Title:

Anaphoric demonstratives occur with fewer and different pointing gestures than exophoric demonstratives

Abstract:

This study investigates the co-organization of place-referring demonstratives (e.g. *here/there*) and pointing gestures by speakers of Ticuna. Ticuna is an Indigenous Amazonian language with a six-term demonstrative system which lexically distinguishes exophoric demonstratives (equivalent to *there far from me*) from anaphoric demonstratives (equivalent to *there where I mentioned*). This lexical contrast overlaps with, but is distinct from, the pragmatic contrast between new and previously mentioned referents. Drawing on a dataset of 742 demonstrative place references, we examine how both contrasts affect the rate and form of pointing gestures accompanying demonstratives. Pointing gestures were ubiquitous, occurring with 66.5% of demonstrative tokens. Ticuna participants pointed more often with exophoric demonstratives and with demonstratives that introduced new referents, but still pointed with a substantial minority of anaphoric demonstratives. Participants were also more likely to use index-finger handshapes with exophoric demonstratives, and to use full arm extension with demonstratives introducing new referents. These findings indicate both lexical and information-structural factors affect the co-organization of pointing and demonstratives.

Keywords: Demonstratives; Deixis; Anaphora; Pointing; Indigenous Languages

Word count (excludes abstract and references): 10,339

1 Introduction

Demonstrative words, such as *this/that* and *here/there*, have an exceptional relationship with pointing gestures. For example, children combine demonstrative words with pointing before they combine words with each other (Capirci et al. 1996; Iverson & Goldin-Meadow 2005). Adults "co-organize" their production of demonstrative words and pointing, varying their demonstrative choice with the presence and precision of pointing (Cooperrider 2016; Peeters & Özyürek 2016). And signed languages often employ pointing signs as demonstratives (Cooperrider & Mesh 2022).

All of these statements apply to demonstratives in **exophoric** uses, where they pick out referents in the physical surroundings of the discourse. But many demonstratives also have **anaphoric** uses, where they pick out referents from the discourse itself. While demonstratives overall are associated with high gesture rates, anaphora and givenness are associated with low gesture rates and reduction of gesture form (Perniss & Özyürek 2015; Azar & Backus & Özyürek 2019; Debreslioska & Gullberg 2019; Holler et al. 2022). This raises questions about the relationship between anaphoric demonstratives and gesture. Do anaphoric demonstratives behave like other demonstratives, occurring with many gestures? Or do they behave like other anaphoric devices, occurring with fewer, articulatorily reduced gestures?

In response to these questions, we empirically investigate the effects of demonstratives' phoric type, or exophoric vs. anaphoric status, on co-occurring pointing gestures. Specifically, we examine 742 demonstrative place references by speakers of Ticuna, an Indigenous Amazonian language. Ticuna has a large demonstrative system with a total of six place-referring terms. Table 1 introduces the paradigm of demonstratives, which is discussed further in §3.

Table 1.

The Place-Referring Demonstratives of Ticuna.

Demonstrative	Paraphrase	Form (Allative Case)
Speaker-Proximal	'here near me'	nu^{5}a^{2}
Dyad-Proximal	'here between us'	ŋe^{5}a^{2}
Speaker-Distal	'there far from me'	ɟe^{5}a^{2}
Regional	'here around me'	nu^{5}ma^{2}
Anaphoric	'there, anaphoric'	ŋe^{5}ma^{2}
Past Anaphoric	'there, anaphoric'	ɟe^{5}ma^{2}

As shown in Table 1, the Ticuna demonstrative system lexically contrasts anaphoric demonstratives with exophoric (e.g. speaker-proximal, speaker-distal) ones. This allows us to identify the phoric type of demonstratives more precisely than is possible in languages with smaller systems. It also allows us to distinguish between the phoric type of a demonstrative and the information status (new vs. previously mentioned) of its referent.

To preview the findings, we show that – while Ticuna speakers pointed less with anaphoric demonstratives than with exophoric ones – they used much more pointing with anaphoric references than the literature on demonstratives predicts. Additionally, speakers pointed less with demonstratives that indexed previously mentioned locations – whether they were exophoric or anaphoric – than with demonstratives that introduced discourse-new locations. Furthermore, across both points occurring with anaphoric demonstratives and points indexing previously mentioned referents, speakers displayed articulatory reduction in pointing form.

2 Background on Demonstratives and Co-Demonstrative Gestures

2.1 Demonstrative Semantics and Phoric Type

Demonstratives are traditionally divided into two main categories: exophoric and anaphoric (see e.g. Diessel 1999; Levinson 2018; Peeters & Krahmer & Maes 2021). A demonstrative's status as exophoric or anaphoric is its phoric type (Botley & McEnery 2001). In

some demonstrative systems, phoric type is exclusively contextual. For instance, in English, each demonstrative (*this/that, here/there*) displays both exophoric uses (*Stand over <u>there</u>*) and anaphoric ones (*When Angel came into the room, Victoria was already <u>there</u>*). This means that the phoric type of a given demonstrative token – whether it picks out a referent from the physical surroundings vs. from the discourse – must be inferred from context.

But in many other languages, including Korean (Ahn 2017: 41–42), Romanian (Ahn 2022), Yucatec Maya (Hanks 1990: 448–455), Tzeltal Maya (Brown & Levinson 2018), and several unrelated Amazonian languages (Guirardello-Damian 2018; Herrmann 2018; Meira 2018; Skilton 2019), phoric type is lexical. In these systems, some demonstratives are exclusively exophoric, always requiring a particular spatial relationship between the discourse participants and referent. Other demonstratives are exclusively anaphoric. They convey nothing about the spatial relationship between the participants and referent, only that the referent has been previously mentioned.

The Yucatec Maya discourse in (1), reproduced from Hanks (1990: 451), illustrates the alternation between lexically exophoric and anaphoric demonstratives over a discourse. In (1a), the speaker uses the exophoric demonstrative circumclitic *téʔel…aʔ* 'here/there (exophoric immediate)' to refer to his motion goal, a cave in the surroundings. In (1b), he refers to the same location again with the anaphoric demonstrative *tíʔ…iʔ*.

(1) a. **téʔ** aáktun kén impul le b'áʔal **aʔ**

'**There (where I'm going)** in a cave will I dispose of this thing,'

b. **tíʔ** kint'aŋk **iʔ**

'**There (anaphoric)** is where I address it.'

The Ticuna discourse in (2), from this study's dataset, shows a parallel example of shift from lexically exophoric to anaphoric demonstratives. In (2a), the speaker uses the exophoric demonstrative *ɟe⁵a²* 'there (distal),' in a syntactic focus (cleft) construction, to introduce a new referent. In (2b), she refers to the same referent again. This time, instead of exophoric *ɟe⁵a²* 'there (distal),' she uses the anaphoric demonstrative *ŋe⁵ma²* 'there (anaphoric),' again in a cleft.

(2) Context: 'Yesterday, because we didn't have the running water turned on yet...'

a. **ɟe⁵a²**ã⁴ma⁴ Kɨ³ʔtʃi³tu¹tʃi⁵ĩ¹wa⁵ ni⁴¹ʔĩ⁴ tʃa¹ɟau¹ʔtʃi⁵ru²ʔ

ɟe⁵a²=ã⁴ma⁴ Kɨ³ʔtʃi³tu¹=tʃi⁵ĩ¹=wa⁵ ni⁴¹ʔĩ⁴ tʃa¹=ɟau¹ʔ=ʔtʃi⁵ru²=ʔ

DEM:DISTAL=toward Cushillococha=liquid=ALL FOC 1SG.SC=wash=clothes=SUB

'It was **THERE (far from me),** in the Cushillococha lake, that I washed clothes.'

b. tʃa¹rɨ³ʔi³¹e²ʔĩ⁴, tɨ³re¹wa⁵, **ŋe⁵ma²** ni⁴¹ʔĩ⁴ ta¹ɟau¹ʔtʃi⁵ru²gɨ⁵ʔ

tʃa¹rɨ³ʔ=i³¹e²=ʔĩ⁴ tɨ³re¹=wa⁵ **ŋe⁵ma²** ni⁴¹ʔĩ⁴

1SG.SUB=go.toward.water=SUB port=ALL **DEM:ANAPHOR** FOC

ta¹=ɟau¹ʔ=ʔtʃi⁵ru²=gɨ⁵=ʔ

1EXCL.SUB=wash=clothes=PL=SUB

'I went down to the port; it was **THERE (anaphoric)** that we washed clothes.' (LGC)

As the translations of (1) and (2) illustrate, the English demonstrative system does not make the distinction in phoric type that Ticuna and Yucatec do, instead using *there* for both distal exophoric functions and anaphoric ones. Thus, in English and other languages where phoric type is contextual, it is often ambiguous whether a given demonstrative token makes exophoric (especially distal) vs. anaphoric reference (Botley & McEnery 2001). But in demonstrative systems where phoric type is lexical, there is no such ambiguity. These systems

therefore offer an ideal environment for analyzing the effects of phoric type on other properties of demonstrative reference.

2.2 Phoric Type vs. Information Status

In demonstrative systems where phoric type is lexical, it is essential to distinguish the phoric type of a demonstrative from the **information status** of the demonstrative's referent. In these languages, information status constrains the inventory of possible demonstratives for every reference, since lexically anaphoric demonstratives cannot index new referents. But this does not mean that information status deterministically **controls** demonstrative choice. All anaphoric demonstratives have previously mentioned referents, but exophoric demonstratives can have either discourse-new or previously mentioned referents.

The Ticuna example in (3) illustrates this. In line (3a), the speaker uses the lexically exophoric demonstrative *nu⁵a²* 'here (near me)' to make the first mention of the referent location. In (3b), she uses the same demonstrative again, this time in a cleft, for the same referent.

(3) Context: 'Where do you go to wash clothes?'

a. **nu⁵a²**ta²ã⁴, pa² tʃau¹e³ɟa̰¹

nu⁵a²=ta²ã⁴		pa²	tʃau¹=e³ɟa̰¹
DEM:PROXIMAL=exactly		VOC	1SG=sister

'Right **here**, sister (pointing to an outdoor tap),'

b. **nu⁵a²**ta²ã⁴ ni⁴¹ʔĩ⁴ tʃa¹ɟau¹ʔtʃi⁵ru²ʔ

nu⁵a²=ta²ã⁴		ni⁴¹ʔĩ⁴	tʃa¹=ɟau¹ʔ=ʔtʃi⁵ru²=ʔ
DEM:PROXIMAL=exactly		FOC	1SG.SUB=wash=clothes=SUB

'RIGHT **HERE** is where I wash clothes.' (LGC)

The token of the speaker-proximal *nu⁵a²* 'here near me' in (3a) introduces a new referent and the token in (3b) refers to an old one, but in both cases the referent is picked out from the surroundings rather than the discourse – that is, the demonstrative is exophoric, not anaphoric. Although the authors do not highlight the contrast between phoric type and information status, similar examples of multiple successive references with exophoric demonstratives also occur in Yucatec (Hanks 1990: 419) and Tzeltal (Brown & Levinson 2018: 167). Another example is the English translation of (3). In (3b), *here* has a discourse-old referent, but it is still exophoric: this discourse would be infelicitous in English if the referent was not near the speaker and did not meet the spatial requirements of *here*.

