO*-type REs are only ambiguous after negative antecedents. If they are used frequently after positive antecedents, these REs have an overall frequency advantage, which might motivate their use in sequential RE combinations.

Neither the feature model nor other models of response systems address the issue of RE combinations. If combinations are used regularly, their use should be integrated into a model of responses. However, although our findings document the regular use of combinations, we will not undertake this theoretical project here, as it requires a larger empirical basis. Nevertheless, we will discuss our data with respect to the issues presented in this section.

4.2. Methodology

Our study employed a discourse completion task that builds on materials developed for acceptability judgment experiments on German response particles described in Claus et al. (2017). Participants in our study watched short videos in DGS, where a narrator told them mini stories about everyday situations. After each story they engaged in a dialogue with another person on video while being video-recorded themselves. The participants' task was to respond to a correct or incorrect negative or positive assertion made by the person in the video. Thus, they had to affirm or reject what the person in the video said, depending on the information provided in the mini stories. Participants were free in their choice of response strategies.

4.3. Participants

24 (near-)native signers of DGS (18 to 55 years, $M = 32$; age of acquisition $\leqq 5$; 18 female, 6 male) participated in the experiment either at the University of Cologne or at the University of Göttingen.

Fourteen signers live in North Rhine-Westphalia, four in Berlin, three in Hesse, and one in Lower Saxony. All participants evaluate their command of German as at least good. They were compensated for their participation.

4.4. Materials and design

The study contained 48 experimental items and one practice item. Each item started with a native signer of DGS acting as a narrator who introduced a situation involving two characters: Peter and Alex. Then another native signer appeared on video facing the participant and made an assertion as Peter. The participants were asked to assume the role of the second character, Alex, and produce a response to Peter's assertion. The information for responding truthfully to the assertion was always given in the narrator's description of the situation: it made clear whether the proposition expressed by the assertion, p or $\neg p$, was true or not. Peter's assertion had either positive or negative polarity (experimental factor: ANTECEDENT). Depending on the situation described by the narrator, the participants' responses were expected to either affirm or reject Peter's assertion (experimental factor: SPEECH ACT). The experiment thus had a 2×2 design resulting in four conditions. (10) gives a sample stimulus translated to English.

(10) Sample stimulus item

Narrator: Peter and Alex are elementary school teachers. They are organizing a school party with the help of some of the parents. Alex just learnt that …

p is true: ...the parents have already bought the beverages.
$\neg p$ is true: ...the parents have not yet bought the beverages.

A little later, Peter and Alex discuss the tasks assigned to the parents.

Peter:

ELTERN1	GETRÄNKE	FRÜHER1	HOLEN1	antecedent: *positive*
parents	drinks	before	fetch	

'The parents have already picked up the beverages.'

ELTERN1	GETRÄNKE	HOLEN1	NOCH-NICHT2	antecedent: *negative*
parents	drinks	fetch	not.yet	

'The parents haven't picked up the beverages yet.'

Alex: … [video recording of participant]

All assertions were transitive sentences. Positive assertions contained the temporal adverbial FRÜHER1 ('before'), negative assertions contained the negator NOCH-NICHT2 ('not yet') accompanied by a headshake.

The items were distributed over two lists, both of which were presented either in regular or in reversed order (effectively creating four lists). The factor ANTECEDENT was manipulated between items: 24 of the lexicalizations contained a negative assertion, 24 contained a positive assertion. Otherwise, we used a Latin square design for the two basic lists. The order of items in each list was pseudorandomized.

Some adaptations of Claus et al.'s (2017) materials were necessary to fit the information-structural, grammatical, and lexical needs of DGS, and to provide culturally appropriate contexts for the DGS community. The basis of Peter's name sign was a physical characteristic of the signer portraying the character, specifically his moustache. The name sign ALEX[7] was kept neutral to allow all participants to easily identify with Alex, independently of gender.

4.5. Procedure

The recordings were made in a language laboratory. Participants were welcomed in DGS by a native or a proficient signer. During the experiment, they sat in front of a computer screen. They first watched an instruction video where a proficient DGS signer introduced Alex and Peter, and explained the task using a sample item and a number of potential (non-)manual responses. The signer explained that the participants should assume Alex's role and respond to Peter's assertion. Participants were encouraged to choose their own responses and to respond spontaneously as in natural conversation. After a practice trial, they received feedback and then moved through the experiment at their own pace via mouse-click. They were recorded by a camera located next to the computer screen. An experimental session lasted approximately two hours; participants could take breaks as needed.

4.6. Data preparation and statistical analysis

The data were annotated in ELAN (Wittenburg et al., 2006) for the presence and type of (non-)manual REs that were produced, for the non-manuals specifically mouthing, head nod, headshake, brow raise, brow furrow, and nose wrinkling. Of the 1152 recordings, 871 (75.6%) could be used for analysis. Two recordings were excluded because of technical problems. 72 items (6.3%) were excluded due to high error rates: in the three lexicalizations in which these items occurred (3 × 24 participants), the signs for 'cover sheet', 'canine tooth', and 'roadblock' proved to be insufficiently conventionalized. A further 90 items (7.8%) from two participants were excluded because the participants did not perform the task as instructed. One participant was not engaging in the conversation but commented on whether or not the claim produced in the antecedent was correct. The other participant reproduced the scene-setting passage before providing a response. Finally, any remaining items where the answer was incorrect were excluded (117 items, 10.2%). Whether or not an answer was correct was decided on the basis of the response clause or some other discourse continuation.

Participants used a variety of different signs as REs. Following the annotation guidelines for the DGS corpus (Konrad et al., 2020b), we considered two forms as variants of the same sign if

[7] The dominant hand assumed the shape of the letter A (in DGS fingerspelling) and performed a sideways movement.

they differed in at most one phonological parameter: handshape, palm orientation, location, or movement. The following signs occurred in variants in this sense.[8] JA 'yes' and STIMMT 'right' occurred with a single and with a repeated movement. FALSCH1 'wrong' occurred with and without a hand-internal opening movement. NEIN 'no' varied in the handshape parameter, occurring with a F handshape or with | or B . Phonologically unrelated forms such as FALSCH1 and FALSCH2 were considered separate signs.

As a result of the open production method, the frequency of occurrence of many categories was very small and/or very imbalanced, so we did not apply full-scale statistical analyses. We mainly report descriptive statistics pooled over participants (i.e., total counts). For some analyses of more general patterns, we fitted generalized linear mixed models with a binomial logit function (R package lme4, Bates et al., 2015), and report these in the footnotes. We initially fitted models with antecedent and speech act as fixed factors and with a maximal random structure per participant and lexicalization including random slopes for the fixed factors and their interaction, but mostly reduced the random structure due to convergence issues. The reported *p*-values are based on the Kenward-Roger approximation (lmerTest; Kuznetsova et al., 2017).

5. Response elements

Signers produced between one and four REs plus a response clause (with lexical material from the antecedent) or a discourse continuation (with different lexical material, e.g., from the scene-setting passage). Manual REs occurred in initial, internal, and final position of the response. Non-manual marking was ubiquitous: There were 85 occurrences of non-manual-only REs in utterance-initial position, and of the 674 manual first REs, 619 (92%) co-occurred with at least one simultaneous non-manual marker. In this section, we discuss the first RE in initial position (manual or non-manual).

5.1. Inventory of response elements

Signers produced sentence-initial first REs in 87 precent (759/871) of the responses. They employed ten different manual REs and five different non-manual REs as the first RE (see Table 2). The manual REs could be accompanied by one or more non-manual markers. The third column in Table 2 shows that most manual REs produced in our study are accompanied by at least one non-manual marker (head movement, mouthing, and/or brow movement). We will discuss the details of these combinations in Section 6. Importantly, what we say in the current section about manual REs is valid independently of the presence or absence of a simultaneous non-manual (with two exceptions detailed in footnote 10)[9], and we are reporting pooled data, that is manual REs with zero, one or more simultaneous non-manuals. The right column in Table 2 represents stand-alone

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[8] Details of the phonology including variants, plus stills of all manuals are provided on https://osf.io/k2h9f/.

[9] We did not investigate interactions of different accompanying non-manuals for any of the manuals because the matrix this produces is too complex for the size of our data set, but see Section 6 for one exception.

non-manual responses, i.e., non-manuals that were produced without a manual RE. Note that neither the English translations nor the German-DGS glosses are necessarily indicative of the lexico-syntactic characteristics of the REs (see Section 5.1.2 for details). Table 2 shows that the manual signs JA, NEIN as well as the positive and negative forms of STIMMT occur most frequently. FALSCH and DOCH are rarely used. Amongst stand-alone non-manuals, headshakes and nods are most frequent. Overall, DGS signers have a clear preference for manual REs over stand-alone non-manual REs.

Table 2. First REs with more than one token.

Manual RE			**Stand-alone non-manual RE**	
Element	***n***	**With at least one simultaneous non-manual**	**Element**	***n***
JA ('yes')	212	79%	headshake	46
NEIN ('no')	170	96%	head nod	19
STIMMT ('right')	149	98%	mouthing /doch/ (m.doch)	11
STIMMT-neg ('not right')	97	99%	mouthing /stimmt/ (m.stimmt)	5
STIMMT NICHT ('not right')	18	100%	mouthing /ja/ (m.ja)	4
FALSCH1 ('wrong')	19	100%		
FALSCH2 ('wrong')	2	100%		
DOCH	2	100%		
Other	5	100%		
Total	674	92%		85

5.1.1. Meaning of response elements

Figure 1 illustrates the distribution of first REs across the experimental conditions. It shows that across positive and negative antecedents, **JA** 'yes' and **STIMMT** 'right' are typically used in affirmations, and that JA, in contrast to STIMMT, also occurs in rejections of negative antecedents. These findings suggest that JA encodes [AGREE] and [+], whereas STIMMT unambiguously signals agreement. Figure 1 also shows that in affirmations of positive antecedents, JA is used most often, followed by STIMMT, whereas in affirmations of negative antecedents, it is the other way round.[10] Syntactically, JA can be analyzed as a response particle occupying the Pol head, lexicalizing the

[10] For manuals without head movements there is no reversed preference for JA vs. STIMMT in affirmations of positive vs. negative antecedents. JA is still more frequent than STIMMT after positive antecedents, but JA and STIMMT are used equally frequently after negative antecedents. Still, irrespective of the presence of a simultaneous head movement, JA is preferred after positive antecedents but not after negative antecedents.

STIMMT and STIMMT(-neg/NICHT) often occur with a mouthing that in principle can be used as a stand-alone non-manual RE, albeit very infrequently: /stimmt/, see Table 2. Other manuals do not occur with such a mouthing. Therefore, the distributions across conditions change when we only consider manual REs with mouthings: STIMMT(-neg/NICHT)) are most frequent across all conditions. Due to the skewed use of mouthing we will not consider this issue here. See Section 6 for discussion.

features [AGREE] and/or [+]. There are no indications for a different syntactic status. For the syntactic status of STIMMT, see Section 5.1.2.

NEIN 'no', **STIMMT-neg** and **STIMMT NICHT** 'not right', are predominantly used in rejections, and NEIN, in contrast to STIMMT-neg and STIMMT NICHT, also occurs in affirmations of negative antecedents. Thus, NEIN seems to lexicalize the features [REVERSE] and [–]. However, note that only three participants used NEIN to encode [–], and only one of them did so consistently. STIMMT-neg is the functional counterpart of STIMMT, unambiguously signaling rejection. Syntactically, NEIN is a response particle occupying the Pol head, lexicalizing [REVERSE] and/or [–]. For the syntactic status of STIMMT-neg, see Section 5.1.2.

