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Vision verbs dominate in conversation across cultures, but the ranking of non-visual verbs varies

Abstract: To what extent does perceptual language reflect universals of experience and cognition, and to what extent is it shaped by particular cultural preoccupations? This paper investigates the universality~relativity of perceptual language by examining the use of basic perception terms in spontaneous conversation across 13 diverse languages and cultures. We analyze the frequency of perception words to test two universalist hypotheses: that sight is always a dominant sense, and that the relative ranking of the senses will be the same across different cultures. We find that references to sight outstrip references to the other senses, suggesting a pan-human preoccupation with visual phenomena. However, the relative frequency of the other senses was found to vary cross-linguistically. Cultural relativity was conspicuous as exemplified by the high ranking of smell in Semai,

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an Aslian language. Together these results suggest a place for both universal constraints and cultural shaping of the language of perception.

Keywords: perception, conversation, lexical frequency, vision, universality, relativity

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1 Introduction

To what extent does the language of perception reflect universals of experience and cognition, and to what extent is it shaped by cultural preoccupations? This broad question is daunting, but can be operationalized into more modest inquiries that nevertheless shed light on the nexus of language, culture and mind. In this paper, we focus on generic perception verbs such as *see* and *taste* and ask two questions about their frequency of use in unrelated communities around the world. First, do frequency measures concur with the view that vision is the most dominant sense cross-linguistically, as has been asserted in the previous literature? And second, does the rank ordering of the five senses reveal a universal hierarchy, or point towards understanding the salience of the senses as a matter of cultural variation? To test these two questions, we examined two aspects of the occurrence of perception terms in spontaneous, face-to-face conversations in 13 diverse languages and cultures: (i) the frequency of basic perception words of different sensory modalities, and (ii) the frequency of references to physical perception using those words.

This introductory section describes the background and motivations for the study and outlines universalist and non-universalist hypotheses for the dominance of vision and a generalized hierarchy of the senses. The methods used to build a database of perception terms drawn from everyday conversation are described in Section 2. We then present our results (Section 3) and conclusions (Section 4).

1.1 Universals and the perception lexicon

A lynchpin in the study of sensory language is Viberg's (1983) survey of perception verbs. In it, Viberg examined how the lexical field of perception is carved up

Table 1: Viberg table for English (Viberg 1983: 128)

	Activity	Experience	Source-based
SIGHT	*look at*	*see*	*look*
HEARING	*listen to*	*hear*	*sound*
TOUCH	*feel*		
TASTE	*taste*		
SMELL	*smell*		

in various languages according to sense modality (vision, hearing, touch, taste, and smell) and more general semantic components which he called activity, experience, and source-based. Activity refers to a process that is controlled by the perceiver (exemplified by the English verb *look at*), experience refers to a state that is not controlled (as in *see*), and source-based refers to constructions where the perceiver is omitted (e.g., *The tree looks big*). Combining the 5 sense modalities with the 3 components leads to 15 different perception situations that could be lexicalized in different ways across languages. For example, Table 1 shows how, according to Viberg's analysis, English has two or more basic expressions for visual and auditory situations, but only a single verb for tactile, gustatory or olfactory situations.

In order to test how languages organize the semantic space of perceptual experience, Viberg compared translations from over 50 languages of a core set of fifteen sentences depicting the logically possible scenarios. Based on these comparisons, he made a number of universalist conclusions concerning the structure of generic verbs in the perceptual lexicon. One of the most significant proposals was a hierarchy of sense modalities, shown in (1).

(1) The hierarchy of the senses according to Viberg (1983)
see > hear > touch > taste, smell

This hierarchy reflects the directionality of meaning extensions across sense modalities (Viberg 1983: 136). According to this implicational hierarchy, terms that have a basic 'sight' meaning may commonly be extended to a 'hearing' meaning, but the reverse extension from hearing to sight is not to be found. The proximal senses of touch, taste, and smell are the lowest in the hierarchy. In a more recent study, Evans and Wilkins (1998, 2000) found support for Viberg's hierarchy in relation to extensions across sense modalities in languages of Australia (an area not well represented in Viberg's original survey).

The hierarchy suggests that vision is the most salient sense modality across languages. In fact, Viberg (1983) presents a number of arguments in favor of vision being in "first place" amongst the senses. First, there is a near-universal presence of a basic perception verb meaning something like 'see' across languages. Second, there is high elaboration of lexical items referring to (active or experiential) vision. Third, vision lexicalization patterns predict lexicalization patterns in other sense modalities (e.g., a language will not have an agency distinction like *listen (to)* versus *hear* in hearing verbs unless it also has one in sight verbs). And finally, there are more non-perceptual extensions (e.g., meanings concerning cognition and social interaction) for vision verbs in comparison to other sensory modalities. Viberg (1993) subsequently found that 'see' belonged to a shared set of high frequency verbs in a sample of 11 European languages, and suggested that this also related to the proposed lexicalization hierarchy (see also Tchantouria and Vamling 2005; Veselinova 2006: 93).

In a highly influential study, Sweetser (1990) argued further that a link between intellection and sight in the language of the senses was universal, because vision is "our primary source of objective data about the world" (1990: 39). Sweetser also notes the significance of audition in human intellection, especially in regard to linguistic communication, but relegates touch, taste and smell to subjective experience, with only a small role to play in the mental domain.

The primacy of vision over the other senses appears to be well supported by our underlying biology. Humans, like other primates, display considerable visual specialization including high visual acuity, stereoscopic vision, trichromacy, and large visual cortices (Barton 2006). Some estimates suggest that up to 50% of the cortex may be involved in visual function (Palmer 1999). Experimental studies also support the dominance of sight over auditory perception (e.g., Colavita 1974; Spence 2009). Therefore, the apparent linguistic dominance of vision may be rooted in our pan-human evolutionary history.

