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The Preference for Pointing With the Hand Is Not Universal

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Abstract

Pointing is a cornerstone of human communication, but does it take the same form in all cultures? Manual pointing with the index finger appears to be used universally, and it is often assumed to be universally preferred over other forms. Non-manual pointing with the head and face has also been widely attested, but it is usually considered of marginal significance, both empirically and theoretically. Here, we challenge this assumed marginality. Using a novel communication task, we investigated pointing preferences in the Yupno of Papua New Guinea and in U.S. undergraduates. Speakers in both groups pointed at similar rates, but form preferences differed starkly: The Yupno participants used non-manual pointing (nose- and head-pointing) numerically more often than manual pointing, whereas the U.S. participants stuck unwaveringly to index-finger pointing. The findings raise questions about why groups differ in their pointing preferences and, more broadly, about why humans communicate in the ways they do.

Keywords: Pointing; Communicative universals; Human diversity; Gesture; Reference; Papua New Guinea

1. Introduction

Humans are often celebrated as the "symbolic species" (Deacon, 1997), but the "pointing species" would be just as apt. A pointing gesture is a movement toward some region of space, produced with the intention of directing attention to that region (Clark, 2003; Eco, 1976; Kendon, 2004). The evidence that non-human animals gesture in this way is scarce and controversial (Kaplan, 2011; Pika & Mitani, 2006; Veà & Sabater-Pi, 1998), but human infants everywhere start to point before they can speak (Bates & Dick, 2002;

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Tomasello, 2008). And they do not stop after infancy: Pointing remains a basic communicative tool throughout the lifespan, deployed across cultures and settings, in both spoken and signed communication (Clark, 2003; Cooperrider, 2011; Kita, 2003a; Pfau, 2010). When spoken language is unavailable—as in "first contacts" between cultures (Hewes, 1974), cases of aphasia (Goodwin, 2003), and contexts in which language-deprived deaf children develop "homesign" systems (Goldin-Meadow & Mylander, 1984) —pointing is pervasive and powerful. For these and other reasons, the pointing gesture has been described as a "foundational building block of human communication" (Kita, 2003b, p. 1).

But does this "building block" always take the same form from one culture to the next? Despite decades of interest in pointing across the cognitive sciences, the answer to this question has been assumed rather than rigorously investigated. In the folk theories of Western Educated Industrialized Rich Democratic (WEIRD) societies (Henrich, Heine, & Norenzayan, 2010), the prototypical form of pointing is with the hand and, specifically, with the index finger extended. Indeed, this prototype is enshrined in the label "index finger" (or "pointer finger") used in English and many other languages, and some have even argued that this form preference has a biomechanical basis (Povinelli & Davis, 1994). But while the notion of a "natural," universally privileged form of pointing seems plausible, others have challenged the idea, declaring it a "myth" (Leavens, 2011). Motivating this challenge are reports of substantive variation in pointing across cultures. One dimension of such variation is in the handshapes used. In several speech communities, alternatives to the index finger extended form carry conventional meanings (Kendon & Versante, 2003), and it has been argued that the index finger extended is not the canonical form of manual pointing everywhere (Wilkins, 2003). A perhaps more striking dimension of variation—and our focus here—lies in whether pointing is done *manually*, with the hand, or *non-manually*, with movements of the head and facial articulators. Use of the head to point is widespread and has been proposed to be universal (McClave, 2000, 2007; McClave, Kim, Tamer, & Mileff, 2007). In a number of cultures, head pointing is supplemented with conventional facial actions, such as protrusion of the lips ("lip-pointing") (Enfield, 2001; Sherzer, 1973) or scrunching of the nose ("nose-pointing") (Cooperrider & Núñez, 2012). Though largely absent from WEIRD communities, facial pointing conventions are hardly marginal across the globe: Lip-pointing in one variant or another has been observed in the Americas, Africa, Asia, and elsewhere, and nose-pointing has been attested in several speech communities in Papua New Guinea (Table 1). Importantly, though such conventions for pointing non-manually are broadly attested, it remains unclear how central they are in the communities where they have been observed.

Do these observations really challenge the idea that there is a universally privileged form of pointing? And if so, how? At least three distinct ideas about universals in pointing can be distinguished. A first idea—*universality of presence*—is that index finger pointing is universal in the sense that it is *present* in all human communities. Current evidence leaves little reason to doubt this claim, notwithstanding impressionistic claims made to the contrary (e.g., about the Barai of Papua New Guinea, reported in Wilkins, 2003, p. 177). Humans are opportunistic when gesturing—using not only the hands to

Table 1
Non-manual pointing conventions across cultures

Gesture	Region	Speech Community	Source
Lip-pointing	Africa	Yoruba (Nigeria)	Orie (2009)
		Kipsigis and others (Kenya)	Creider (1977)
	Americas	Tucano, Arawak (Brazil)	Dixon (2003)
		Colombian Spanish	Saitz and Cervenka (1972)
		Cuna (Panama)	Sherzer (1973)
		Ojibwe (United States)	Erdrich (2003)
	Asia	Jahai (Malaysia)	Burenhult (2008)
		Lao (Laos)	Enfield (2001)
	Australia	Arrernte	Wilkins (2003)
	Papua New Guinea	Awtuw	Feldman (1986)
Nose-pointing	Papua New Guinea	Enga	Kendon (1980)
		Yupno	Cooperrider and Núñez (2012)

point but also elbows, feet, and tools (Floyd, 2016; Kendon, 2004, p. 199)—making it likely that people everywhere use their index fingers to point at least sometimes. But, crucially, by the same reasoning, non-manual pointing is also likely universal. While only certain communities have developed facial conventions for non-manual pointing (see Table 1), people around the globe use their heads to point, including in the United States and other WEIRD societies (Clark, 2003; McClave, 2000; McClave et al., 2007). In sum, both manual pointing and non-manual pointing are likely universally present.