FALSCH1 and **FALSCH2** 'wrong' unambiguously signal rejection. Three participants used the sign FALSCH1 'wrong'; one additionally used FALSCH2. See Section 5.1.2 for the syntactic status of FALSCH1; since FALSCH2 only occurred twice, we will not consider it further.

DOCH encodes the rejection of a negative antecedent but it is used only twice, suggesting that DGS has not conventionalized a manual RE to mark this discourse type.[11]

Head nod and **headshake** have a similar distribution to the manual REs JA and NEIN, although they are much less frequent.[12] Nods occur predominantly in affirmations but are also found in rejections of negative antecedents; headshakes occur mostly in rejections but also affirm negative antecedents. If we assume that both head movements are response particles, they can be assumed to realize absolute and relative polarity features.

Half of the **bare mouthings** consist of /doch/ (11 tokens), for which DGS has no independent sign (see above). It is borrowed or code-switched from German and exhibits the same distribution, i.e., occurs only in rejections of negative antecedents. Only four signers used *doch*, one of them fairly consistently (5 of 8 responses in this category). Bare mouthing of /stimmt/, /ja/, and /nein/ occurs very rarely. The low numbers do not permit any conclusions regarding their meaning and grammar.

[11] The sign DOCH is based on the manual sign MUSS1 plus the mouthing /doch/.
[12] This also holds if we compare them to JA and NEIN without any simultaneous non-manuals.

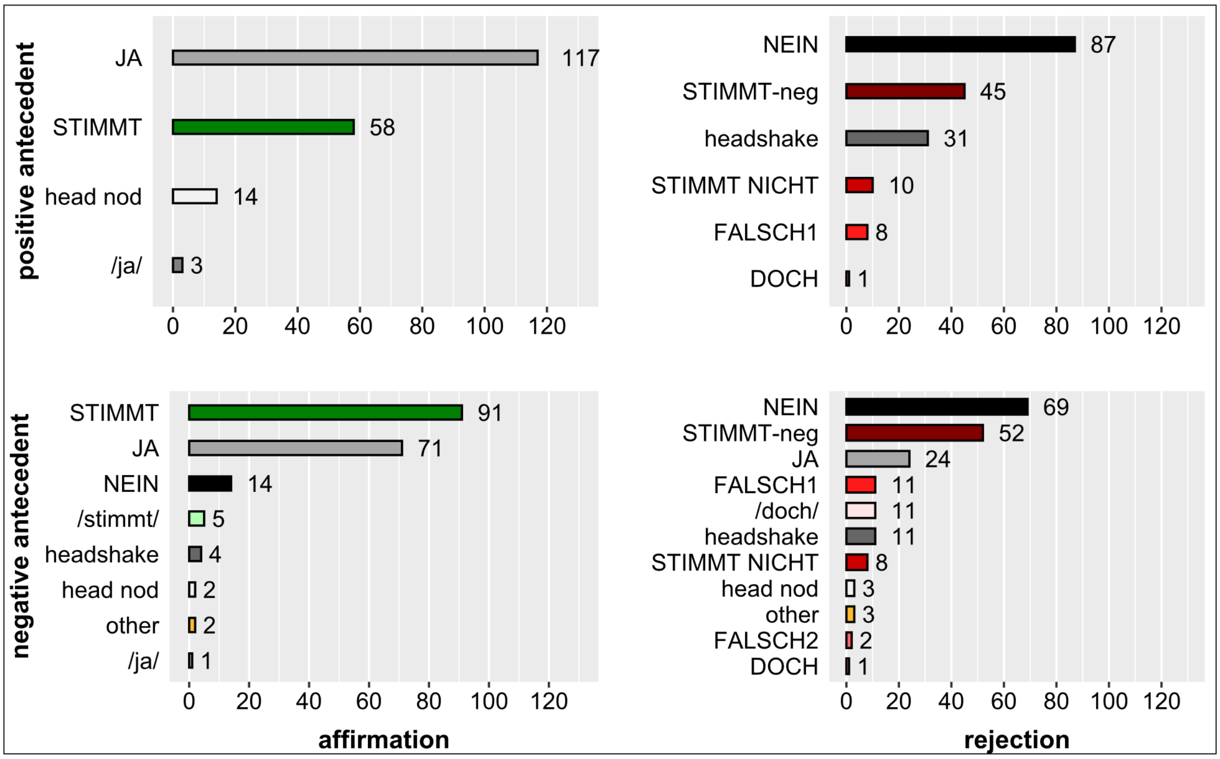


Figure 1. Total number of occurrences of first RE per condition, ordered by descending frequency. Most manuals were accompanied by at least one non-manual element (see Table 2). The non-manual REs did not accompany a manual RE. Red shades represent elements encoding only [REVERSE], green shades represent elements encoding only [AGREE], black-grey-white shades represent ambiguous REs.

5.1.2. *The morpho-syntactic status of STIMMT, STIMMT-neg* and FALSCH1.

For three of the REs that occurred regularly in our data, the syntactic status requires closer scrutiny as there is evidence that they are not, or not yet, particles. Starting with STIMMT and STIMMT-neg, they can, in principle, be analyzed as particles occupying the head of PolP or as verbal predicates in the prejacent with a dropped propositional subject anaphor referring to the antecedent proposition. The latter analysis corresponds to the grammatical status of *stimmt* (*nicht*) in the contact language German. In the following, we first discuss arguments in favor of a particle analysis of STIMMT before turning to STIMMT-neg, and finally to FALSCH1.

Particles often have homonymous counterparts in other word classes, which typically share a common semantic core (at least diachronically) with the particle. For instance, German modal particles often have adjectival or adverbial homonyms (Helbig, 1990; Müller, 2014; Dörre et al., 2018). Similarly, STIMMT, whose use as RE is illustrated in (11)(a-b), assumes a number of different syntactic functions in DGS, see (12)(a-d) from the DGS corpus. The examples show that given the appropriate mouthing, STIMMT can function as a noun meaning ‘law’ (12)(a), an adjective meaning ‘real, true, original’ (12)(b), an intensifying adverb (12)(c), or an intransitive verb (12)(d) (note that in these corpus examples, the sign we gloss as STIMMT receives a number of different glosses). This multifunctionality contrasts with STIMMT-neg, which only has verbal uses (see below).

(11) a. *Positive Antecedent:*

	top	top		
	KOCH3	SUPPE2	FRÜHER1	CL:ZUBEREITEN
	cook	soup	before	prepared

‘The cook has (already) prepared the soup.’

Response:

STIMMT	SUPPE2	FERTIG1	STIMMT
right	soup	finish	right

‘Right, the soup’s ready, right.’

b. *Positive Antecedent:*

hs				
KUNST4 3a	CL:BILD 3b	CL:DARAUF 3b	SOMMER4 3a	MALEN3 3b
artist	picture	on.it	summer	paint

NOCH-NICHT2
not.yet

‘The artist has not painted the summer painting yet.’

Response:

hs				
JA	**STIMMT**	NOCH-NICHT2	FERTIG1	MALEN3
Yes	right	not.yet	finish	paint

‘Yes, right, (she) hasn’t painted it yet.’

/recht/

(12) a.

/recht/	
STIMMT	LOCH1+
law	hole

‘The law has many loopholes.

[04:57:31, dgskorpus_fra_09]

b.

WÜNSCH4	SPÄTER10	IX3	**STIMMT**	REISE
wish	later	there	right	travel

‘At some point later I’d like to make a **real** trip/journey there.’

[06:52:48, dgskorpus_mst_03]

c. WIRTSCHAFT-GASTRONOMIE1 IX3 **STIMMT** GUT1 AMERIKA1 HIN-UND-HER1
bar there right good America back-and-forth
'It was a **really** good bar and Americans usually visited it.'
[03:23:06, dgskorpus_fra_12]

/recht/

d. ABER1 BIS-DAHIN1 GUT1 ACHTUNG1 ZEICHEN1 IX1 **STIMMT**
but since-then good attention drawing I right
'But until then everything was fine, my draft was **correct**.'
[00:13:15, dgskorpus_mvp_07]

Further, particles do not inflect. Two native DGS signers we consulted agree that STIMMT can exhibit person agreement marking in its verbal use. In (13), STIMMT agrees with its single (null) argument such that the final location of the sign corresponds to the referential locus of the subject.

(13) a. STIMMT1
am.correct
'I am right.'

b. STIMMT3
is.correct
'S/he is right.'

In our data, STIMMT never occurs with agreement marking, which suggests that is was used as a particle rather than a verb.[13] Furthermore, if the RE STIMMT were a verbal predicate, we would expect it to co-occur with and follow an overt subject in at least some examples. Recall that in the DGS corpus, STIMMT occurs with overt pronominal and full DP subjects. However, our dataset contains no RE STIMMT with an overt DP or CP argument. Moreover, the fact that we find overt subject pronouns with clearly predicative REs like FALSCH (see below) points towards the particle status of STIMMT in responses.

Finally, particles cannot be extended into full phrases by, for example, an intensifying adverb (Müller, 2014). Our data contained no degree adverbs like BISSCHEN1 ('a little') or VOLL2 ('completely') accompanying STIMMT. We followed up with two native signers of DGS, who did not accept degree adverbs with STIMMT (14).

(14) ?? BISSCHEN1 / ?? VOLL2 / ?? SEHR4 **STIMMT**
little totally very right
'a little right/ completely right/ very right'

One diagnostic that points to STIMMT not yet having acquired full particle status is its frequent accompaniment by mouthing. Mouthings tend to occur less frequently on closed-class than on

[13] A few tokens of STIMMT exhibit displacement of the movement endpoint towards an argument (a common strategy for marking agreement in sign languages, Pfau et al., 2018), but a native signer consultant interpreted the resulting larger path movement of the sign as emphatic rather than as expressing agreement.

open-class lexemes (Hohenberger & Happ, 2001). We investigated this issue by looking at the occurrence of mouthings with the closed class elements JA/NEIN vs. STIMMT vs. STIMMT-neg and found that JA/NEIN occur with mouthing 85 times (22.2% of all JA/NEIN occurrences), STIMMT 126 times (85%) and STIMMT-neg 89 times (92%). These numbers suggest that STIMMT and STIMMT-neg behave more like open- than closed-class lexemes with respect to mouthing.

Focusing now on STIMMT-neg, this RE shares several characteristics with STIMMT. It can be inflected (15)(c), but never occurs with agreement marking in our data. According to our consultants, it may select as its subject argument a full DP (15)(a), a CP (15)(b), or a pronoun (15)(c), but it never does so in our data. Furthermore, it does not allow degree modification (15)(d).

(15) a. ______________top
CONNI GESCHICHTE2 INHALT1 **STIMMT-neg**
Conni story content right-not
'Conni's story is not true.'

b. ______________Top
WETTER9 SCHLECHT1 **STIMMT-neg**
weather bad right-not
'That the weather is bad is not true.'

c. IX3 **STIMMT-neg3**
this right-not
'What he said/He's not right.'

d. ?? BISSCHEN1 / ??VOLL2/ ??SEHR4 **STIMMT-neg**
little totally very wrong
'a little not true/ completely not true/ very not true'

In contrast to STIMMT, however, STIMMT-neg is only used as a verb and cannot, for instance, serve as an adjectival modifier (16), or as a noun.

(16) IX3 ZAHN1 ***STIMMT-neg** / FALSCH DA1
he tooth right-not / wrong exist
'He has false teeth.'