1.2 Relativity and the perception lexicon

Universalist claims, such as those of Viberg and Sweetser, have not been accepted by everyone, however. Within the research tradition of the "anthropology of the senses", scholars have argued that "sensory perception is a cultural, as well as a physical act" (Classen 1997: 401), and that cultures make use of different sensory domains in different ways, thus exhibiting substantial variation in the processes and values that are associated with them. In fact, the hierarchy of the senses has had many forms in Western thought across the ages. The classic Aristotelian hierarchy departs from Viberg's linguistic hierarchy, running as follows: sight,

hearing, smell, taste, touch (Jütte 2005). Over the centuries, European philosophers have argued over precise rankings but most maintain the priority of vision. Classen recognizes this in her own work, but argues that this is a culture-specific bias which can in turn skew scholarly or popular Western interpretation of other societies.

Senses other than sight can be vaulted to the forefront, as shown by Feld's (1982) study of the "ear-minded" Kaluli from the Highlands of Papua New Guinea, or van Beek's (1992) work on "smell as a social frontier" amongst the Kapsiki of Cameroon and Nigeria. And while Evans and Wilkins (1998, 2000) found support for Viberg's hierarchy in regard to polysemous extensions across sense modalities, they argued that in Australian languages audition was a more important source for cognition meanings than was vision. Against this backdrop, Aikhenvald and Storch (2013) have recently questioned the validity of Viberg's and Sweetser's linguistic claims, arguing that the language samples used by these researchers are not representative of the world's languages. According to them "[t]here is hardly any doubt that universal claims concerning the preferred status of 'vision' (e.g., Viberg 1983; Sweetser 1990) are highly Eurocentric, and do not hold for the majority of non-Western societies" (Aikhenvald and Storch 2013: 3).

Thus, in addition to furnishing evidence of universal trends, the perceptual lexicon can "yield rich insights into the differential importance of specific senses across cultures" (Majid and Levinson 2011a: 7; Levinson and Majid 2014). Howes and Classen (1991: 263) interpret the presence of an elaborate set of smell verbs in Quechua as proof of smell's "practical or popular" importance in that speech community, and Ritchie (1991) draws attention to the basic perception verb inventory in Hausa, which includes one verb for seeing (*gani*) and one for all other sensory perception (*ji*, including hearing, touching, smelling and tasting); he argues that this represents a profound difference in the treatment of the sensorium compared to languages such as English. Such a view is supported by experimental psycholinguistic studies that show that the way a language "cuts up the sensorium" can have a significant effect on how people respond to perceptual stimuli (e.g., Majid and Levinson 2011a; Wolff and Holmes 2011). Sight is not always the most privileged form of evidence (Aglioti and Pazzaglia 2011; Sommerfield et al. 2007), and if we examine the experimental evidence in more detail, we find cases where auditory stimuli, for example, can influence visual perception (Shams et al. 2000). So, the senses may well be more culturally variable than previously supposed.

1.3 Perception verbs and conversational data

As the previous discussion illustrates, the perceptual lexicon has been the subject of study from a variety of perspectives, including cross-linguistic surveys based largely on written data and questionnaires (e.g., Viberg 1983; Sweetser 1990; Vanhove 2008; Fedriani et al. 2012), participant-observation in particular cultural contexts (e.g., Ritchie 1991; the articles in Majid and Levinson 2011b), and experimental studies (e.g., Dingemanse and Majid 2012; Wnuk and Majid 2014; Majid and Burenhult 2014). However, little is known cross-linguistically about the use of perception words in face-to-face conversation, a primary forum for the sharing, manipulation, and negotiation of perceptual experience through language. For example, is Viberg's hierarchy, originally proposed in relation to the lexicalization of perceptual experience, reflected in everyday, interactive language use? Conversational data add new evidence to the ongoing debate concerning how cultural and universal forces shape the perceptual lexicon.

There are numerous arguments for basing linguistic inquiry on conversational data. Conversation is the major setting for the acquisition and use of language (Levinson 2006) and is the primordial site of human sociality (Schegloff 2006). The use of language in conversational contexts arguably shapes the structure of linguistic systems (see, e.g., Brysbaert and New 2009; Bybee 1985; Bybee and Hopper 2001; Enfield and Levinson 2006; Fox 2007; Ochs, Schegloff and Thompson 1996). Furthermore, while only some languages have written traditions, it is almost certainly the case that all languages are used (or have been used) in face-to-face communication. Thus, conversational data support wider cross-linguistic comparison of certain features (e.g., lexical frequency) that would not otherwise be feasible. Our study contributes to the small but growing number of quantitative comparative studies on underdescribed languages using conversational data (e.g., Stivers et al. 2009; Stivers, Enfield and Levinson 2010).

1.4 Cultural prominence and frequency

There is a general assumption in the literature that lexical frequency will correlate with cultural prominence (see, e.g., Ahrens 2006; Brown and Witkowski 1983; Bybee and Hopper 2001: 20; Dahl 2001; Evans 2003; Leech and Fallon 1992; Wierzbicka 1997: 15; Witkowski and Brown 1983: 575; Yokoyama 1986). Witkowski and Brown (1983), for example, argue that the growing cultural importance of horses for Navajo speakers led to an increase in use of the word 'horse' in that community. In a more recent study, Ahrens (2006) argues that the decreasing frequency of the word *man* to refer to all human beings (e.g., as in *the best hope of*

man on earth) in US presidential addresses from 1945–2006 reflects a shift from a gender-biased society towards one with greater gender equality. In relation to the perception lexicon in particular, Ritchie (1991: 194) argues that the low frequency of sight verbs in Hausa reflects the relative importance of multisensory perception in Hausa culture, in contrast to the English cultural emphasis on vision. However, as Evans (2003: 28) observes, inquiries into the culture-language interface and frequency in conversation are "vanishingly small". The present study aims to address this lack through quantitative scrutiny of conversational data from a diverse sample of languages.