A second idea—*universality of preference*—is that, in cases where different forms are available, people in all human communities *prefer* to point with their hands. Some have challenged this idea, albeit on the basis of informal impressions. For example, about the Cuna of Panama, Sherzer (1983) observes that, relative to pointing with the hand, lip-pointing is "more common by far" (p. 169). Similarly, Feldman (1986, p. 196) describes Awtuw speakers of Papua New Guinea as pointing "typically" with the lips and "occasionally" with the index finger. Everett (2005), after briefly describing forms of manual pointing used by the Pirahã, observes: "More often, they point, as is common around the world, with their lower lip or jaw or a motion of their head" (p. 624). Yet these and other claims about the prominence of non-manual pointing in certain groups have never been rigorously tested.

Finally, a third idea—*universality of developmental priority*—is that, in all cultures, manual pointing emerges in infants before other forms of pointing. One of the most thoroughgoing cross-cultural studies of pointing to date presented evidence from seven unrelated cultures in support of this possibility (Liszkowski, Brown, Callaghan, Takada, & de Vos, 2012). Across these groups, pointing with the whole hand emerged first, switching to a preference for index-finger pointing by about 1 year of age (see also Liszkowski & Tomasello, 2011). Note, however, that infant and adult pointing preferences do not necessarily align; thus, evidence in favor of *universality of developmental priority* does not necessarily imply *universality of preference*.

The present study attempts the most rigorous test to date of one of these ideas: that pointing with the hand is universally preferred. To this end, we carried out a novel, controlled communication task in two groups: The first group consisted of adult speakers of Yupno, a language of the Finisterre Range of Papua New Guinea; the second consisted of adult, undergraduate speakers of English in the United States. Both groups have been shown to use manual and non-manual pointing, but preferences for these different forms have never been systematically assessed in either group. Our own previous impressions were that non-manual pointing played a central role in Yupno communication (Cooperrider & Núñez, 2012). However, such observations were limited. For one, we primarily observed references to highly familiar landmarks—such as houses, villages, and land features—leaving it unclear whether non-manual forms would also be used for less familiar referents. Our communication task—"Stacks and Squares"—was designed to elicit pointing gestures to novel, visible locations and objects on the scale of a room; it offers an opportunity to make a controlled comparison across communities in the bodily resources preferred for carrying out one of our most basic and distinctively human communicative acts. It remains possible that non-manual pointing is merely an "occasional alternative" (Hewes, 1981, p. 265) to manual pointing, even in groups, like the Yupno, where facial conventions are attested. Or it may not be so marginal after all. Such a finding would invite questions about the sources of pointing preferences across cultures and—more generally—about the forces shaping human communication.

2. Methods

2.1. Participants

The Yupno portion of the study was conducted in the upper Yupno valley of Papua New Guinea, in the village of Gua. Sixteen Yupno adults (eight men; approximate age range: 18–55) participated in pairs in exchange for a small gift. All participants were local residents and native speakers of Yupno, some with additional fluency in Tok Pisin, the English-based creole used in Papua New Guinea. Most participants had limited experience in Westernized urban areas. The U.S. portion of the study was conducted at the University of California, San Diego. Eighteen adult undergraduates participated in exchange for course credit. All were fluent speakers of English, some with additional fluency in Mandarin, Cantonese, Vietnamese, or Spanish. One pair was eliminated because they thought pointing was not allowed during the task. Sixteen participants (12 men; approximate age range: 18–25) were included in the final analysis.

2.2. The "Stacks and Squares" task

"Stacks and Squares" is a novel referential communication task in which a director tells a builder how to arrange objects ("stacks") on a fixed array of locations ("squares").[11] Unlike many classic communication games, the participants worked in full

view of each other, inviting gesture as a powerful strategy. A participant was seated before an array of five square cloths on the ground, with a stack of objects off to one side of the array. This participant, the "director," was shown a photo of the objects arranged on the cloth squares and told that the goal was to get the other participant, the "builder," who could not see the photo, to arrange the objects as shown. Gesture was not mentioned in the instructions. Each photo depicted eight objects (of 11 total) arranged on the cloths, with every square occupied.

The five squares (one 16 by 16 in. red square, two 8 by 8 in. red squares, and two 8 by 8 in. blue squares) were arranged on the ground in a symmetrical array (Fig. 1). To one side of the array was a small rectangular platform on the ground that served as the "staging area" for the objects. All 11 objects—two white cylindrical tops (one small, one large), two cardboard cylinders (one small, one large), three colored beanbags (red, green, blue), and four yellow foam cubes—started on the staging area at the beginning of a trial and were returned to it after the trial.