2.3 Co-Demonstrative Gesture

Gesture researchers classify co-speech gestures into four main categories: pointing gestures, iconics, emblems, and beats (McNeill 1992). Pointing gestures identify a referent by projecting a vector from the speaker's body to the referent. Many pointing gestures occur with demonstratives. We refer to these as "co-demonstrative" pointing gestures (Cooperrider 2023), and we refer to the combination of a pointing gesture and a demonstrative as a "demonstrative composite utterance" (Enfield 2009). To define the other types, iconic gestures depict the appearance of a referent; emblems are conventional forms such as shaking the head for negation; and beats are non-referential gestures aligned with prosodic boundaries. These other gesture types are not completely mutually exclusive with pointing: for example, pointing gestures can have iconic handshapes (Cooperrider & Mesh 2022).

2.3.1 Gesture and Phoric Type

Research on demonstratives proposes a close relationship between the phoric type of a demonstrative and the use of co-demonstrative pointing gestures. For example, in a well-known

typological study, Diessel (1999) – focusing on languages where phoric type is contextual – argues that the exophoric use of demonstratives represents "the only use that is commonly accompanied by a pointing gesture" (p. 111). Elsewhere, he asserts the opposite about anaphoric uses: they "are usually not accompanied by a pointing gesture" (Diessel 2006: 476). Diessel's arguments on this point do not distinguish between nominal or entity-referring demonstratives (e.g. *this, that*) and locative or place-referring ones (e.g. *here, there*).[1]

Researchers in formal semantics make less explicit claims than Diessel, but their analyses still suggest a close link between phoric type and gesture. For example, Roberts (2002) posits that the English nominal demonstratives *this* and *that* – in both anaphoric and exophoric use – presuppose that the speaker produces an accompanying "demonstration" of the referent (cf. Kaplan 1989). Exophoric uses of these demonstratives presuppose only that the speaker produces **some** demonstration, though in Roberts' examples the demonstration is always a pointing gesture or other visible behavior. In contrast, anaphoric uses of the nominal demonstratives specifically presuppose a demonstration that is part of the spoken discourse. As a result of this presupposition, Roberts' semantics for anaphoric nominal demonstratives includes no component which would allow for visible demonstrations to contribute to anaphoric reference (Roberts 2002: 119–123). Thus, Roberts' analysis suggests, but does not state outright, that anaphoric reference and pointing are mutually exclusive. Other discussions of demonstratives in formal semantics (e.g., King 2001; Wolter 2006; Nowak 2021) are similar: they analyze the relationship between pointing and exophoric demonstratives in detail, but say nothing about pointing with anaphoric demonstratives.

[1] *Here/there* and their equivalents are also called 'demonstrative adverbs.' I avoid this term for two reasons: (a) it is ambiguous between place-referring demonstratives and manner adverbs such as *thus*, and (b) in Ticuna the *here/there* equivalents are syntactically nouns, not adverbs.

Ahn (2022), on the other hand, does make explicit claims about the relationship between pointing and phoric type. In her analysis of English and Korean nominal demonstratives, Ahn first distinguishes between languages where phoric type is contextual, like English, and those where it is lexical, like Korean. English demonstratives, she argues, contain a reference argument which can be saturated by either a pointing gesture or an anaphoric index. Korean demonstratives have the same argument structure, but include lexical restrictions on the reference argument. The exophoric terms require a pointing gesture as the reference argument, while the anaphoric ones require an anaphoric index (Ahn 2022: 1389). Since this analysis treats anaphoric indices and gestures as occurring in the same argument position, it predicts that they will be mutually exclusive. Ahn accepts that prediction, though not in its strongest form: she writes that pointing is incompatible with anaphoric uses if it overlaps with the demonstrative, but may be acceptable if the gesture is made "in a casual manner" and after the demonstrative (Ahn 2022: 1365).

To summarize, within linguistic research on demonstratives, both formal and functional-typological works suggest that pointing gestures occur only with exophoric uses of demonstratives, not anaphoric ones. Some authors, such as Diessel and Ahn, make this claim explicitly. Others, including Roberts, make it implicitly – by assigning exophoric uses, but not anaphoric ones, a semantics where pointing can contribute to reference. Because Roberts (2002) and Ahn (2022) are interested primarily in comparing demonstratives to definite articles, their analyses focus on nominal demonstratives; however, Diessel's (1999; 2006) claims include both nominal and locative demonstratives.

2.3.2 Gesture and Information Status

Information status has pervasive effects on all types of referential co-speech gesture, affecting both gesture rate and gesture form. The literature on co-speech gesture has documented these effects in detail, though not specifically for demonstratives. First, when speakers describe or index previously mentioned referents, they gesture less often than with new referents. This effect is seen in rates of all gesture types in German (Debreslioska & Gullberg 2022); in iconic gesture rates in English, Georgian, German, and Dutch (McNeill & Levy 1993; Gullberg 2006; Foraker 2011; Debreslioska & Gullberg 2019); and in pointing gesture rates in Turkish (Azar et al. 2019).

Pointing signs are not entirely comparable to co-speech pointing gestures (Perniss & Özyürek 2015; Fenlon et al. 2019; Cooperrider et al. 2021). However, Auslan signers employ fewer pointing signs with previously mentioned referents (Hodge & Ferrara & Anible 2019). For DGS signers, though, information-status differences among previously mentioned referents have no effect on the frequency of pointing signs (Perniss & Özyürek 2015). Furthermore, pointing signs often function as both pronouns and modifiers; the effect of information status on frequency can differ between these functions (Grosso 2017).

Turning to gesture form, when speakers point at previously mentioned referents, or referents which their addressees can identify independent of the gesture, their points display articulatory reduction. In pointing gestures with "insecure reference" (i.e., previously mentioned referents), Lao speakers are less likely to fully extend the elbow or orient their head toward the pointing target (Enfield & Kita & De Ruiter 2007). Similarly, when English speakers and ASL signers produce pointing signs and gestures, they are less likely to fully extend the arm if the point is not "load-bearing" – that is, the addressee has other sources of information about the

referent's location (Cooperrider et al. 2021). Reduction also affects gesture duration. Dutch speakers (Peeters et al. 2015) and ASL signers (Cooperrider et al. 2021) use shorter stroke durations in pointing when their addressees can identify the target independently of gesture. Taking extension and duration as dimensions of a broader concept of visual salience, these findings indicate that increases in shared knowledge about pointing referents are associated with decreases in the visual salience of pointing gestures. This same pattern holds in both entity reference (Peeters et al. 2015) and place reference (Enfield et al. 2007).

As well as arm extension and duration, givenness and other information-structural factors may also affect handshape in pointing. Speakers of Arrernte (Pama-Nyungan) more often use "canonical index-finger pointing" for emphatic reference and on first mentions of referents that continue to be important. By contrast, for "anaphoric" (i.e., subsequent) mentions or mentions of less important entities, they more often point with the entire hand (Wilkins 2003: 193). Kendon and Versante (2003: 129, 134) echo this association between index-finger pointing and emphatic reference. They write that Neapolitan speaker-gesturers use index pointing when a "precise location is foregrounded," but use whole-hand pointing when the referent is the backgrounded source of other information, activity, or properties under discussion.

Both authors are explicit that these handshape patterns hold in both entity and place reference (Kendon & Versante 2003: 126; Wilkins 2003: 192). In place reference specifically, pointing handshapes are also affected by the contrast between reference to locations (*it's <u>here</u>*) and reference to directions (*it's <u>this way</u>*). Across many unrelated speech and gestural communities (Haviland 2003; Levinson 2003; Orie 2009; Streeck 2009; Mesh 2017), it is reported that people use the index finger to point at locations, but use the entire hand to point at directions or at entities distributed in space. Some authors argue that this pattern is iconic

(Levinson 2003); others, that it arises from the relationship between index pointing and emphasis or foregrounding (Mesh 2017).

3 Language Background

Against this background, we investigated the effects of phoric type and information status on the co-organization of demonstratives and pointing. Our data comes from speakers of Ticuna. Ticuna is an Indigenous language isolate spoken by at least 48,580 people (Eberhard & Simons & Fennig 2023) living along the Amazon River in Brazil, Colombia and Peru.

As described by Skilton (2019, 2021), Ticuna displays two sets of demonstratives: six nominal (entity-referring) demonstratives, equivalent to English *this/that*, and six locative (place-referring) demonstratives, equivalent to English *here/there.* For reasons discussed in §5.2, this study analyzes only locative demonstratives. Table 2 (repeated from Table 1) displays the citation forms of the six locative demonstratives, along with glosses and paraphrases for each form.

Table 2.

The Locative (Place-Referring) Demonstratives of Ticuna.

Demonstrative	Paraphrase	Form (Allative Case)
Speaker-Proximal	'here near me'	nu^{5}a^{2}
Dyad-Proximal	'here between us'	ŋe^{5}a^{2}
Speaker-Distal	'there far from me'	ɟe^{5}a^{2}
Regional	'here around me'	nu^{5}ma^{2}
Anaphoric	'there, anaphoric'	ŋe^{5}ma^{2}
Past Anaphoric	'there, anaphoric'	ɟe^{5}ma^{2}

We now summarize the characteristics of the locative demonstratives in Table 2, following Skilton (2019). The first four demonstratives here – the speaker-proximal, dyad-proximal, speaker-distal, and regional forms – are always exophoric. They require a particular spatial relation between the speaker and the referent location: near speaker (speaker-proximal), enclosing speaker (regional), between speaker and addressee (dyad-proximal), or far from

speaker (speaker-distal). Following these, the next form in Table 1, anaphoric *ŋe⁵ma²*, appears both in anaphoric place reference and as an exophoric demonstrative indexing places near the addressee (addressee-centered) (Skilton 2019: Chapter 4). Since no addressee-centered uses appeared in this data, we treat *ŋe⁵ma²* as lexically anaphoric. Past anaphoric *ɟe⁵ma²* is identical to anaphoric *ŋe⁵ma²*, except that it (a) occurs only in clauses with past temporal reference (Soares 2017) and (b) does not have addressee-centered or other exophoric uses. Both anaphoric *ŋe⁵ma* and past anaphoric *ɟe⁵ma²* can be coreferential with any exophoric demonstrative, showing that they have no spatial deictic content (Skilton 2019: Chapter 7). All of the demonstratives – both exophoric and anaphoric – can appear in emphatic and/or contrastive location focus, such as (2) and (3) above.

As in many languages (Diessel 1999), the Ticuna demonstratives have certain grammaticalized uses unrelated to place reference. Regional *nu⁵ma²* can be used, together with an iconic gesture, to convey the size of an object (compare English *this* in *this big*). Both of the anaphoric items, *ŋe⁵ma²* and *ɟe⁵ma²*, can function as relative pronouns and temporal connectives as well as demonstratives. As relative pronouns, the anaphoric demonstratives introduce location relative clauses which lack a nominal head, like English relative *where*. As temporal connectives, they convey temporal sequence of clauses, like *and then*. (4) gives an example of the relative pronoun use; (5) shows the temporal sequence use.

(4) Context: "We lived right here [in this part of the compound]…"

ŋʉ̃¹ʔma⁵ ta³¹ŋu³¹ ga⁴ na⁴ **ɟe²ʔma⁴** ta¹a³pe⁴³gɨ⁵ʔɨ̃⁴

ŋʉ̃¹ʔma⁵	ta³¹=ŋu³¹	ga⁴ na⁴	**ɟe²ʔma⁴**
until	1EXCL.SBJ>3OBJ=finish	PST.COMP	**DEM:PST.ANAPHOR**

ta¹=a³=pe⁴³=gɨ⁵=ʔɨ̃⁴

1EXCL.SBJ.SUB=go.and=sleep=PL=SUB

"Until we finished (the building) **where** we go in to sleep." (HCG)

(5) Context: "My grandmother and grandfather died."