Furthermore, in addition to lacking homonyms in other word classes, the morphosyntactic structure of STIMMT-neg provides evidence for an analysis as a (modal) verb rather than a particle. In STIMMT-neg, the sign STIMMT hosts a negation clitic, which is typical for modal verbs in many sign languages. This clitic is realized as an alpha-shaped movement appended to the sign STIMMT. Pfau and Quer (2002, 2007) argue that the clitic is the head of NegP, and is picked up by a verbal head moving into a higher functional projection where modal verbs surface. Since only modal verbs can host the negation clitic in DGS, this characteristic aligns STIMMT-neg with verbal heads rather than with particles.

In sum, the two REs STIMMT and STIMMT-neg are functional analogues, expressing affirmation and rejection, respectively. Syntactically, STIMMT can be analyzed as a particle when used as an RE, while STIMMT-neg seems to be a verbal head, albeit one whose projection cannot be modified. STIMMT may currently be in a transition phase in responses and may sometimes occur as a particle and sometimes as a verbal predicate (e.g., when combined with the negative marker NICHT). For the particle STIMMT, one can assume that it has undergone grammaticalization from a verb expressing agreement with an antecedent to a particle expressing the relative polarity feature [AGREE], which occupies the Pol head rather than a lower position for (modal) verbs (Roberts & Roussou, 2003; van Gelderen, 2011ab; see Pfau & Steinbach, 2013 for grammaticalization of DGS auxiliaries). For the modal verb STIMMT-neg, the Pol head seems unlikely as the (final) target of syntactic movement.

For FALSCH1 there is sufficient evidence that it is a verbal predicate but it also has adjectival uses, see (16) above. The verbal status is corroborated by the fact that FALSCH1 may take an argument. One of our signers used FALSCH1 four times with a pronominal subject, which may refer to the signer of the previous utterance, as does the pronoun IX2 in (17). Alternatively, it may refer to a propositional antecedent: IX3 in (17), which picks up the proposition ‘He already shelved the chocolate’.

(17) **FALSCH1** IX2. HABEN1 SCHON1 SCHOKOLADE2 CL:EINRÄUM SCHON1++. JA
wrong you have already chocolate shelved already yes
BEDEUTUNG1 **FALSCH1** IX3
mean wrong that
‘You’re wrong. (He) has already shelved the chocolate. Yes, (that) means that is wrong.’

Note finally that FALSCH1, unlike STIMMT and STIMMT-neg, can be modified: it occurs with the degree adverb BISSCHEN1 ‘a little’ in (18).

/du/ /falsch/
(18) NEIN WÜNSCHEN1 NÄCHSTE1 TAG1, STIMMT. IX2 BISSCHEN1 **FALSCH1** IX2
no wish next day right. you a-little wrong you
‘No, (s/he) wants (to do it) the next day, right. You’re a bit wrong.’

Thus, FALSCH1 does not exhibit the characteristics of a (response) particle. It is a verb used to express that the antecedent proposition (or, metonymically, the person who uttered it) is incorrect.

5.2. Discussion and analysis

Summarizing thus far, our findings show that DGS signers use the *YES/NO*-type ambiguous REs JA ‘yes’ and NEIN ‘no’, which are both very frequent, and head nod and headshake, which are less frequent. All four REs are particles encoding relative and absolute polarity features. Furthermore, signers use non-ambiguous REs with STIMMT encoding affirmation, and STIMMT-neg, FALSCH1, FALSCH2 encoding rejection. DOCH is not conventionalized in DGS. Finally, the unambiguous REs fall into different grammatical categories: particles and (modal) verbs.

The different REs are used with different frequencies in the four discourse types under investigation. For ease of exposition, Table 3 summarizes the distribution in abbreviated form in terms of frequency rankings, which we interpret as feature realization preferences. The preferences regarding *YES/NO*-type REs seem to be similar to those for *ja* and *nein* in the ambient language German (Section 2): in affirmations of negative antecedents, relative [AGREE] (expressed by JA) has a higher realization need than absolute [–] (expressed by NEIN); in rejections of negative antecedents, relative [REVERSE] (expressed by NEIN) has a higher realization need than absolute [+] (expressed by JA). Stand-alone head movements display the corresponding preference patterns (Figure 1, Section 5.1.1) but are very infrequent after negative antecedents.

Table 3. Ranking of RE frequencies per condition for the three most frequent REs per condition

Antecedent	Speech act	Features to be realized	Frequency ranking of utterance-initial RE
positive	affirmation	[AGREE, +]	JA > STIMMT > head nod
	rejection	[REVERSE, –]	NEIN > STIMMT-neg > headshake
negative	affirmation	[AGREE, –]	STIMMT > JA > NEIN
	rejection	[REVERSE, +]	NEIN > STIMMT-neg > JA

Prima facie these findings suggest a similar constraint weighting as for the ambient language German, with the modification that EXPRESSIVENESS is not effective in DGS, because DOCH is not conventionalized, thus: MAXIMIZE RELATIVE >> MAXIMIZE MARKED. However, this 'simple' ranking does not account for several other observations:

(i) Non-manual REs are much less frequent than manual REs.
(ii) JA is more frequent than unambiguous STIMMT in affirmations of positive antecedents, while STIMMT is more frequent than JA in affirmations of negative antecedents.[14]
(iii) For STIMMT-neg we do not observe a similar reversal.

Starting with observation (i), we might implement this directly by a constraint MAXIMIZE MANUAL, which has a higher weight than the other two constraints. However, an interesting question is what

[14] Recall from Section 5.1.1 that the difference between positive vs. negative antecedents is smaller for JA/STIMMT without an accompanying simultaneous head movement, but that JA is always more frequent than STIMMT after positive but not after negative antecedents Our analysis in terms of the constraints AVOID AMBIGUITY and DIRECT MAPPING (see below) accounts for this finding. For ease of exposition, we will restrict our discussion to the results for the pooled data.

the source of such a constraint might be. Note that in the domain of negation DGS has been argued to be a non-manual dominant language (Zeshan 2004; Pfau & Quer 2002, 2007). This seems to contradict our findings. However, the non-manual negation marker headshake (and the multifunctional head nod) typically spreads over and accompanies manual signs in its scope. Therefore, the observation that DGS is a non-manual dominant language cannot be applied to stand-alone non-manual REs. Non-manuals tend to be generally aligned with manual markers, which is also confirmed for non-manual REs in our study.

A second factor contributing to the preference of manuals over non-manuals might be the fact that head movements display a great variety of grammatical and pragmatic functions (Section 3). Headshakes and head nods are universal multifunctional gestures which can be used in quite different contexts. This multifunctionality might favor the use of more specific (grammaticalized) manual markers for efficient communication in response settings. Also note in this connection that head nods have a larger range of functions than headshakes, and that head nods are less frequent stand-alone REs than headshakes. Still, the connection between the preference for manuals and the degree of functional variety must be tested against the variety of functions that JA and NEIN have in DGS. In spoken languages, response particles have a considerable range of functions, for instance as backchanneling devices, topic change markers, self-confirmation etc. (e.g., Drummond & Hopper, 1993; Hoek & de Hoop, 2016, Lee-Goldman, 2011). This issue thus needs thorough investigation in future research.

A final aspect that might play a role is the experimental setting: participants might have felt that without producing a manual sign, they weren't responding. This is an issue that must be investigated in corpus research.

Turning to observation (ii), the different frequency rankings of JA and STIMMT after positive vs. negative antecedents, we need to ask two questions. First, why is JA more frequent than STIMMT after positive antecedents, and second, why is the preference pattern reversed after negative antecedents?

The answer to the second question seems straightforward: STIMMT is non-ambiguous whereas JA is ambiguous. Hence, our proposal to integrate a constraint AVOID AMBIGUITY (Section 2) receives empirical support from our data. To explore the role of ambiguity on a more general level – beyond JA and STIMMT – we investigated how often unambiguous REs occurred in utterance-initial position, see Figure 2. Unambiguous REs occurred more often in responses to negative antecedents.[15] This further supports the role of ambiguity for RE choice.

[15] To substantiate the descriptive finding, we fitted a generalized linear mixed model (per-participant slope for antecedent; lexicalization intercept). There was a main effect of antecedent ($b = -0.55$, $SE = 0.11$, $z = -5.14$ $p < 0.001$).

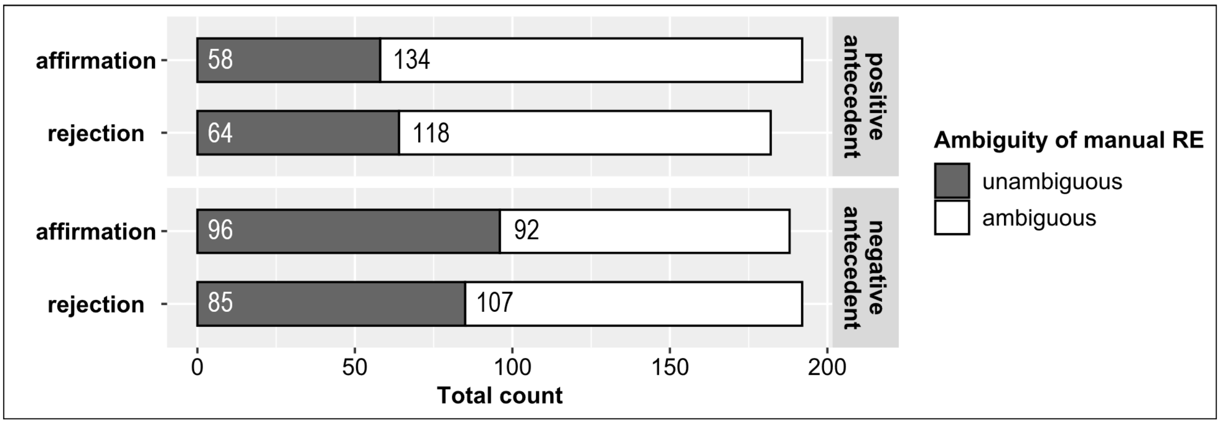
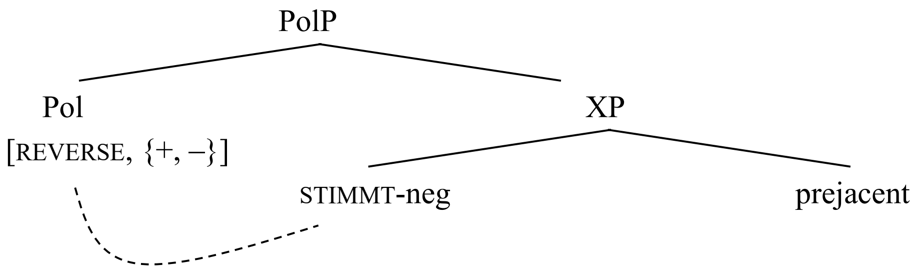


Figure 2: Ambiguity of the clause-initial RE per condition. Total counts.

Let us turn to the first question regarding observation (ii): Why is JA more frequent than STIMMT after positive antecedents? We will discuss this question together with a question arising from observation (iii): why is NEIN *generally* more frequent than STIMMT-neg (or STIMMT NICHT)? To answer these two questions, we will take the morpho-syntax of the REs into account. Recall that we argued in Section 5.1.2 that (a) STIMMT is currently grammaticalizing into a particle (and still is used as a verb in STIMMT NICHT), and that (b) STIMMT-neg and FALSCH1 are not particles: STIMMT-neg is a modal verb, and FALSCH1 is a verb. So, it seems that STIMMT-neg and FALSCH1 cannot lexicalize the features in Pol via direct vocabulary insertion in Pol. For STIMMT, we will assume that due to its transitional status, vocabulary insertion is available but that JA, which has a clear syntactic status, is inserted more regularly unless other factors – like ambiguity resolution – become relevant. Such an assumption requires that there be a preference for REs which by default lexicalize the polarity features *in* Pol, i.e., by lexicalizing the Pol head itself. We may conceive of such a preference as a kind of faithfulness constraint. Let us call it DIRECT MAPPING. As we will see below, this constraint also accounts for the lower frequency of STIMMT-neg in comparison to NEIN. We propose that DIRECT MAPPING has a lower weight than MAXIMIZE MANUAL but a higher weight than MAXIMIZE RELATIVE >> MAXIMIZE MARKED (see Table 4 further below), thus still accommodating the higher frequency of manuals in comparison to non-manuals.

