The semiotic diversity of doing reference in a deaf signed language

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ARTICLE INFO

ABSTRACT

This article describes how deaf signers of Auslan (a deaf signed language of Australia) coordinate fully conventionalised forms (such as lexical manual signs and English finger-spelling and/or mouthing) with more richly improvised semiotics (such as indicating verbs, pointing signs, depicting signs, visible surrogates and/or invisible surrogates) to identify and talk about referents of varying agency. Using twenty retellings of *Frog, Where Are You?* and twenty retellings of *The Boy Who Cried Wolf* archived in the Auslan Corpus, we analysed 4,699 tokens of referring expressions with respect to: (a) activation status; (b) semiotic form; and (c) animacy. Statistical analysis confirmed choice of strategy was most strongly motivated by activation status: new referents were expressed with more conventionalised forms (especially lexical manual signs and English mouthing), whereas maintained and reintroduced referents typically involved fewer and more richly impro-vised, context-dependent semiotics. However, animacy was also a motivating factor: humans and animals were often depicted via visible surrogates (not pointing signs), whereas inanimate referents favoured depicting signs and invisible surrogates. These findings highlight the role of animacy in signed language discourse and challenge the claim that informativeness decreases as cognitive saliency increases, while demonstrating the 'pretend world' indexicality of signed language use and the pluralistic complexity of face-to-face communication.

1. Introduction

By directing someone's attention to some other person or thing, we establish someone or something as a referent and offer a conceptualisation or perspective on them (Clark and Bangerter, 2004; Sidnell and Enfield, 2016). These acts of referring are collaborative and multimodal, grounded in human sociality and previous experiences (Krauss and Weinheimer, 1966; Grice, 1975; Schegloff, 1984; Clark and Bangerter, 2004; Enfield, 2013). As such, the way in which referring acts are done partly depends on the 'semiotic repertoire' available to interactants within given spatiotemporal contexts (Enfield, 2009, 2013; Kendon, 2014; Kusters et al., 2017). For example, during face-to-face interactions, signers and speakers may point with

their hand (or other body parts) to disambiguate context *in situ* and anchor their signed or spoken references to people, animals and things in the material or imagined world. They may also produce enactments with or without more conventionalised semiotics, such as lexically encoded information, to demonstrate who did what to whom and how (see e.g. Sherzer, 1973; Tannen, 1989; Clark and Gerrig, 1990; Haviland, 1993; Kita, 2003; Sidnell, 2006; D'Arcy, 2015 for spoken languages, and Metzger, 1995; Winston, 1991, 1992; Liddell, 2003; Cormier et al., 2013b; Cormier et al., 2015 for signed languages).

However, most investigations of referencing in spoken and/or written language use have tended to focus on the pro/ nominal, lexically encoded and/or anaphoric aspects of referential coherence. For example, linguists working within broadly cognitive/functional approaches have investigated topic and focus constructions, preferred argument structure, pronouns and pronominal anaphora, other types of anaphora, referential density, animacy, and perceptual salience and accessibility as determining factors in the selection of conventionalised referential forms (see e.g. Chafe, 1976; Li and Thompson, 1976; Du Bois, 1980; Givón, 1983; Ariel, 1990; Gundel et al., 1993; Lambrecht, 1994; Halliday, 1994; van Hoek, 1995; Dahl and Fraurud, 1996; Yamamoto, 1999; Huang, 2000; Bickel, 2003).

In addition to nominal expression, signed language linguists have attended to the role of verbal predicates and use of space for doing reference, investigating the role of grammatical relations, pronominal pointing (also known as 'pronouns' and 'indexing signs' in the literature), indicating signs (also known as 'agreement verbs'), depicting signs (also known as 'classifier predicates', of which 'entity classifiers' are a subset), noun phrases, anaphoric reference or 'pro-drop', enactment (also known as 'role shift') and/or perspective shift (see e.g. Friedman, 1976; Lillo-Martin and Klima, 1990; Meier, 1990; Wulf et al., 2002; Perniss, 2007; McKee et al., 2011; Barberà and Zwets, 2013; Engberg-Pedersen, 2015; Fenlon et al., 2018). The coordination of specific semiotics (typically lexical signs, pointing signs, depicting signs and enactment) within the signing space have also been investigated, mostly using narrative data (e.g. Winston, 1991, 1992; Engberg-Pedersen, 1993; Ahlgren and Bergman, 1994; Janzen, 1999; Morgan, 2006; Cresdee, 2006; Cormier et al., 2013b; Frederiksen and Mayberry, 2016; Fenlon et al., 2018).

Furthermore, investigations of multimodal spoken language narratives have shown that cognitive accessibility is a strong predictor of speaker's use of co-speech gestures, the types of co-speech gesture used, and their meaningful use of space (see e.g. Gullberg, 2003, 2006; Levy and McNeill, 1992; McNeill and Levy, 1993). Speakers tend to produce more co-speech gestures with fully lexical spoken expressions when introducing and re-introducing referents, and less with maintained referents indexed via spoken pronouns or zero anaphora — which incidentally also tend to co-occur with 'anaphoric' use of space (see Gullberg, 2003, 2006). They may also choose particular kinds of co-speech gestures depending on both character versus observer viewpoint (Debreslioska et al., 2013). For example, visible bodily enactments (i.e. 'character viewpoint gestures') are preferred for maintained/more accessible contexts, whereas depicting signs (i.e. 'observer viewpoint gestures') are preferred for re-introduced/less accessible contexts. Transitivity, event structure (i.e. visual-spatial and motoric properties) and discourse structure have also been found to influence speaker's viewpoint gesture choices (Parrill, 2010).

A consensus across the signed/spoken language and gesture literature is therefore that many patterns of doing reference (especially within narrative retellings, cf. the canon of *Pear Stories* inspired by Wallace Chafe) can be explained by cognitive accessibility and information management: signers and speakers tend to choose phonologically heavier and more informative referring expressions (such as fully lexical noun phrases) to introduce new referents, whereas less heavy and less informative expressions (including pronominal forms or zero anaphora) are used for referents that are conceptually more salient in the discourse (Chafe, 1976; Du Bois, 1980; Givón, 1983). However, as also discussed in some of the earlier literature above, there are many other factors which may influence how signers and speakers do reference, especially when the availability of space, the use of diverse semiotics, and the ontology of animacy are considered (Johnston, 1996; Dahl, 2008; Kendon, 2014).

For example, cross-linguistic comparison of the multimodal narratives produced by deaf DGS (German Sign Language) signers and hearing German speakers confirmed that the quantity of referential information in both groups varies according to activation status of the referent (i.e. new vs. maintained vs. reintroduced), and that motivated use of space (i.e. referents being consistently located within the space in front of the body) makes referents more cognitively accessible for both signers and speakers (Perniss & Özyürek, 2014). However, results did suggest that referring expressions in German (a 'non-pro-drop language') were more likely to be overt (versus zero) in both maintenance and reintroduction contexts compared to DGS (a 'tentative pro-drop language'). In other words, DGS signers seemed to rely more on anaphoric 'pro-drop' reference (i.e. zero) and/or use of space (e.g. via modification of indicating signs) compared to German speakers. The authors therefore raised the possibility of language and modality-specific differences for doing reference, and wondered whether results might be different if DGS were compared to a 'spoken pro-drop language' such as Turkish. More recent investigations of co-speech gestures used by Turkish speakers seem to support this claim (Azar et al., 2018).

The coordination of diverse semiotics involved in face-to-face communication — many of which draw upon vivid sensory depictions that are arguably more informative than lexical description — also calls into question the principle that 'less informative' expressions are used for referents that are conceptually more salient (see Dingemanse, 2017; Ferrara and Hodge, 2018). This is supported by findings on speaker's co-speech gesture choices described above. For example, how certain can we be that a token manual depiction used to introduce a referent within observer viewpoint is more or less informative than a token bodily enactment used to maintain a referent within character viewpoint? Both are isomorphic form-meaning resemblances prompting a certain conceptualisation of the referent, which may also depend on other co-occurring semiotics framing/indexing each depiction within the referring expression.

Finally, the effects of animacy have been described as "so pervasive in the grammars of human languages that it tends to be taken for granted and become invisible" (Dahl and Fraurud, 1996; see also Yamamoto, 1999) — as reflected by the limited consideration of how animacy might influence the way deaf signers do reference. One early investigation (via an elicitation task) of

different groups of deaf children's use of entity constructions in British Sign Language (BSL) indicated all groups were fairly consistent with using depicting signs to talk about animate and inanimate referents (Cormier and Smith, 2010). However, deaf children with minimal exposure to BSL tended to use fewer depicting signs compared to native signers or early learners, possibly compensating with more enactment. All groups also displayed more variation in handshapes for depicting people, but less variation in handshapes for depicting inanimate entities, raising the possibility that animacy may be a factor influencing variability in form. Another more recent corpus-based investigation of indicating verbs in BSL found that animacy, verb position and coreference also influence modification of indicating verbs in the signing space, in addition to signer's use of enactment (Fenlon et al., 2018).

Strategies for doing reference may therefore be more complex than we think. Here we seek a broader understanding of the principles for doing reference during face-to-face interactions by investigating narrative retellings in a deaf signed language, thus contributing to what Kendon describes as an "account of how the semiotically diverse resources that all languaging individuals use are organised in relation to one another" (Kendon, 2014: 1). Taking a comparative semiotic approach, we explore whether factors additional to information management (i.e. semiotic form and animacy) influence patterns of referring expressions produced by deaf Auslan signers. The following sections outline our theoretical and methodological approach. We then use generalised linear mixed-effect modeling (Baayen, 2008; Baayen et al., 2008) and Hierarchical Clustering on Principal Component Analysis (Lê et al., 2008) to explore 4,699 tokens of referring expressions according to: (a) activation status (introduced, maintained or reintroduced), (b) the semiotic form and composition of referring expressions (e.g. lexical manual sign, pointing sign, enactment), and (c) animacy (humans, animals or inanimate objects). We discuss these findings in relation to previous research on deaf signed languages, spoken languages and face-to-face communication more generally.

2. Composite utterances and the semiotic diversity of face-to-face communication

Both signers and speakers co-construct meaning by drawing upon diverse semiotic resources (their body, their voice, the surrounding physical environment) to strategically 'describe, indicate and depict' during face-to-face interactions (Clark, 1996; Dingemanse, 2013; Ferrara & Hodge, 2018; see also Duranti and Goodwin, 1992; Johnston, 1996; Liddell, 2003; Kendon, 2004). We combine speech and/or sign, gesture and enactment (i.e. semiotic signs of different types) to produce multimodal 'composite utterances' (Enfield, 2009). Composite utterances are communicative moves, or turns, in face-to-face interaction during which fully conventionalised semiotic signs (such as lexical signs, spoken/mouthed/fingerspelled words and emblematic gestures) combine with symbolic indexicals (such as finger-pointing actions) and non-conventional signs (such as mimetic enactments of what an entity is doing or saying) to create unified utterances that are interpreted holistically. In this way, face-to-face interactions are constantly negotiated between two or more interactants via ostensive and inferential communicative acts (LaPolla, 2003; Enfield, 2009). Often this involves the *umwelten* differentiation of 'chunks of space' described as "semiotically activated temporarily stable delimitations of thin air" (Enfield, 2009: 152). Once ignited by some signifying act, these temporarily stable chunks are immediately treated like physical objects (see also von Uexküll, 1992).