Ma³ **ɟe²ʔma⁴** na⁴rɨ³ʔo² ga⁴ gu⁵ʔɨ̃⁴ma³ ga⁴ tą̃²ʔkɨ⁴.

ma³	**ɟe²ʔma⁴**	na⁴rɨ³ʔ=o²	ga⁴	gu⁵ʔɨ̃⁴ma³	ga⁴	tą̃²ʔkɨ⁴
PERF	**DEM:PST.ANAPHOR**	3SBJ=quit	PST.DET	all	PST.DET	INDEF

"**And then** absolutely everything (that I had planned) became futile." (SSG)

Relative pronoun, temporal connective, and size-related uses of locative demonstratives are distinct from true demonstrative uses because they do not index places.

4 Predictions

Combined with the language-specific facts above, the theories discussed in §2 yield two sets of predictions about the co-organization of pointing and demonstratives in Ticuna.

4.1 Predictions for Gesture Rate

Semantics and pragmatics research on demonstratives argues that gesture contributes to reference for exophoric demonstratives, but not for anaphoric ones. As a result, authors in this literature argue, anaphoric demonstratives "do not usually occur" or do not overlap with pointing, while exophoric demonstratives do (Diessel 1999; 2006; Ahn 2022). Thus, this claim predicts that Ticuna speakers will point less often when using the anaphoric demonstratives *ŋe⁵ma²* and *ɟe⁵ma²* than when using any of the four exophoric demonstratives (Prediction 1.1). Additionally, while Diessel and Ahn's claims are not expressed in quantitative terms, they suggest that the gesture rate with anaphoric demonstratives will approach zero (Prediction 1.2). While Ahn's claims specifically concern entity-referring demonstratives, Diessel's claims do not

distinguish between entity and location reference; therefore, these predictions apply to both types of reference.

Gesture studies research on information status also offers predictions about gesture rate. This literature indicates that familiar and/or discourse-old referents are associated with lower gesture rates, whether we consider iconic gestures (Debreslioska & Gullberg 2019), object-referring pointing gestures (Azar et al. 2019), or all gesture types together (Debreslioska & Gullberg 2022). These studies are specific to entity reference rather than place reference. However, if place reference patterns the same, these findings predict that referent information status will affect the co-organization of demonstratives and pointing: people will be more likely to point when introducing discourse-new referents than when referring back to previously mentioned ones (Prediction 1.3). This is a prediction about information status, not (only) about phoric type; it therefore requires us to distinguish between demonstratives with new vs. previously mentioned referents.

4.2 Predictions about Gesture Form

Gesture studies literature shows that, when people point at objects or places that are previously mentioned and/or otherwise identifiable to the addressee, they reduce the visual salience of their pointing gestures (Enfield et al. 2007; Peeters et al. 2015; Cooperrider et al. 2021). This reduction affects many different articulatory features, including stroke duration, head orientation, and arm extension. For methodological reasons, we analyze only arm extension. For this variable, we predict – following Enfield et al. (2007) and Cooperrider et al. (2021) – that speakers will be less likely to extend the arm when pointing at previously mentioned referents (Prediction 2.1).

While the reduction studies just cited are all quantitative, qualitative research also makes predictions about the relationship between information status and gesture form, specifically handshape. Ethnographers of pointing have argued that when people point at previously mentioned referents or make "anaphoric" mentions, they are less likely to use index-finger handshapes (Kendon & Versante 2003; Wilkins 2003). In a possibly related pattern, people are also less likely to use index handshapes when pointing out directions vs. when pointing at locations (e.g., Haviland 2003). Thus, we predict that Ticuna speakers will be less likely to use index-finger pointing handshapes (a) when pointing at previously mentioned referents (Prediction 2.2) and (b) when pointing indexes a direction, rather than a location (Prediction 2.3). While we express the first of these predictions in terms of information status, Wilkins' (2003) description actually contrasts "anaphoric" mentions with "first" mentions, meaning that it can also be understood as a prediction about phoric type.

5 Methods

5.1 Participants and Procedure

Six Ticuna speakers from the town of Cushillococha, Peru, aged 35 to 72 years, participated in 30-minute monolingual interviews about the town's landscape. Three participants (SSG, DGG, and ABS) were male, three (HCG, LGC, and YCG) were female. All of them were hearing, had no exposure to sign language, and spoke Ticuna as their sole first language. SSG, DGG, ABS and YCG spoke Spanish as sequential bilinguals. HCG and LGC understood some Spanish but did not speak it.

Interview questions were adapted from Kita's (2001) landscape description task. [name redacted], an L1 Ticuna speaker from Cushillococha, translated the interview guide into Ticuna and assisted the author in adapting it for the area. The interview questions prompted participants

to describe the current and historical locations of landmarks; describe locations where they had lived; give route directions; and provide eyewitness accounts of a flood.

The author interviewed all six participants in Ticuna, which she speaks well as a second language. She conducted the interviews, rather than a native-speaker interviewer, because many of the Kita locality description questions would be pragmatically odd if asked by a person from the same location as the interviewee. To avoid priming effects, prior to debrief we did not inform participants that the study concerned pointing gestures.

Interviews took place in 2017 and 2018 in Cushillococha or the neighboring town of Caballococha. They were held outdoors (or in spaces with half-walls) in and near participants' homes. Interviews were recorded in HD with one camera (2017: Sony PJR540, 2018: Canon XA30).

5.2 Speech Coding

All speech in the interviews was transcribed and translated into Spanish by the author and [names redacted], two L1 Ticuna speakers. The first five minutes of each interview were transcribed, but treated as a warmup period and excluded from all further analysis.

We identified all locative demonstrative tokens in the transcripts and coded each token for phoric type, information status, and referent type (location vs. direction), all treated as binary. Speaker-proximal, dyad-proximal, speaker-distal, and regional demonstratives were coded as exophoric; anaphoric and past anaphoric demonstratives were coded as anaphoric. To code information status and referent type, we identified the referent of each demonstrative, then determined (a) whether it had been mentioned previously in the interview and (b) whether it was a location (point or region) vs. a direction (path or bearing). The discourse in (6) includes demonstratives of each phoric type, information status, and referent type.

(6) Context: "After we moved out of our old house…"

a. **nu⁵a**²ta²ã⁴ a³rɨ¹

nu⁵a²=ta²ã⁴ a³rɨ¹

DEM:PROXIMAL=exactly INFO

'(We came) **right here** (speaker-proximal, first mention, location),'

b. **ɻe²ʔma⁴** ta⁴ʔã³tʃi⁵ɪ̃¹gɨ⁴,

ɻe²ʔma⁴ ta⁴=ã³=tʃi⁵ɪ̃¹=gɨ⁴

DEM:PST.ANAPHOR 1EXCL.SBJ=have=house=PL

'We moved into a new house **there** (past anaphoric; previously mentioned – same as 6a; location),'

c. **ɻe²ʔa⁴ma⁴**

ɻe²ʔa⁴=ã⁴ma⁴

DEM:DISTAL=towards

'(It was) **that way** (speaker-distal; previously mentioned – same as 6a; direction).'

(HCG)

We analyze only locative demonstratives (equivalent to *here/there*), not nominal demonstratives (*this/that*). This is because the nominal and locative demonstrative tokens were not comparable in count, distribution, or referent type. First, the transcripts contained many more locative demonstratives (724 tokens) than nominal ones (395 tokens). Second, while most locative demonstratives in the transcripts were exophoric (Table 5), most nominals were anaphoric (64.5%, 256 of 395 tokens). Third, a large fraction of the anaphoric nominal demonstratives had abstract referents such as time periods (*that year*) or propositions (*they liked that*). These kinds of referents are not comparable to places or concrete objects because they do not have locations in

space. We also did not analyze non-deictic location references, which generally employed absolute or intrinsic frames of reference.

5.3 Gesture Coding

Seven US-based research assistants coded the manual gestures in the footage. The coders were aware of the study hypotheses, but did not understand Ticuna and were not provided with translations of the audio. Coders identified all manual gestures in the footage. They were also trained to identify non-manual gestures, such as lip pointing. Coders did not identify any exclusively non-manual gestures. They did identify head and lip movements occurring with manual gestures, but these were not analyzed for reasons of interrater reliability (discussed later in this section).

Based on visual criteria, each manual gesture was coded for handshape, arm extension, and orientation of the speaker's head relative to the pointing vector. Handshapes were coded according to a controlled vocabulary with seven possible values (Table 3).

Table 3

Handshape Codes Used in Gesture Annotation.

Code	Description
Index	Only the index finger is extended
Index+1	The index finger and one other finger are extended
Index+2	The index finger and two other fingers are extended
Flat	Four fingers extended in parallel, regardless of action of thumb (like ASL "B")
Open	All fingers, including thumb, are extended and spread (like ASL "5")
Thumb	Only the thumb is extended
Other	Any other handshape

For arm extension, gestures were coded as displaying full arm extension if the participant's forearm attained a 180° angle with their upper arm during the movement. Gestures where the elbow was already fully extended at the beginning of the movement were <u>not</u> coded as

including full arm extension. As a proxy for eye gaze, coders also annotated the orientation of the speaker's head as toward vs. away from the pointing target at the gesture peak. Arm extension and head orientation were treated as binary. All speech and gesture coding was performed in ELAN using Transcription Mode (Wittenburg et al. 2006; Dingemanse et al. 2012).

To assess reliability, a secondary coder re-coded the footage for 25% of the primary coder's annotations, blinded to their codes. Primary and secondary codes were compared in *R* 4.3.1 (R Core Team 2023) using the *irr* package (Gamer et al. 2019). For handshape, our research questions were concerned mostly with the contrast between index and non-index pointing. We therefore transformed the handshape codes from Table 3 into a binary variable which contrasted handshapes with an extended index finger (index, index+1 and index+2) with all other handshapes. Inter-rater agreement on the binary handshape variable was 93.1% (κ = 0.831), indicating "almost perfect" agreement. For arm extension, inter-rater agreement was 92.9% (κ = 0.734), indicating "substantial" agreement, which we considered sufficient. For head orientation, inter-rater agreement was 77.8% (κ = 0.535), indicating only "moderate" agreement. Due to this low level of agreement, head orientation/eye gaze data was not further analyzed. Only primary coders' results were used in the analyses.

Following gesture coding, we combined the speech and gesture transcripts using the *fuzzyjoin* and *tidyverse* packages (Wickham et al. 2019; Robinson 2020) and identified all demonstrative tokens that overlapped with gestures for >100ms. We reviewed the video of each gesture which overlapped with a demonstrative and coded the gesture type, taking into account both the gesture's form and the co-occurring speech. The interview questionnaire, fully coded speech transcripts, fully coded gesture transcripts, and analysis code are included as Supplementary Materials.

6 Results

6.1 Speech Results

Participants produced 742 total locative demonstrative tokens. As described in §3, the Ticuna Regional, Anaphoric, and Past Anaphoric demonstratives can appear in non-demonstrative functions, for example as relative pronouns. All tokens of these types were reviewed to identify any non-demonstrative uses. We found 22 demonstrative tokens (3.0%) used in non-demonstrative functions: 12 were temporal connectives, eight were relative pronouns, and two indexed the size of a referent. All 22 non-demonstrative tokens were excluded from further analyses.

After this, 720 demonstrative tokens remained in the dataset. Table 4 shows the number of tokens of each lexical item there. Table 5, grouping together all exophoric and all anaphoric forms, shows the number of tokens of each demonstrative lexical item which occurred with new vs. previously mentioned referents.

Table 4.

Demonstrative Tokens by Lexical Item.