We test two hypotheses regarding the perception lexicon by examining video-recordings of spontaneous conversation in 13 languages. We first consider how the frequencies of basic perception words in our corpora relate to the supposed importance of vision in perceptual language, treating this as a potentially absolute universal.[1] The strongest version of the visual dominance hypothesis predicts that for all languages in our sample speakers will talk about sight more than they talk about hearing, touch, taste, or smell. Second, we examine whether the rank ordering of all five senses is the same cross-linguistically. According to strictly universalist accounts, the rank ordering of the senses should be exactly the same, but the relativist view predicts that rank order will differ across cultural contexts.

2 Data and methods

2.1 Languages in the sample

Data from a convenience sample of 13 languages, listed in Table 2, were included in the study. The languages are diverse, coming from nine language families from around the globe. They include endangered languages with small speaker groups living in fairly isolated circumstances in hunter-gatherer or subsistence communities (e.g., Semai, Cha'palaa), as well as national or even international languages spoken by millions of people (e.g., English, Lao). The data and coding of these languages were provided by the investigators as named in Table 2; the English data recordings were taken from the Santa Barbara Corpus of Spoken American English (Du Bois et al. 2000).

1 Of course, our data only have the potential to disprove rather than prove an absolute universal. See, e.g., Dryer (1989) for discussion of the conundrum of proving strict universals, and Piantadosi and Gibson (2014) for suggestions on how to deal with this problem.

The typological characteristics of the 13 languages vary widely.[2] Dominant word orders include SOV, SVO and VOS, and the expression of person ranges from obligatory verbal inflection to optional noun phrases. Several of the languages have other lexical or grammatical features that are especially relevant to encoding perception. For example, Siwu, Avatime and Semai all have extensive inventories of ideophones or expressives, "marked words that depict sensory imagery" (Dingemanse 2012), comprising a specialized lexicon for perceptual experience (see also Dingemanse 2011; Tufvesson 2011). Semai has an unusually rich vocabulary for smell terms, a feature that is shared by other members of the Aslian language family (e.g., Burenhult and Majid 2011; Wnuk and Majid 2014), and Duna has a complex evidential system, whereby the information source for

Table 2: Languages included in the study

Language name	Linguistic affiliation: Family (subgroup)	Main location of recording	Approximate size of speaker group[3]	Investigator(s)
Avatime	Niger-Congo (Kwa)	Ghana	15,000	R. Defina & S. van Putten
Cha'palaa	Barbacoan	Ecuador	10,000	S. Floyd
Chintang	Sino-Tibetan (Kiranti)	Nepal	4,000	T. Dirksmeyer
Duna	Duna-Bogaia	Papua New Guinea	20,000	L. San Roque
English	Indo-European (Germanic)	United States	334,800,000	K. Kendrick
Italian	Indo-European (Romance)	Italy	55,000,000	G. Rossi
Lao	Tai-Kadai	Laos	15,000,000	N. Enfield
Mandarin	Sino-Tibetan (Chinese)	Taiwan	847,800,000	K. Kendrick
Semai	Mon-Khmer (Aslian)	Malaysia	40,000	S. Tufvesson
Siwu	Niger-Congo (Kwa)	Ghana	15,000	M. Dingemanse
Spanish	Indo-European (Romance)	Colombia	405,600,000	E. Norcliffe
Tzeltal	Mayan	Mexico	460,000	P. Brown
Whitesands	Austronesian (Oceanic)	Vanuatu	7,500	J. Hammond

2 For further information on the smaller, less well-described languages discussed, and/or further details on the language of perception in the languages of this study see, e.g.: Avatime, Defina (in press), van Putten (in press); Chintang, Dirksmeyer (2008), Stoll et al. (2012); Cha'palaa, Floyd (2010); Duna, San Roque (2008); Lao, Enfield (2011); Semai, Diffloth (1976), Tufvesson (2011); Siwu, Dingemanse (2011); Tzeltal, Brown (2011); Whitesands, Hammond (2009).

3 Sources: Duna (Haley 2002), English (Lewis 2009), Italian (Lewis 2009), Lao (Enfield 2007), Mandarin (Lewis 2009), Siwu (Dingemanse 2011), Spanish (Lewis 2009), Tzeltal (Instituto Nacional de Estadística y Geografía 2010). Figures without specified sources are as supplied by the relevant researcher.

an event or situation (e.g., whether it was seen or heard) is typically marked on the verb through bound morphology (San Roque 2008). These factors are not explored in detail in this study, as they fall outside the basic vocabulary examined (see Section 2.3), but we considered them, where relevant, in our interpretation of the data.