In the corpus-based analysis of deaf signed languages, it is useful to identify tokens of signs according to degree of conventionalisation and how they are used. Depending on their instantiation within a specific usage event, tokens of signs may be described as varying gradiently from fully lexical, through to partly lexical and non-lexical according to degrees of conventionality, complexity and schematicity (Johnston and Schembri, 2010). Consider the two composite utterances from one retelling of *Frog, Where Are You?* archived in the Auslan Corpus shown in Fig. 1.[1] Here the Auslan signer coordinates different methods of signalling (i.e. description, indication and/or depiction) to communicate the existence of a frog in a jar, and a boy looking down at the frog in the jar. Each composite utterance unites different tokens of signs which vary in degree of conventionalisation. The tokens of manual signs and other indexical activity such as eye-gaze coordinated within these utterances also establish a semiotically activated chunk of 'frog-in-jar' space.

mouth:	have_____	frog_____	frog_____		
right hand:	HAVE	FS:FROG	FROG	POINT	SEE
left hand:		FS:FROG	DSS(BC):SPHERICAL-JAR--		
					CA:BOY
	"There was a frog in the jar."				"The boy looks at it."
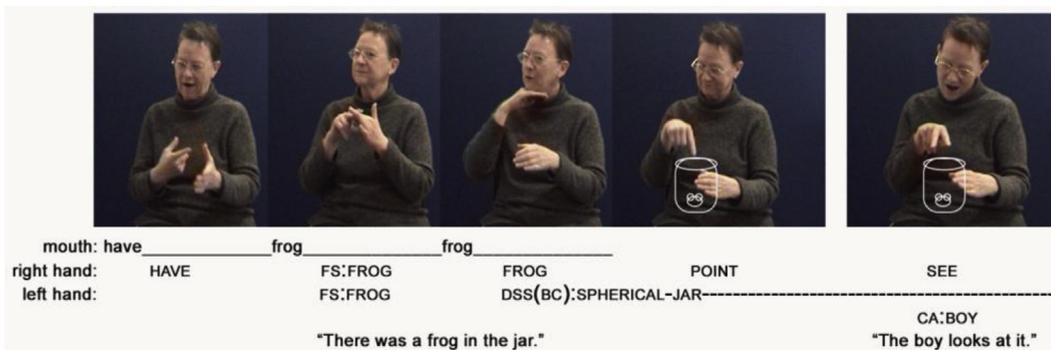
Fig. 1. Introducing and indexing referent 'frog' using different types of signs (Auslan Corpus, PCNB2c7a: 00:8:07—00:11:42, images used with consent).

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[1] The examples from the Auslan Corpus used in this paper can be viewed in the online collection: https://elar.soas.ac.uk/Collection/MPI55247.

Fully lexical signs have most meaningful characteristics specified in their form and are heavily entrenched in use. These signs constitute the listable lexicons or citation forms of language use (and can potentially be archived within a form-based lexical database such as the Signbank format). The tokens of HAVE and FROG in Fig. 1 can be analysed as fully lexical Auslan signs. Partly lexical signs have only some characteristics specified in their form (e.g. handshape and orientation); all other specification emerges from mapping these forms onto the signing space. They are all types of symbolic indexicals insofar as they have partly conventional aspects and index something in the signing space or text (see Johnston, 2012; Cormier et al., 2013a). Pointing signs and indicating verbs are two major sub-classes of partly lexical signs (e.g. the tokens glossed as POINT and SEE in Fig. 1). Depicting signs are a third major sub-class of partly lexical signs. Depicting signs both symbolically index and depict aspects of the physical characteristics of the conceptualised object. Depicting signs can therefore provide a high level of conceptual informativeness (traditionally seen as a defining feature of lexicality in the spoken language literature), even though they are only partly conventionalised. The manual sign glossed as DSS(BC)-SPHERICAL-JAR in Fig. 1 is an example of a token depicting sign, as are the two tokens of FALL shown in Fig. 2. Note that the first example in Fig. 2 is the citation entry in the lexical database Auslan Signbank, while the second example is from a narrative retelling in the Auslan Corpus. The lexicality or degree of conventionalisation of such tokens and how they are dealt with in the Auslan Corpus is discussed further in §3.3.
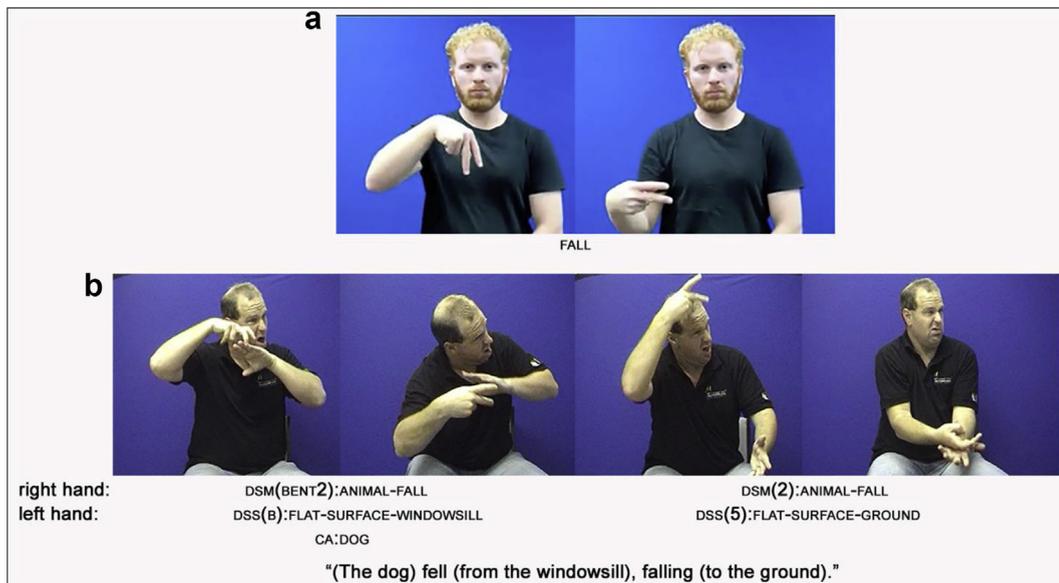
Fig. 2. (a) lexical sign FALL as it appears in the lexical data base Auslan Signbank, and (b) depiction of referent 'dog' falling from a window using two tokens of FALL, both analysed here as delexicalised depictions (Auslan Corpus, SGMB2c7a: 00:41:2—00:42:5, image used with consent).

Non-lexical signs, such as token enactments of action, have very little conventionalisation or specification of form and meaning, relying heavily on the spatiotemporal communicative context and inference for correct interpretation. These forms emerge enchronically within the discourse context. As such, they do not have properties of conventionalised symbolism, i.e. meanings that are additional or predictable from the value of their form given a particular context (see also Johnston, 2012: 4). For example, a visible bodily enactment of a shepherd boy catching sight of a predatory wolf while holding a stick in fear (see Fig. 3) does not have arbitrary or conventionalised properties that might facilitate highly-specified understanding if repeated in other, unframed contexts with a new audience. While some aspects of the token depiction may be isomorphic with particular physical events, we cannot know that it also specifically references a boy, a stick and a wolf as in this context. As enactments are primarily context-dependent embodied demonstrations of what an entity is doing or saying, they are 'singular events' during which interactants enchronically interpret a form as 'standing for' a meaning (Kockelman, 2005).

Enactments involve elements of manual and non-manual expression to partially demonstrate or 'construct' action, thought, feelings and dialogue (Metzger, 1995). They both depict a person, thing or event as it happened, while also colouring this event with the enactor's experience, stance, emotion and communicative intent. During constructed action one enacts a non-linguistic action ('quotes an action'), while during constructed thought and dialogue (essentially sub-types of the former) one enacts a language event ('quotes signs or words'). Enactments may therefore incorporate tokens of other types of signs (Clark and Gerrig, 1990; Clark, 1996; Cormier et al., 2013b; Cormier et al., 2015). While the literature might suggest that signers typically use enactment to depict animate referents, it is certainly possible to use enactment to depict inanimate referents — in fact, it may even be seen as a strategy for affording greater agency to a given referent. Fig. 4 reproduces a transcribed and translated example from Johnston (2016) demonstrating how one Auslan signer enacted a referent 'egg' in order to depict these eggs as thrown about too vigorously in boiling water, while feeling concern at the possibility of them breaking apart.

Fig. 3. Indexing referent 'wolf' as an invisible surrogate by visibly enacting the referent 'boy' looking at the imagined 'wolf' (Auslan Corpus, SSSB1c2a: 01:13:40—01:14:50, image used with consent; wolf image designed by vexels.com).

Fig. 4. Composite utterances containing a visible enactment of an egg boiling in water produced by a deaf Auslan signer during face-to-face conversation (Johnston, 2016: 61).

Along with unified bodily actions such as eye gaze and posture, many of the signs described above can also be used to co-create 'invisible surrogates', whereby a confluence of indexing actions enables interactants to conceptualise an entity in the signing space, and behave as if it were present (Winston, 1991; Engberg-Pedersen, 1993; Liddell, 2003). The referents 'frog' and 'jar' illustrated with white line drawings in Fig. 1 above are examples of invisible surrogates. The referent 'wolf' illustrated in Fig. 3 is another example. Here the signer's visible bodily enactment simultaneously depicts the actions of the boy and indexes an imagined wolf entity to wherever the boy (or rather, the 'signer as boy') is looking. Invisible surrogates are not a type of sign or even tokens of a type — they are the conceptual result of specific indexing actions, such as an enactment of what an entity is doing (i.e. the 'visible surrogates'). This phenomenon (along with many others described here) is a consequence of the availability of space during face-to-face interactions (Engberg-Pedersen, 1993; Johnston, 1996; Liddell, 2003).