Moving on to STIMMT-neg (and FALSCH1, which is much less frequent), for which we just argued that it cannot realize the features in Pol by direct vocabulary insertion, we find that the second avenue for feature realization proposed in the feature model – via the prejacent (whatever its technicalities, Section 2) – is not available either. The reason is that STIMMT-neg is not an echoic response, i.e., a truncated prejacent. Rather, like the rejoinders discussed by Holmberg (2015), it takes the prejacent as semantic argument. We therefore propose that responses may have two alternative syntactic structures. The Pol head in a response either takes the prejacent as its complement (as in the feature model), or it takes a phrase headed by a rejoinder as complement, which itself takes the prejacent as complement, see (19). The lexical semantics of the verbal RE (e.g., STIMMT-neg) must match the discourse type encoded by the polarity features in Pol. STIMMT-neg expresses [REVERSE], so a response with STIMMT-neg is appropriate in the discourse types [REVERSE, +] and [REVERSE, –]. The absolute polarity can be expressed overtly by the prejacent, which can also be elided. From an ambiguity resolution perspective, ellipsis is harmless since STIMMT-neg is unambiguous.

(19)



For STIMMT we assume that due to its transitional status as almost-particle it may occur in Pol or in the lower position. We suggest that the lack of this flexibility for STIMMT-neg is the reason why STIMMT-neg is dispreferred in comparison to NEIN even in ambiguous discourses, i.e., after negative antecedents: If DIRECT MAPPING (directly realizing features in the Pol head) has a higher weight than AVOID AMBIGUITY, and STIMMT is 'flexible' in its syntactic status whereas STIMMT-neg is not, these are the expected preference patterns.

Table 4 summarizes our proposal for the optimality-theoretic analysis of clause-initial REs in DGS. Constraints are ranked by decreasing weight from left to right.[16] Recall from Section 2 that violations of a constraint lead to degrees of dispreference rather than ungrammaticality. Furthermore, constraint violations accumulate. Since violations of higher ranked constraints correlate with greater dispreference than violations of lower constraints, the preference pattern in the first three discourse types in Table 4 is accounted for. The transitional syntactic status of STIMMT makes the violation of DIRECT MAPPING uncertain, which we have marked by a question mark. We can conceive of this uncertainty as a prediction for considerable inter-individual and intra-individual variation in the choice of STIMMT vs. the other REs in affirmations, which is indeed what we observe. Turning to [REVERSE, +] discourses, Table 4 shows that JA accumulates violations of the three lowest-ranked constraints. This explains the observation that JA is dispreferred in comparison to NEIN, and also to STIMMT-neg, which violates one higher-ranked constraint.

[16] A proper linear OT model would require a larger database including acceptability judgments and is beyond the scope of the present paper. Therefore, we only offer a non-numerical description and also refrain from using 'dummy' numerical values for the weights of the five constraints.

Table 4. Analysis of the three most frequent REs per condition (see Table 3) in an optimality-theoretic framework. Candidates are ordered top-down by frequency of occurrence (and thus preference) per discourse type.

	Discourse	Candidate	Features realized by candidate in discourse	MAXIMIZE MANUAL	DIRECT MAPPING	AVOID AMBIGUITY	MAXIMIZE RELATIVE	MAXIMIZE MARKED
positive antecedent	[AGREE, +]	JA	[AGREE] [+]					
		STIMMT	[AGREE]		(?)			
		head nod	[AGREE] [+]	*				
	[REVERSE, −]	NEIN	[REVERSE] [−]					
		STIMMT-neg	[REVERSE]		*			
		headshake	[REVERSE] [−]	*				
negative antecedent	[AGREE, −]	STIMMT	[AGREE]		(?)			*
		JA	[AGREE]			*		*
		NEIN	[−]			*	*	
	[REVERSE, +]	NEIN	[REVERSE]			*		
		STIMMT-neg	[REVERSE]		*			
		JA	[+]			*	*	*

Our proposal for the syntax and semantics of REs in DGS can account for the distribution of utterance-initial first REs including non-particle REs and non-manuals. As we will see in Section 7, the constraint setup also captures the distribution of sequential RE combinations, where *YES/NO*-type particle REs typically precede rejoinders. However, we will not integrate combinations into our model because a larger database is required for that.

6. Simultaneous combinations of REs

As discussed in Section 1, the availability of multiple articulators in sign languages allows signers to produce more than one RE at a time. Of the 674 manual REs in utterance-initial position, 92 percent were combined with at least one simultaneous non-manual marker. Such combinations occurred more often in rejections than in affirmations (98% vs. 86%).[17] This finding matches to some extent the results of studies of co-speech gesture reviewed in Section 3, which found an increase of non-manuals in rejections of negative antecedents (without investigating all discourse types). In the following, we discuss simultaneous combinations of utterance-initial manuals with head movements, mouthings, and brow movements. Head movements are particularly interesting because they are also stand-alone REs.

[17] This difference is significant (b = 1. 24, SE = 0.55, z = 2.23, $p < 0.05$; model with by-participant slope for speech act, lexicalization intercept).

6.1. Accompanying head movements

Head movements accompanied 68 percent (459/674) of the manual first REs: 31 percent head nods (210/674), and 37 percent headshakes (249/674). Rejections more often contained head movements than affirmations, and responses to positive antecedents more often contained head movements than responses to negative antecedents,[18] see Figure 3 for the total counts per condition. Figure 3 shows that head movements display the same distribution in simultaneous combinations as when they are used as stand-alone REs: after positive antecedents, head nods occur in affirmations but not in rejections whereas headshakes occur in rejections but not in affirmations; after negative antecedents both head movements occur in affirmations and in rejections with head nods being more frequent than headshakes in affirmations, and headshakes being more frequent than head nods in rejections.

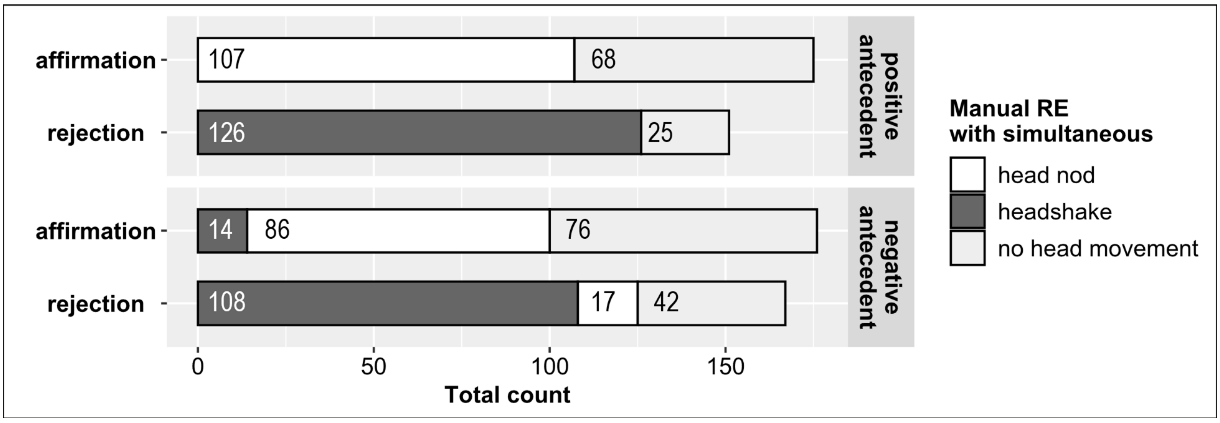


Figure 3. First manual REs with accompanying head movements by condition.

This distribution matches the observed preference of stand-alone head movements for realizing relative features. However, it differs from head movements in spoken languages. In the few spoken languages for which we have head movement data, nods are the most common head movement when rejecting a negative antecedent. Thus, they express the positive polarity of the response, even in a language with a preference for realizing relative features, viz. Mandarin (Li et al., 2016; González-Fuente et al., 2015). To examine this difference with spoken languages, as well as potential disambiguation by simultaneous combinations in DGS, we investigated the occurrence of head movements in relation to the manual they occur with: unambiguous manuals ([AGREE]: STIMMT; [REVERSE]: STIMMT-neg, STIMMT NICHT, FALSCH1, FALSCH2, DOCH) vs. ambiguous JA and NEIN, see Figure 4. Concentrating on negative antecedents, we find that apart from two exceptions (marked with a blue frame) head movements always co-occurred with a manual realizing the same feature. In affirmations, nods co-occurred with STIMMT and with JA, all realizing [AGREE]; headshakes co-occur with NEIN, realizing [–]. In rejections, nods co-occurred with JA, realizing

[18] Main effect of speech act (*b* = 0.67; *SE* = 0.22, *z* = 3.00, $p < 0.01$), of antecedent (*b* = -0.25, *SE*= 0.11, *z* = -2.27, $p < 0.05$); by-participant slope for antecedent and speech act, lexicalization intercept.

[+], and headshakes co-occur with one of the unambiguous reversing REs or with NEIN, all realizing [REVERSE]. There was one co-occurrence of a nod with DOCH, which realizes [REVERSE, +] (marked by an arrow in Figure 4).

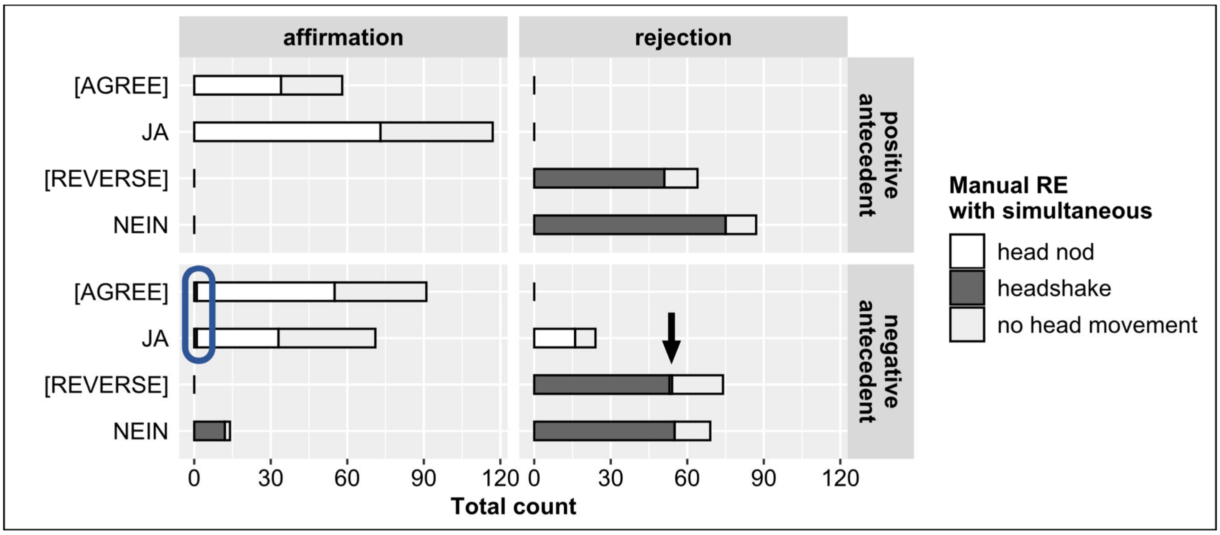


Figure 4. Simultaneous first RE combinations of manual type and head movement by condition. The blue frame singles out non-isofunctional combinations. The arrow points at a combination of DOCH *with a nod.*

The combination of the head nod with JA and DOCH in rejections is potentially relevant for the comparison of the function of the nod in rejections in spoken languages. DOCH is considered Signed German (*lautsprachbegleitende Gebärden*, LBG) by two native signers we consulted, which is why we will not consider DOCH plus nod here: it is an instance of code-switching. As for JA, the nod simply aligns in function with the manual, as already mentioned. Importantly, this combination is much less frequent than the combination of NEIN plus headshake in rejections. Thus, these combinations simply follow the general preference pattern of the individual REs in DGS.