Demonstrative	Mean (SD) Count of Tokens per Participant	Total Count of Tokens
Speaker-Proximal	49.8 (18.6)	299
Speaker-Distal	28 (14.3)	168
Dyad-Proximal	5.2 (3.3)	31
Regional	2.5 (1.7)	10
Anaphoric	25.7 (5.8)	154
Past Anaphoric	14.5 (7.1)	58

Table 5.

Demonstrative Tokens by Lexical Item and Information Status.

Demonstrative	Information Status	Mean (SD) Tokens per Participant	Total Count of Tokens
Speaker-Proximal	New	10.8 (4.0)	65
	Mentioned	39.0 (15.3)	234

Speaker-Distal	New	14.2 (7.9)	85
	Mentioned	13.8 (7.4)	83
Dyad-Proximal	New	2.7 (2.3)	16
	Mentioned	2.5 (1.1)	15
Regional	New	0.7 (1.0)	4
	Mentioned	1.0 (0.9)	6
Anaphoric	New	0.2 (0.4)	1
	Mentioned	25.5 (6.1)	153
Past Anaphoric	New	0.2 (0.4)	1
	Mentioned	9.5 (9.1)	57
Exophoric Total	New	28.3 (13.1)	170
	Mentioned	56.3 (23.7)	338
Anaphoric Total	New	0.3 (0.5)	2
	Mentioned	35.0 (10.3)	210

As Table 4 indicates, the majority of all exophoric demonstratives in the data were Speaker-Proximals and the majority of anaphoric demonstratives were the temporally unmarked Anaphoric item. Further, as the Exophoric Total rows of Table 5 show, exophoric demonstratives both introduced new referents and indexed previously mentioned referents, in line with the theoretical predictions from §2.2. In particular, the Speaker-Proximal exophoric demonstrative indexed previously mentioned referents more than three times as often as it indexed new referents. The other exophoric demonstratives were about equally likely to index new or previously mentioned referents.

While we had expected that anaphoric demonstratives would index only previously mentioned referents, the Anaphoric Total rows in Table 5 show that two tokens of anaphoric demonstratives actually introduced new referents. (7) shows one of the two new-referent anaphoric tokens. This example is biclausal. In the first clause, the speaker describes an event; in the second clause, he refers to the location of the event with the past anaphor *ɟe⁵ma²*.

(7) ri¹ ŋẽ⁴ʔgu²ma³ no⁵¹ri³ avión nu⁵a² ɲa⁴³ʔgu² ri¹, pa³¹ʔa²ma³ĩ¹ki² ɟe⁵ma² tʃa³ɲa⁴³

ri¹	ŋẽ⁴ʔgu²ma³	no⁵¹ri³	avion	nu⁵a²	ɲa⁴³=ʔgu²	ri¹
TOP	CONN	3POSS	SP:airplane	DEM:PROX	run=SUB	TOP

pa³¹ʔa²ma³=ĩ¹kɨ² **ɟe⁵ma²** tʃa³=ɲa⁴³

quickly=INFO **DEM:PST.ANA** 1SG=run

'Whenever their airplane landed here (i.e., in town), I quickly ran **there (anaphoric)** (i.e., up to it).' (SSG)

The token of *ɟe⁵ma²* in the second clause of (7) can be seen as introducing a new referent, since it is not coreferential with any noun phrase in the subordinate clause or earlier in the discourse. On the other hand, this location can also be seen as previously mentioned, since it is the location of a previously mentioned event (the landing) and referent (the airplane). The other new-referent token of an anaphoric demonstrative in the dataset involves a similar bridging use, indexing the location of a previously mentioned event. As the data included only two anaphoric tokens which displayed this type of ambiguous information status, we excluded them from all analyses, leaving 718 demonstratives in the dataset.

Finally, turning to referent type, Table 6 reports the total number of demonstratives which indexed locations vs. directions, by phoric type and information status.

Table 6

Demonstrative Tokens by Phoric Type and Referent Type.

Phoric Type	Information Status	Referent Type	Mean (SD) Count of Tokens per Participant	Total Count of Tokens
Anaphoric	Previously mentioned	Location	33.7 (10.8)	202
		Direction	1.3 (2.0)	8
Exophoric	New	Location	10.7 (7.0)	64
		Direction	17.7 (8.8)	106
Exophoric	Previously mentioned	Location	44.2 (18.4)	265
Exophoric		Direction	12.1 (7.8)	73

As Table 6 shows, almost all demonstratives indexing directions – 179 of 187 (95.7%) – were exophoric. This reflects that participants frequently indexed the direction of a place using

an exophoric demonstrative, then referred back to the place itself with an anaphoric term. (8) is an example of this structure. In (8a), the participant describes the direction in which the town of Erené lies, relative to another town that she has already mentioned, Bellavista. Her direction reference uses the speaker-distal exophoric demonstrative. In (8b), she states that her brother lives in Erené. This is a location reference, not a direction one (the man lives **in** Erené, not in its direction); it uses an anaphoric demonstrative.

(8) Context: "Where is Erené?"

a. E³re³ne⁵, na⁴ŋẽ²ʔma⁴ i⁴ Bellavista=a¹rɨ³ **ɟe⁵a²ã⁴ma⁴ɨ̃¹ra¹ma³**.

E³re³ne⁵ na⁴=ŋẽ²ʔma⁴ i⁴ Bellavista=a¹rɨ³ **ɟe⁵a²=ã⁴ma⁴=ɨ̃¹ra¹=ma³**

Erene 3SBJ=located DET Bellavista=POSS **DEM:DISTAL**=toward=a.little=INFO

'Erene is located **a little farther in that direction** (speaker-distal, first mention, direction) from Bellavista.'

b. **ŋe⁵ma²** ni⁴¹ʔɨ̃⁴ na¹ŋẽ²ʔma⁵ʔɨ̃⁴

ŋe⁵ma² ni⁴¹ʔɨ̃⁴ na¹=ŋẽ²ʔma⁵=ʔɨ̃⁴

DEM:ANAPHOR FOC 3SBJ.SUB=located=SUB

'He lives **THERE** (anaphoric, previously mentioned, location).' (YCG)

6.2 Gesture Results

Of the 718 demonstrative tokens analyzed, 512 co-occurred with gestures. In 475 of these composite utterances, the gesture was classified – based on its form and the content of the co-occurring speech – as a pointing gesture coreferential with the demonstrative. In the other 37, the gesture either was not a point or was not coreferential with the demonstrative. Table 7 classifies all of the co-demonstrative gestures in the data.

Table 7.

Classification of All Co-Demonstrative Gestures.

Gesture Type	Total Count of Tokens
Pointing, coreferential with demonstrative	475
Iconic	13
Beat	12
Emblem	8
Pointing, not coreferential with demonstrative (all were points at speaker or addressee)	4

Since the 33 iconic, beat, and emblem gestures do not index places, they are not comparable to the place-referring pointing gestures that occurred with other demonstratives. The points at the speaker or addressee may index places (e.g. on their bodies), but are not comparable to points that index places and are reinforced with a coreferential demonstrative. These composite utterances were therefore excluded from all analyses, leaving 475 demonstrative composite utterances and 681 total demonstrative tokens in the dataset.

7 Analyses

To analyze the effects of information status and phoric type on gesture rate and form, we constructed a series of mixed-effects logistic regression models using the *lme4* and *lmerTest* packages in R (Bates et al. 2015). All models were initially fit with random intercepts for participants and by-participant random slopes for every predictor. In some analyses, these "maximal" models did not converge or produced a singular fit, indicating overfitting. We describe how convergence issues were resolved for each model in detail in the Supplementary Materials.

7.1 Gesture Rate

On average, participants pointed with 66.5% (range: 30.0 – 87.7%) of all demonstrative tokens. Specifically, pointing occurred with 88.8% (range: 61.1% – 100%) of exophoric

demonstratives indexing new referents, 70.2% (range: 33.3% – 89.9%) of exophoric demonstratives indexing previously mentioned referents, and 43.3% (range: 4.0% – 62.5%) of anaphoric demonstratives indexing previously mentioned referents. Figure 1 displays the proportion of exophoric vs. anaphoric demonstratives, with new vs. previously mentioned referents, occurring with pointing gestures for each participant. Figure 2 provides video still examples of two pointing gestures occurring with exophoric (left) and anaphoric (right) demonstratives.

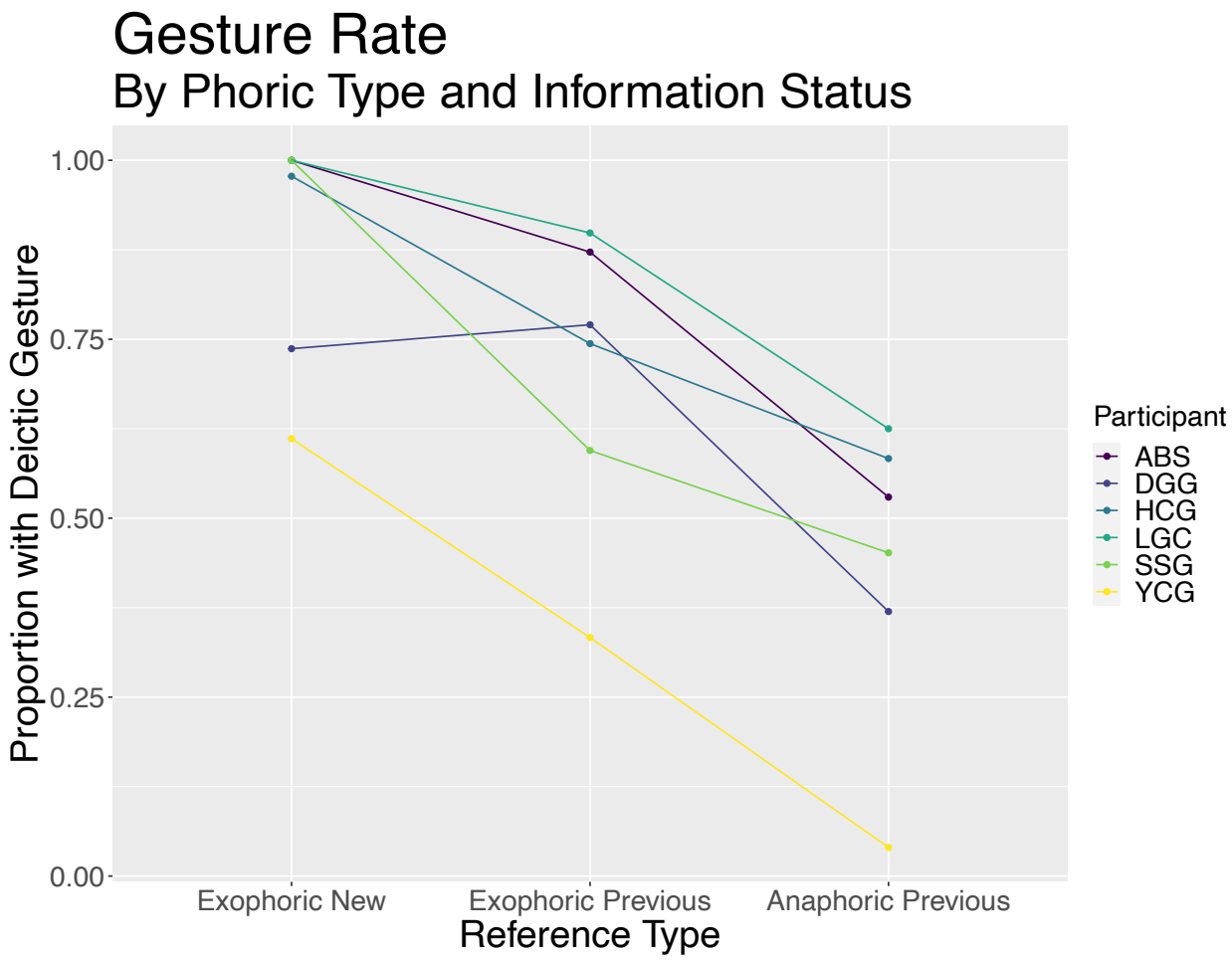

Figure 1. Proportion of demonstratives occurring with a pointing gesture, by phoric type of the demonstrative and information status of the referent.