It is the skillful coordination of these diverse semiotic resources which enables signers to do reference in a deaf signed language. By way of illustration, consider again the composite utterances Fig. 1. The signer first introduces referent 'frog' into her retelling by: (a) fingerspelling and mouthing the English word "frog"; (b) signing the Auslan sign FROG while again mouthing the English word "frog"; (c) pointing with her right hand to an imagined frog located inside an imagined jar in front of her body, which she depicts with her left hand. The signer thus simultaneously depicts the visible actions of the boy looking into the jar, while also indexing the invisible frog and jar referents to the space in front of her body. In this way, the signer encoded agent 'frog' into her retelling according to how it is conventionally referred to in both English (the ambient spoken language) and Auslan, and then indexed agent 'frog' by both pointing with her hands and intentionally looking to where it was located in the imagined scene unfolding within her semiotically activated signing space.

The signer then embellishes how the boy looks at the frog in the jar by incorporating the Auslan sign LOOK (an indicating sign) within an enactment of the boy looking at the frog in the jar. The boy is the visible surrogate depicted by the signer's bodily actions, and the frog and jar are the invisible surrogates in front of her body indexed by these actions (with the jar being partially depicted by the signer's left hand). In this way, agent 'frog' was introduced, overtly identified and elaborated, and then later indexed using both conventionalised and more contextually improvised semiotics. The boy, the frog and the jar referents

are all indexed to specific locations in the signing space, and these locations align with the signer's conceptualisation of the event. Note this example directly contradicts the idea that new information is best kept separate from other information in order to facilitate processing (cf. Chafe, 1976; Du Bois, 1980). The availability of space and diverse semiotic resources enables signers to package some degree of new information at the same time as other, given information. The specific patterns of how deaf signers reference human, animal and inanimate objects in their narrative retellings is the focus of the rest of this paper.

3. Methodology

3.1. Research questions and predictions

Two separate statistical analyses (one confirmatory, one exploratory) were conducted to investigate the semiotic diversity of referencing in these Auslan retellings. Firstly, we took the number of strategies used in referring expressions as a measure of phonological heaviness, and the activation status of a referent (new vs. maintained vs. re-introduced) as a measure of cognitive accessibility. Given the literature outlined in §1, we expected an interaction between phonological heaviness and the activation status of the referent, whereby introduced referents are expressed with more semiotic strategies, while maintained or reintroduced referents are expressed with fewer semiotic strategies. Secondly, we explored the patterning of referring expressions according to activation status, semiotic form and animacy. Given the literature outlined in §2, we expected that both referent status and animacy would partially determine the choice of semiotic strategies used by signers, but that the specifics of this patterning would be a revelation. We also expected results from both analyses to problematise earlier claims about the relationship between informativeness and cognitive accessibility.

3.2. Data and participants in the study corpus

The data in the study corpus comes from forty Auslan narratives archived in the Auslan Corpus (Johnston, 2008): twenty retellings of the picture-based story *Frog, Where Are You?* (Mayer, 1969)? and twenty retellings of a written English version of the Aesop's fable *The Boy Who Cried Wolf*. Each narrative subset contains four retellings each from Adelaide, Brisbane, Melbourne, Perth and Sydney. Six signers participated in both elicitation tasks. Overall, the data represents thirty-four male and female signers of different ages across forty retellings totalling 83.6 min in duration (*Frog* = 49.8 min; *Wolf* = 33.8 min). Retellings of *Frog* tend to be longer in duration that retellings of *Wolf*, with greater range across individuals: the median durations for each set of narratives are 2.5 min and 1.48 min respectively.

3.3. Enriching the study corpus with annotations

Each retelling was enriched with annotations time-aligned with the digital video input using ELAN[2] software (Crasborn and Sloetjes, 2008). All ELAN files contained annotations on approximately twenty tiers from earlier investigations (e.g. Ferrara & Johnston, 2014; Ferrara & Johnston, 2014; Hodge & Ferrara, 2014), including tiers for annotating tokens and types of signs, instances and durations of enactment, and 'clause-like' composite utterances, i.e. composite utterances identified as candidate clauses. These are inclusive of the full range of semiotic strategies available to signers, including tokens of enactment, but which have not traditionally been included in clause structure analyses (see Hodge, 2014). Annotations for the current study were tagged on tiers that use or build upon these earlier annotations and the conventions outlined in the Auslan Corpus Annotation Guidelines (Johnston, 2016). Two new tiers were created for this study: (1) Narrative Referent, and (2) Referring Expression.

Annotations on the Narrative Referent tier tag: (a) tokens of referents produced by the signer, and (b) the activation status of the referent, i.e. whether the token was introduced, maintained or reintroduced. We took the position that once a referent is introduced, it does not cease to be maintained, even if several utterances pass without mention of either the maintained referent or another referent. Reintroduced referents are essentially switch reference and were determined on the basis of the immediately preceding clause-like unit: if the referent was not mentioned in the preceding unit and another referent was mentioned during the interim, then the referent was tagged as reintroduced. For example, the first mention of the deer in *Frog* was tagged as 'deerNEW' on the Narrative Referent tier. Maintained references to the deer were simply tagged as 'deer', while reintroductions were tagged as 'deerREIN'. Annotations on the Referring Expression tier are time-aligned with annotations on the corresponding Narrative Referent tier. These annotations tag the semiotic composition of the referring expression (see Table 1). Three sets of these tiers were required to accommodate circumstances where a signer expressed more than one referent at the same time, e.g. one on each hand in addition to something indexed in the signing space.

In the case that a referring expression included more than one strategy, tags were sequenced alphabetically within the annotation. For example, an introduction of the referent 'deer' expressed via a pointing sign and a lexical Auslan sign was tagged as 'LEXICAL.POINTING' on the Referring Expression tier. This tag represents one token of this referring expression, which is a type that gathers all tokens of referents expressed using a lexical sign and a pointing sign. This includes: (a) a pointing sign followed by a lexical sign; (b) a lexical sign followed by a pointing sign; and (c) a pointing sign produced simultaneously with a lexical sign. These tags therefore describe the specific semiotic composition of a given referring expression without saying anything about the

sequencing or simultaneity of how it was expressed. In this way, we can achieve a global description of the semiotic strategies used to overtly express or index referents, thus preparing for more specific investigations of compositionality in the future.

In the case that a referring expression contained strategies expressed using the non-dominant or 'weak' hand, each relevant strategy was tagged as 'WEAK-HANDED'. The use of the weak hand in simultaneous constructions is attested, but not well understood (see e.g. Crasborn, 2011, for a discussion of one versus two-handed signing in signed language phonotactics and speculation on discursive behaviours). However, recent research suggests the use of weak-handed signs in Auslan clause-like units is semiotically motivated: if used independently of the strong hand, the weak hand is often a pointing or depicting sign contributing to core argument—predicate relations (Ferrara & Johnston, 2014). For these reasons, we differentiated referring expressions (or parts of referring expressions) produced with the weak hand. In other words, tokens of weak-handed expression were counted as both: (a) tokens of the semiotic strategy they participated in, and (b) instances of their own unique strategy. For example, a token 'WEAK-HANDED DEPICTING SIGN' was counted as both a depicting sign and a weak-handed sign.

Finally, we wanted to recognize that some lexical signs (typically tokens that bear strong physical resemblances to an object or action) are able to be 'delexicalised' within specific usage events (Johnston & Ferrara, 2012; Cormier et al., 2012; see Dingemanse, 2017, on this process in spoken languages). Delexicalisation involves a fully conventionalised, symbolic sign being produced in such a way as to re-activate its underlying iconic component structure to provide a token depiction (Johnston and Schembri, 1999; Johnston & Ferrara, 2012). For example, an Auslan signer may modify the typically lexical form FALL to depict a specific entity with legs falling from a great height, rather than to simply describe that an act of falling has occurred (compare the citation form of the sign FALL and the two tokens glossed as DSM(BENT2):ANIMAL-FALL and DSM(2):ANIMAL-FALL in Fig. 2).[3] In such cases, the delexicalised signs are annotated as either tokens of constructed action or depicting signs. If the sign is used in its lexical sense, then we annotated the sign as a lexical token that has potentially more contextually-dependent depictive qualities (see Table 1). In this way, we acknowledge the referential potential of these forms, which is congruent with the referential nature of depicting signs and enactments.

These annotations enabled us to systematically catalogue: (a) the human, animal and inanimate referents identified in each retelling, (b) the activation status of the referring expression, and (c) the number and type of semiotic strategies used to describe, index and/or depict the identified referents. This method also enabled us to quantify uncertain analyses (i.e. cases where the annotators could not confidently assign one code instead of another code) by systematically coding uncertain tokens of referents or semiotic strategies involved in specific referring expressions. While it is possible that some uncertain analyses mirror real-time ambiguity or vagueness experienced by the signers during their interaction, deeper differentiation of these two types of uncertainty is beyond the scope of this paper. Exploration of these new annotations with other annotations created in earlier studies further enabled us to consider the development of referential semiotics within and across composite utterances. Following multiple revisions of the data, all annotations were exported to Excel using Annotations Overlaps Information in ELAN. Codes denoting whether the referent was human, animal or an inanimate object were then added, and the data were analysed using R software. All data and R code used for the analyses is available via the Open Science Framework at osf.io/jctp4.

Table 1
Tags used to annotate the semiotic composition of tokens of referring expressions.

Strategy	Tag	Description
Conventional	LEXICAL	Fully lexicalised sign cited in Auslan Signbank lexical database, e.g. BOY, FROG, WOLF
	LEXICAL NP	Noun phrase containing only fully lexicalised signs available in Auslan Signbank, e.g. BIG GREY WOLF
	LEXICALISED DEPICTING	Fully lexicalised sign cited in Auslan Signbank similar in form to a token depicting sign, e.g. FALL
	FINGERSPELLING	Fingerspelled English word, e.g. FS:JAR, FS:VILLAGE
	MOUTHING	Mouthing of an English word, e.g. boy, frog, wolf
Partly conventional	INDICATING VERB	Fully lexicalised indicating sign cited in Auslan Signbank lexical database, e.g. LOOK, YELL, and spatially modified to index a referent in the signing space.
	POINTING[a]	(Pluri)functional finger-pointing action indexing an in/animate referent and/or location in space, e.g. PT:PRO1SG, PT:LOC/PRO
	DEPICTING	Partly lexicalised depicting sign, e.g. DSM(1):HUMAN-MOVE, DSS(BENT5):CURVED-VESSEL
Non-conventional	GESTURE	Manual gesture, e.g. G:WATER-LOW
	VISIBLE SURROGATE	Visible surrogate, i.e. constructed action, e.g. CA:BOY-LOOKS-OVER-LOG
	INVISIBLE SURROGATE[b]	Invisible surrogate resulting from a confluence of indexing actions such as indicating verbs, pointing, depicting signs and enactments. Typically evidenced by meaningful eye-gaze pointing and/or other strategies.
Weak-hand	WEAK-HANDED	Referring action produced with the non-dominant hand.
Indeterminate	UNCERTAIN	Indeterminate or uncertain identification of a referent and/or strategy on behalf of the annotators.