After consenting to participate, one member of the pair was seated in a cross-legged fashion behind a rope, with the arms in front of the body and available for gesture. Other sitting positions, such as leaning back on the hands, were corrected by the experimenter. The participant seated first served as the first director. After a practice trial (five-object array), the director completed two full trials (eight-object arrays). The director and builder then switched roles and completed two trials. After four total trials, the roles were switched again and the director's seating position was moved to the opposite side of the array. All other aspects of the array remained fixed. There were then two more trials,
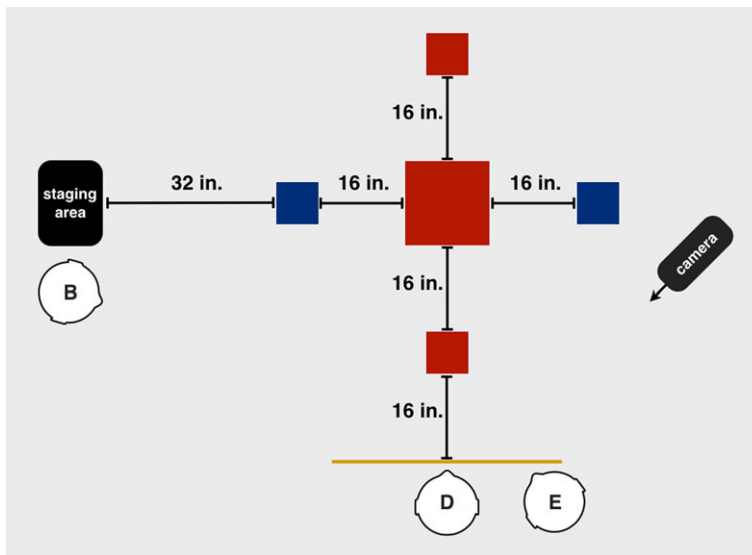

Fig. 1. The layout of the "Stacks and Squares" task. The red and blue squares represent cloths on the ground in front of the director (D). The director's task is to tell the builder (B) how to arrange objects (retrieved from the staging area) on the squares so that they match a photo presented by the experimenter (E).

another role switch, and two final trials. In all, each participant served as director for four trials, two from each side of the array. Throughout the task, the experimenter sat to one side of the participant, holding a laptop with a full-screen photograph of each target array. The director was video-recorded from a camera positioned to one side and at a 45° angle. The same order of trials was used for all participants, and which side of the array the participants started on was counterbalanced across pairs. For Yupno participants, an assistant with good proficiency in both Yupno and English was present to answer any questions.

2.3. Gesture analysis

The directors' pointing and iconic gestures (not discussed in the present report) were analyzed using ELAN annotation software, developed at the Max Planck Institute for Psycholinguistics, Language Archive (https://tla.mpi.nl/tools/tla-tools/elan/; see Wittenburg, Brugman, Russel, Klassmann, & Sloetjes, 2006). Builders spoke infrequently and their gestures are not analyzed here. Pointing gestures were defined as effortful movements toward a region of the task area (e.g., the staging area), produced with the apparent intention of directing attention toward that region (Kendon, 2004). In manual pointing, the speaker's finger, hand, or arm defines a vector in space projecting toward the target region. In non-manual pointing, the speaker's gaze defines the vector and other head and face movements, by virtue of their marked nature, serve to highlight the speaker's gaze (Enfield, 2001). These head movements may include lifting, lowering, tossing, tilting, or thrusting, or even an accelerated full torso movement with the head and neck fixed. In nose-pointing, one of the above types of head movement is co-produced with the conventional facial scrunching, or S-action.

For each pointing gesture, the form of the gesture was classified into one of six mutually exclusive categories: (1) index finger extended handshape, (2) other handshape, (3) a head-pointing movement with S-action ("nose-pointing"), (4) a head-pointing movement without S-action ("head-pointing"), (5) S-action without a head-pointing movement, or (6) a combination of manual and non-manual forms. Because S-action has conventional uses in Yupno that do not involve pointing (see Cooperrider & Núñez, 2012), cases of S-action without obvious head-pointing (i.e., category 5) were excluded from further analysis. Yupno participants occasionally produced manual pointing and non-manual pointing gestures simultaneously (category 6); these were considered separate manual and non-manual gestures in analysis.

The first author (KC) coded all the videos. Reliability was assessed by having a second coder—who was naive to the primary research question—analyze the gestures in one randomly selected trial for each participant (25% of the data). Agreement as to the presence of pointing was 76% ($N = 297$). Discrepancies resulted from one coder failing to annotate a pointing gesture coded by the other, one coder considering a gesture to be iconic rather than a pointing gesture, or one coder dividing a gesture sequence into a more gestures than the other. Of the 227 pointing gestures that both coders identified, agreement on the

form used was 94% (Cohen's K = .86). The annotations of the primary coder were used for all analyses.

3. Results

The "Stacks and Squares" task elicited high rates of pointing in both groups (Yupno: N = 598, M = 37.4 per director, SD = 23.6; United States: N = 496, M = 31 per director, SD = 14.8) (see Fig. 2 for examples). This mean number of pointing gestures per director did not differ between the two groups (t = 0.92, df = 30, p = .37). Yupno directors took more time to do the task (from the start of the first direction to the end of the last; all four trials combined) (Yupno: M = 6.48 min.; United States: M = 4.15 min.; t = 6.85, df = 30, p < .001), but the groups did not differ in the mean rate of pointing gestures per minute spent directing (Yupno = 5.97; United States = 7.64; t = 1.12, df = 30, p = .27).

Consistent with prior observations, participants in both groups used manual and non-manual forms of pointing. The proportion of participants using manual forms did not differ between the two groups (Yupno = .88; United States = 1.00; two-tailed Fisher's exact p = .48), but the proportion using non-manual forms did (Yupno = 1.00; United

Fig. 2. Examples of pointing gestures produced by two participants in the "Stacks and Squares" task. Yupno participants (top row) produced a mix of non-manual (left and middle panel) and manual pointing gestures (right panel). U.S. participants (bottom row) produced almost exclusively index finger pointing gestures (all panels). Participants always had their hands free and available.