Turning to the two instances where manual and head movement do not realize the same feature (blue frame), these both involve a manual realizing [AGREE] (JA/STIMMT), and the headshake realizing [–]. (20) illustrates for STIMMT.

(20) Antecedent: MALEN2 KÜCHE3 MALEN2+ NOCH-NICHT2
painter kitchen paint not.yet
'The painter hasn't painted the kitchen yet.'
hs
Response: **STIMMT**. WÜNSCHEN1 BALD1 NÄCHSTE1 TAG1 WÜNSCHEN1 WEITER1
right wish soon next day wish continue
MALEN2...
once

‘That’s right. He wants to continue painting over the course of the next few days...’

It is surprising that such combinations are so rare. Our findings clearly indicate that simultaneous REs involving head movements have a high pressure to align in function. They are not used to disambiguate potentially ambiguous responses, contrary to expectations.

Finally, note that head movements are not an obligatory component of any of the manual REs, contrary to what is sometimes suggested in the literature (cf. Papaspyrou et al. (2008) on JA and the head nod). As Figure 4 indicates, JA occurs with a nod regularly but not predominantly (57%). For the combination of NEIN and headshake, which occurs both in affirmations and in rejections, we observe a higher proportion (84%), but headshakes overall were more frequent anyway.

6.2. Accompanying mouthings

About half of the utterance-initial manual REs (341/674) occurred with simultaneous mouthing. There were marginally more mouthings in responses to negative antecedents than in responses to positive antecedents,[19] see Figure 5 for the total counts. Thus, mouthings do not align with head movements (Section 6.1) or co-speech gesture (Section 3), which are more frequent after antecedents and/or in rejections.

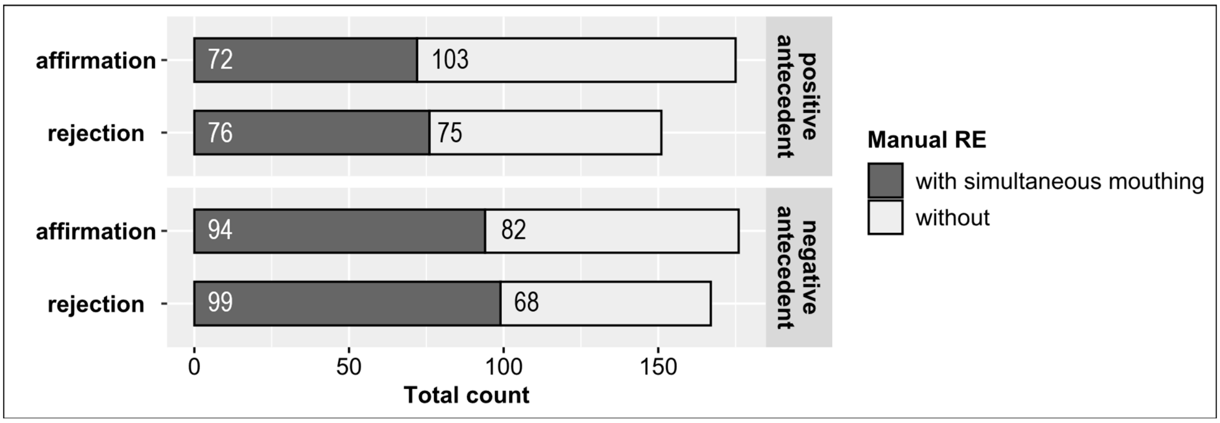


Figure 5. Utterance-initial manual REs with accompanying mouthing by condition.

We grouped mouthings according to their meaning into unambiguous mouthings realizing relative features, and ambiguous JA and NEIN (excluding mouthings not fitting these categories, e.g., /aah/, and ellipsis remnants, e.g. *schon* ‘already’). Figure 6 shows that manual RE and mouthing mostly match: as with the head movements, we observe a strong pressure to align in function, which here is also a lexical alignment between the manual sign and the German word represented by the mouthing. However, there also seem to be deviations from this pattern in

[19] Main effect of antecedent (b = 0.32, SE = 0.18, z = 1.73. p = 0.08; by-participant slopes for antecedent and speech act; without random factor lexicalization).

rejections: they are marked by arrows in Figure 6. The black arrows highlight combinations of an unambiguous [REVERSE]-manual (=STIMMT-neg) and an unambiguous [AGREE]-mouthing (/stimm/). This seems to be an obvious mismatch. However, mouthings frequently are truncated variants of the spoken language signal from which they are borrowed (Schermer, 2001). Therefore, we assume that /stimm/ most likely is truncated from /STIMMT NICHT/ 'not right'.

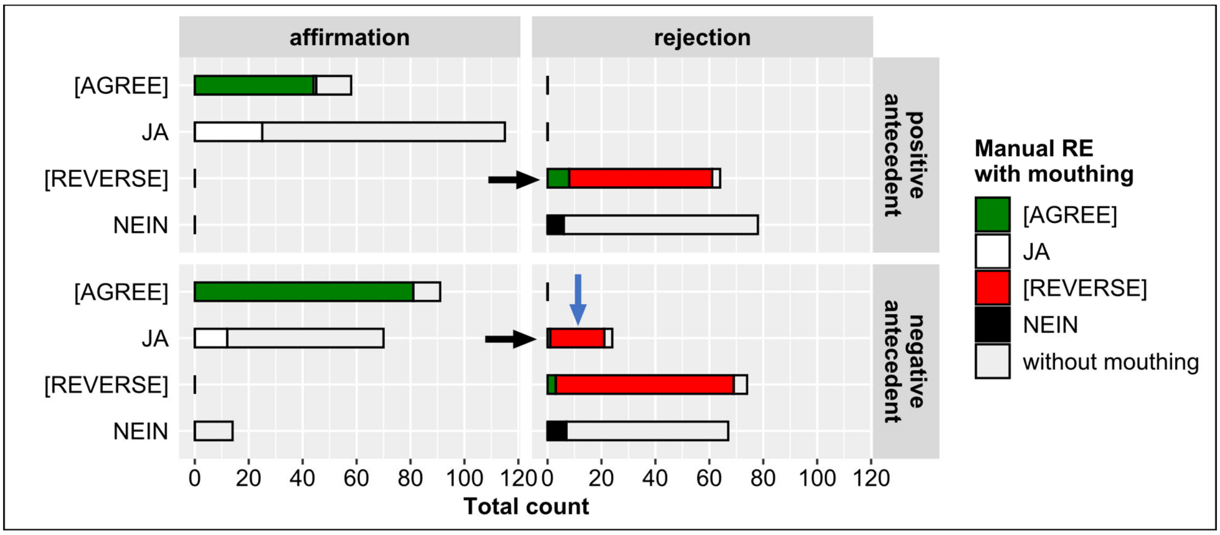


Figure 6. Utterance-initial manual RE types with different mouthing types by condition. Arrows mark combinations with potential mismatches between manual and mouthing.

The blue arrow points to the combination of the manual JA with a [REVERSE]-mouthing, which is /doch/. There are 20 JA$^{/doch/}$ instances (14 with head nod, compare previous section), which all occurred in rejections of negative assertions. JA$^{/doch/}$ is a candidate for a grammaticalizing RE combination. JA contributes absolute polarity [+] and /doch/ signals both positive polarity and rejection. The grammaticalization hypothesis is supported by the observation that /doch/ does not co-occur with any other manuals. Still, JA$^{/doch/}$ is only employed by four participants, two of whom use it only once, suggesting ongoing, rather than completed grammaticalization or conventionalization. Two analyses are possible: JA$^{/doch/}$ may either result from signers combining JA with the mouthing that corresponds to the German particle *doch*, which results in an RE lexically specified for the feature combination [REVERSE, +], or it may result from signers integrating the mouth movements of the spoken word as an additional phonological feature to distinguish different meanings of manual signs (Boyes Braem & Sutton-Spence, 2001). While this latter strategy is simply a special case of cross-linguistic borrowing, the former is a modality-specific strategy not available to spoken languages.

6.3. Accompanying brow movements

Brow movements accompanied 30 percent (199/674) of the utterance-initial manual REs with 13 percent brow raises (88/674) and 16 percent brow furrowing (111/674). Descriptively, brow raising was more frequent in rejections of negative antecedents than in other discourses; brow furrowing was most frequent in rejections in general,[20] see Figure 7 for the total counts across conditions. Neither brow movement is restricted to particular manual RE types. Their overall low frequency suggests that they are not regular markers of polarity despite the fact that they have been associated with polar interrogatives (Section 3).

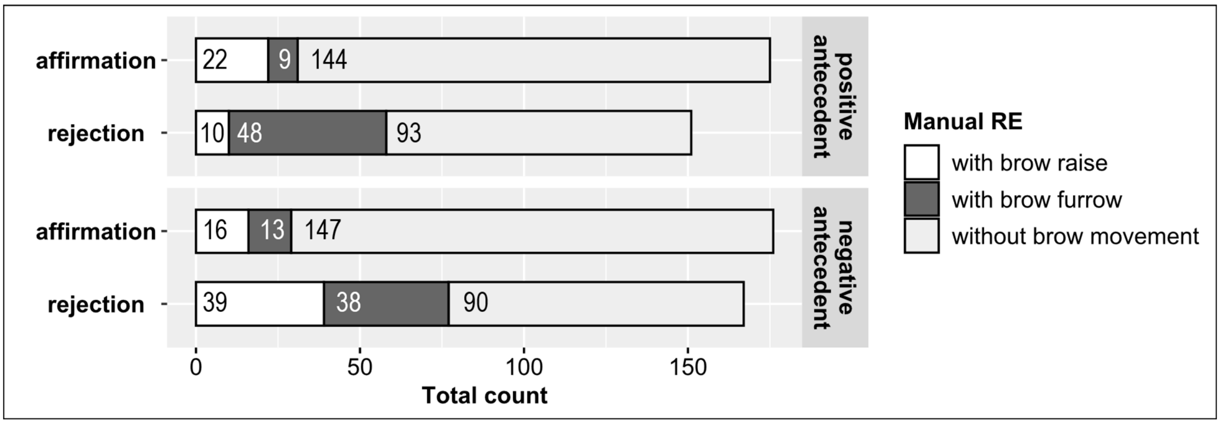


Figure 7. Utterance-initial manual RE with accompanying brow movements by condition.

The higher frequency of brow raising in rejections of negative antecedents is similar to that observed for spoken languages, although brow raises in DGS are much less frequent than in Catalan or Russian (Catalan rejections of negative antecedents: 92%; Russian: 80%; González-Fuente et al., 2015). Since brow raising in sign languages has been associated with salience, brow raising on an RE may serve to direct the interlocutor's attention to the marked [REVERSE, +] discourse. Future studies must investigate whether the co-speech gesture is also a marker of salience or if it is associated with positive polarity directly: in Catalan it also occurs in affirmations of positive antecedents, although less frequently.