[a] Pointing actions may also index conceptual 'objects' (e.g. ideas, feelings, opinions) in the signing space, but this kind of pointing was not observed in these retellings.
[b] Recall that INVISIBLE SURROGATE is not a type of sign or even a token of a type — it is a conceptual result of some indexing action(s). Here this tag identifies chunks of space made meaningful because they were indexed in some way by the signer, e.g. via indicating verb and/or enactment, eye gaze, etc. This phenomenon was annotated to tentatively explore how signers are indexically enriching their narratives as well as encoding them (see Enfield, 2009: 15).

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[3] Note it is also possible to later use the lexical form FALL to index the earlier event depicted by the delexicalised DSM(BENT2):ANIMAL-FALL. In other words, processes of (de)lexicalisation are not unidirectional.

3.4. Contextualising the study corpus

For a global understanding of the number and type of semiotic strategies used by signers in these retellings, we first report on the frequency of the meaningful manual behaviour in the study corpus. We also frame these retellings in terms of utterance frequency and overall use of enactment. Table 2 reports the observed relative frequencies (per 1,000 tokens) of dominant-handed manual signs in the study corpus and compares these frequencies with the larger Auslan Corpus and the subset of all narratives in the Auslan Corpus. The figures for the Auslan Corpus and Auslan Corpus narratives date from late 2011 and were reported in the Auslan lexical frequency study (Johnston, 2012).

Based on these normalised frequencies, tokens of non-lexical signs are more frequent in the study corpus compared to the Auslan corpus, and even the larger subset of all narratives in the Auslan Corpus. The *Frog* and *Wolf* retellings also differ with respect to the frequency of partly lexical pointing and depicting signs: depicting signs feature heavily in the *Frog* retellings but much less in the *Wolf* retellings, whereas pointing signs feature heavily in the *Wolf* retellings and much less in the *Frog* retellings. These differences could be due to the size of the study corpus and the fact that it is represented by only two stimuli. However, it is more likely a consequence of the picture-based nature of the *Frog* stimulus, which contains many referents of varying agency interacting within a rapidly changing spatial environment (with animate referents moving from the boy's bedroom, to the park, cliff, river and a log). Conversely, the *Wolf* retellings were elicited from a written English text containing comparably fewer referents interacting within a more restricted spatial environment (i.e. the village and the pasture where sheep graze).

Table 2
Observed relative frequencies (per 1,000 tokens) of signs across three corpora.[a]

Sign type	Auslan Corpus ($n = 63,436$)	Auslan Corpus narratives ($n = 23,401$)	Study corpus narratives ($n = 8,177$)	
			Frog retellings (n = 4,491)	Wolf retellings (n = 3,686)
Fully lexical (incl. numbers)	650	607	609	705
Fully lexical (fingerspelling)	50	51	57	45
Fully lexical (name signs)	2	0	0	0
Partly lexical (pointing/indexical, incl. possessives and buoys)	123	74	63	90
Partly lexical (depicting)	110	214	179	62
Non-lexical (gestures and manual enactments, incl. fragments/false starts)	65	54	92 (82)	98 (92)
Total	*1,000*	*1,000*	*1,000*	*1,000*

[a] Study corpus narratives are a subset of Auslan Corpus narratives; study corpus narratives and Auslan Corpus narratives are subsets of the Auslan Corpus. Durations of enactment that occur simultaneously with manual signs are not included in this comparison because they were not quantified in the 2012 lexical frequency study of the Auslan Corpus, i.e. only tokens of full body enactments annotated on the IDgloss tiers are included in this count. Note that 11.1% of the non-lexical signs in the Frog narratives ($n = 46$) and 5.8% of the non-lexical signs in the Wolf narratives were identified as fragments of signs or false starts ($n = 21$). The true observed relative frequency for gestures and enactments is therefore 82/1,000 in the Frog retellings and 92/1,000 in the Wolf retellings.

As frequency data are best understood in relation to a measurement of dispersion across corpus parts, the normalised deviation of proportion (DP_{norm}) values for manual signs in the study corpus are provided in Table 3 (Gries, 2010). The DP_{norm} is a normalised value between 0 and 1 that reflects the dispersion of each sign type (fully, partly or non-lexical) with respect to given corpus parts — in this case, the individual retellings. It tells us if the observed frequencies of tokens of partly and non-lexical signs are idiosyncratic to one or two signers or if these tokens feature in all retellings in the study corpus. As Table 4 shows, all DP_{norm} values are much closer to 0 than to 1, so we can be confident that all signers represented in the study corpus embraced both conventional and more improvised, context-dependent aspects of face-to-face communication in their retellings.

Table 3
Measurements of dispersion of sign types across individual retellings in study corpus.

Sign type	Frog retellings (DP_{norm})	Wolf retellings (DP_{norm})
Fully lexical	0.035	0.037
Partly lexical	0.066	0.116
Non-lexical	0.157	0.146

All retellings contain annotations of clause-like units (CLUs) grouping tokens of manual signs into clause-level composite utterances, totaling 3,076 CLUs. The *Frog* retellings contain 1,875 CLUs and the *Wolf* retellings contain 1,201 CLUs, a small proportion of which are hypotactically linked via embedding and/or dependency relations (see Hodge, 2014). In addition to tokens of full body enactments annotated on the ID-gloss tiers (e.g., the token enactment of a boy seeing a wolf depicted in Fig. 3), these retellings also contain annotations of periods of enactment co-occurring with manual activity (e.g., the visible enactment of the dog falling from a great height co-produced with a manual depiction of the dog's fall shown in Fig. 2). In

total, 39% of these retellings (32.61 min) co-occur with constructed action or dialogue: approximately 37% of *Frog* and 42% of *Wolf* retellings (Hodge & Ferrara, 2014). Auslan signers make extensive use of enactment in their retellings of both illustrated and written narrative texts.

3.5. Referents identified in the study corpus

In total, 4,699 tokens of referents were annotated in the study corpus (see Table 4). In the *Frog* retellings, 21 types of referents were identified, including human (e.g. the boy), animal (e.g. the dog, the frog) and inanimate referents (e.g. two different trees, a beehive). The *Wolf* retellings contained 16 human (e.g. the boy, the villagers), animal (e.g. his sheep, the wolf), and inanimate referents (e.g. the pasture, the shepherd boy's crook). Approximately one-tenth of all referring expressions were expressed entirely or partly using the weak hand ($n = 366$, 7.8% of tokens). A small proportion of referents were uncertainly identified in the *Frog* (1.1%) and *Wolf* (1.6%) retellings, and these tokens were counted as one type. This uncertainty typically related to our cautious identification of enactment or invisible surrogates. A small number of referring expressions identified more than one referent, e.g. the boy and his flock of sheep, or the bees and their beehive ($n = 212$, 4.3% of all tokens). This was often a consequence of it not being necessary to differentiate one referent from another at that point in time, especially if both were involved with each other in some joint action, e.g. both boy and dog running away from angry bees. While it is certainly possible for a referring expression to reference multiple referents with different animacy at the same time, tokens of referring expressions referencing more than one referent are not included in this analysis (see §5.4 for more detail).

Table 4
Summary of referent tokens (total $n = 4,699$) and activation status in *Frog* and *Wolf* retellings.

	Frog				Wolf			
	Human	Animal	Inanimate	Total (n)	Human	Animal	Inanimate	Total (n)
Introduced	20 (0.01)	151 (0.06)	190 (0.06)	361 (0.12)	54 (0.03)	42 (0.02)	55 (0.03)	151 (0.09)
Reintroduced	287 (0.10)	362 (0.12)	185 (0.06)	834 (0.28)	230 (0.13)	165 (0.09)	66 (0.04)	461 (0.26)
Maintained	726 (0.25)	644 (0.22)	352 (0.12)	1,722 (0.58)	857 (0.49)	194 (0.11)	59 (0.03)	1,110 (0.63)
Uncertain	15 (0.00)	12 (0.00)	5 (0.00)	32 (0.01)	24 (0.01)	2 (0.00)	2 (0.00)	28 (0.02)
Total (n)	1,048 (0.36)	1,169 (0.40)	732 (0.24)	2,949 (1.00)	1,165 (0.67)	403 (0.23)	182 (0.10)	1,750 (1.00)

Overall, signers describe, index, and depict many different referents in their retellings, with more types of referents identified in *Frog* retellings compared to the *Wolf* retellings (expected given the higher proportion of animals and things in the *Frog* stimulus). Approximately one tenth of all tokens represent the introduction of a referent in a retelling; most tokens identify maintained or reintroduced referents. We ran separate analyses of the referring expressions identified in the *Frog* and *Wolf* retellings using hierarchical clustering on the Principle Component Analysis (see §4.3 below) and discovered no notable structural differences. Based on the similarity of the *Frog* and *Wolf* retellings in most descriptive measures up until this point, and continuing similarities in our clustering approach, we henceforth report on the combined *Frog* and *Wolf* datasets.

4. Findings

4.1. Number of semiotic strategies used in referring expressions

The literature suggests that phonologically 'heavier' referring expressions are used to express referents that are less cognitively salient (see §1). Here we use the number of semiotic strategies identified in the 4,699 tokens of referring expressions as a measure of phonological heaviness. Furthermore, as personal preferences for using particular semiotic strategies to do referencing may be expected (see §2), we also account for individual preferences of study participants. Here we explain some of this variability by assessing the number of semiotic strategies in each of the 4,699 tokens of referring expressions using a generalised linear mixed effects model. This method accounts for the fact that individuals may have different preferences, and that their sensitivity to semiotic factors may vary. By including the behavior of an individual against other factors of interest, linear mixed effect analyses allow results to be more confidently extended from the individual sample to the general population (Taglimonte and Baayen, 2012).

The number of semiotic strategies used ranged from 1 to 12 ($M = 1.9$, $SD = 1.21$). We observed that very high counts (e.g. $n = 8$) usually resulted from signer disfluencies or clarification between interactants. We relied on model trimming to filter them out where appropriate. To assess whether any difference in the number of semiotic strategies used was attributable to semantic qualities of the referents, we measured the average number of strategies for activation status (new, maintained or reintroduced), referent animacy (human, animal, or inanimate), and narrative selection (*Frog* or *Wolf*) using mixed-effect modeling with crossed random effects for individual participants and referents (Baayen, 2008; Baayen et al., 2008). This was estimated using the lme4 package in R (Bates et al., 2013). *P*-values were calculated using the lmerTest package (Kuznetsova et al., 2013). For the generalised linear mixed effects model, all instances of uncertainty in referent status were omitted ($n = 60$, 1.3% of total observations).