States = .13; χ^2 = 24.9, df = 1, p < .001). Indeed, form preferences differed starkly (Table 2). Overall, the Yupno participants produced a much lower mean proportion of points with the hand (M = .34, SD = .24, bootstrapped 95% CI [.21, .45]) than did U.S. participants (M = .95, SD = .19, bootstrapped 95% CI [.90, 1.00]), a difference that was highly significant (Wilcoxon rank-sum test, W = 246, p < .001, Cohen's d = 2.83) (Fig. 3). In the literature on hand dominance—analogous in that it also involves measuring preferences between two alternatives—three preference categories are sometimes distinguished: right-handed (>.75 use of right hand), no preference (.25–.75), and left-handed (<.25) (see Michel, Babik, Sheu, & Campbell, 2013). If we adopt parallel cut-offs here (i.e., preference for manual pointing defined as >0.75 use of the hand), only a single Yupno participant (of 16) preferred manual pointing, compared to 15 (of 16) U.S. participants who did (χ^2 = 24.5, df = 1, p < .001). Finally, the Yupno pointed non-manually more often than they pointed manually (non-manual: M = 22.3, SD = 14.8; manual: M = 15.1, SD = 17.5), but this difference did not reach significance (Wilcoxon signed-rank test, W = 98, p = .13, Cohen's d = 0.32). U.S. participants, in contrast, pointed

Table 2
Counts of pointing forms used

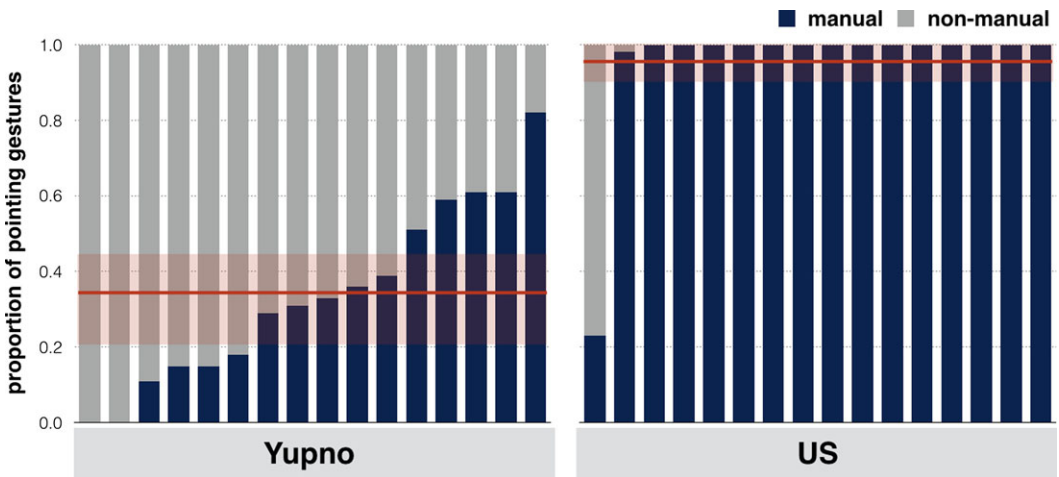|	Manual Pointing (% of total)		Non-manual Pointing (% of total)		
	Index Finger	Other Hand	Nose-pointing	Head-pointing	Total
Yupno	234 (39%)	8 (1%)	252 (42%)	104 (17%)	598
United States	450 (91%)	35 (7%)	0 (0%)	11 (2%)	496

Fig. 3. The proportion of pointing gestures in each group that were produced manually (hand) or non-manually (head and face). Each bar represents one participant; the red-shaded regions represent 95% confidence intervals around the group means, indicated by the red lines.

manually much more than they pointed non-manually (manual: $M = 30.3$, $SD = 15.8$; non-manual: $M = 0.69$, $SD = 2.5$), and this difference was highly significant (Wilcoxon signed-rank test, $W = 134$, $p < .001$, Cohen's $d = 1.74$). Thus, whereas the U.S. participants exhibited a clear, strong preference for manual pointing, the Yupno made balanced use of both non-manual and manual forms, with no significant preference between the two.

4. Discussion

This study compared preferences for different forms of pointing in two groups, with the goal of testing whether pointing with the hand is universally preferred. Using a novel, controlled communication task, we found that speakers in both groups pointed pervasively and at comparable rates. The U.S. undergraduates relied heavily on manual pointing with the extended index finger, consistent with prototypes of pointing in WEIRD societies, and showed only trace amounts of non-manual pointing. The Yupno speakers, in contrast, commanded a balanced repertoire of forms and produced numerically more non-manual pointing gestures than manual ones. These results demonstrate, for the first time, that the strong preference for pointing with the hand seen in WEIRD groups is not universal; non-manual pointing is more than a marginal quirk or "occasional alternative," at least in some communities. Moreover, while the findings do not directly counter the idea that infants everywhere initially prefer manual pointing (Liszkowski et al., 2012), they do highlight the interest of future work on this issue. Investigating pointing preferences in Yupno infants—or in infants in other communities where non-manual pointing is prominent in adults—would provide an especially strong test of claims about the developmental priority of manual pointing.[2] Prior work has shown that early cultural experience can shape the emergence of infant pointing (Salomo & Liszkowski, 2013), lending credence to the possibility that Yupno infants might differ from their counterparts in other cultures. We turn now to the possible explanations for these contrasting preferences.

4.1. Motivations for differing pointing preferences

What motivates the starkly contrasting pointing preferences we observed? One appealing explanation is that pointing is a "technique of the body" (Mauss, 1973), an engrained bodily practice that differs from one group to the next. There is nothing incorrect about this answer as far as it goes, but it only pushes back the question of why these two cultures have developed strikingly different preferences for pointing techniques. Another attractive—but, again, unsatisfying—explanation is that manual pointing is taboo in Yupno culture, perhaps akin to taboos on gesture reported elsewhere (e.g., Kita & Essegbey, 2001). Not only is there no evidence for this ethnographically, there is no evidence for it in our data: Manual pointing made up 40% of all Yupno pointing gestures and was used by 14 (of 16) participants. More satisfying answers, we argue, can be found in two broad classes of explanation: (a) how gestural behavior is interwoven with cultural

models of communication and comportment; and (b) how manual and non-manual pointing differ in their basic "design features."