2.2 Sampling method

From each language, a comparable sample of video data was extracted from available source recordings. These samples consisted of six conversation segments of approximately ten minutes length each. The admittedly modest 60-minute sample size was taken in order to allow the inclusion of diverse languages for which large transcribed corpora do not exist, while still maintaining comparability. The sample ensured breadth of speakers and conversational topics. To test the validity and reliability of the '6 × 10' sampling method, we compared three samples of English (each composed of 6 × 10 minute sections) from the Santa Barbara Corpus of Spoken American English. For each sample, we compared the frequency of perception verbs using a one-way ANOVA, which showed no statistically significant difference across samples $F(2, 8) = 2.95$, $p = .11$. The correlation of frequencies across samples was extremely robust ranging from .98 to .99. This suggests that the sampling, while limited, is nonetheless robust to the phenomenon being studied.[4]

While the cultures and languages included in the sample are diverse, the contexts for the data share certain similarities. The conversations were recorded primarily in domestic settings (indoor and outdoor) and include people doing things such as preparing food, doing laundry, or just talking together (see Appendix for further details). Most participants are familiar with each other; they are family members, neighbors, flatmates, colleagues, and/or friends. The number of interactants ranges from two to as many as eight, with an age range from small children to the elderly. Across languages, conversation segments were selected

4 Further evidence that this sampling technique is reliable comes from comparing the rank ordering of the English sample to the $SUBTLEX_{US}$ database (http://expsy.ugent.be/subtlexus/, approximately 51 million words, compiled from US English film and television subtitle text). The rank ordering was almost identical. The relative frequency of sight and hearing terms, for example, were identical, with sight terms four times as frequent as hearing terms in both corpora. There was a slight discrepancy in the ranking of smell and taste terms across corpora, with smell ranking lowest in the Santa Barbara Corpus of Spoken American English but taste ranking lowest in the SUBTLEX. This can be accounted for by the overall lower frequency of these senses, which suggests caution in interpreting the rank ordering of low frequency verbs.

randomly, without monitoring for perception descriptions. Section boundaries coincided with boundaries of grammatically or pragmatically coherent units (e.g., the end of a sentence or turn). Where there was an interruption of more than one minute to the conversation (e.g., one of the participants takes a telephone call), this was not included in the 10-minute sample.

2.3 Core perception vocabulary

For each language, the investigator identified a set of core perception predicates. Viberg's (1983) established framework was used as a guide (see Table 1), so that every sense modality was represented by one or more lexemes. The means identified for expressing perception included simple verbs, as well as complex predicates (e.g., verb serializations) and (derived) nominal roots. Following Viberg's study, only perception terms that the researcher identified as semantically general were included. For example, the Spanish word *ácido* 'acidic, sour' occurred in the Spanish data sample, but this describes one specific gustatory percept rather than taste in general, and was not treated as core perception vocabulary. Similarly, the Duna sample includes the word *simusimu* 'sniff excitedly, be aroused by a delicious smell', but this was not considered a basic smell term as its meaning is complex, in contrast to the more general Duna smell verbs *kori* 'smell (pleasant)' and *ringa* 'smell (unpleasant)'. Terms that referred only to internal sensation (e.g., nausea, pain), temperature, proprioception and/or emotion, and did not also have a clear "external" tactile meaning, were not included. Such terms are undoubtedly relevant to the perceptual lexicon (see also Evans and Wilkins 2000: 554) but are beyond the scope of the present study.

For seven languages in the sample, the set of perception predicates included a "multi-sense" term. A multi-sense term is one that can refer to more than one mode of sensory perception without any clause-internal constructional support (such as incorporation of a body-part noun). In Avatime, Duna, Italian, Spanish, Tzeltal and Whitesands, the main multi-sense verb can refer to all senses except sight. In Semai there is a single touch/taste term (borrowed into the lexicon from Malay, see also Viberg 1983: 145). Multi-sense terms that occurred in the data sample are shown in Table 3.[5]

5 The lexical inventories of several of the languages also include a general multi-sense term for all modalities (e.g., *perceive* in English, *luma* 'be perceptible' in Chintang) or other combinations (e.g., English *sense*, Tzeltal *maklij* 'visually/aurally attend to'). These did not occur in the data sample and will not be discussed further here. Siwu can also be analyzed as having a general 'hear/touch/smell/taste' verb, as the form *nɔ* can be involved in expressing all of these

Table 3: Multi-sense terms in the data sample.

	SIGHT	HEARING	TOUCH	TASTE	SMELL
Avatime		*nu*			
Duna		*waki*			
Italian		*sentire*			
Semai			*rasaak*		
Spanish		*sentir*			
Whitesands		*tetou*			
Tzeltal		*a'y*			
	chiknaj				

Note: In Avatime, Duna, Italian, and Whitesands the default meaning relates to hearing. It is not possible to identify a single default meaning for the remaining languages.

While multi-sense verbs potentially cover several sensory modalities, some have a default interpretation that relates to just one sense. We identified default meanings according to the translation equivalent a native speaker would supply for this word in the absence of other context, and the way this verb would likely be interpreted in a potentially ambiguous frame. Using these criteria, the default interpretation of the multi-sense terms in Avatime, Duna, Italian, and Whitesands relates to hearing. In Semai, according to examples that have been examined so far, both the 'touch' and 'taste' meanings of *rasaak* are prominent, with the typical interpretation relating to bodily/somatosensory experience. For Colombian Spanish and for Tzeltal it is not possible to identify a default modality-specific perceptual meaning for the multi-sense terms (although the Tzeltal term *chiknaj* is most usually associated with either seeing or hearing). Perception words that apply across sensory modalities can be argued either to have several clearly distinct meanings or to have a single semantically general meaning, for example, as with English 'perceive' (see, e.g., Goddard and Wierzbicka 1994; Evans and

sensory experiences (e.g., in combination with the verb *fɔrɛ̃* 'inhale, smell' to mean 'perceive (by) smelling' or with the verb *pegu* 'touch' to mean 'perceive (by) touching'). However, it requires intra-clausal constructional support to be understood as anything other than 'hear', and in this study we treat it as a 'hearing' verb. Note that, although not represented in Table 3, for multi-sense terms that can be used to refer to internal sensation (e.g., Italian *sentire*, Semai *rasaak*, Spanish *sentir*, Tzeltal *a'y*) these meanings may be equally as prominent as those relating to external physical perception.