First, we estimated an omnibus model for strategy count. The model was subjected to criticism focusing on the residuals (Kuznetsova et al., 2013). Data points ($n = 124$; 3% of the data) with absolute standardised residuals exceeding 2.5 standard deviations were removed from the data set and the model was re-estimated, resulting in slightly improved fit. Correlation of fitted values with trimmed counts was $R^2 = 0.23$, up from $R^2 = 0.22$; BIC = 11,818.05, down from 14,123.08. The average number of strategies for the intercept (maintained human referents) was 1.30. This reference level was selected because it contained the greatest number of observations (see Table 3). There were significant main effects of referent strategy and animacy with an increase in the average number of strategies used for new referents ($\beta = 0.93$, $t = 8.33$, $p < 0.001$), reintroduced referents ($\beta = 0.45$, $t = 9.95$, $p < 0.001$), animal referents ($\beta = 0.49$, $t = 3.13$, $p = 0.005$) and inanimate referents ($\beta = 0.30$, $t = 2.08$, $p = 0.05$) compared to the intercept. There were also two significant interactions between referent status and animacy: reintroduced inanimate referents received lower strategy counts ($\beta = -0.26$, $t = -3.06$, $p = 0.002$) and reintroduced animal referents received higher strategy counts ($\beta = 0.21$, $t = 3.13$, $p = 0.002$). There were no effects of the narrative text variable on the average strategy count (Table 5).

These results allow us to consider the interactions of referent status and in/animacy on phonological heaviness: when a signer introduced, maintained or reintroduced a referent, did the number of semiotic strategies in the referring expression vary? When a signer referenced a human, animal or inanimate object, did the number of semiotic strategies vary? The generalised linear mixed effects model confirmed that they did. The main effect of referent status showed that the first mention of a referent is phonologically heaviest, followed by reintroduced and maintained. The main effect of animacy indicated that human referents (e.g. the boy, the villagers) received the least number of strategies in comparison to animals and inanimate objects. Inanimate referents (e.g. tree, rock) received more strategies than human referents, but less strategies than animal referents. Animal referents (e.g. the bees, deer) received the greatest number of strategies overall. Finally, there was a significant interaction between animacy and activation status. There were significantly more strategies used for reintroduced animal referents. For example, the average number of semiotic strategies used to reintroduce the deer were higher compared to the average number of strategies used to reintroduce the trees or the boy. This indicates animal referents were heaviest when they were being reintroduced rather than in their first mention or while being maintained. Inanimate reintroduced referents were expressed with fewer strategies (Fig. 5).

Table 5
Main effects and interactions: number of semiotic strategies.

| Fixed effects and interactions	β	t	p
(Intercept, i.e. Maintained Human)	1.30	9.29	< 0.001
Referent Status = New	0.93	8.33	<0.001
Referent Status = Reintroduced	0.45	9.95	<0.001
Animacy = Animal	0.49	3.13	0.005
Animacy = Inanimate	0.30	2.08	0.05
Narrative type = Wolf	−0.06	−0.53	0.63
Animal x Reintroduced	0.21	3.13	0.002
Inanimate x Reintroduced	−0.26	−3.06	0.002
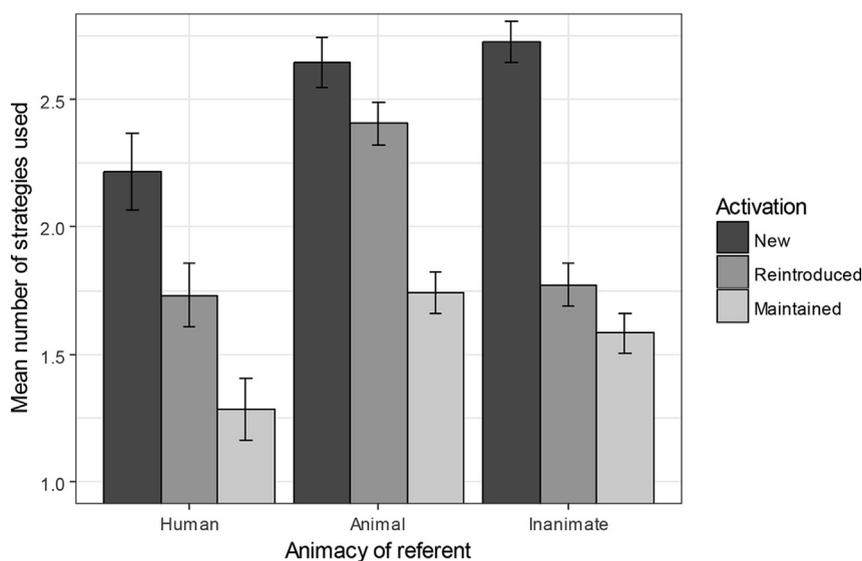
**Fig. 5.** Interactions of animacy and referent status on number of semiotic strategies.

4.2. Method for undertaking clustering analysis of referring expressions

The literature also suggests that 'more informative' referring expressions are used to express referents that are less cognitively salient (see §1). As a measure of informativeness, here we describe and categorise the underlying covariation of the semiotic strategies used in the 4,699 tokens of referring expressions, and two factors which potentially regulate them (activation status and animacy). This was done using hierarchical clustering on Principle Component Analysis (PCA, Lê et al., 2008). The PCA method allows categories to be sifted out from the variability of the dataset. This process is akin to panning for gold and then identifying the alloys. After the category has been identified, a hierarchical clustering solution classifies the properties in this category according to its composition. For example, if we find four gold nuggets in our pan, we also want to know which alloys make up each nugget − such as silver and copper yielding a reddish gold nugget.

As the generalised linear mixed effects model reported in §4.1 confirmed a lack of main effects for narrative text, the *Frog* and *Wolf* datasets were combined for the clustering analysis. PCA was computed first to reduce the multiple co-occurrence of tagged semiotic strategies to a small set of underlying factors not *a priori* specified. This allowed us to determine whether we could identify interpretable dimensions of semiotic strategy variation, and the relationships between these dimensions (Levshina, 2015: 365). A correlation table of semiotic strategies by item was calculated and we observed that 11 of the 13 semiotic strategies coded (see Table 1) correlated at greater than an absolute value of 0.3 with at least one other strategy, and no correlations exceeded 0.9. A Bartlett's test of sphericity was significant ($\chi2$ (78) = 510.83, $p < 0.005$), indicating that even though some values (i.e. tokens of VISIBLE SURROGATE and INDICATING VERBS) had low overall correlation, each tagged strategy shared some common variance with the other strategies. Component analysis was therefore suitable with all 13 strategies tagged in the data.

Eigenvalues indicated that the first four components explained 18%, 14%, 10% and 9% of the variance. The remaining components explained ~6% of the variance each. This four-component solution explained 52% of the variance and was preferred because: (a) the eigenvalues leveled off after four components, and (b) the subsequent components were difficult to interpret (Fig. 6). While the main function of the PCA analysis was to identify groupings of semiotic strategies, and not to additionally describe the properties of the referents that they are used for, we can still see that the first component (Dim 1) patterned around referent status and the second component (Dim 2) patterned around animacy (Fig. 7).

Hierarchical clustering allowed us to better ascertain the interaction of these now largely uncorrelated groupings of semiotic strategies (components) as clusters of referents with related underlying semantic properties (clusters). Our hierarchical clustering on the four-component PCA with 123 selected referents[4] was computed using Euclidean distance and Ward agglomerative clustering, which prioritizes the generation of interpretable compact clusters (Fig. 8). We cut the resulting dendrogram at four clusters because this solution had the highest inertia (Fig. 6). Inertia is a measure of the within-class variability compared to the between-class variability. High inertia values indicate that the members of a cluster are very likely to occur together.
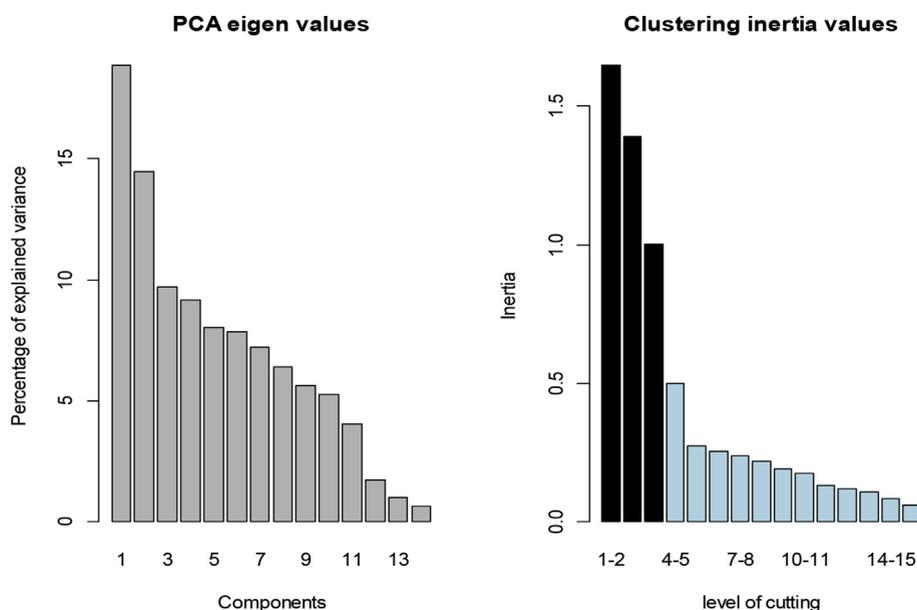

Fig. 6. Contributions of (a) PCA eigenvalues and (b) inertia for hierarchical clustering.

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[4] This number is higher than the values in §3.5 because new referents were counted as separate from maintained, reintroduced, and uncertain. This distinction was made because each could be expressed using different semiotic strategies.