First, pointing in Yupno may embody culturally shared understandings of proper communication and comportment. Throughout New Guinea there is an emphasis on controlling the broadcasting of communication, as evident in institutionalized practices of revelation and concealment in men's cults (e.g., Barth, 1975; Herdt, 2003), "secret languages" used to disguise the true meaning of speech from outsiders (Schieffelin, 2008), and the value placed on "circumspection" in reference to persons (Levinson, 2007). Among the Yupno, whispering, ingressive speech (i.e., speaking while inhaling; see Eklund, 2008), and subtle facial gestures (e.g., eyebrow raising for affirmation) are used extensively, apparently to narrow the cast of communication to those being addressed. Non-manual pointing may thus be part of a repertoire of bodily techniques that reduce the broadcasting of communicative signals, as indeed some Yupno consultants have suggested to us. Another Yupno cultural model that may bear on gestural behavior is the ideal of the "easy-going" person (*yawori*)—one who is not overactive and aggressive, but calm and contained (Keck, 2005). A notable manifestation of this model of calm comportment is the ideal of a slightly stooped posture (Wassmann, 2016), and the less "active" demeanor involved in non-manual pointing may be another.

A second class of explanations considers the different design features of manual and non-manual pointing. One obvious feature is that manual pointing is not possible when the hands are occupied. (Note, of course, that we controlled for this factor in this study by having participants in both groups adopt a sitting position with the hands available.) Availability of the hands certainly governs the choice of pointing form from one moment to the next; it has been observed, for instance, that English speakers resort to head-pointing when their hands are unavailable (e.g., Emmorey & Casey, 2001). But manual availability could also affect a community's pointing preferences on cultural-historical timescales: In communities where the hands are commonly occupied while communicating (e.g., during activities like food processing), non-manual gesturing could become more frequent and could eventually carry over to times when the hands are free.

Other design features of these different pointing forms are more subtle: Manual pointing is generally more precise than non-manual pointing, but also more effortful; non-manual pointing is less precise, but less effortful.[3] Speakers in cultures where non-manual pointing is common may thus tailor the gesture's form according to the "principle of least effort" (Clark, 1996; Zipf, 1949), using non-manual pointing unless the increased precision of a manual form is required. To investigate this possibility, future adaptations of the "Stacks and Squares" task could manipulate the degree of spatial precision required for successful reference, using crowded object arrays (which require more precision) for some trials and spaced arrays (which require less) for others. Note that, if indeed Yupno speakers observe a principle of least effort when pointing, the interesting question becomes, not why Yupno speakers often avoid manual pointing, but why English speakers so often "over-extend" themselves.

As we have argued, if members of a speech community often have their hands occupied during communication, this could give rise to more non-manual pointing even when

the hands are free. Following a similar logic, if members of a speech community generally have little need for precision in their gestures, this might lead to more non-manual pointing. Yupno speakers live in a world that is, by WEIRD standards, small and highly familiar; it is uncommon for Yupno speakers to go somewhere totally new or to encounter someone they do not already know. As a result, the locations of things that Yupno speakers most often talk about—houses of friends, gardens of kin, neighboring villages— are known to all. Non-manual pointing to such referents may be all that is required (see Enfield, 2001, p. 198 on lip-pointing as having a "recognitional" flavor). And, if non-manual pointing is usually sufficient, it may come to be used even when pointing to less familiar referents, as in our task.

Another reason that Yupno speakers may not generally need much precision in their pointing has to do with features of Yupno grammar.[4] The language boasts a highly elaborated demonstrative system involving uphill-downhill distinctions and a three-way distance contrast (Cooperrider, Slotta, & Núñez, 2016). Such spatially specific demonstratives were used pervasively by Yupno speakers in our task, whereas U.S. speakers only had the comparatively blunt English demonstratives (e.g., "this" vs. "that") to work with. Speakers of languages that habitually provide increased spatial precision in their spoken demonstratives, such as Yupno, might have less need for spatial precision in the pointing gestures that often accompany those demonstratives.

4.2. Broader implications

To date, cross-cultural variability in pointing has been considered to be of marginal theoretical interest. We argue that, in fact, such variability bears on a number of fundamental questions about why humans communicate in the ways that they do. A first is the question of how communicative practices evolve within communities. One emerging proposal is that languages are not products of "random drift"; rather, they are adapted to particular cultural and environmental niches, and this adaptation is reflected at different levels of linguistic structure (Lupyan & Dale, 2010; see also De Busser & La Polla, 2015). More broadly, though, it is *communicative practices*, not just linguistic structures per se, that are adapted to niches, and gesture is a critical part of such practices. Researchers have long linked gestural practices to broader cultural, linguistic, and even ecological factors (e.g., Blythe, Mardigan, Perdjert, & Stoakes, 2016; Haviland, 1993; Kendon, 2004; Kita & Ide, 2007; Levinson, 2003; Núñez & Cornejo, 2012). For instance, Kendon (2004, pp. 349–54) has suggested that the dense urban ecology prevailing in Naples in recent centuries has promoted the region's famed gestural exuberance. In a similar way, it may that the pointing repertoire within a community is not a product of "random drift," but an *adaptation* to a particular ecology. It could, for instance, be a direct adaption to a particular socio-ecological niche (e.g., the small, highly familiar world of the Yupno valley, discussed earlier) or, less directly, to aspects of language related to that niche (e.g., semantic complexity of demonstratives systems, associated with small-scale communities; Lupyan & Dale, 2010). While speculative, such possibilities could account

for the puzzling fact that non-manual pointing conventions are so widely attested in small-scale communities and yet essentially absent from the WEIRD world.