Wilkins 2000; Pawley 1994). In general, we take an "agnostic" approach (see Koptjevskaja-Tamm 2008: 8–11) as to whether the multi-sense terms shown in Table 3 should be considered polysemous or truly semantically general.

2.4 Our database

All instances of the identified perception terms were located in the data for each language on the basis of their form. The examples identified included not only those used as main predications but also those used with referential or grammatical function (e.g., in conative constructions, i.e., those that express attempting an action). Lexical items that ultimately derived from a perception word but have become lexicalized and/or show phonological changes particular to one usage (e.g., Tzeltal *yael* 'apparently', from *a'y* 'non-visually perceive') were not included. Three samples included instances of code-switching, where speakers switch briefly to an alternative language, including using perception terms in that language.[6] These items were not included in the frequency counts. Verbal complexes that included more than one use of a perception verb (e.g., verb root reduplication to express iterative aspect) were counted as one instance of the lemma. Other kinds of repetition (e.g., 'reformatting' self-repairs, see Schegloff 2013) were counted twice.[7]

The conversational turn in which the perception term occurred was extracted, given a unique identifier, and incorporated into a database for further coding and analysis. Each item was coded for a number of features, including those listed below:

a. Sense modality: the sense modality of the lemma. Possible values: sight, hearing, touch, taste, smell, multi-sense.
b. Perception meaning and modality: researchers were asked to judge whether, in this particular context, the word could be understood as referring to physical perception, and to specify which modality or modalities this perceptual

6 Details are as follows: Chintang, 4 uses of Nepali *hernu* 'look', 1 use each of Bantawa 'see' and 'listen'; Duna, 2 uses of Tok Pisin *lukim* 'see, look' and 6 of *harim* 'hear, listen'; Whitesands, 1 use of Bislama *taj* 'touch'.

7 The data included 17 instances of reduplication (or similar). 'Restart' self-repairs consisting of a cutoff or partially produced perception term followed by a fully produced term (3 examples) were counted as one instance. Apparent restart self-repairs consisting of two fully produced terms (8 examples) were counted twice (because the speaker was not required to produce the form a second time). Other types of repetition that were counted twice included alternative question constructions where the second iteration of the verb was optional (4 examples), i.e., in contrast to reduplication where repetition is an unavoidable feature of construction choice.

meaning belonged to. For example, if a multi-sense verb was used to talk about perceiving a noise, it was coded as referring to hearing. Further examples are discussed below.

c. Stimulus: the nature of the percept in this context. Possible values: human, concrete (non-human), situation, sound, speech, abstract, other. For example, where an Avatime speaker talks about seeing cassava peels [Ava_127],[8] this is coded as a 'concrete' stimulus.

Basic perception verbs often have other meanings beyond the expression of physiological experience. For example, in several of the languages in our sample, the basic hearing verb can also be used with the cognitive meaning, 'understand a language' (cf. Vanhove 2008), while a basic vision verb can be used with social meanings such as 'meet' (see, e.g., Alm-Arvius 1993 for a detailed study of meanings of the English verb *see*). In order to provide further, more detailed semantic information, researchers were also asked to give a free translation of the perception term in each example.

Predications were coded as 'non-perceptual' for item (b) if their meaning in context was grounded in a domain other than sensory experience, and physical perception was not judged to be a plausible reading. For example, the verb *mɔ̀* 'see' in Avatime can be used to mean 'have, get', and such uses were not recorded as instances of reference to vision. Grammaticized or discourse uses that did not plausibly reference perception were also coded as 'non-perceptual'. For example, in Duna, where the vision verb *ke-* is used in a serial verb construction to express trying to do something (e.g. *ka yia* ***kepa***, 'You **try** and call out!' [Dun_76]) this was not counted as a 'sight' meaning. An English example of a non-perceptual discourse use is where a teenage girl appeals to her mother for an increased allowance: *Now* ***see*** *Mom, it's like this – When you're my age, you need a lot of extra money* (Eng_89). For the purposes of this study, emotion, internal sensation and temperature were also classified as 'non-perceptual'.

3 Results

We present our results concerning the possible dominance of vision (Section 3.1) and the question of whether there is a uniform rank ordering of the senses (Section 3.2). For each research question we examine two frequency measures: (i) the

8 Examples from the database are referred to using their unique identifiers, composed of the first three letters of the language name followed by a number (assigned according to the order in which they were extracted from the original data).

frequency of forms, as represented by the number of times each core perception word occurs, and (ii) the frequency of references to physical perception (as opposed to uses of perception verbs that express non-perceptual meanings, as outlined in the preceding section).

3.1 Is vision dominant in all languages?

The hypothesis that vision dominates our senses predicts that sight-related terms will be the most frequent across all languages. We tested the most extreme version of this hypothesis by comparing the frequency of vision words to the frequency of all other modalities combined, for each language separately.[9] Table 4

Table 4: Comparison of visual and non-visual perception words.