Figure 2. Two pointing gestures occurring with exophoric (left) and anaphoric (right) demonstratives.

Figure 1 visually suggests that both phoric type and information status affected participants' rate of pointing. However, because the dataset contains no anaphoric demonstratives with new referents, only three of the four possible cells of the phoric type by information status interaction are defined. This makes it impossible to construct models which include both of these fixed effects and their interaction. Instead, we analyzed the effects of phoric type and information status using two separate models.[2] Because referent type (location vs. direction) is only relevant to our predictions for handshape, not for gesture rate, we do not include it in these models. Additionally, because only exophoric demonstratives have spatial deictic content (proximal vs.

[2] The alternative would have been to collapse the phoric type and information status variables into a single three-level categorical variable (Exophoric New vs. Exophoric Previously Mentioned vs. Anaphoric), and dummy-code the variable with Exophoric Previously Mentioned as the reference level. This would allow us to construct a single model for each outcome (i.e. rate, arm extension, handshape).
Because of how dummy-coded categorical variables are treated in regression, this alternative is not meaningfully different from constructing two separate models. However, if we fit only one model per outcome, we would not be able to use spatial deictic content as a predictor (again due to empty cells). This led us to fit two models per outcome instead. As demonstrated in the Supplementary Materials, fitting a single model per outcome would not have changed any of our findings.

medial vs. distal), we include spatial deictic content as a predictor only in the models of information status, which are limited to exophoric demonstratives.

First, in order to investigate differences in gesture rate motivated by phoric type, we began by comparing exophoric vs. anaphoric demonstratives with previously mentioned referents. Using mixed-effects logistic regression, we modelled the outcome of the presence of a pointing gesture with phoric type as the sole predictor variable; random intercepts for participants; and by-participant random slopes for phoric type. In order to control for the effects of information status, this model included only demonstratives with previously mentioned referents (n = 512). In this and all subsequent models, phoric type was coded as binary with exophoric as the reference level. We observed a significant effect of phoric type on the presence of co-demonstrative pointing gestures. When participants indexed previously mentioned referents, they were less likely to point if they used anaphoric demonstratives than if they used exophoric ones ($\beta = -1.37$, $SE = 0.23$, $p < 0.001$).

Next, to investigate the effect of information status on gesture rate, the binary outcome of the presence of a pointing gesture was modelled with information status, spatial deictic content, and their interaction as predictors, and random intercepts for participants.[3] Since this model includes random intercepts but not random slopes, it assumes that participants vary in baseline gesture rate, but not in the effects of information status or spatial deictic content on gesture rate. In order to control for the effects of phoric type, the model included only observations with exophoric demonstratives (n = 497). To create the spatial deictic content variable, Speaker-Proximal and Regional demonstratives were coded as proximal, Dyad-Proximal demonstratives were coded as medial, and Speaker-Distal demonstratives were coded as distal. The variable was

[3] The model did not include random slopes because models with random slopes did not converge regardless of the fixed effects and random effects structure. See the Supplementary Materials for further detail.

dummy-coded with proximal as the reference level. Information status was coded as binary with new as the reference level. We observed a significant effect of information status. When participants used exophoric demonstratives, they were less likely to point if the referent was previously mentioned than if it was new ($\beta = -1.22$, SE = 0.40, $p = 0.002$). For exophoric demonstratives, there was no evidence for an effect on gesture rate from use of medial or distal demonstratives, or from interactions between medial/distal demonstrative use and information status (all p-values > 0.1).

7.2 Gesture Form: Arm Extension

Next, we analyzed the relationship between gesture form, demonstrative phoric type, and referent information status in the 475 demonstrative composite utterances. Our first form analysis concerned arm extension. On average, participants extended the arm completely in 46.2% (range: 27.3% – 75.7%) of gestures occurring with exophoric demonstratives indexing new referents; 25.7% (range: 9.1% – 56.5%) of gestures with exophoric demonstratives indexing previously mentioned referents; and 16.8% (range: 0% – 35.3%) of gestures with anaphoric demonstratives indexing previously mentioned referents.

Figure 3 displays the proportion of co-exophoric vs. co-anaphoric gestures, with new vs. previously mentioned referents, occurring with full arm extension for each participant. Figure 4 shows two example gestures with vs. without full arm extension, both occurring with (different tokens of) the exophoric, speaker-distal demonstrative *ɻe⁵a²*.

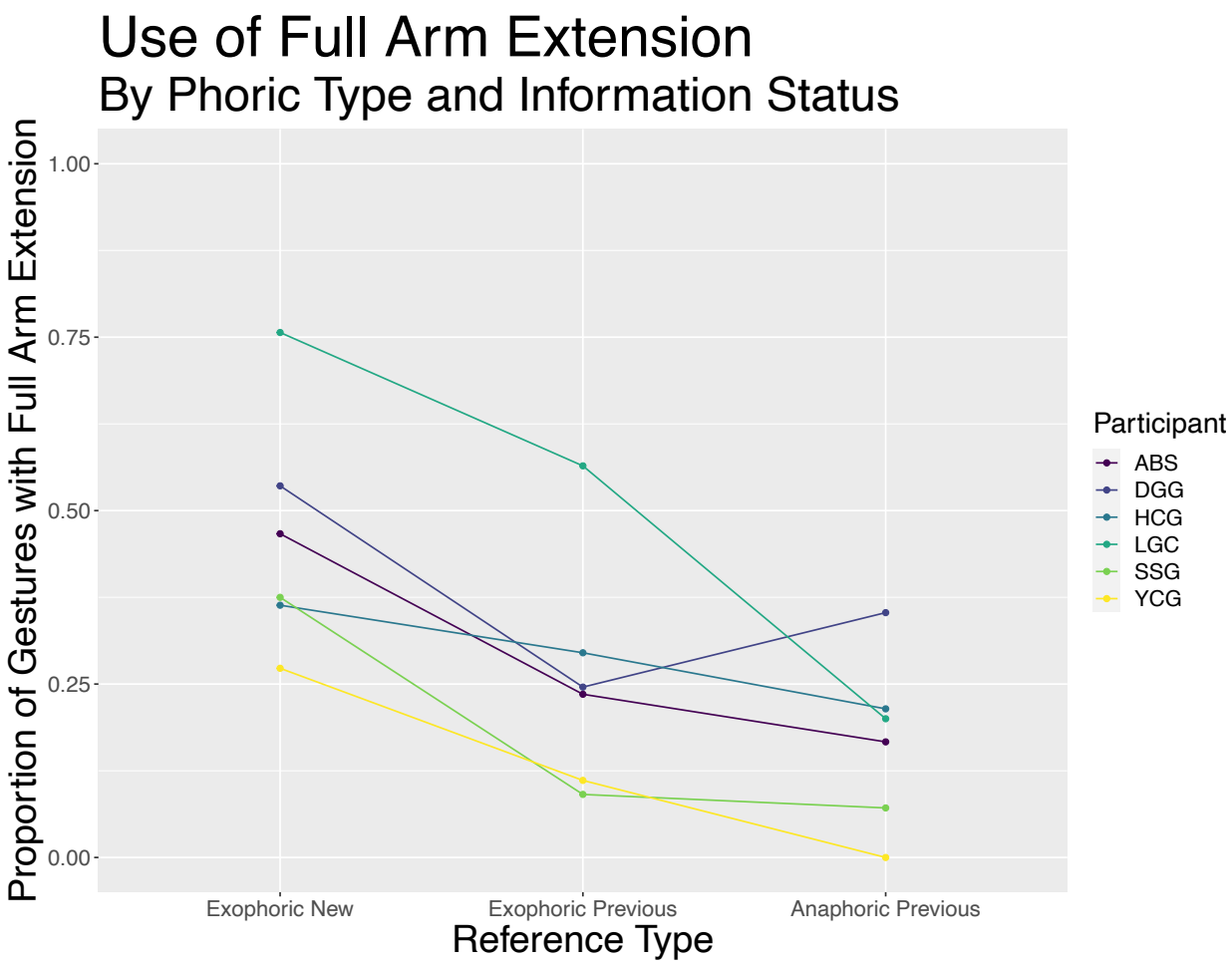

Figure 3. Proportion of co-demonstrative pointing gestures with full arm extension, by phoric type of the demonstrative and information status of the referent.

Figure 4. Two pointing gestures co-occurring with exophoric distal demonstratives. Gesture in left panel has full arm extension; gesture in right panel does not.

Our first analysis of this data examined phoric type. We modelled the outcome of the presence of full arm extension with phoric type as the sole predictor variable and random intercepts for participants, but no random slopes.[4] In order to control for the effects of information status, the model included only composite utterances with previously mentioned referents (n = 324). The model indicated no significant effect of phoric type on the presence of full arm extension ($\beta = -0.52$, SE = 0.32, $p = 0.11$).

Our next analysis considered the impact of information status on arm extension. We modelled the outcome of full arm extension with information status, spatial deictic content, and their interaction as predictors, and random intercepts for participants.[5] To control for the effects of phoric type, this model included only observations with exophoric demonstratives (n = 396). It indicated a significant effect of information status on the presence of full arm extension. When

[4] Models with random slopes did not converge. See the Supplementary Materials for further detail.
[5] Models with random slopes again did not converge. See the Supplementary Materials.

participants produced an exophoric demonstrative and pointed, they were less likely to extend their arm completely if the referent was previously mentioned than if it was new ($\beta = -0.94$, SE = 0.33, $p = 0.005$). There was no significant effect of using medial or distal demonstratives, or of the interactions between medial/distal demonstrative use and information status (all p-values > 0.6), on the presence of full arm extension with exophoric terms.

7.3 Gesture Form: Index Handshape

Our second form analysis examined participants' use of index-finger pointing handshapes. On average, participants pointed with the index finger in 43.2% (range: 18.2% – 59.5%) of gestures accompanying exophoric demonstratives with new referents; also 43.2% (range: 27.3% – 59.6%) of gestures accompanying exophoric demonstratives with previously mentioned referents; and 23.3% (range: 0.0% – 47.1%) of gestures accompanying anaphoric demonstratives. Figure 5 summarizes participants' use of index handshapes by phoric type and information status.