A second theoretical issue concerns the bodily basis of communication. A common, seemingly uncontroversial observation is that the "hands are by far the most typical vehicles for gesture by adult speakers" (Hostetter & Alibali, 2008, p. 505). This observation has spurred neuroanatomical and evolutionary explanations for the tight link between speaking and gesturing manually, as well as between oral and manual activities generally (e.g., Forrester & Rodriguez, 2015; Gentilucci, Benuzzi, Gangitano, & Grimaldi, 2001; Iverson & Thelen, 1999). In light of such proposals, the present findings become all the more surprising. How might they be accommodated? One possibility is that the preference for gesturing with the hand may be much stronger for imagistic gestures than for pointing gestures. Another is that any neuroanatomical links between hand and mouth are malleable, a possibility suggested by cortical reorganization of classic "hand" areas (e.g., Hahamy et al., 2017). In sum, though a species-wide preference for manual gesturing is often taken for granted, our results underscore that the nature, origins, and boundary conditions of this preference are not well understood.

5. Conclusion

Pointing is among our most distinctively human acts, one that people everywhere carry out routinely and unreflectively. Intuition and evidence have previously converged on the idea that pointing with the hand is not only universally present but is also universally preferred. Our data challenge this universality of preference and open up new questions. Do the many other cultures with facial pointing conventions also use non-manual pointing as much as—or even more than—manual pointing? Deeper questions also come into focus. Evidence of unexpected cultural variation—such as in concepts of space (Levinson, 2003), time (Núñez & Cooperrider, 2013), number (Frank, Everett, Fedorenko, & Gibson, 2008), sensory experience (Majid & Burenhult, 2013), and emotion (Jack, Garrod, Yu, Caldara, & Schyns, 2012)—has spurred new accounts of relationships between communication and cognition, body and culture. In a similar way, our results invite a new account of the forces that shape one of the most foundational—and most taken for granted—cornerstones of communication.

Acknowledgments

Notes

1. Additional information about the "Stacks and Squares" task, including photos of the arrays used and a full experimental protocol, is publicly available on the Open Science Framework: osf.io/fxskg. The gesture coding manual, raw data files, and information about statistical analyses can be found at the same site.

2. Liszkowski et al. (2012) found a preference for manual pointing in infants from Rossel Island, part of the Louisiade Archipelago of Papua New Guinea. However, Papua New Guinea is famously culturally diverse, and there is little reason to assume continuity of gestural practices from the interior mountains—where this study was conducted—to the outlying islands. Within Papua New Guinea, groups have been described that use nose-pointing (e.g., Yupno), lip-pointing (e.g., Awtuw), or no facial conventions for pointing (e.g., Manambu; see Aikhenvald, 2015, p. 40, fn).

3. This idea has been both endorsed (e.g., Hewes, 1981, p. 265) and contested (e.g., Wilkins, 2003, p. 175) perhaps because it has been formulated too coarsely. When pointing to large, distant, or separated targets, there may be no appreciable difference in precision between manual and non-manual forms; but when pointing to small, nearby, or crowded targets, manual pointing is considerably more precise (see Cooperrider, 2011).

4. We are not the first to note possible connections between a speech community's grammatical structures and its gestural habits. Charles S. Peirce (1998) comments that, whereas most languages have vague spatial demonstratives that are supplemented with precise spatial information in gesture, "the Eskimo are so wrapped up in their bearskins that they have demonstratives distinguishing landward, seaward, north, south, east, and west" (p. 16, fn).

References

Aikhenvald, A. Y. (2015). Distance, direction, and relevance: How to choose and use a demonstrative in manambu. *Anthropological Linguistics*, *57*(1), 1–45.

Barth, F. (1975). *Ritual and knowledge among the Baktamin of New Guinea*. New Haven, CT: Yale University Press.

Bates, E., & Dick, F. (2002). Language, gesture, and the developing brain. *Developmental Psychobiology*, *40*(3), 293–310.

Blythe, J., Mardigan, K. C., Perdjert, M. E., & Stoakes, H. (2016). Pointing out directions in Murrinhpatha. *Open Linguistics*, *2*, 132–159.

Burenhult, N. (2008). Spatial coordinate systems in demonstrative meaning. *Linguistic Typology*, *12*(1), 99–142.

Clark, H. H. (1996). *Using language*. Cambridge, UK: Cambridge University Press.

Clark, H. H. (2003). Pointing and placing. In S. Kita (Ed.), *Pointing: Where language, culture, and cognition meet* (pp. 243–268). Mahwah, NJ: Lawrence Erlbaum.

Cooperrider, K. (2011). *Reference in action: Links between pointing and language* (Doctoral dissertation). Retrieved from eScholarship (b7207917).

Cooperrider, K., & Núñez, R. (2012). Nose-pointing: Notes on a facial gesture of Papua New Guinea. *Gesture*, *12*(2), 103–129.

Cooperrider, K., Slotta, J., & Núñez, R. (2016). Uphill and downhill in a flat world: The conceptual topography of the Yupno house. *Cognitive Science*, *41*, 768–799.

Creider, C. A. (1977). Towards a description of East African gestures. *Sign Language Studies*, *14*, 1–20.

De Busser, R., & La Polla, R. (Eds.) (2015). *Language structure and environment: Social, cultural, and natural factors*. Philadelphia, PA: John Benjamins.

Deacon, T. (1997). *The symbolic species*. New York: W.W. Norton.