Language	Comparison of form frequencies (including all uses)		Comparison of meaning frequencies (excluding non-perceptual uses)	
	N	χ^2	N	χ^2
Avatime	177	77.34*	144	58.78*
Cha'palaa	42	9.52	37	6.08
Chintang	14	2.57	13	1.92
Duna	172	60.49*	129	20.16*
English	87	15.74*	70	16.51*
Italian	112	32.14*	98	27.59*
Lao	46	22.27*	36	19.56*
Mandarin	86	39.12*	74	31.13*
Semai	74	26.16*	66	19.64*
Siwu	111	35.76*	103	31.54*
Spanish	89	22.75*	80	26.45*
Tzeltal	366	29.55*	190	12.13*
Whitesands	100	21.16*	83	28.93*

Note: The frequency of vision verb forms was higher in all languages, except Tzeltal where the multi-sense verb (*a'y*) was significantly higher. But when we consider meanings, all languages pattern similarly: vision is refered to more often in conversation than all other senses combined.
* indicates significance at .0001

9 The chance of one of these comparisons showing significance even if there is no difference between sensory modalities is high (48.67%). Therefore we used a more conservative significance value of .0038, which is compatible with both Sidak's and Bonferonni adjustments. This more stringent value means that some comparisons do not meet the criterion.

shows the results. Vision was the most dominant sense in 10 out of the 13 languages. Cha'palaa and Chintang showed the same numerical trend but the differences were not statistically significant. Amidst this apparent homogeneity, Tzeltal stands out. Tzeltal's multi-sense verb was almost twice as frequent as its vision verbs (see Figure 1). The Tzeltal multi-sense verb (*a'y*) is often used in a phrase that expresses understanding, something like 'I see' or 'y'see' in English. This highly conventionalized form is also a discourse marker, as well as (potentially) a description of a sensory experience, highlighting the fact that many uses of perception verbs have little to do with literal perceptual reference. Therefore, we also tested the vision dominance hypothesis by restricting focus to instances of perception terms that in their context can be understood to refer to events of physical perception.

For each example from each language, we used the 'Perception meaning and modality' coding values (Section 2.4) to establish whether the perceptual meaning related to vision or one of the other senses. Cases where both vision and non-vision meanings could be intended were discarded (so as not to violate the statistical assumptions of chi-square). This led to 31 cases being omitted. The analyses do not change if these cases are included. Vision was the most frequent sense talked about in all languages, including Tzeltal (see Figure 2). Vision meanings occur more than twice as often as non-vision meanings for Cha'palaa and Chintang but did not reach the conventional level of significance. Overall, these results support the vision dominance hypothesis across languages.

3.2 Is rank ordering the same across languages?

A universalist view predicts that languages will share a common rank order of frequencies for the five senses, while a relativist view predicts that rank orderings will vary from language to language. In relation to these predictions we look first at the frequency of forms, followed by an examination of the frequency of perception references. Figure 1 shows the form frequency of perception terms across the 13 languages for all five senses, by frequency (upper panel) and proportion (lower panel). For example, the one hour sample of Mandarin conversation included 72 uses of a basic sight verb (accounting for 84% of the basic perception verbs found in the sample), 12 hearing verbs (14%), and 2 touch verbs (2%), with no basic taste or smell verbs at all.

To test whether the rank ordering of the senses in terms of form frequency was reliably associated across languages, we conducted Kendall's tau-b correlations. Since some languages have distinct verbs for all five modalities, but others do not, we calculated Kendall's tau-b amongst languages that do not employ a

multi-sense verb (Cha'palaa, Chintang, English, Lao, Mandarin, Siwu) and those that do (Avatime, Duna, Italian, Semai, Spanish, Tzeltal, Whitesands) separately. For those languages without multi-sense verbs, there were statistically significant positive correlations (r_τ between .88 and 1.0) between all the languages, apart from between Cha'palaa and English, and Cha'palaa and Mandarin $r_\tau = .67$, $p = .06$. This non-significant correlation was because Cha'palaa deviates from the predicted universalist hierarchy: smell is ranked third, after sight and hearing, with touch and taste not attested at all.

For the group of languages with multi-sense terms, the picture was murkier. While some languages did show a statistically significant correlation in their rank orderings (Whitesands and Spanish $r_\tau = .71$, $p = .03$; Tzeltal with Avatime $r_\tau = .67$, $p = .05$; and Avatime with Italian $r_\tau = .93$, $p = .007$), the remainder did not.

These results are consistent with the relativist view, since rank order correlations between languages do not equal 1 as would be expected from an absolute universalist perspective. But correlations have to be interpreted with some caution since touch, taste, and smell verbs occur with low frequency. Multi-sense verbs pose a challenge to a universalist hypothesis as the rank orderings were variable even when the possible range of perceptual meanings of the verbs were roughly similar. The multi-sense verb ranks second in Avatime, Duna and Italian; third in Semai and Whitesands; and fourth in Spanish. In the Avatime sample the multi-sense predicate clearly outstrips the hearing predicate, but in Spanish this situation is reversed.[10]

Turning to perception references, Figure 2 shows the frequency and proportion of meanings by modality for each language. In these analyses, where a perception word had two or more plausible perceptual meanings these were all counted (thus, a single token may be the source for two or more 'meaning' counts, since this does not violate the assumptions of Kendall's tau-b). The figure illustrates some cross-linguistic similarity in the ranking of references to perception. As discussed previously, sight is the most talked about sense in all 13 languages. More than two-thirds of perceptual references are vision-related in nine languages, with the range falling between 62% (Tzeltal) and 82% (Avatime and Mandarin). Hearing is ranked second for all languages – ranging between 16% (Italian

10 This is probably due to the different default meanings of the Avatime and Spanish multi-sense verbs, as outlined in Table 3. Both verbs can refer to all non-visual senses, but Avatime's multi-sense verb prototypically refers to hearing (contrasting with an audition-only predicate that refers to careful listening), while the Spanish multi-sense verb does not have a clear modality-specific default reading (and complements several audition-specific verbs in the lexicon).