The more frequent occurrence of brow furrowing in rejections may be a reflex of signers signaling their affective or epistemic state. Across cultures, furrowed eyebrows accompany negative affective states such as anger or sadness (Ekman & Friesen, 1978; for how such affective markers interact with grammatical brow markers in ASL, see Weast, 2011). In DGS, brow furrowing also occurs as an epistemic marker of certainty (Bross, 2020: 204), over *wh*-questions (Herrmann & Steinbach, 2013), and also over some imperatives (e.g., orders, Happ & Vorköper, 2014: 342; Brentari et al., 2018). These functions do not suggest themselves as a source of comparison.

6.4. Discussion: Integrating non-manual gestures and limitations to simultaneity

In this section, we have shown that accompanying non-manuals in DGS polar responses differ in their distribution across the different discourse types, and they differ in their semantic and

[20] Due to the low numbers we did not fit a model.

pragmatic functions. Accompanying head movements, like stand-alone head movements, may realize relative and absolute polarity features, exhibiting the same preference for realizing relative features as the corresponding manual elements and usually showing isofunctionality with the manual they accompany. Accompanying mouthings also show isofunctionality with the manual RE. Moreover, they typically show lexical alignment, although some signers combine the manual JA, the mouthing /doch/, and mostly a head nod to express the meaning of German *doch*, which we interpreted as the beginning of a grammaticalization process. Regarding brow movements, which were quite infrequent, furrowing is preferentially used in rejections and probably signals the signer's affective state rather than rejection itself. Brow raising is associated with the positive polarity of a response, especially in rejections, which aligns DGS with Catalan and Russian, albeit with a smaller frequency. We suggested that brow raising may be a highlighting device in DGS, drawing attention to the marked discourse type [REVERSE, +], rather than a marker of positive polarity.

In sum, simultaneous combinations of manual and non-manual markers are not systematically used for disambiguation. Only very few responses exploited this opportunity, the combination JA/$^{\text{doch/}}$ + head nod being the only one that is used by more than one speaker. To explain this unexpected finding, we will discuss both linguistic and extralinguistic factors. For combinations with head movements, we suggest that the high degree of conventionalization for headshakes and nods as bona fide REs in DGS is responsible for the lack of disambiguating simultaneous productions. They are subject to the optimality-theoretic constraints proposed in Section 5.2 and thus show the same preference for realizing relative features as the manual REs do. However, recall that we also proposed in Section 5.2 that the constraint AVOID AMBIGUITY has greater weight than the constraint MAXIMIZE RELATIVE, so disambiguation should be given preference over the realization of relative features. Now, we did not discuss RE combinations in Section 5.2., and there is an important aspect that only applies to simultaneous combinations: As mentioned in Section 4.1, if a combination of ambiguous REs is to be unambiguous, the different articulators must have different realization preferences for the different types of features in the combination. For instance, the non-manuals might preferably realize the absolute feature whereas the manuals preferably realize the relative feature. Alternatively, one could imagine a scenario where when occurring in simultaneous combinations, manual REs always and only realize one type of feature and non-manual REs the other, which leads to disambiguation. However, none of this is supported by our data for DGS.

An alternative linguistic explanation of the (virtual) lack of disambiguation by simultaneous RE combinations is the following. Recall from Section 6.1 that NEIN frequently combines with the headshake, which might be an argument that this combination forms a complex lexicalized RE. Let us assume that manual NEIN is ‘primary’, the headshake being an ‘additional’ part of this RE. If this is so, headshakes on NEIN cannot easily be replaced by nods, thus excluding potential disambiguation. Now, for JA we observed a much weaker association with head nods, so in principle headshakes should occur more freely on JA. However, this is not the case, so that the explanation in terms of the grammaticalization of NEIN + headshake is inferior to the above account. Still, we do note that the one instance of JA/NEIN plus head movement expressing complementary polarity functions is JA + headshake.

Our findings parallel observations on bimodal bilinguals, whose simultaneous productions of a a spoken and sign language often result in semantically equivalent code-blends (e.g., signing SURE in ASL while saying *sure* in English) rather than truly composite utterances where each articulatory channel contributes complementary information (Emmorey et al., 2016; but see, e.g., Donati & Branchini, 2013 for composite utterances in Italian and Italian SL). Lillo-Martin et al.'s (2012) Language Synthesis Model accounts for this streamlining of production channels by assuming that the language production system of bimodal bilinguals generates a unified structure that allows dual lexical retrieval and therefore simultaneous spell-out of the same information via two channels (see also Emmorey et al., 2016). This model may account for our finding that mouthings display a clear pressure to be lexically isomorphic (*pace* truncations), which excludes disambiguation. For the head movements, we could assume that a single system constrains which features are preferentially realized, and if morphological exponents for the Pol head are available that use different articulators both exponents may be produced simultaneously with the same feature expression preferences. The resulting predictions for the distribution of head movements align with those of our above proposal.[21]

Extralinguistic factors might be relevant in several ways for simultaneous productions. Since movements of the head and limbs are connected via postural reflexes (Magnus & de Kleijn, 1912), directional and rhythmic constraints on motor coordination may affect simultaneous productions. Meesen et al. (2005) find that stability and accuracy of arm-leg coordination decrease when anti-directional head rotations are added (e.g., wrists and ankles twisting right and head rotating left) but not with isodirectional head rotations. Furthermore, head rotations co-occurring with the bi-manual operation of a steering wheel are more accurate when both rotate in the same direction (Heuer & Klein, 1999). Regarding rhythm, simultaneously produced motor sequences are subject to a single timing mechanism, which is limited in how many different timing specifications it can maintain: when the hands move in parallel, the movements of the slow hand are subordinated to those of the fast hand (Summers et al., 1993). Now, in JA + headshake combinations, head and dominant hand rotate along the transverse axis either iso- or antidirectionally, with wrist rotations (for JA) repeating at a faster rate than head rotations. As long as wrist rotations repeat at a multiple of head rotations, no motor constraints seem to be violated. Thus, the (virtual) lack of JA + headshake combinations is not explained. In NEIN + head nod combinations, the wrist or elbow moves along the transverse (for NEIN) while the head moves along the vertical axis, potentially violating directional constraints on hand-head coordination.

[21] This argumentation also fits the observation made in Kita and Özyürek (2003) that the performance of iconic co-speech gestures depends on the linguistic system of the underlying spoken language.

Note finally that cognitive processing constraints may be another factor explaining the restrictions on simultaneous productions: the parallel processing of different response functions by different articulators might be cognitively demanding and conversationally impractical. However, at least two aspects speak against this hypothesis. First, sign languages frequently employ multiple articulators simultaneously to encode different types of information. For instance, a manually produced clause may be accompanied by raised eyebrows for conditional marking and headshake for negation and is effortlessly interpreted as a negated antecedent of a conditional. Second, Russian speakers seem to be able to process a spoken particle *net* 'no' with a concurrent head nod (Esipova 2021).

7. Sequential combinations

This section investigates RE combinations where the utterance-initial RE is followed by another RE, which is another potential source of disambiguation. In Section 5 we mentioned that participants produced up to four REs at the beginning of their responses. We restrict our discussion here to the first two REs in an utterance. 21 percent (158/759) of the utterances with an utterance-initial RE contained at least a second RE immediately after the first RE.[22] In this set, 59 percent of the first REs but only 18 percent of the second REs were ambiguous. Figure 7 shows the distribution of responses with vs. without a second (un)ambiguous RE in relation to the ambiguity of the first RE. We see that a second RE occurred more often after a potentially ambiguous first RE (30%) than after unambiguous first REs (6%). However, this was independent of the actual ambiguity of the discourse: the great majority of second REs occurred in affirmations both after positive and after negative antecedents.

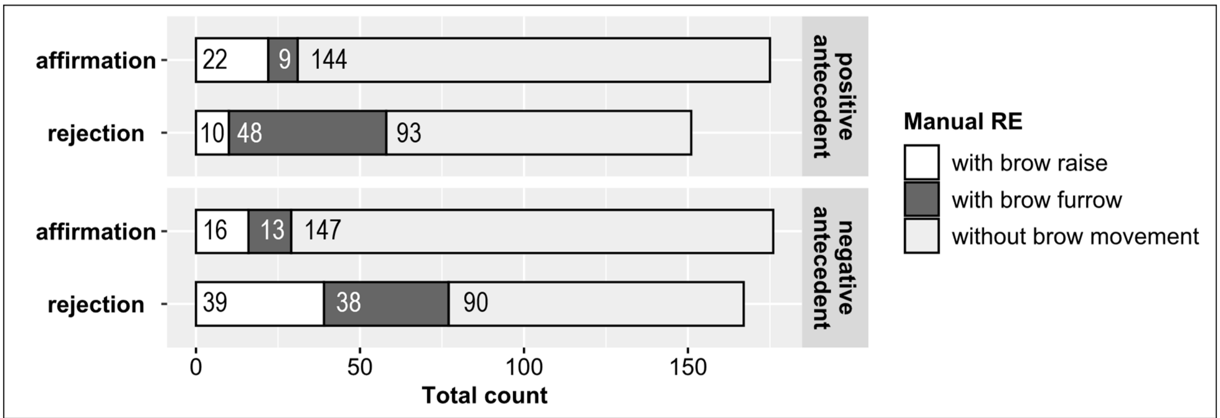


Figure 7. Type of first and second REs across the experimental conditions.

[22] Six combinations combined the same sign. They were treated as separate tokens rather than repetitions because of clear pauses, lowering of the hands between two productions, or different phonological realizations.

The observed distribution is driven by the highly frequent combination JA STIMMT (51%; 81/158), which occurs in affirmations of positive and negative antecedents. Figure 8 shows the distribution of frequent RE combinations with an ambiguous first RE (*n* = 122). The second-most frequent combination is NEIN STIMMT-neg (*n* = 19), which occurs in rejections of positive and negative antecedents. We suggest that both of these manual combinations are collocations. They are used independently of the concrete pay-off of disambiguation. Still, in ambiguous discourses they do disambiguate. Furthermore, they allow the signer to use a particle that is the preferred RE in a response first (JA, NEIN; see Section 5.2). Note that in both collocations, the ambiguous first RE realizes the same feature as the unambiguous second RE.

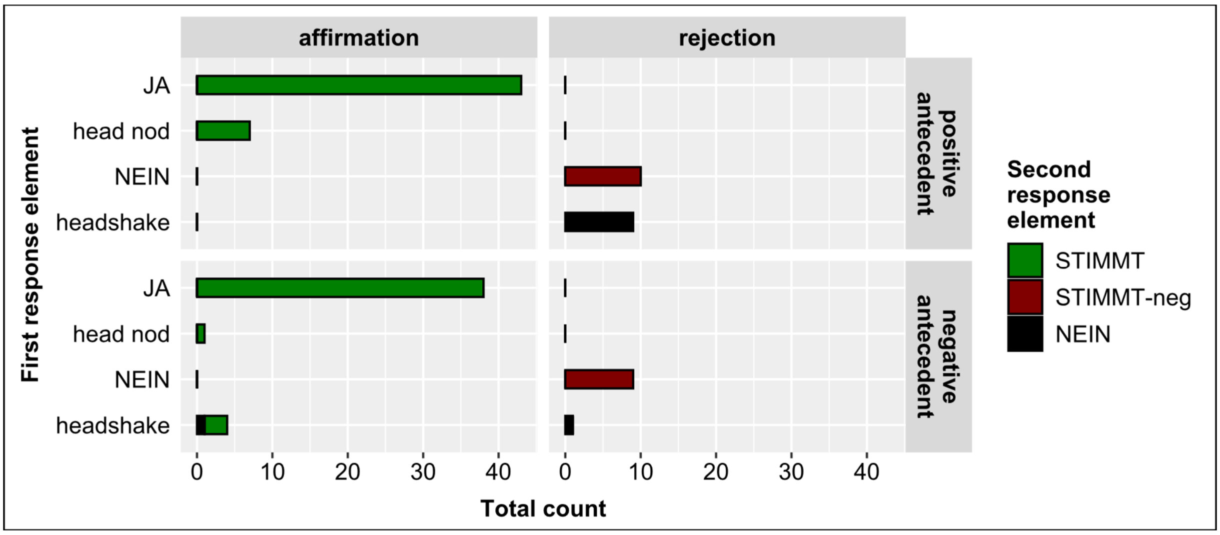


Figure 8. Distribution of sequential RE combinations with an ambiguous first RE across conditions.