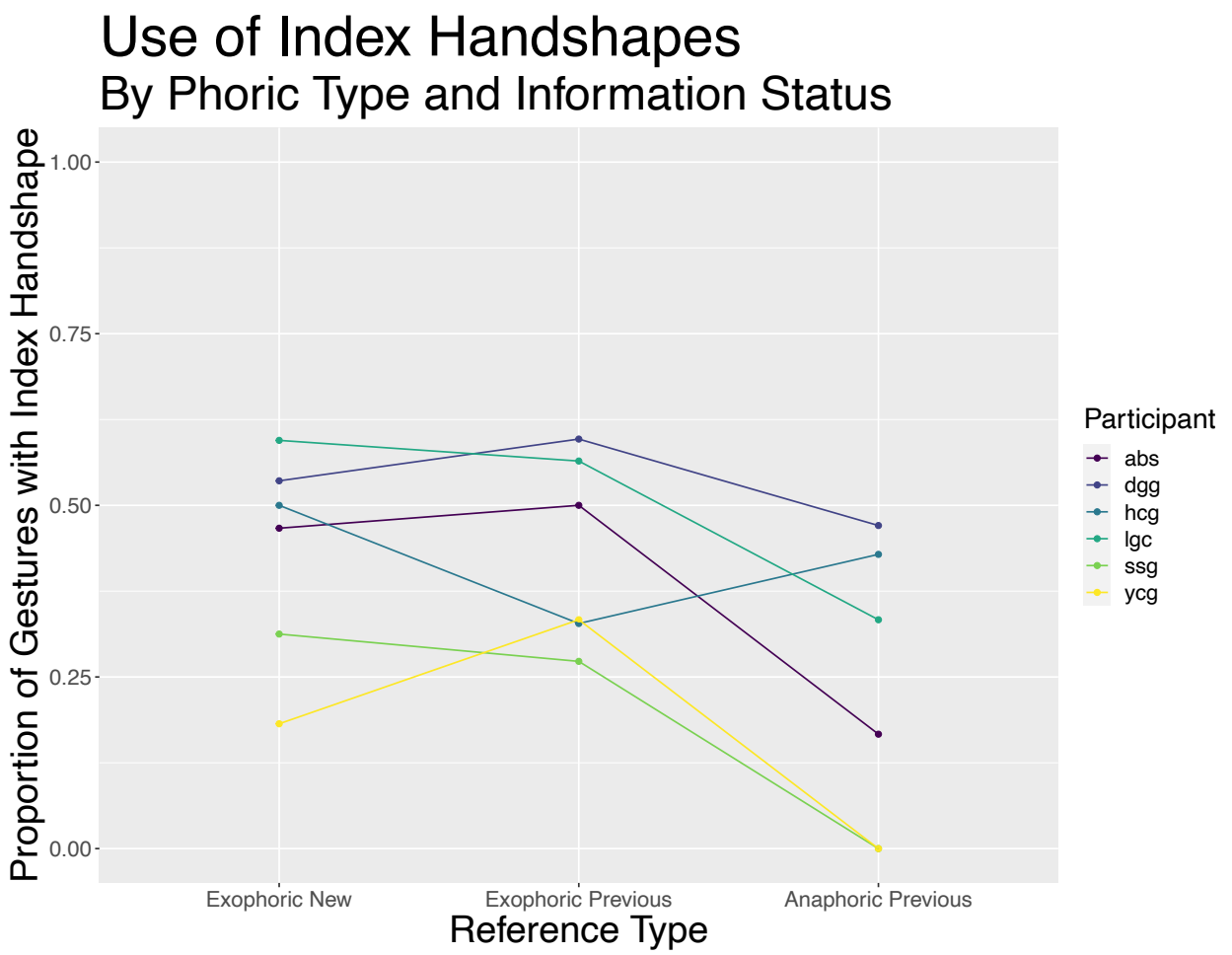

Figure 5. Proportion of co-demonstrative pointing gestures with index handshape, by phoric type of the demonstrative and information status of the referent.

As Figure 5 shows, these Ticuna participants do not share Western speakers' (Wilkins 2003; Cooperrider & Slotta & Núñez 2018) strong preference for pointing with the index finger.[6] Overall, only 210 (44.2%) of the 475 co-demonstrative pointing gestures used an index handshape. Because of reliability issues (§5.3), we did not conduct detailed analyses of the different non-index handshapes. However, based on the primary coders' annotations, the most common non-index pointing handshapes in the dataset involve the entire hand: they are the flat

[6] Although, as an anonymous reviewer notes, there are no studies of the Western index-finger preference specifically in place reference.

(ASL “B”-like) and open (ASL “5”-like) handshapes. Figure 6 provides examples of these handshapes occurring with exophoric (left) and anaphoric (right) demonstratives.

Figure 6. Two demonstrative-accompanying pointing gestures with non-index handshapes.

In light of the theorized relationship between referent type (direction vs. location) and handshape (§2.3.2), we also calculated the proportion of gestures using the index handshape for each referent type. These figures do not immediately suggest a difference between locations and directions: on average, participants used index handshapes in 38.3% (range: 13.2% – 62.0%) of points at locations and 40.0% (range: 27.3% – 54.2%) of points at directions.

Our first analysis of the handshape data examined the effects of phoric type and referent type. We modelled the outcome of use of the index-finger handshape with phoric type and

referent type as predictors, random slopes, and random intercepts for participants.[7] Referent type was coded as binary with location as the reference level. In order to control the effects of information status, the model considered only observations with previously mentioned referents (n = 324, per above). It indicated a significant effect of phoric type on participants' use of index-finger pointing handshapes: when participants used a demonstrative and a gesture to index a previously mentioned referent, the gesture was less likely to display an index handshape if the demonstrative was anaphoric than if it was exophoric ($\beta = -0.95$, SE = 0.46, $p = 0.040$). However, the model indicated no significant effect of referent type on handshape: for previously mentioned referents, participants were no less likely to use index handshapes when pointing at directions than when pointing at locations ($\beta = -0.01$, SE = 0.48, $p = 0.98$).

Our second analysis of the index-finger pointing data considered information status. Here, we modelled the outcome of use of an index-finger handshape with information status, spatial deictic content, and referent type as predictors and random intercepts for participants.[8] In order to control for the effects of phoric type, the model included only observations with exophoric demonstratives (n = 396, per above). The model indicated no significant effect of information status ($\beta = -0.14$, SE = 0.24, $p = 0.55$), referent type ($\beta = -0.37$, SE = 0.24, $p = 0.12$), or use of a medial demonstrative ($\beta = -0.09$, SE = 0.44, $p = 0.84$) on the use of index-finger pointing handshapes with exophoric terms. However, there was a significant effect of the use of distal demonstratives: people used index handshapes more often with distals ($\beta = 0.54$, SE = 0.23, $p = 0.02$) than with proximals.

[7] Models which included interactions as predictors did not converge. See the Supplementary Materials.
[8] Models which included interactions as predictors and/or included random slopes did not converge. See the Supplementary Materials.

8 Discussion

This study investigated the co-organization of demonstratives and pointing gestures by speakers of Ticuna, an Indigenous Amazonian language with a large, semantically rich demonstrative system. We video-recorded six Ticuna speakers describing the locations of landmarks in their community, then analyzed the participants' use of demonstratives and co-occurring, coreferential pointing gestures. Specifically, we analyzed how the phoric type (exophoric vs. anaphoric status) of demonstratives and the information status (new vs. previously mentioned) of referents affected participants' rate and form of pointing. We make the same theoretical predictions for both entity-referring and place-referring demonstratives. However, due to the distribution of place vs. entity references in this dataset, we analyze only place-referring demonstratives and gestures.

To summarize, the phoric type of demonstratives affected both the rate and the form of co-demonstrative gestures. When people used anaphoric demonstratives, they were less likely to point, though their gesture rates remained well above zero. Additionally, when participants did point with anaphoric demonstratives, their gestures were less likely to display an index-finger handshape. Information status also affected both rate and form. When participants used demonstratives to refer to previously mentioned locations, they were less likely to point than when they used demonstratives to introduce discourse-new locations. Furthermore, when participants did point when indexing a previously mentioned referent, their gestures were less likely to include full extension of the arm. Figure 7 provides a visual summary of these effects.

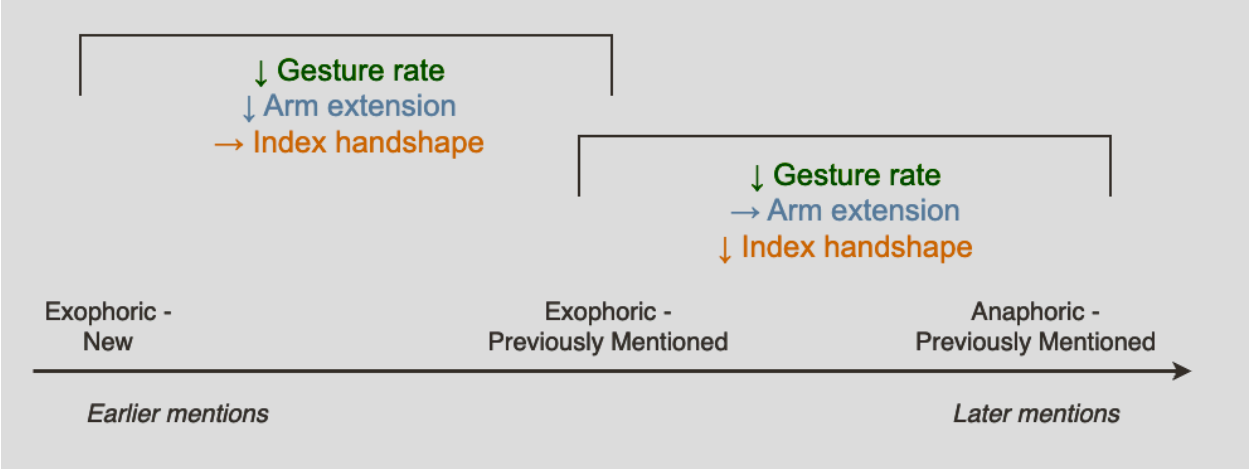

Figure 7. Visual summary of differences between demonstrative tokens differing in phoric type and information status.

The contrast between proximal, medial, and distal exophoric demonstratives did not affect gesture rate or arm extension, but did affect handshape: people used index-finger handshapes more often with distal than with proximal demonstratives.

8.1 Both phoric type and information status affect gesture rate

We considered two sets of predictions about the relationship between the phoric type of demonstratives, the information status of demonstrative referents, and the frequency of co-demonstrative pointing gestures. First, linguistic research on demonstratives claims that anaphoric demonstratives rarely or never occur with pointing, while exophoric demonstratives often do (Diessel 1999; 2006; Ahn 2022). For our dataset, this claim predicts that phoric type will influence the rate at which pointing gestures co-occur with demonstratives, and more specifically, that the gesture rate with anaphoric demonstratives will be near zero. In line with this prediction (Prediction 1.1), we do observe effects of phoric type on gesture rate: participants point less with anaphoric demonstratives than with exophoric demonstratives. Contrary to the stronger claims in this literature, however, the effect of phoric type is not categorical (Prediction 1.2). Numerically, participants pointed relatively often with anaphoric demonstratives, and they

quite often omitted pointing with exophoric demonstratives, especially when they indexed previously mentioned referents (Figure 1). Second, gesture studies research – by Azar and colleagues (2019), Debreslioska and Gullberg (2019; 2022), and many others – has shown that references to previously mentioned entities occur with fewer gestures than references to discourse-new entities. This predicts that people will point less with demonstratives indexing previously mentioned referents (Prediction 1.3). Our results fell exactly in line with this prediction: participants pointed more with demonstratives used for new referents than for previously mentioned referents, even when we considered only exophoric terms.

Thus, we partly confirm the theoretical position that deixis and anaphora have different relationships with gesture, and partly challenge it. Because we observe an effect of phoric type, our findings do support the core argument of the literature on demonstratives and gesture – that gesture is more important to fixing reference for exophoric demonstratives than anaphoric ones (Ahn 2022). However, our findings empirically disprove the claim that anaphoric demonstratives do not occur, only rarely occur, or do not overlap with pointing (Diessel 1999; 2006; Ahn 2022).