Concentration of activation categories   **Concentration of animacy categories**
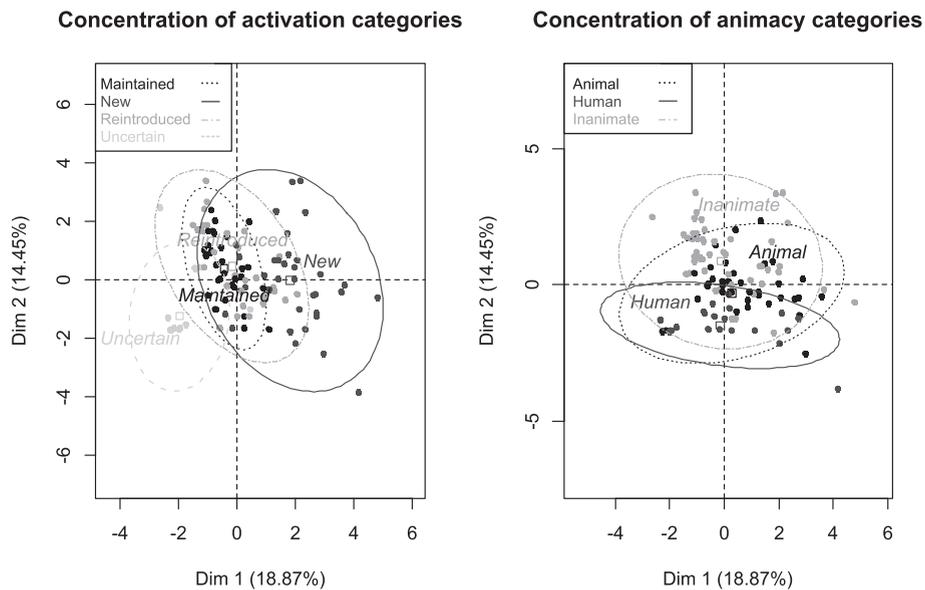
Fig. 7. Confidence ellipses around center of categories for Principle Components 1 and 2.
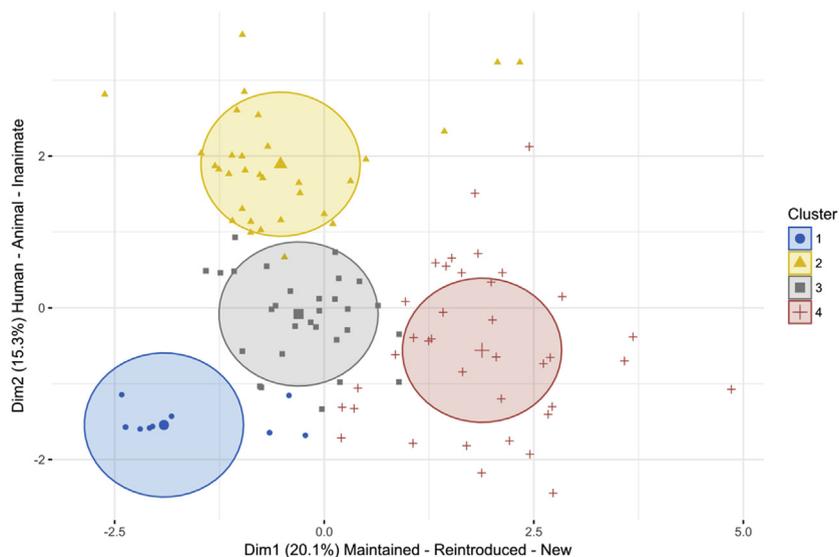

Fig. 8. Factor map of clustering solution (circles show the Euclidean distance from cluster centers at a 95% confidence level).

4.3. Clustering analysis of referring expressions with semiotic composition

The most common tag in cluster 1 (Fig. 8) was UNCERTAIN, denoting that identification of these referents was uncertain (i.e. 1.6% of all tokens, see Table 3). UNCERTAIN occurred in 0.75 of referring expressions in cluster 1 compared to 0.16 in the entire sample. While these tokens could have been excluded as 'noisy', we decided it was more important to be systematic about our coding practice and analysis, which involved quantifying uncertain tokens and treating them separately from tokens that are unambiguous and clear. We therefore kept instances of both intended referent uncertainty and semiotic strategy uncertainty, so that confident claims are made about confident data, and not a mix of confident and unconfident data.

Interestingly, the other tags occurring in cluster 1 (at very low levels) are ENGLISH MOUTHING, VISIBLE SURROGATES, INVISIBLE SURROGATES and WEAK-HANDED SIGNS — all of which denote strategies which can potentially be articulated or produced less clearly than LEXICAL

NP, FINGERSPELLING, DEPICTING SIGNS or LEXICAL SIGNS (none of which occur in this cluster). Uncertainty therefore patterns in predictable ways in this data set, and these patterns mirror the properties of different semiotic strategies: it is more difficult to confidently identify less conventionalised strategies compared to more conventionalised strategies, at least during the acts of interpretation required for annotating the data. This pattern aligns with our understanding of the function and use of diverse semiotic strategies for describing, indexing and depicting (see §2). It is a further question if these observations hold for the retelling events as they unfolded in real time between signers.

The most common tag in cluster 2 was DEPICTING SIGNS, which occurred in 0.71 of referring expressions in cluster 2 compared to 0.30 in the entire sample, followed by INVISIBLE SURROGATES which occurred in 0.44 of referring expressions in cluster 2, compared to 0.29 in the entire sample. This cluster also contained WEAK-HANDED SIGNS, ENGLISH MOUTHING, LEXICAL SIGNS, POINTING, UNCERTAIN tokens, VISIBLE SURROGATES and LEXICAL NP at lower levels. The most common tag in cluster 3 was INVISIBLE SURROGATES. These occurred in 0.50 of the referring expressions in cluster 3 compared to 0.29 in the entire sample, followed by VISIBLE SURROGATES which comprised 0.22 in cluster 3 compared to 0.08. This cluster also contained ENGLISH MOUTHING, DEPICTING SIGNS, WEAK-HANDED SIGNS and the only co-occurrences of INDICATING VERBS and LEXICALISED DEPICTING SIGNS.

The most common tag in cluster 4 was ENGLISH MOUTHING which occurred in 0.74 of these referring expressions, compared to 0.33 in the entire sample, followed by Auslan LEXICAL SIGNS which occurred in 0.57 in cluster 4, compared to 0.25 in the entire sample. This cluster also contained occurrences of POINTING, FINGERSPELLING, INVISIBLE SURROGATES, LEXICAL NP, WEAK-HANDED SIGNS and UNCERTAIN tokens. See Fig. 8 for a factor map of the four clusters and their dimensions, and Table 6 for a full listing of the tags in each cluster. The occurrence of WEAK-HANDED SIGNS in all clusters indicates weak-handed semiotic strategies are used in all environments, and that sometimes articulation is not clear (i.e. cluster 1). As the weak hand is mainly used to articulate pointing and depicting signs in referring expressions in this dataset, this suggests that signers primarily use their weak hand to create figure-ground depictions in the signing space.

Table 6
Co-occurrence of semiotic strategies within the four clusters following HPCA.

Strategy	Cluster	Mean occurrence in cluster	Overall mean occurrence	*p*-value
UNCERTAIN	1	0.75	0.16	<0.005
ENGLISH MOUTHING	1	0.02	0.34	<0.005
VISIBLE SURROGATES	1	0.02	0.08	0.050
INVISIBLE SURROGATES	1	0.01	0.29	<0.005
WEAK-HANDED SIGNS	1	0.01	0.12	<0.005
DEPICTING SIGNS	2	0.71	0.30	<0.005
INVISIBLE SURROGATES	2	0.44	0.29	0.001
WEAK-HANDED SIGNS	2	0.34	0.12	<0.005
ENGLISH MOUTHING	2	0.20	0.33	<0.020
LEXICAL SIGNS	2	0.11	0.25	0.002
POINTING	2	0.06	0.19	0.002
UNCERTAIN	2	0.05	0.19	0.002
VISIBLE SURROGATES	2	0.02	0.08	0.018
LEXICAL NP	2	0.01	0.06	0.041
INVISIBLE SURROGATES	3	0.50	0.29	<0.005
VISIBLE SURROGATES	3	0.22	0.08	<0.005
ENGLISH MOUTHING	3	0.21	0.33	0.020
DEPICTING SIGNS	3	0.17	0.30	0.013
INDICATING VERBS	3	0.12	0.07	0.023
LEXICALISED DEPICTING SIGNS	3	0.01	0.04	<0.005
WEAK-HANDED SIGNS	3	0.05	0.12	0.016
ENGLISH MOUTHING	4	0.74	0.33	<0.005
LEXICAL SIGNS	4	0.57	0.25	0.003
POINTING	4	0.30	0.19	0.003
FINGERSPELLING	4	0.18	0.10	0.001
INVISIBLE SURROGATES	4	0.18	0.29	0.003
LEXICAL NP	4	0.15	0.06	0.003
WEAK-HANDED SIGNS	4	0.05	0.12	0.016
UNCERTAIN	4	0.01	0.16	0.002

4.4. Clustering analysis of referring expressions with referent status and animacy

When combined with the referent types (e.g. boyNEW, frog, holeREIN) and the classifications of activation status and animacy, a very close correspondence between the class of the variable and the cluster in which referents occurred was found (see Table 7 for examples of the most central members of each cluster and their distance from the center point of their cluster). In cluster 1, the most central and common members were human referents tagged UNCERTAIN. In cluster 2 they were primarily inanimate maintained referents depicted or indexed via DEPICTING SIGNS and INVISIBLE SURROGATES. In cluster 3 they were primarily human and animal maintained referents depicted via INVISIBLE SURROGATES and VISIBLE SURROGATES. In cluster 4 they were

primarily new referents typically encoded using fully conventionalised semiotics such as ENGLISH MOUTHING and LEXICAL SIGNS, although less conventional semiotics such as POINTING were also used.

Given the attention that pointing signs have received in the signed language literature (and their supposed importance for doing reference), as well as the importance of pronouns for doing reference in spoken languages, we took a closer look at the distribution of POINTING SIGNS in the data. We modeled the frequency of pointing in our dataset using linear mixed effects with animacy and reference status as fixed effects and subjects and referents as random effects in the same way as §4.1. We found that animal ($\beta = -0.23$, $t = -2.47$, $p = 0.02$) and inanimate ($\beta = -0.22$, $t = -2.52$, $p = 0.02$) referents received less tokens of pointing than human referents. We also found that maintained referents have fewer tokens of pointing than new referents ($\beta = -0.12$, $t = -8.01$, $p < 0.005$), but there is no significant difference for pointing between reintroduced and new referents ($\beta = -0.02$, $t = -1.35$, $p =$ n.s.). This suggest that signers primarily used pointing signs to introduce or reintroduce human referents in these narratives (see §5.2 for further discussion). Many of these pointing signs functioned as determiners (e.g. PT:DET BOY, lit. 'the/that boy') rather than pronominally.

Overall these results indicate that the co-occurrence of semiotic strategies was moderately internally consistent and correlates to several semantic factors. Namely, conventionalised strategies such as lexical manual signs, English fingerspelling and/or mouthing are typically used to introduce new referents, regardless of animacy distinctions and often in combination with less conventionalised strategies. English mouthing is used across the board, as the hands and mouth are separate articulators. Both humans and animals are frequently maintained or reintroduced via visible and invisible surrogates. In other words, once these referents are introduced, lexical manual signs and pointing signs are not typically used to reference humans and animals, although English mouthing and other strategies may continue to play a role. Inanimate objects are frequently maintained or reintroduced using depicting signs, invisible surrogates and weak-handed signs, i.e. semiotic strategies in which the handshape can depict physical characteristics of entities, sometimes in conjunction with lexical signs and English mouthings, or where a confluence of indexing actions enables interactants to pretend there is some entity located in the signing space and behave as if it is present. Pointing signs are rarely used to reference animal, inanimate or maintained referents, and visible surrogates are not used for inanimate referents at all. Even though it is certainly possible to visibly enact inanimate objects and there may be good reasons for doing so (see e.g. Fig. 4 above), signers did not enact objects such as the jar, log or pasture in these retellings.