Of all initial RE combinations, only 5 were non-isofunctional: headshake + STIMMT (*n* = 3), illustrated in (21), STIMMT NEIN and /doch/ JA (both *n* = 1). Note that the unambiguous REs in these latter two combinations occur in first position, unlike in the collocations.

(21) *Antecedent:* REBEKKA FOTO1^CL:rechteck CL:rechteck.darunter SCHREIBEN1
Rebekka photo under-photo write
NOCH-NICHT2
not.yet
'Rebekka hasn't labeled the photos yet.'

hs (headshake)
Response: **STIMMT**, NOCH-NICHT2 BALD1 MORGEN3 SCHREIBEN1
right not.yet soon tomorrow write
'That's right, (she) hasn't, (she'll) label them soon, tomorrow.'

The combinations of a head movement and a second RE either involve STIMMT (3 headshakes (e.g., (21)), 8 nods) or NEIN (11 headshakes: 10 affirmations, 1 rejection: NEIN realizes the same features as the headshake). In these combinations, the head movement always precedes the second RE, which confirms Esipova's (2021) findings for Russian (Section 3). Regarding the overall order of the REs, we do not observe the trend suggested by Esipova (2021) for Russian that disagreement, i.e. [REVERSE], must be signaled first.[23]

8. Summary and conclusion

We have presented the first large-scale controlled open production study on the response system of a (sign) language. The data provide novel insights into response particles, other REs, and RE combinations in responses to positive and negative assertions. By considering manual and non-manual response components, this study also contributes to improving our understanding of multimodal response strategies across spoken and sign languages. In this final section, we summarize our main findings in terms of the research questions posed in Section 4.

Regarding the question which REs are attested in DGS, we found that signers use various manual REs, the most frequent ones being JA and NEIN, which are ambiguous as responses to negative antecedents because they may realize both absolute and relative polarity features, i.e., indicate polarity and truth. Signers also frequently used the (emerging) particle STIMMT and the verbal signs STIMMT-neg/ STIMMT NICHT, which only realize relative polarity features. Furthermore, two non-manual REs were used regularly, but less frequently, as stand-alone REs: head nod and headshake. Their syntax and semantics parallel those of JA and NEIN, respectively. Bare mouthings were rare.

Regarding the theoretical repercussions of our findings, we have proposed an extension of the optimality-theoretic framework suggested by Farkas & Roelofsen (2019) which takes into account the modality of the response (constraint MAXIMIZE MANUAL), the syntactic status of the RE (constraint DIRECT MAPPING), and which also integrates ambiguity resolution as a factor for RE choice into the system (constraint AVOID AMBIGUITY). All of these factors contribute to preferences in the use of the first RE in an utterance in DGS. Furthermore, we have put forth a syntactic proposal for non-particle responses, specifically for responses where the RE is a predicate taking the response clause as argument. Our proposal makes relevant predictions for other languages, signed and spoken alike. The constraint MAXIMIZE MANUAL is of course sign-language-specific, but it is conceivable that there may be a modality/articulator-related spoken-language counterpart, for instance when it comes to the choice between verbal means and head movements, which are important indicators of polarity in spoken languages too. Furthermore, we already know from research on spoken languages that non-particle responses may replace particles in certain discourse settings (viz. Holmberg's 2015 rejoinders). Observe that the ambient language of DGS, German,

[23] The following REs never occurred as second RE: headshake, head nod, STIMMT NICHT, FALSCH2, DOCH, /doch/, /stimmt/. The RE GENAU ('exactly') only occurred as second RE (n = 6).

uses counterparts of STIMMT and STIMMT-neg. Thus, models accounting for the choice of REs must integrate such REs as well.

Turning to the question how DGS exploits the potential of visual-gestural languages to realize absolute and relative polarity features with different articulators simultaneously, we found that more than half of all manual REs were accompanied by a head movement, a mouthing or both. However, the overwhelming majority of non-manuals fulfilled the same function as the manual signs. The one fairly frequent exception, the combination JA$^{/doch/}$, has not (yet) fully grammaticalized into a RE in DGS. Thus, DGS does not systematically signal truth and polarity simultaneously on different articulators, and we argued that this gap cannot easily be explained by extra-linguistic factors such as processing load or motor coordination constraints. Instead, discourse-pragmatic constraints and the grammaticalization of head movements in DGS may account for the observed lack of expressing different functions simultaneously. These suggestions must of course be tested against future findings for other sign languages as well as co-speech gesture in spoken languages. Recall that earlier observations on head movements as co-speech gesture suggest that they do not seem to be subject to the investigated language's overall preferences regarding the truth- and polarity indicating functions.

Finally, regarding sequential combinations of REs in DGS, we found that in the most frequent RE combinations, the second RE realizes a relative polarity feature, i.e., signals affirmation or rejection. However, since these combinations were used in ambiguous and unambiguous discourses alike, their choice is not motivated by ambiguity avoidance in the particular discourse. Rather, we suggested that these combinations are collocations, which combine the advantage of using the most preferred RE (mainly JA) in clause-initial position with disambiguation. It is likely that this phenomenon also exists in other spoken and sign languages, for instance German speakers use *ja stimmt*. We have not included collocations or other sequential combinations in our theoretical discussion. It seems clear, though, that they should compete with other response forms.

Overall, our study provides important insights into response strategies across modalities and makes novel contributions to the theoretical analysis of the morpho-syntax and meaning of response elements beyond particles, as well as to the cross-linguistic empirical description of response element (combination)s.

References

Aronoff, M., I. Meir and W. Sandler (2005). The paradox of sign language morphology. *Language* 81(2), 301-344.

Bates, D., M. Mächler, B.M. Bolker and S.C. Walker (2015). Fitting linear mixed-effects models using lme4. *Journal of Statistical Software* 67(1), 1-48.

Battison, R. (1978). *Lexical Borrowing in American Sign Language*. Silver Spring, MD: Linstok.

Becker, C. (2016). Die Bausteine der Gebärdensprache. In U. Domahs and B. Primus (eds.), *Handbuch Laut, Gebärde, Buchstabe*. Berlin: De Gruyter, 203-221.

Boyes Braem, P. and R. Sutton-Spence (eds.) (2001). *The Hands are the Head of the Mouth: The Mouth as Articulator in Sign Languages*. Hamburg. Hamburg: Signum.

Brasoveanu, A., D. Farkas and F. Roelofsen (2013). N-words and sentential negation: evidence from polarity particles and VP-ellipsis. *Semantics and Pragmatics* 6, 1-33.

Brentari, D. (1998). *A Prosodic Model of Sign Language Phonology*. Cambridge, MA: MIT Press.

Brentari, D., J. Falk, A. Giannakidou, A. Herrmann, E. Volk and M. Steinbach (2018). Production and comprehension of prosodic markers in sign language imperatives. *Frontiers in Psychology* 9, 770, 1-14.

Bross, F. (2020). *The Clausal Syntax of German Sign Language: A Cartographic Approach*. Berlin: Language Science Press.

Bross, F. (2021). Why do we shake our heads? On the origin of the headshake. Gesture 19(2-3), 269-298.

Burridge, K. and M. Florey (2002). 'Yeah-no he's a good kid': A discourse analysis of *Yeah-no* in Australian English. *Australian Journal of Linguistics*, 22(2), 149-171.

Claus, B.A. M. Meijer, S. Repp and M. Krifka (2017). Puzzling response particles: an experimental study on the German answering system. *Semantics and Pragmatics* 10(19), 1-52.

Crasborn, O. (1995). *Articulatory Symmetry in Two-handed Signs*. Unpublished MA Thesis, Radboud University Nijmegen.

Dörre, L., A. Czypionka, A. Trotzke and J. Bayer (2018). The processing of German modal particles and their counterparts. *Linguistische Berichte* 255, 313-346.

Drummond, K. and R. Hopper (1993). Some uses of *yeah*. *Research on Language and Social Interaction*, 26(2), 203-212.

Ebbinghaus, H. and J. Hessmann (1996). Signs and words. Accounting for spoken language elements in German Sign Language. *International Review of Sign Linguistics* 1, 23-56.

Ekman, P. and W.V. Friesen (1978). *Facial Action Coding System: A Technique for the Measurement of Facial Movement*. Palo Alto: Consulting Psychologists Press.

Esipova, M. (2021). Polar Responses in Russian across Modalities and across Interfaces. *Journal of Slavic Linguistics*, 29, FASL extra issue. http://ojs.ung.si/index.php/JSL/article/view/151.

Farkas, D. and F. Roelofsen (2019). Polarity particles revisited. *Semantics and Pragmatics* 12(15), 1-16.

Fusaro, M. P.L. Harris and B.A. Pan (2012). Head nodding and head shaking gestures in children's early communication. First Language 32(4), 439-458.

Geist, L. and S. (In Press). Responding to negative biased questions in Russian. In P. Biskup, M. Börner, O. Mueller-Reichau, I. Shcherbina (eds.), *Advances in Formal Slavic Linguistics 2021*. Language Science Press.