Some readers may ask why participants so often pointed with anaphoric demonstratives, since the point in this type of composite utterance is "redundant" (i.e. repeats location information that was already present in earlier references). We offer two responses to this question. First, the locality description interview questions require participants to constantly introduce new locations into the discourse, as well as referring back to many previously introduced ones. Thus, location references in this task – whether exophoric or anaphoric – are highly ambiguous. This may lead participants to increase their rate of pointing in order to disambiguate between multiple recently mentioned referents (cf. Azar et al. 2019). Additionally, location reference in this task is very often contrastive. As a result, many of the demonstrative

tokens in the data appear in syntactic focus (cleft) constructions (e.g., 2a,b; 3b; 8b). Contrastive focus (as a semantic category) and/or clefting could conceivably also elevate gesture rates with anaphoric demonstratives.

Second, we offer a more general response to the idea that producing the same information multiple times in a discourse or utterance is "redundant." If this is true, "redundancy" is a core feature of both grammar and co-speech gesture. For instance, morphological agreement between a verb and an overt argument is arguably redundant. Similarly, the literature on iconic gesture observes that – while people sometimes express entirely different information in gesture and speech – they also sometimes express overlapping information in the two channels (Goldin-Meadow 2003: Chapter 7; Alibali et al. 2009). There is no reason to predict that demonstratives, or the gestures that accompany them, will be less "redundant" than other speech and gesture.

For gesture studies research, on the other hand, this study makes two contributions. First, we replicate in a less-studied language the finding that new referents are associated with higher gesture rates than previously mentioned referents (Foraker 2011; Debreslioska & Gullberg 2019; 2022, among others). Second, we show that referring expressions can belong to the same syntactic category, but still be associated with different gesture rates. This finding has precedent in results showing that speakers of Turkish (Azar et al. 2019) and German (Debreslioska & Gullberg 2022) gesture more with noun phrases than with pronouns. Azar and colleagues, as well as Debreslioska and Gullberg, interpret this result as showing that gesture rate is sensitive to the semantic richness of the co-occurring speech, arguing that NPs are associated with higher gesture rates because they are "richer" -- i.e., convey more information about the referent -- than pronouns. In contrast, our findings about the association between exophoric demonstratives and higher gesture rates cannot be explained by the richness, i.e. informativity, of the co-occurring

speech. Exophoric demonstratives and anaphoric demonstratives convey equal amounts, but different types, of information about their referents: exophoric demonstratives convey the referent's location in space, while anaphoric demonstratives convey its information status. As such, our findings support the conclusion that gesture rate is sensitive not only to the quantity of information that the co-occurring speech conveys, but also to whether this information is spatial. Speakers gesture more when they produce referring expressions that convey spatial information – that is, exophoric demonstratives – than when they produce equally informative expressions, of the same syntactic category, which convey non-spatial information – that is, anaphoric demonstratives.

8.2 Information status, but not phoric type, affects arm extension

In addition to our analysis of gesture rate, we also tested predictions about the effect of phoric type and information status on gesture form. Gesture studies literature (e.g., Enfield et al. 2007) has shown that when more information about a referent is in the common ground, people point at the referent using reduced, or less visually salient, gestures. Using arm extension as our measure of articulatory reduction, we predicted that Ticuna speakers would extend the arm less often when pointing to previously mentioned referents than when pointing to new ones (Prediction 2.1).

Our results upheld this prediction: when speakers used a demonstrative and pointed, their pointing gesture was less likely to include full arm extension if the referent was previously mentioned. This effect strongly resembles Enfield and colleagues' findings (2007) about arm extension for Lao speakers, as well as Cooperrider and colleagues' (2021) results on arm extension for English speakers and ASL signers. The difference between our results and theirs concerns the content of the co-occurring speech. Previous authors compare composite utterances

where the speech contains more vs. less location information, whether this is described in terms of focus (Enfield et al. 2007) or as sharing the informational load with the gesture (Cooperrider et al. 2021). In contrast, all composite utterances in our information status analysis contained exophoric demonstratives. Thus, all of these utterances include the same minimum degree of location information, showing – much as in our rate analysis – that reduction in gesture form can occur even in the absence of total reduction in the semantic richness of speech (e.g. in the zero location anaphora examined by Enfield and colleagues). In contrast to information status, phoric type had no effect on participants' arm extension. This is conceptually in line with Mesh's (2017) finding that, in co-demonstrative pointing gestures by speakers of San Juan Quiahije Chatino (Oto-Manguean; Mexico), there is no relationship between elbow height (a correlate of arm extension) and (exophoric) demonstrative lexical item.

Our analysis of arm extension has the methodological limitation that we coded arm extension visually and as a binary variable. In reality, arm extension is continuous, and analyzing it as such, for example using computer vision (Pouw & Trujillo & Dixon 2020), could have produced different results. Another limitation is that we did not analyze non-deictic location information, such as place names or location descriptions, that occurred in the speech accompanying gestures. Future work should explore how the presence and content of other location information affects arm extension (Cooperrider et al. 2021).

8.3 Phoric type, but not information status or referent type, affects handshape

As a second dimension of gesture form, we also analyzed handshape. Wilkins (2003) and Kendon and Versante (2003) have suggested that people are more likely to use index-finger handshapes (compared to whole-hand handshapes) on first mention of a referent, for more important referents, and for emphasis. With this background, we predicted that Ticuna speakers

would be more likely to use index handshapes when pointing at new referents (Prediction 2.2). Additionally, given the many observations in the literature about the relationship between index-finger pointing and location (vs. direction) reference, we predicted that speakers would be more likely to use index handshapes when pointing at locations (Prediction 2.3).

Our result were not consistent with either Prediction 2.2 or 2.3. We observed no effect of either information status or referent type (direction vs. location) on the use of index-finger pointing gestures accompanying demonstratives. We did, however, observe an effect of phoric type. Points that accompanied exophoric demonstratives were more likely to display index handshapes than points that accompanied anaphoric demonstratives. This finding is not readily explainable in terms of articulatory reduction, since the flat and open handshapes that dominate in our data are not necessarily less effortful or visually salient than the index handshape. We also observed an effect of spatial deictic content: among co-exophoric points, people were more likely to use index handshapes with distal demonstratives than with proximals. These findings on phoric type and spatial deictic content are surprising, because other research on pointing has not suggested associations between index handshapes and specific demonstrative lexical items. For example, Mesh (2017: 99–100) observed no effect of the contrast between demonstratives and other referring expression types, and no effect of any individual demonstrative, on Chatino speakers' use of index vs. open pointing handshapes. Likewise, despite an extensive discussion of handshape, Wilkins (2003: 193) describes no influence of demonstrative lexical item on handshape for Arrernte speakers.

Our finding that there was no effect of referent type on handshape also departs from many observations in the literature, as well as from our own previous qualitative impressions (and many individually clear video examples) of handshape use in this community. One possible

explanation is that other properties of the referents in this dataset, such as size or distance (Mesh 2017), favor the use of non-index handshapes so strongly that they overshadow effects of the location vs. direction contrast. Unpublished data on child-caregiver interaction collected by the author shows that when pointing at objects in their immediate surroundings, Ticuna adults use >90% index handshapes. This suggests possible relationships between handshape and distance, or between handshape and the contrast between object and place reference. Future research should pursue these possibilities further. Last, and more general, our handshape results provide further evidence that whole-hand pointing is cross-culturally commonplace (cf. Wilkins 2003; Mesh 2017; Fenlon et al. 2019). Researchers should therefore avoid excluding whole-hand gestures from analysis in studies of pointing (Enfield et al. 2007: 1725).

9 Conclusion

This study investigated the effects of two pragmatic contrasts – the contrast between exophoric and anaphoric demonstratives, and the contrast between first and subsequent mentions – on co-speech pointing gestures by Ticuna speakers. Pointing was ubiquitous with demonstratives: on average, speakers accompanied almost two-thirds of their demonstrative uses with pointing. In line with the linguistic literature on demonstratives, speakers were more likely to point with exophoric demonstratives, which we argue reflects that exophoric (but not anaphoric) demonstratives convey spatial information. In contrast to this literature, however, speakers still routinely pointed with anaphoric items. Additionally, in line with the findings of gesture studies research, we also observed effects of information status: demonstratives used to introduce new referents were more likely to occur with points, and points indexing new referents were more likely to involve complete extension of the arm.

These results indicate the co-organization of demonstratives and pointing gestures is influenced by both lexical factors, such as the phoric type of the demonstrative, and information-structural ones, such as the information status of the referent. Some properties of co-demonstrative gestures, such as rate, respond to both lexical and information-structural factors; others, such as arm extension, are affected only by information structure. Together, these results underline the importance of studying deictic language and gesture as an integrated system.

Abbreviations

Glossed examples use the Leipzig Glossing Rules.

Data Availability Statement

The interview questionnaire, fully coded speech transcripts, fully coded gesture transcripts, and analysis code are included as Supplementary Materials. Original interview videos are available in [archive name redacted].

Ethics and Consent

Participants provided informed consent to interviews and the archiving of the videos. The study was approved by the Committee for the Protection of Human Subjects at the University of California, Berkeley (approval 2017-08-10232).

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Competing Interests

The author has no competing interests to declare.

References

Ahn, Dorothy. 2017. Definite and demonstrative descriptions: a micro-typology. In Michael Yoshitaka Erlewine (ed.), *Proceedings of GLOW in Asia XI*, 33–48. Cambridge: MIT Working Papers in Linguistics.

Ahn, Dorothy. 2022. Indirectly direct: An account of demonstratives and pointing. *Linguistics and Philosophy* 45(6). 1345–1393. DOI: https://doi.org/10.1007/s10988-022-09350-5

Alibali, Martha W. & Evans, Julia L. & Hostetter, Autumn B. & Ryan, Kristin & Mainela-Arnold, Elina. 2009. Gesture–speech integration in narrative: Are children less redundant than adults? *Gesture* 9(3). 290–311. DOI: https://doi.org/10.1075/gest.9.3.02ali

Azar, Zeynep & Backus, Ad & Özyürek, Aslı. 2019. General-and language-specific factors influence reference tracking in speech and gesture in discourse. *Discourse Processes* 56(7). 553–574. DOI: https://doi.org/10.1080/0163853X.2018.1519368

Bates, Douglas & Mächler, Martin & Bolker, Ben & Walker, Steve. 2015. Fitting linear mixed-effects models using lme4. *Journal of Statistical Software* 67(1). 1–48.

Botley, Simon & McEnery, Tony. 2001. Demonstratives in English: A corpus-based study. *Journal of English Linguistics* 29(1). 7–33.

Brown, Penelope & Levinson, Stephen C. 2018. Tzeltal: The Demonstrative System. In Stephen C. Levinson & Sarah Cutfield & Michael Dunn & Nick Enfield & Sergio Meira & David Wilkins (eds.), *Demonstratives in Cross-Linguistic Perspective*, 150–175. Cambridge: Cambridge University Press. DOI: https://doi.org/10.1017/9781108333818.008

Capirci, Olga & Iverson, Jana M. & Pizzuto, Elena & Volterra, Virginia. 1996. Gestures and words during the transition to two-word speech. *Journal of Child Language* 23(3). 645–673.

Cooperrider, Kensy. 2016. The Co-Organization of Demonstratives and Pointing Gestures. *Discourse Processes* 53(8). 632–656. DOI: https://doi.org/10.1080/0163853X.2015.1094280

Cooperrider, Kensy. 2023. Fifteen ways of looking at a pointing gesture. *Public Journal of Semiotics* 10(2). 40–84. DOI: https://doi.org/10.37693/pjos.2023.10.25120

Cooperrider, Kensy & Fenlon, Jordan & Keane, Jonathan & Brentari, Diane & Goldin-Meadow, Susan. 2021. How Pointing is Integrated into Language: Evidence From Speakers and Signers. *Frontiers in Communication* 6. 567774. DOI: https://doi.org/10.3389/fcomm.2021.567774

Cooperrider, Kensy & Mesh, Kate. 2022. Pointing in gesture and sign. In Aliyah Morgenstern & Susan Goldin-Meadow (eds.), *Gesture in language: Development across the lifespan.*, 21–46. Boston: De Gruyter Mouton. DOI: https://doi.org/10.1037/0000269-002

Cooperrider, Kensy & Slotta, James & Núñez, Rafael. 2018. The Preference for Pointing With the Hand Is Not Universal. *Cognitive Science* 42(4). 1375–1390.