Table 7
Examples of the most central members of each cluster described by feature.

Referent	Cluster	Animacy	Referent status	Distance
Cluster 1: UNCERTAIN				
boyf?	1	human	uncertain	0.71
boywREIN?	1	human	uncertain	0.71
villagersREIN?	1	human	uncertain	0.67
boyw?	1	human	uncertain	0.47
villagers?	1	human	uncertain	0.34
Cluster 2: DEPICTING SIGNS and INVISIBLE SURROGATES				
hole1	2	inanimate	maintained	0.69
logREIN	2	inanimate	reintroduced	0.55
hole2	2	inanimate	maintained	0.52
log	2	inanimate	maintained	0.44
jar	2	inanimate	maintained	0.42
Cluster 3: VISIBLE SURROGATES and INVISIBLE SURROGATES				
parentfrogs	3	animal	maintained	0.92
frog	3	animal	maintained	0.90
villagers	3	human	maintained	0.80
sheep	3	animal	maintained	0.71
owl	3	animal	maintained	0.63
Cluster 4: ENGLISH MOUTHING and LEXICAL SIGNS				
sheepNEW	4	animal	new	0.95
grassNEW	4	inanimal	new	0.94
frogNEW	4	animal	new	0.89
windowNEW	4	inanimate	new	0.82
frogREIN	4	animal	reintroduced	0.66

4.5. Summary of results of linear modeling and principal components analysis

In this study, we asked whether factors in addition to information management influence signers' choice of referring expressions. Taking the total number of semiotic strategies in each referring expression as a measure of phonological heaviness, a generalised linear mixed effects model confirmed that both activation status and animacy have a significant effect on the number of strategies used by signers in each referring expression. Signers use significantly more semiotic strategies for referents that are not cognitively salient, i.e. new referents, and fewer strategies for referents that are more cognitively salient, i.e. reintroduced or maintained referents (in that order). Furthermore, animate non-human referents (e.g.

animals such as the dog, frog, wolf) were expressed using the greatest number of strategies, followed by inanimate referents (e.g. objects such as the jar, log, pasture). Human referents (i.e. the boy, the villagers) receive the least number of strategies overall. However, we also found that animate referents (both animals and humans) tend to be phonologically heavier than inanimate referents when they are reintroduced, in contrast to their first introduction where they tend to be equally heavy. These findings hold even when individual preferences for using particular semiotic strategies and different referents are accounted for as crossed random effects.

This pattern is mirrored by the tendency for the use of conventionalised semiotics within referring expressions to decrease as activation progresses from new to reintroduced to maintained. Exploratory analysis using hierarchical clustering on principal components confirmed choice of semiotic strategy was most strongly motivated by activation status: new referents were expressed with more conventionalised forms (especially lexical manual signs and English mouthing), whereas reintroduced and maintained referents typically involved fewer and less conventionalised/more contextually-dependent semiotics (especially depicting signs, visible surrogates and invisible surrogates). However, silent mouthing of English words (a fully lexical, conventionalised strategy) is used across the board, and is much more common than fingerspelling English words, although one-to-one correspondences with depicting signs are less likely.

If we take the distribution of semiotic strategies across referring expressions as a measure of informativeness, and if we accept that strategies of depiction (e.g. the token depicting signs and visible surrogates coded here) enable signers to express richly detailed information (e.g. by depicting an action rather than describing it), it is not necessarily the case that new referents always contain 'more information' than maintained or reintroduced referents. The use of depiction and the availability of space to Auslan signers — and humans communicating face-to-face more generally — means that rich and vivid information content can be a quality of any and all referring expressions regardless of activation status. There is also the fact that English mouthing can be used simultaneously with any of these strategies at any time. These findings therefore challenge earlier claims about the interaction between informativeness and activation status.

Finally, the importance of both activation status and animacy identified by the generalised linear mixed effects modelling corresponds nicely to the patterns exhibited in clusters 2, 3 and 4 produced by the principal component analysis. Together these two different types of statistical analyses (one confirmatory, one exploratory) indicate that both activation status and animacy were significant predictors for the realisation of semiotic strategies across referring expressions in this dataset. In other words, animacy was a significant motivating factor influencing the semiotic strategies signers used to compose these referring expressions: once introduced into the narrative discourse, humans and animals were often depicted via visible surrogates (not pointing signs), whereas inanimate objects favoured depicting signs and invisible surrogates.

5. Discussion

5.1. Overall comparison to the signed and spoken language literature

We now discuss these patterns for doing reference and relate our findings to previous work. Overall, statistical exploration of 4,699 tokens of referring expressions identified in the Auslan data confirms that information management is a crucial factor influencing signer's choice of referring expression, especially with respect to phonological heaviness. Bearing in mind that earlier studies of referencing in deaf signed languages have not typically considered the role of mouthing from the ambient spoken language and/or the use of invisible surrogates for doing reference, this finding reflects what the Chafe/Givón program has found quite consistently for both signed and spoken languages. In this respect, the Auslan data analysed here aligns with earlier descriptions of how deaf signers do reference (e.g. Engberg-Pedersen, 1993; Ahlgren and Bergman, 1994; Janzen, 1999; Morgan, 2006; Cresdee, 2006; Perniss, 2007; Frederiksen and Mayberry, 2016).

The data also align with findings resulting from investigations of speaker's multimodal narratives (Levy and McNeill, 1992; McNeill and Levy, 1993; Gullberg, 2003, 2006; Parrill, 2010; Debreslioska et al., 2013) and the direct comparison of DGS and German gesture-with-speech ensembles (Perniss & Özyürek, 2014). However, it is striking that we needed more than one principle component to capture a good amount of the variation in this dataset. When the use of diverse semiotic strategies and animacy distinctions are treated as possible factors influencing signer choices, the data therefore also demonstrates the pluralistic complexity of doing reference using a deaf signed language and hints at a range of influential factors that are not yet well understood.

5.2. The role of the availability of space and use of diverse semiotic strategies

One finding of particular importance not yet quantified elsewhere using corpus data is the prevalent use of invisible surrogates for doing reference in these Auslan retellings. Specifically, for indexing referents other than the signer (or referents the signer is enacting) to some location in the signing space. This pattern attests to the embodied *origo*-guided nature of doing reference (Bühler, 1990/1934; Fricke, 2014). One recent investigation of referencing in American Sign Language (ASL) touched on this phenomenon by analysing zero anaphora resulting from lexical signs (i.e. implicatures) separately from zero anaphora resulting from 'agreement verbs' (indicating verbs) and 'constructed action' (visible surrogates) (Frederiksen and Mayberry, 2016: 65). The authors explained this may be partly why there was no difference between maintained and reintroduced referring expressions in their data, a finding which was partly replicated here, and which also aligns with earlier observations on speakers' use of 'anaphoric' space for conceptually salient referents (e.g. Gullberg, 2003, 2006).

However, it is a further question how inclusion of invisible surrogates in future analyses of signed and spoken language data might challenge previous analyses of 'pro-drop' or zero anaphora. Previous large-scale studies have not directly addressed how signers create invisible surrogates for doing reference, although other factors in addition to information management have been considered. Information management (i.e. activation status) has been found to account for variable subject presence (i.e. overt versus null subjects) in ASL, Auslan and New Zealand Sign Language (Wulf et al., 2002; McKee et al., 2011) as well as the framing of visible enactments via noun phrases in BSL (Cormier et al., 2013b). However, these studies found that other linguistic and social factors are also significant, including the influence of English, person/number, co-reference, age and gender. We suggest that a reanalysis of zero anaphora that differentiates invisible surrogates from true anaphoric reference might warrant an analysis of referencing in signed language that considers more complex factors influencing face-to-face language use. This is because inferring from 'invisible' (in which a chunk of space becomes semi-otically activated via the coordination of one or more ostensive indexical acts) is different to inferring from 'zero' (where it is the absence of ostensive acts that enables interactants to mentally keep track of who does what to whom, Hodge et al., 2018).

While reiterating the importance of lexical signs, English fingerspelling, visible surrogates, and depicting signs in narrative retellings, the data also indicate that finger-pointing is less important — and that English mouthing and invisible surrogates are more important — than previously assumed in the signed language literature. For example, while not all pointing signs in the Auslan data analysed here function pronominally, and both narratives contain only one human protagonist, this does align with recent findings about the limited role of 'pronouns' in ASL narratives (Frederickson and Mayberry, 2016: 63, cf. Perniss & Özyürek, 2014). The limited use of pointing signs in these retellings, whereby pointing is reserved for referring expressions that introduce human referents, may be a consequence of the scenic nature of the narratives and the availability of space for facilitating acts of indexing by means other than pro/nominal description. The fact that pointing was primarily used within referring expressions that introduce human referents in this dataset suggests there is a humanness factor influencing the signer's choice of this strategy, in addition to activation status. While many spoken language narratives may make extensive use of pronominal forms for established referents (see §1), the same cannot be said for the Auslan narratives analysed here — in fact, the Auslan patterns could not be more opposite.

This finding may support the case for the analysis of pointing signs as partly 'gestural' rather than akin to pronouns in spoken languages, as referencing is another area in which pointing signs do not behave like pronouns in many spoken languages (Johnston, 2013; Cormier et al., 2013a, b; see also Goldin-Meadow and Brentari, 2015), but rather more like pointing in co-speech gesture (e.g. Debreslioska et al., 2013). This case stems from observations that speakers also use their lips, hand and body to point to meaningful locations in space, in addition to (and often co-occurring with) grammaticalised spoken pronouns (see Clark, 1996; Kita, 2003). Recent corpus-based analysis of all (often plurifunctional) pointing actions (i.e. not just those with a pronominal function) produced by deaf native and near-native signers of Auslan suggests these are not fundamentally different to the co-speech pointing actions produced by hearing speakers, and so the linguistic analysis of signed language pointing as fully grammaticalized pronominal forms may not be warranted (Johnston, 2013).

However, one recent comparison of pronominal pointing in the BSL (British Sign Language) Corpus and the Tavis Smiley American English dataset found that the self- and other-directed pointing actions produced by deaf native signers of BSL are more conventionalised and reduced in form compared to those produced by hearing non-signing speakers of American English, although the function of these pointing acts requires further investigation (Fenlon et al., 2019). Note that the Auslan pointing data analysed here also aligns with another investigation of speech-and-gesture ensembles in Turkish, which is a 'pro-drop' language (Azar et al., 2018; see §1). This study found that spoken Turkish pronouns in introduced and reintroduced contexts very often occurred with manual gestures (possibly for contextual disambiguation) more often than previously found for 'non-pro-drop' spoken languages (e.g. German). This may suggest language-specific patterns for spoken pronoun and gesture ensembles (see also Wilkins, 2003, for other possible language-specific patterns of pointing). Languages with dual pronoun systems (e.g. many Australian languages that rely mainly on 'bound' pronouns, reserving 'free' pronouns for specific contrasting contexts, see Mushin and Simpson, 2008) may also display a different distribution across speech-and-gesture referencing systems.[5] It is clear that further investigations of bodily pointing actions, spoken or mouthed pronouns and their role in doing reference across diverse signed and spoken languages are necessary.