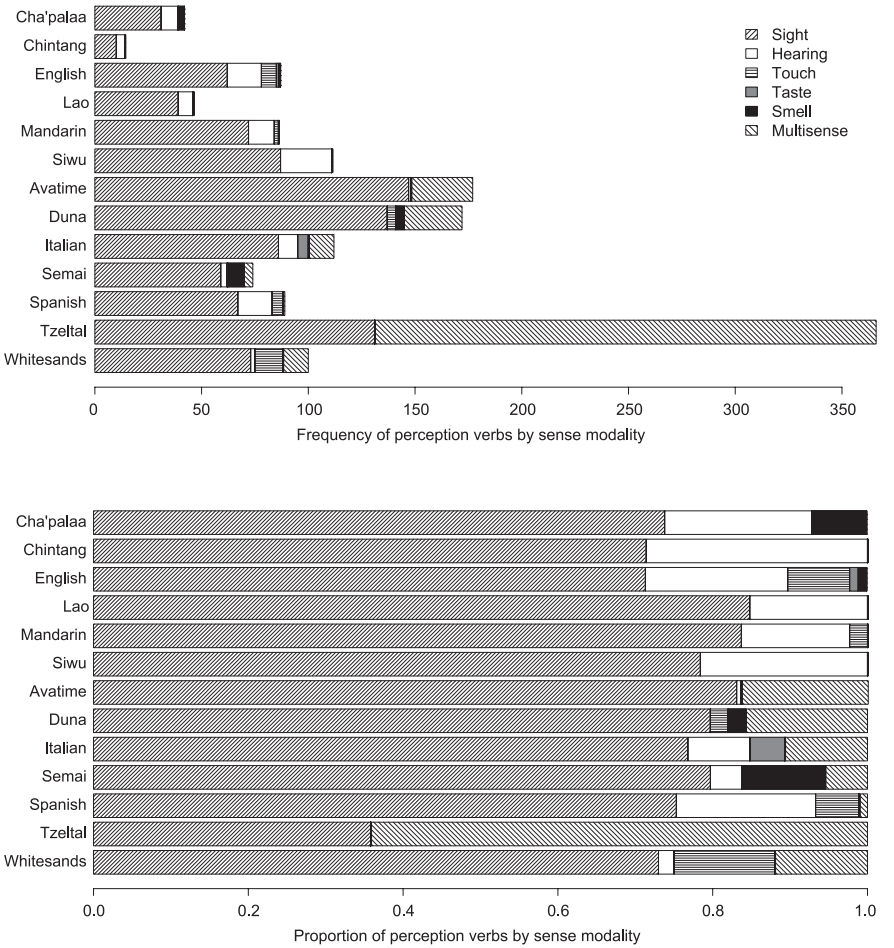

Fig. 1: Frequency (upper panel) and proportion (lower panel) of perception terms for all 13 languages by sense modality

and Mandarin) and 38% (Tzeltal) – except Semai, where smell comes in second place.

Kendall's tau-b tests revealed that all correlations between languages were positive, but only around a half were significant ($r_\tau \geq .88$). Correlations ranged between .32 and 1. For example, Avatime, Whitesands, and Mandarin are correlated at 1, with identical rank ordering (sight, hearing, touch, taste=smell). However, the correlation between each of these languages and Semai (which has the order sight, smell, hearing, taste, touch) is only .32. The results are a far cry from the unanimity predicted by a universalist view.