Debreslioska, Sandra & Gullberg, Marianne. 2019. Discourse Reference Is Bimodal: How Information Status in Speech Interacts with Presence and Viewpoint of Gestures. *Discourse Processes* 56(1). 41–60. DOI: https://doi.org/10.1080/0163853X.2017.1351909

Debreslioska, Sandra & Gullberg, Marianne. 2022. Information Status Predicts the Incidence of Gesture in Discourse: An Experimental Study. *Discourse Processes* 59(10). 791–827. DOI: https://doi.org/10.1080/0163853X.2022.2085476

Diessel, Holger. 1999. *Demonstratives: form, function and grammaticalization*. John Benjamins Publishing.

Diessel, Holger. 2006. Demonstratives, joint attention, and the emergence of grammar. *Cognitive Linguistics* 17(4). 463–489.

Dingemanse, Mark & Hammond, Jeremy & Stehouwer, Herman & Somasundaram, Aarthy & Drude, Sebastian. 2012. A high speed transcription interface for annotating primary linguistic data. In *Proceedings of the 6th Workshop on Language Technology for Cultural Heritage, Social Sciences, and Humanities*, 7–12. Association for Computational Linguistics.

Eberhard, David M. & Simons, Gary F. & Fennig, Charles D. 2023. *Ethnologue: Languages of the World* Twenty-sixth edition. Dallas: SIL International.

Enfield, N.J. 2009. *The anatomy of meaning: speech, gesture and composite utterances*. Cambridge: Cambridge University Press.

Enfield, N.J. & Kita, Sotaro & De Ruiter, Jan Peter. 2007. Primary and secondary pragmatic functions of pointing gestures. *Journal of Pragmatics* 30(10). 1722–1741.

Fenlon, Jordan & Cooperrider, Kensy & Keane, Jon & Brentari, Diane & Goldin-Meadow, Susan. 2019. Comparing sign language and gesture: Insights from pointing. *Glossa: A Journal of General Linguistics* 4(1). 2. DOI: https://doi.org/10.5334/gjgl.499

Foraker, Stephani. 2011. Gesture and discourse: How we use our hands to introduce versus refer back. In Gale Stam & Mika Ishino (eds.), *Integrating gestures: The interdisciplinary nature of gesture*, 279–292. Amsterdam: John Benjamins.

Gamer, Matthias & Lemon, Jim & Fellows, Ian & Puspendra, Singh. 2019. {irr}: Various coefficients of interrater reliability and agreement. (Version 0.84.1). Retrieved from https://CRAN.R-project.org/package=irr

Goldin-Meadow, Susan. 2003. *Hearing gesture: how our hands help us think*. Cambridge, Mass: Belknap Press of Harvard University Press.

Grosso, Tamara Michelle. 2017. *Referring Forms and cognitive status in non-narrative {American Sign Language} texts*. University of North Dakota dissertation.

Guirardello-Damian, Raquel. 2018. Trumai: Non-contrastive Exophoric Uses of Demonstratives. In Stephen C. Levinson & Sarah Cutfield & Michael Dunn & Nick Enfield & Sergio Meira & David Wilkins (eds.), *Demonstratives in Cross-Linguistic Perspective*, 242–256. Cambridge: Cambridge University Press. DOI: https://doi.org/10.1017/9781108333818.012

Gullberg, Marianne. 2006. Handling Discourse: Gestures, Reference Tracking, and Communication Strategies in Early L2. *Language Learning* 56(1). 155–196. DOI: https://doi.org/10.1111/j.0023-8333.2006.00344.x

Hanks, William F. 1990. *Referential practice: language and lived space among the Maya*. Chicago: University of Chicago Press.

Haviland, John B. 2003. How to point in Zinacantán. In Sotaro Kita (ed.), *Pointing: where language, culture and cognition meet*, 139–170. Mahwah: Lawrence Erlbaum.

Herrmann, Stefanie. 2018. Warao Demonstratives. In Stephen C. Levinson & Sarah Cutfield & Michael Dunn & Nick Enfield & Sergio Meira & David Wilkins (eds.), *Demonstratives in Cross-Linguistic Perspective*, 282–302. Cambridge: Cambridge University Press. DOI: https://doi.org/10.1017/9781108333818.014

Hodge, Gabrielle & Ferrara, Lindsay N. & Anible, Benjamin D. 2019. The semiotic diversity of doing reference in a deaf signed language. *Journal of Pragmatics* 143. 33–53. DOI: https://doi.org/10.1016/j.pragma.2019.01.025

Holler, Judith & Bavelas, Janet & Woods, Jonathan & Geiger, Mareike & Simons, Lauren. 2022. Given-New Effects on the Duration of Gestures and of Words in Face-to-Face Dialogue. *Discourse Processes* 59(8). 619–645. DOI: https://doi.org/10.1080/0163853X.2022.2107859

Iverson, Jana M. & Goldin-Meadow, Susan. 2005. Gesture paves the way for language development. *Psychological Science* 16(5). 367–371.

Kaplan, David. 1989. Demonstratives: an essay on the semantics, logic, metaphysics, and epistemology of demonstratives and other indexicals. In Joseph Almog & John Perry & Howard Wettstein (eds.), *Themes from Kaplan*, 480–614. Oxford: Oxford University Press.

Kendon, Adam & Versante, Laura. 2003. Pointing by hand in Neapolitan. In Sotaro Kita (ed.), *Pointing: Where language, culture, and cognition meet*, 109–137. Mahwah, NJ: Lawrence Erlbaum.

King, Jeffrey C. 2001. *Complex demonstratives: A quantificational account*. MIT Press.

Kita, Sotaro. 2001. Locally-anchored spatial gestures, version 2: historical description of the local environment as a gesture elicitation task. In Stephen C. Levinson & N. J. Enfield (eds.), *Manual for the field season 2001*, 132–135. Nijmegen: Max Planck Institute for Psycholinguistics.

Levinson, Stephen C. 2003. *Space in language and cognition: explorations in cognitive diversity*. Cambridge ; New York: Cambridge University Press.

Levinson, Stephen C. 2018. Demonstratives: patterns in diversity. In Stephen C. Levinson & Sarah Cutfield & Michael J. Dunn & N. J. Enfield & Sergio Meira (eds.), *Demonstratives in cross-linguistic perspective*, 1–42. Cambridge: Cambridge University Press.

McNeill, David. 1992. *Hand and mind: what gestures reveal about thought*. Chicago: University of Chicago Press.

McNeill, David & Levy, Elena T. 1993. Cohesion and gesture. *Discourse Processes* 16(4). 363–386. DOI: https://doi.org/10.1080/01638539309544845

Meira, Sérgio. 2018. Tiriyó: Non-contrastive Exophoric Uses of Demonstratives. In Stephen C. Levinson & Sarah Cutfield & Michael Dunn & Nick Enfield & Sergio Meira & David Wilkins (eds.), *Demonstratives in Cross-Linguistic Perspective*, 222–241. Cambridge: Cambridge University Press. DOI: https://doi.org/10.1017/9781108333818.011

Mesh, Kathryn. 2017. *Points of comparison: what indicating gestures tell us about the origins of signs in San Juan Quiahije Chatino Sign Language*. University of Texas at Austin dissertation.

Nowak, Ethan. 2021. Complex demonstratives, hidden arguments, and presupposition. *Synthese* 198(4). 2865–2900. DOI: https://doi.org/10.1007/s11229-019-02250-5

Orie, Ọlanikẹ Ọla. 2009. Pointing the Yoruba way. *Gesture* 9(2). 237–261. DOI: https://doi.org/10.1075/gest.9.2.04ori

Peeters, David & Chu, Mingyuan & Holler, Judith & Hagoort, Peter & Özyürek, Aslı. 2015. Electrophysiological and Kinematic Correlates of Communicative Intent in the Planning and Production of Pointing Gestures and Speech. *Journal of Cognitive Neuroscience* 27(12). 2352–2368. DOI: https://doi.org/10.1162/jocn_a_00865

Peeters, David & Krahmer, Emiel & Maes, Alfons. 2021. A conceptual framework for the study of demonstrative reference. *Psychonomic Bulletin & Review* 28(2). 409–433. DOI: https://doi.org/10.3758/s13423-020-01822-8

Peeters, David & Özyürek, Aslı. 2016. This and That Revisited: a Social and Multimodal Approach to Spatial Demonstratives. *Frontiers in Psychology* 7.

Perniss, Pamela & Özyürek, Asli. 2015. Visible Cohesion: A Comparison of Reference Tracking in Sign, Speech, and Co-Speech Gesture. *Topics in Cognitive Science* 7(1). 36–60. DOI: https://doi.org/10.1111/tops.12122

Pouw, Wim & Trujillo, James P. & Dixon, James A. 2020. The quantification of gesture–speech synchrony: A tutorial and validation of multimodal data acquisition using device-based and video-based motion tracking. *Behavior Research Methods* 52(2). 723–740. DOI: https://doi.org/10.3758/s13428-019-01271-9

R Core Team. 2023. *R: A Language and Environment for Statistical Computing*. Vienna, Austria: R Foundation for Statistical Computing. Retrieved from https://www.R-project.org/

Roberts, Craige. 2002. Demonstratives as definites. In Kees van Demter & Rodger Kibble (eds.), *Information sharing: reference and presupposition in language generation and interpretation*, 89–136. Stanford: CSLI.

Robinson, David. 2020. *fuzzyjoin: Join Tables Together on Inexact Matching*. Retrieved from https://CRAN.R-project.org/package=fuzzyjoin

Skilton, Amalia. 2019. *Spatial and non-spatial deixis in Cushillococha Ticuna*. University of California Berkeley dissertation. Retrieved from https://escholarship.org/uc/item/50w177t6

Soares, Marília Facó. 2017. A Análise de Tempo em Ticuna (Tikuna) Revisitada: questões sobre Anáfora Temporal e Sequenciamento Temporal. *Revista LinguíStica* 13(2). 263–285.

Streeck, Juergen. 2009. *Gesturecraft: the manu-facture of meaning*. Amsterdam: John Benjamins.

Wickham, Hadley & Averick, Mara & Bryan, Jennifer & Chang, Winston & McGowan, Lucy & François, Romain & … Yutani, Hiroaki. 2019. Welcome to the Tidyverse. *Journal of Open Source Software* 4(43). 1686. DOI: https://doi.org/10.21105/joss.01686

Wilkins, David P. 2003. Why pointing with the index finger is not a universal (in sociocultural and semiotic terms). In Sotaro Kita (ed.), *Pointing: where language, culture and cognition meet*, 171–216. Mahwah: Lawrence Erlbaum.

Wittenburg, Peter & Brugman, Hennie & Russel, Albert & Klassmann, Alex & Sloetjes, Han. 2006. ELAN: a professional framework for multimodality research. In *5th International Conference on Language Resources and Evaluation (LREC 2006)*, 1556–1559.

Wolter, Lynsey. 2006. *That's that: the semantics and pragmatics of demonstrative noun phrases*. University of California Santa Cruz dissertation.