The ubiquitous yet patterned use of English mouthing is highlighted in this dataset. Even though tokens of signs of different types can be combined within referring expressions, English is always available as the mouth is a separate articulator to the hands. Even so, the data indicates that English mouthing is more likely to co-occur with fully lexical signs and English fingerspelling, rather than less conventionalised and more contextually-dependent semiotic strategies such as depicting signs. This aligns with corpus-based research attesting to the close one-to-one alignment between the silent mouthings of spoken English words and fully lexical signs of Auslan used by deaf signers in the Auslan Corpus overall (Johnston et al., 2016). It is also clear that the semiotic composition of referring expressions also depends on animacy distinctions, as seen by the strong tendency for signers to use depicting signs for referencing inanimate (and not animate) referents. This also mirrors an earlier investigation of animacy using elicitation tasks (Cormier and Smith, 2010).

The use of an exploratory statistical method also shed light on another interesting aspect of the data: less con-ventionalised semiotic strategies were more likely to be less confidently identified and analysed by the annotators. This may

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be due to constraints on form production and/or degree of conventionalisation (i.e. gradience) resulting from the different functions and uses of the various semiotic strategies included in the analysis. The former constraint would account for the presence of English mouthing (a fully conventional strategy) in the uncertain category: any deaf speech-reader will attest to the fact that spoken language mouthings are often unclear, despite their high degree of conventionality. This tendency may also reflect ambiguities that arise between interactants as the retellings unfolded in real time, as competing Gricean implicatures suggest interactants may not be clear about everything all of the time (Grice, 1975). For example, the heuristic to be as informative as required (Maxim of Quantity) may compete with the drive for brevity and order (Maxim of Manner). This relates to interactants' awareness of their common ground and knowledge about what they "could have said but didn't" (Enfield, 2009: 27). However, this finding also illustrates a limitation of the HPCA method: the clustering method effectively highlighted a property in the variability of the dataset which counts for only 1.3% of all tokens (i.e. tokens tagged as UNCERTAIN, see Table 3). Overall, we can say that the patterns of analytical uncertainty mirror the properties of different semiotic strategies in this dataset, and that ambiguity or uncertainty may be expected in both real-time language use and retrospective data analysis.

5.3. The role of animacy and humanness

Another finding of particular importance not yet quantified elsewhere using corpus data is the effect of animacy on the semiotic composition of referring expressions. In this dataset, signer's choice of referring expression significantly depends on whether the referent is a human, animal or inanimate object. Crucially, referents that are not *origo*-guided are more likely to be depicted and/or indexed to a location within the signing space (and 'away' from the signer's body), particularly once referents have been introduced and signers need less time and effort to reference them. This aligns with recent corpus-based findings regarding the importance of the non/humanness of referents in both signed and spoken languages (e.g. Everett, 2009; Haig and Schnell, 2016; Meir et al., 2017) and character versus observer viewpoint (e.g. Debreslioska et al., 2013). It also aligns with more general findings regarding preferences for person reference (e.g. see Enfield, 2013) and the influence of animacy more generally (e.g. Dahl, 2008).

For example, using a corpus of nineteen typologically-diverse spoken languages, Haig and Schnell (2016) tested Du Bois's (1987) claim for a discourse basis of ergativity and subsequent extensive claims that this pattern aligns with a specific argument realisation[6] (e.g. Dixon, 1995; Du Bois, Kumpf & Ashby, 2003). The authors found that this claim is not attested anywhere outside of Sakapultek and English. Instead, a tripartite interaction between S, A and P (where S ranges somewhere between A and P with some variation across corpora) is most common — and humanness accounts for this pattern, especially for consistently low lexicality levels in A (see also Everett, 2009). In a similar vein, it has been argued that a 'human first' principle might account for specific 'word order' patterns in emerging signed languages more comprehensively than grammatical relations or argument structure, although this study did not investigate information management specifically (Meir et al., 2017).

However, with respect to the Auslan data analysed here, it is important to note there are many more non-human (animal and inanimate) referents in these retellings compared to human referents. It is possible that the first mention of a non-human referent requires more time and semiotic material to specify, especially if there is no single Auslan lexical sign that denotes a specific referent. For example, the referent 'gopher' is a characteristically North American animal but these retellings were produced in an Australian context, where there are no gophers. In such cases, strategies of depiction are always available but may require more time and effort to flesh out for a signer who may not know about the animal in question (and/or is confused about why it is up for discussion). Other social cognition factors may also influence signer choices, whereby animate referents (once introduced) are inherently more interesting than inanimate referents as well as being more central to these narratives (which focus on actions and relationships, not objects).

5.4. The role of other factors not quantified in this study

Recall that the four-component PCA solution describes 52% of the variance in this dataset (see §4.2). The remaining nine components explained ~6% of the variance each, indicating there are other factors at play. Some obvious and potentially influential factors not quantified in this study include the syntactic function and position of referents, the viewpoint taken by the signer, the temporal distance between referring expressions, and their relevance to the discourse topic. Both the Frog and Wolf retellings have a human boy as their central character — it is a further question if the animacy patterns described above hold for narratives that have, for example, a fish or plant as the central character (see e.g. Janzen, 1999; Schnell and Barth, 2018). In such cases, the animacy distinctions noted above may be reversed, or they may not, e.g. if the referents were given some particular agency within the discourse event, possibly via enactment (see §2). Furthermore, discourse topic may be conflated with other pressures, for example, such as narrative structure and performance effect. Recall that the average number of semiotic strategies used to reintroduce the deer were higher compared to the average number of strategies used to reintroduce the trees or the boy (see §4.1). Note that the introduction of the deer occurs at a particularly climactic turn of

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[6] Whereby intransitive subjects and transitive objects introduce new referents via full noun phrases, while transitive subjects are dispreferred for this function and mostly realized as pronouns or zero (Haig and Schnell, 2016: 591).

events, whereby the boy first understands himself to be standing on a rock, which then moves. The boy then realises he is actually standing on − and holding onto the antlers − of a deer. It may be that a higher number of semiotic strategies (especially those which depict) are required to fulfil the performative and narrative expression of this part of the retelling.

This is the main reason we have refrained from suggesting a referential and/or animacy hierarchy for the Auslan data presented here − the potential effects of discourse topicality (and agency afforded to various referents) and any possible interaction with character vs. observer viewpoint (see e.g. Debreslioska et al., 2013), among other factors, should first be more rigorously investigated using other texts. It has also been suggested that local, cultural constraints such as kin relationships and other social sensitivities may influence some types of reference more so than information management (see Enfield and Stivers, 2007; Enfield, 2013). Investigation of non-narrative text types, especially dyadic conversation, should illuminate some of these sensitivities further. We do expect that the patterns for the Auslan retellings described here may vary as a function of text type and contextual use.

Other possibilities specific to face-to-face language use include the distribution of weak-handed signs, and instances of multiple referents expressed simultaneously. Further investigation of these factors may clarify any interaction of animacy and weak-handed signs, especially given the clustering of WEAK-HAND and DEPICTING SIGNS in the current analysis. It is also important to consider more thoroughly the effects of the specific elicitation task, especially the real-world relevance of referents and whether the referents present in the elicitation stimulus (i.e. the Frog and Wolf stories) have corresponding lexical forms used by deaf Auslan signers. For example, the lexical sign FROG is widely known to Auslan signers, but there are no conventionalised forms for 'gopher', 'hole', 'log' or many other (mostly inanimate) referents present in the Frog and Wolf stimulus.

Conversely, it may be that there are certain elements that signers do not need to elaborate on as much given their real-world knowledge of certain referents. For example, given the context of the Frog narrative, if a signer points to an imagined glass jar, interactants may be more likely to assume that the referent inside the jar cannot be the boy or the dog, but must be the frog. It is also important to consider the location of specific referents within the signing space, and if/how these locations change over time. We expect such a study would show that (contrary to popular pedagogy) signers frequently move referents from one location to another in the signing space, depending on the scenic and action qualities of the event they are expressing, and how they want to express it. We hypothesize that animate referents may be more 'spatially mobile' than inanimate referents, by dint of their active agency (or possibly the agency that signers give them, see e.g. the boiling egg example in Fig. 4).

6. Conclusion

The immediate experience of jointly understanding who did what to whom during a signed interaction may be characterised as a sense of flow − a state of complete absorption in the activity at hand (Csikszentmihalyi, 1990) − as if the imagined world induced by one's signing is temporarily inhabited by the other. Statistical analysis of 4,699 tokens of referring expressions in forty Auslan retellings illustrates how this is achieved through skilful coordination of diverse semiotic strategies for describing, indexing and depicting within the multi-dimensional signing space (Johnston, 1996; Ferrara & Hodge, 2018). In addition to information management, we have systematically shown that the availability of space, the use of diverse semiotic strategies and the role of animacy are important organizing principles for doing reference in a deaf signed language. The exact semiotic composition of referring expressions depends on both the cognitive saliency and animacy of referents, in addition to the diverse semiotic strategies available to signers in their face-to-face interactions and their degree of conventionalisation. In particular, a diverse semiotic repertoire enables signers to produce richly informative expression at any stage of discourse. The data show that by coordinating different strategies for describing, depicting and indexically enriching their signing space, signers co-create their imagined conceptualisation of the discourse event − one that is anchored to the embodied origo of the signers, the coordinate system established by their space, time and person (Bühler, 1990/1934; see also Diessel, 2012; Fricke, 2014). However, the use of confirmatory and exploratory statistical methods has also indicated that these factors alone do not explain the full variability of referring expressions within this dataset. Other possibly influential factors, some of which not yet well understood, must also be considered in future. Together these findings highlight the role of animacy in signed language discourse and challenge the claim that informativeness decreases as cognitive saliency increases, while demonstrating the 'pretend world' indexicality of signed language use and the pluralistic complexity of face-to-face communication.

Author attribution statement

GH and LF conceptualized the study, annotated the corpus data, checked each other's annotations, and detailed the theoretical argumentation. BA conceptualized and operationalised the statistical methods, wrote the R scripts, and created the OSF deposit. GH wrote 65% of the manuscript, BA wrote 25% and LF wrote 10%. All authors revised the reviewed manuscript.

Declarations of interest

None.

Acknowledgements

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.pragma.2019.01.025.

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