Dixon, R. M. W. (2003). Demonstratives: A cross-linguistic typology. *Studies in Language*, *27*(1), 61–112.

Eco, U. (1976). *A theory of semiotics*. Bloomington: Indiana University Press.

Eklund, R. (2008). Pulmonic ingressive phonation: Diachronic and synchronic characteristics, distribution and function in animal and human sound production and in human speech. *Journal of the International Phonetic Association*, *38*(3), 235–324.

Emmorey, K., & Casey, S. (2001). Gesture, thought and spatial language. *Gesture*, *1*(1), 35–50.

Enfield, N. J. (2001). 'Lip-pointing': A discussion of form and function with reference to data from Laos. *Gesture*, *1*(2), 185–211.

Erdrich, L. (2003). *Books and islands in Ojibwe country*. Washington, DC: National Geographic Books.

Everett, D. L. (2005). Cultural constraints on grammar and cognition in Pirahã: Another look at the design features of human language. *Current Anthropology*, *46*(4), 621–646.

Feldman, H. (1986). *A grammar of Awtuw*. Canberra: Australian National University.

Floyd, S. (2016). Modally hybrid grammar? Celestial pointing for time-of-day reference in Nheengatú. *Language*, *92*(1), 31–64.

Forrester, G. S., & Rodriguez, A. (2015). Slip of the tongue: Implications for evolution and language development. *Cognition*, *141*, 103–111.

Frank, M. C., Everett, D. L., Fedorenko, E., & Gibson, E. (2008). Number as a cognitive technology: Evidence from Pirahã language and cognition. *Cognition*, *108*(3), 819–824.

Gentilucci, M., Benuzzi, F., Gangitano, M., & Grimaldi, S. (2001). Grasp with hand and mouth: A kinematic study on healthy subjects. *Journal of Neurophysiology*, *86*, 1685–1699.

Goldin-Meadow, S., & Mylander, C. (1984). Gestural communication in deaf children: The effects and noneffects of parental put on early language development. *Monographs of the Society for Research in Child Development*, *49*(3–4), 1–151.

Goodwin, C. (2003). Pointing as situated practice. In S. Kita (Ed.) *Pointing: Where language, culture and cognition meet* (pp. 217–241). Mahwah, NJ: Lawrence Erlbaum.

Hahamy, A., Macdonald, S. N., van den Heiligenberg, F., Kieliba, P., Emir, U., Malach, R., & Makin, T. R. (2017). Representation of multiple body parts in the missing-hand territory of congenital one-handers. *Current Biology*, *27*(9), 1350–1355.

Haviland, J. B. (1993). Anchoring, iconicity, and orientation in Guugu Yimithirr pointing gestures. *Journal of Linguistic Anthropology*, *3* (l), 3–45.

Henrich, J., Heine, S. J., & Norenzayan, A. (2010). The weirdest people in the world? *Behavioral and Brain Sciences*, *33*(2–3), 61–83.

Herdt, G. (2003). *Secrecy and cultural reality: Utopian ideologies of the New Guinea men's house*. Ann Arbor: University of Michigan Press.

Hewes, G. W. (1974). Gesture language in culture contact. *Sign Language Studies*, *4*(1), 1–34.

Hewes, G. W. (1981). Pointing and language. In T. Myers, J. Laver, & J. Anderson (Eds.), *The cognitive representation of speech* (pp. 263–269). New York: North-Holland.

Hostetter, A. B., & Alibali, M. W. (2008). Visible embodiment: Gestures as simulated action. *Psychonomic Bulletin & Review*, *15*(3), 495–514.

Iverson, J. M., & Thelen, E. (1999). Hand, mouth, and brain: The dynamic emergence of speech and gesture. In R. Núñez & W. J. Freeman (Eds.), *Reclaiming cognition: The primacy of action, intention, and emotion* (pp. 19–40). Bowling Green, OH: Imprint Academic.

Jack, R. E., Garrod, O. G. B., Yu, H., Caldara, R., & Schyns, P. G. (2012). Facial expressions of emotion are not culturally universal. *Proceedings of the National Academy of Sciences*, *109*(19), 7241–7244.

Kaplan, G. (2011). Pointing gesture in a bird—merely instrumental or a cognitively complex behavior? *Current Zoology*, *57*(4), 453–468.

Keck, V. (2005). *Social discord and bodily disorders: Healing among the Yupno of Papua New Guinea*. Durham, NC: Carolina Academic Press.

Kendon, A. (1980). A description of a deaf-mute sign language from the Enga Province of Papua New Guinea with some comparative discussion. Part II: The semiotic functioning of Enga signs. *Semiotica*, *32* (1/2), 81–117.

Kendon, A. (2004). *Gesture: Visible action as utterance*. Cambridge, UK: Cambridge University Press.

Kendon, A., & Versante, L. (2003). Pointing by hand in Neapolitan. In S. Kita (Ed.), *Pointing: Where language, culture, and cognition meet* (pp. 109–137). Mahwah, NJ: Lawrence Erlbaum.

Kita, S. (Ed.) (2003a). *Pointing: Where language, culture, and cognition meet*. Mahwah, NJ: Lawrence Erlbaum.

Kita, S. (2003b). Pointing: A foundational building block of human communication. In S. Kita (Ed.), *Pointing: Where language, culture, and cognition meet* (pp. 1–6). Mahwah, NJ: Lawrence Erlbaum.

Kita, S., & Essegbey, J. (2001). Pointing left in Ghana How a taboo on the use of the left hand influences gestural practice. *Gesture*, *1*(1), 73–95.

Kita, S., & Ide, S. (2007). Nodding, *aizuchi*, and final particles in Japanese conversation: How conversation reflects the ideology of communication and social relationships. *Journal of Pragmatics*, *39*(7), 1242–1254.