Goldin-Meadow, S. and D. Brentari (2017). Gesture, sign, and language: The coming of age of sign language and gesture studies. *Behavioral and Brain Sciences* 40, 1-60.
González-Fuente, S., S. Tubau, M. Espinal and P. Prieto (2015). Is there a universal answering strategy for rejecting negative propositions? Typological evidence on the use of prosody and gesture. *Frontiers in Psychology* 6(899), 1-16.
Gonzalez, A., K. Henninger and K. Davidson (2019). Answering negative questions in American Sign Language. *Proceedings of NELS* 49, 1-14.
Goodhue, D. and M. Wagner (2015). It’s not just what you say, it's how you say it: intonation, *yes* and *no*. *Proceedings NELS* 45, 227-240.
Goodhue, D. and M. Wagner (2018). Intonation, *yes* and *no*. *Glossa: A Journal of General Linguistics*, 3(1), 5, 1-45.
Guntly, E.A. (2021). *‘Yeah, I Doubt it.’ ‘No, it’s True.’ How Paradoxical Responses Impact the Common Ground*. Doctoral dissertation, University of British Columbia.
Halle, M. and A. Marantz (1993). Distributed morphology and the pieces of inflection. In K. Hale and S.J. Keyser (eds.), *The View from Building 20: Essays in Linguistics in Honor of Sylvain Bromberger*. Cambridge, MA: MIT Press, 111-176.
Hamblin, C.L. (1973). Questions in Montague English. *Foundations of Language* 10, 41-53.
Happ, D. and M.-O. Vorköper (2014). *Deutsche Gebärdensprache: Ein Lehr- und Arbeitsbuch*. Frankfurt a. M.: Fachhochschulverlag.
Helbig, G. (1990). *Lexikon deutscher Partikeln*. 2nd edition. Leipzig: Enzyklopädie.
Herrmann, A. and M. Steinbach (2013). Satztypen in Gebärdensprache. In J. Meibauer, M. Steinbach and H. Altmann (eds.), *Satztypen des Deutschen*. Berlin: De Gruyter, 786-814.
Hoek, J. and H. de Hoop (2016). On the optimal interpretation of ‘yes’ and ‘no’ in Dutch. In G. Legendre, M.T. Putnam and H.E. de Swart (eds.), *Optimality-Theoretic Syntax, Semantics, and Pragmatics. From Uni- to Bidirectional Optimalization*. Oxford: Oxford University Press, 220-247.
Michael T. Putnam, Henriëtte de Swart, and Erin Zaroukian (eds). *OUP 220-247*
Hohenberger, A. and D. Happ (2001). The linguistic primacy of signs and mouth gestures over mouthing: Evidence from language production in German Sign Language (DGS). In P. Boyes Braem and R. Sutton-Spence (eds.), *The Hands are the Head of the Mouth: The Mouth as Articulator in Sign Language*. Hamburg: Signum, 153-189.
Holmberg, A. (2013). The syntax of answers to polar questions in English and Swedish. *Lingua* 128, 31-50.
Holmberg, A. (2015). *The Syntax of yes and no*. Oxford: Oxford University Press.
Horn, L. (1984). Toward a new taxonomy for pragmatic inference: Q-based and R-based implicature. In D. Schiffrin (ed.), *Meaning, Form, and Use in Context: Linguistic Applications*. Washington, DC: Georgetown University Press, 11-42.
Jakobson, R. (1972). Motor signs for ‘yes’ and ‘no’. *Language in Society*, 1, 91–96.
Jones, B.M. (1999). *The Welsh Answering System*. Berlin: De Gruyter.

Keller, F. (2000). *Gradience in Grammar: Experimental and Computational Aspects of Degrees of Grammaticality*. PhD dissertation, University of Edinburgh.

Kendon, A. (2002). Some uses of the head shake. Gesture, 2 (2), 147–182.

Kita, S. and A. Özyürek (2003). What does cross-linguistic variation in semantic coordination of speech and gesture reveal?: Evidence fora n interface representation of spatial thinking and speaking. *Journal of Memory and Language*, 48, 16-32.

Konrad, R., T. Hanke, G. Langer, D. Blanck, J. Bleicken, I. Hofmann, O. Jeziorski, L. König, S. König, R. Nishio, A. Regen, U. Salden, S. Wagner, S. Worseck, O. Böse, E. Jahn and M. Schulder (2020a). *MEINE DGS – annotiert. Öffentliches Korpus der Deutschen Gebärdensprache, 3. Release / MY DGS – annotated. Public Corpus of German Sign Language, 3rd release* [Dataset]. Universität Hamburg.

Konrad, R., T. Hanke, G. Langer, S. König, L. König, R. Nishio and A. Regen (2020b). Public DGS Corpus: Annotation conventions. University of Hamburg, Project Note AP03-2018-

Kramer, R. and K. Rawlins (2011). Polarity particles: an ellipsis account. *Proceedings of NELS* 39, 479-492.

Krifka, M. (2013). Response particles as propositional anaphors. *Proceedings of SALT* XXIII, 1-18.

Kuznetsova, A., P.B. Brockhoff and R.H.B. Christensen (2017). lmerTest Package: Tests in linear mixed effects models. *Journal of Statistical Software* 82(13), 1-26.

Lee-Goldman, R. (2011). *No* as a discourse marker. *Journal of Pragmatics*, 43(10), 2627-2649.

Li, F., S. González-Fuente, P. Prieto and M.T. Espinal (2016). Is Mandarin Chinese a truth-based language? Rejecting responses to negative assertions and questions. *Frontiers in Psychology* 7, 1967, 1-10.

Lillo-Martin, D. and R. Müller de Quadros (2008). Focus constructions in American Sign Language and Lengua de Sinais Brasiliera. In J. Quer (ed.), *Signs of the Time: Selected Papers from TISLR 2008*. Hamburg: Signum, 161-176.

Meier, R.P. (2002). Why different, why the same? Explaining effects and non-effects of modality upon linguistic structure in sign and speech. In R. P. Meier, K. Cormier and D. Quinto-Pozos (eds.), *Modality and Structure in Signed and Spoken Languages*. Cambridge: Cambridge University Press, 1-25.

Meijer, A.M., B. Claus, S. Repp and M. Krifka (2015). Particle responses to negated assertions: Preference patterns for German *ja* and *nein*. In T. Brochhagen, F. Roelofsen and N. Theiler (eds.), *Proceedings of the 20th Amsterdam Colloquium*, 286-295.

Müller, S. (2014). *Modalpartikeln*. Heidelberg: Universitätsverlag Winter.

Papaspyrou, Ch., A. von Meyenn, M. Matthaei and B. Hermann (2008). *Grammatik der Deutschen Gebärdensprache aus der Sicht gehörloser Fachleute*. Hamburg: Signum.

Paulus, L. (2019). *Der Konditionalsatz in Deutscher Gebärdensprache (DGS) und Brasilianischer Gebärdensprache (Libras) – Eine empirische soziolinguistische Studie*. PhD dissertation, University of Göttingen.

Pfau, R. (2008). The grammar of headshake: A typological perspective on German Sign Language negation. *Linguistics in Amsterdam* 2008(1), 37-74.

Pfau, R. (2015). The grammaticalization of headshakes: From head movement to negative head. In A.D.M. Smith, G. Trousdale and R. Waltereit (eds.), *New Directions in Grammaticalization Research*. Amsterdam: John Benjamins, 9-50.

Pfau, R. and J. Quer (2002). V-to-Neg raising and negative concord in three sign languages. *Rivista di Grammatica Generativa* 27, 73-86.

Pfau, R. and J. Quer (2007). On the syntax of negation and modals in German Sign Language (DGS) and Catalan Sign Language (LSC). In P. Perniss, M. Steinbach and R. Pfau (eds.), *Visible Variation. Comparative Studies on Sign Language Structure*. Berlin: Mouton de Gruyter, 129-161.

Pfau, R. and J. Quer (2010). Nonmanuals: their prosodic and grammatical roles. In D. Brentari (ed.), *Sign Languages*. Cambridge: Cambridge University Press, 381-402.

Pfau, R., M. Salzmann and M. Steinbach (2018). The syntax of sign language agreement. Common ingredients but unusual recipe. *Glossa: A Journal of General Linguistics* 3(1), 107, 1-46.

Pfau, R. and M. Steinbach. (2005). Relative clauses in German sign language: extraposition and reconstruction. In L. Bateman and C. Ussery (eds.) *Proceedings of NELS* 35, 507-521.

Pfau, R. and M. Steinbach. (2006). *Modality-independent and modality-specific aspects of grammaticalization in sign languages*. Potsdam: Universitätsverlag.

Pfau, R. and M. Steinbach (2011). Grammaticalization in sign languages. In: B. Heine and H. Narrog (eds.), *Handbook of Grammaticalization*. Oxford: Oxford University Press, 681-693.

Pfau, R. and M. Steinbach (2013). PERSON climbing up a tree (and other adventures in sign language grammaticalization). *Sign Language & Linguistics* 16(2), 189-220.

Pope, E. (1976). *Questions and Answers in English*. The Hague: Mouton.

Puupponen, A. (2019). Towards understanding nonmanuality: a semiotic treatment of signers' head movements. *Glossa: A Journal of General Linguistics* 4(1), 39, 1-39.

Puupponen, A., T. Wainio, B. Burger and T. Jantunen (2015). Head movements in Finnish Sign Language on the basis of motion capture data: A study of the form and function of nods, nodding, head thrusts, and head pulls. *Sign Language & Linguistics 18*(1), 41-89.

Repp, S., M. Meijer and N. Scherf (2019). Responding to negative assertions in Germanic: on *yes* and *no* in English, Dutch and Swedish. In M.T. Espinal, E. Castroviejo, M. Leonetti, L. McNally and C. Real-Puigdollers (eds.), *Proceedings of Sinn und Bedeutung 23*, 267-285.

Roberts, I. and A. Roussou (2003). *Syntactic Change. A Minimalist Approach to Grammaticalization*. Cambridge: Cambridge University Press.

Roelofsen, F. and D. Farkas (2015). Polarity particle responses as a window onto the interpretation of questions and assertions. *Language* 91, 359-414.

Sandler, W. (2012). Visual prosody. In R. Pfau, M. Steinbach and B. Woll (eds.), *Sign Language. An International Handbook*. Berlin: De Gruyter Mouton, 55-76.
Schermer, G.M. (2001). The role of mouthing in Sign Language of the Netherlands: some implications for the production of sign language dictionaries. In P. Boyes Braem and R. Sutton-Spence (eds.), *The Hands are the Head of the Mouth: The Mouth as Articulator in Sign Languages*. Hamburg: Signum Press, 273-284
Schlenker, P. (2018). Visible meaning: Sign language and the foundations of semantics. *Theoretical Linguistics* 44(3-4), 123-208.
van Gelderen, E. (2011a). *The Linguistic Cycle. Language Change and the Language Faculty*. Oxford: Oxford University Press.
van Gelderen, E. (2011b). Grammaticalization and generative grammar: A difficult liaison. In B. Heine and H. Narrog (eds.), *The Oxford Handbook of Grammaticalization*. Oxford: Oxford University Press, 43-55.
van Loon, E., R. Pfau and M. Steinbach (2014). The grammaticalization of gestures in sign languages. In C. Müller, A. Cienki, E. Fricke, S.H. Ladewig, D. McNeill and S. Tessendorf (eds.), *Body – Language – Communication: An International Handbook on Multimodality in Human Interaction*. Volume 2. Berlin: De Gruyter Mouton, 2131-2147.
Weast, T. (2011). American Sign Language tone and intonation: A phonetic analysis of eyebrow properties. In R. Channon and H. van der Hulst (eds.), *Formational Units in Sign Languages*, Berlin: De Gruyter Mouton and Ishara Press, 203-225.
Wilbur, R. (2012). Information structure. In R. Pfau, M. Steinbach and B. Woll (eds.), *Sign Language. An International Handbook*. Berlin: De Gruyter Mouton, 462-489.
Wilbur, R. and C. Patschke (1999). Syntactic correlates of brow raise in ASL. *Sign Language & Linguistics* 2(1), 3-41.
Wittenburg, P., H. Brugman, A. Russel, A. Klassmann and H. Sloetjes (2006). ELAN: A professional framework for multimodality research. *Proceedings of LREC 2006*, 1556-1559.
Zeshan, U. (2004). Hand, head, and face: Negative constructions in sign languages. *Linguistic Typology* 8, 1-58.

Notational conventions

Signs are glossed in small caps. Subscripts represent areas in the signing space that are used as referential loci linked to discourse referents.

Signs and interlinear glosses	
IX	indexical pointing sign

IX_1, $_2GIVE_3$	subscript: indicates whether a sign points at or has its initial/final location at the signer (1), the addressee (2), somewhere else (3).
M-A-L-T-E	hyphens between letters: fingerspelled sign
NOCH-NICHT	hyphens within gloss: single sign represented by a gloss consisting of more than one word
CL:move-in-zigzag-line, CL:square	classifier predicate
-neg	negation morpheme (α-shaped movement appended to sign)
q	question morpheme
Non-manual markers	
hs	headshake
hn	head nod
top	topic marking (min. raised eyebrows)
br	brow raise
bf	brow furrow
/ja/, /doch/	mouthing