Leavens, D. A. (2011). Joint attention: Twelve myths. In A. Seeman (Ed.), *Joint attention: New developments in psychology, philosophy of mind, and social neuroscience* (pp. 43–72). Cambridge, MA: MIT Press.

Levinson, S. C. (2003). *Space in language and cognition*. Cambridge, UK: Cambridge University Press.

Levinson, S. C. (2007). Optimizing person reference—perspectives from usage on Rossel Island. In N. Enfield & T. Stivers (Eds.), *Person reference in interaction: Linguistic, cultural, and social perspectives* (pp. 29–72). Cambridge, UK: Cambridge University Press.

Liszkowski, U., Brown, P., Callaghan, T., Takada, A., & de Vos, C. (2012). A prelinguistic gestural universal of human communication. *Cognitive Science*, *36*, 698–713.

Liszkowski, U., & Tomasello, M. (2011). Individual differences in social, cognitive, and morphological aspects of infant pointing. *Cognitive Development*, *26*(1), 16–29.

Lupyan, G., & Dale, R. (2010). Language structure is partly determined by social structure. *PLoS ONE*, *5*(1), e8559.

Majid, A., & Burenhult, N. (2013). Odors are expressible in language, as long as you speak the right language. *Cognition*, *130*(2), 266–270.

Mauss, M. (1973). Techniques of the body. *Economy and Society*, *2*(1), 70–88.

McClave, E. (2000). Linguistic functions of head movements in the context of speech. *Journal of Pragmatics*, *32*(7), 855–878.

McClave, E. (2007). Potential cognitive universals: Evidence from head movements in Turkana. In S. Duncan, J. Cassell, & E. T. Levy (Eds.), *Gesture and the dynamic dimension of language. Essays in honor of David McNeill* (pp. 91–98). Philadelphia, PA: John Benjamins.

McClave, E., Kim, H., Tamer, R., & Mileff, M. (2007). Head movements in the context of speech in Arabic, Bulgarian, Korean, and African-American Vernacular English. *Gesture*, *7*(3), 343–390.

Michel, G. F., Babik, I., Sheu, C.-F., & Campbell, J. M. (2013). Latent classes in the developmental trajectories of infant handedness. *Developmental Psychology*, *50*(2), 349–359.

Núñez, R., & Cooperrider, K. (2013). The tangle of space and time in human cognition. *Trends in Cognitive Sciences*, *17*(5), 220–229.

Núñez, R., & Cornejo, C. (2012). Facing the sunrise: Cultural worldview underlying intrinsic-based encoding of absolute frames of reference in Aymara. *Cognitive Science*, *36*(6), 965–991.

Orie, O. O. (2009). Pointing the Yoruba way. *Gesture*, *9*(2), 237–261.

Peirce, C. S. (1998). Of reasoning in general. In The Peirce Edition Project (Ed.), *The essential Peirce, Vol. 2: Selected philosophical writings (1893–1913)* (pp. 11–26). Bloomington, IA: Indiana University Press.

Pfau, R. (2010). A point well taken: On the typology and diachrony of pointing. In D. J. Napoli & G. Mathur (Eds.), *Deaf around the world: The impact of language* (pp. 144–163). Oxford, UK: Oxford University Press.

Pika, S., & Mitani, J. (2006). Referential gestural communication in wild chimpanzees (*Pan troglodytes*). *Current Biology*, *16*(6), R191–R192.

Povinelli, D. J., & Davis, D. R. (1994). Differences between chimpanzees (*Pan troglodytes*) and humans (*Homo sapiens*) in the resting state of the index finger: Implications for pointing. *Journal of Comparative Psychology*, *108*(2), 134–139.

Saitz, R., & Cervenka, E. (1972). *Handbook of gestures: Colombia and the United States*. The Hague: Mouton.

Salomo, D., & Liszkowski, U. (2013). Sociocultural settings influence the emergence of prelinguistic deictic gestures. *Child Development*, *84*(4), 1296–1307.

Schieffelin, B. (2008). Tok bokis, tok piksa: Translating parables in Papua New Guinea. In M. Meyerhoff & N. Nagy (Eds.), *Social lives in language: Sociolinguistics and multilingual speech communities* (pp. 111–134). Philadelphia, PA: John Benjamins.

Sherzer, J. (1973). Verbal and nonverbal deixis: The pointed lip gesture among the San Blas Cuna. *Language in Society*, *2*, 117–131.

Sherzer, J. (1983). *Kuna ways of speaking: An ethnographic perspective*. Austin, TX: University of Texas Press.

Tomasello, M. (2008). *Origins of human communication*. Cambridge, MA: MIT Press.

Veà, J., & Sabater-Pi, J. (1998). Spontaneous pointing behaviour in the wild pygmy chimpanzee (*Pan paniscus*). *Folia Primatologica*, *69*(5), 289–290.

Wassmann, J. (2016). *The gently bowing person: An ideal among the Yupno in Papua New Guinea*. Heidelberg: Universitatsverlag Winter.

Wilkins, D. (2003). Why pointing with the index finger is not a universal (in sociocultural and semiotic terms). In S. Kita (Ed.), *Pointing: Where language, culture, and cognition meet* (pp. 117–215). Mahwah, NJ: Laurence Erlbaum.

Wittenburg, P., Brugman, H., Russel, A., Klassmann, A., & Sloetjes, H. (2006). *ELAN: A professional framework for multimodality research*. Paper presented at the LREC 2006, Fifth Conference on Language Resources and Evaluation, Las Palmas, Spain.

Zipf, G. K. (1949). *Human behavior and the principle of least effort*. Menlo Park, CA: Addison-Wesley.