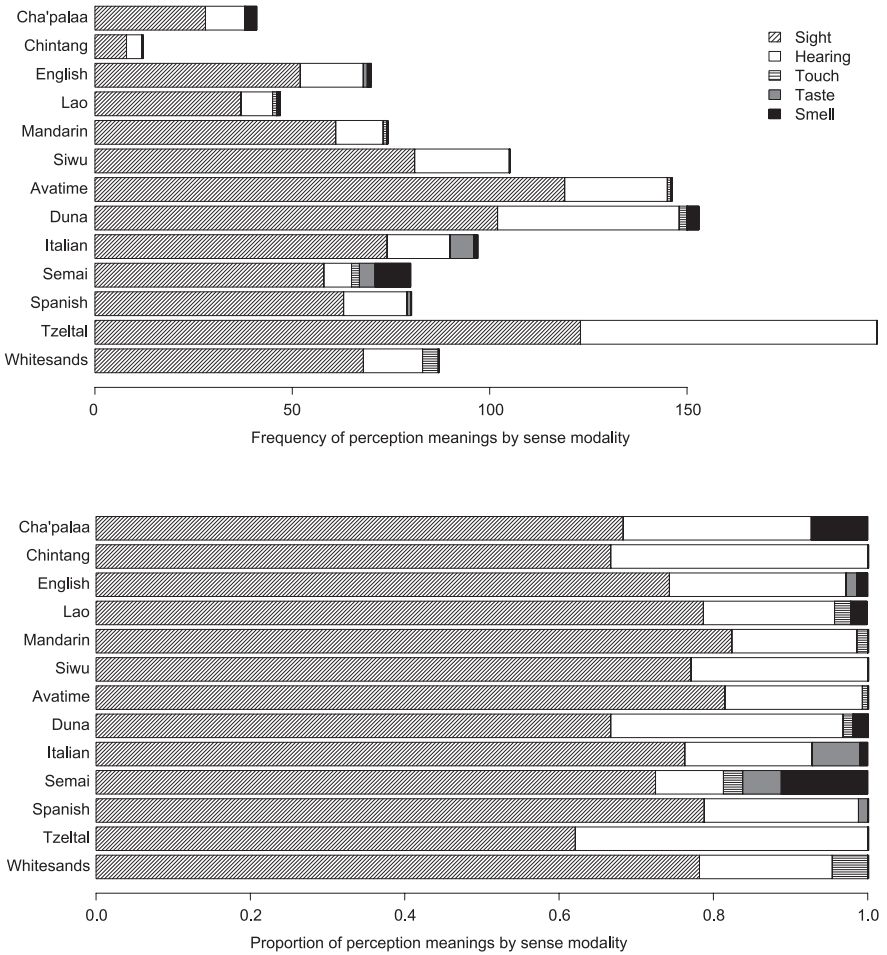

Fig. 2: Frequency (upper panel) and proportion (lower panel) of perception references for all 13 languages by sense modality

It is notable that the profile for hearing in Figure 2 looks quite different from that in 1. This change results largely from the fact that when multi-sense verbs refer to perception in Avatime, Duna, Italian, Tzeltal and Whitesands they predominantly refer to hearing. A typical context for this is where the percept of the multi-sense verb is speech, as in the Whitesands sentence, ***iakatou*** *Daniel tateni* 'I **heard** what Daniel says' (Whi_24). In this utterance, the multi-sense verb *iakatou* 'sense non-visually' is clearly best understood as having a hearing meaning. More than half of all multi-sense verbs in Avatime (52%), Duna (85%), Tzeltal

(70%) and Whitesands (58%) were identified as having a 'speech' stimulus. Overall, speech was the most common stimulus type for verbs used with a hearing meaning in 11 languages (i.e., all except Cha'palaa and Semai).[11] In many languages this included examples where speech in the current conversation was treated as a stimulus, (e.g., as in the Spanish utterance, ***oiga*** *niños*, *no es por echarlos pero* ... '**Listen** guys, not to throw you out but ...' [Spa_82]).

Verbs with sight meaning showed less cross-linguistic consensus about their object. The most common stimuli were 'situation' (6 languages), 'non-human concrete' (4 languages) or 'human' (2 languages), with human and non-human concrete stimuli equally common in Lao. The stimuli for verbs with touch meaning were either concrete (non-human) objects or situations involving concrete objects (e.g., feeling the movement of someone's hand). For verbs that were used with taste and smell meanings, stimuli were always coded as concrete (non-human), except for two instances in Duna of a human smell stimulus.

4 Conclusions

In 12 out of 13 languages from around the globe, vision verbs were the most frequent forms, accounting for more than two-thirds of the generic perception terms used in everyday conversation. In all 13 languages, references to vision were more frequent than references to the other senses. This evidence provides strong support for the vision dominance hypothesis, suggesting a "common core" of human experience in perceptual language (cf. Evans and Wilkins 2000: 561–562), and is contrary to the relativist predictions of Aikhenvald and Storch (2013).

Why is it that, of all the senses, references to sight predominate in spoken interaction? One possibility suggested by the biological literature is that language use reflects a pan-human preoccupation with visual experience. Much of

11 For Spanish and Italian, the preponderance of speech-as-stimulus appears to have an effect on the rank ordering of perceptual meanings by modality. If we remove all cases that have a speech stimulus from the sample, verbs with hearing meaning move from undisputed second place to a tied second place with taste. That is, if we ignore references to the perception of speech, taste meanings and hearing meanings are equally frequent in both of these languages. In relation to the rank order of form frequencies (i.e., regardless of whether meanings are perceptual or otherwise) the exclusion of speech stimulus examples causes changes in three languages: the multi-sense verb in Duna moves from undisputed second place to tied second place with smell verbs; for Spanish the order sight, hearing, touch, multi-sense changes to sight, touch, hearing= multi-sense; and in Tzeltal, the vision verb moves from second place up to first place, deposing the multi-sense verb *a'y*.

our brain is devoted to visual processing and vision often dominates our interpretation of sensory information (e.g., Colavita 1974; Palmer 1999). A 'hardwired' reliance on the visual modality is, therefore, one explanation for why across cultures vision is talked about the most. But that is not the only possibility. It could be that there are simply more occasions to talk about visual objects than objects apprehended through the other senses. For example, verbs of taste require objects that can be put in the mouth, while verbs of sight are selectionally much less restrictive and indeed encompass most gustatory percepts. This would mean there are simply more visual experiences to talk about (see also Sweetser 1990: 39). A third possibility is that perceptual language reflects both sensory and social concerns. As a distal sense, it seems likely that sight is one of the most readily and regularly shared perceptual experiences among interlocutors, and vision is generally treated as the primary foundation for joint attention (Moore and Dunham 1995) (although in principle joint attention could be grounded in any sensory modality). Indeed, there is evidence that conversationally-embedded, socio-interactional factors specifically influence and interact with the perceptual lexicon. We see this evidence in such phenomena as the grammaticalization of demonstratives, which typically ground their referential meaning in the speech situation, into evidential or epistemic forms that encode individual or joint perceptual access to objects and situations (e.g., Aikhenvald 2004; Kratochvil 2011; Pitkin 1984; Schapper and San Roque 2011); and, in the opposite direction, in the grammaticalization of perception verbs into demonstratives (Evans 1990). Studies from a wide variety of language families record conventionalized uses of perception verbs for pragmatic functions, such as securing the attention of the addressee, for example, turn-initial *listen* in English (e.g., Aikhenvald 2010, 2013; Brinton 2001; Fedriani et al. 2012; Sidnell 2007; Romero Trillo 1997); establishing legitimacy of evidence in the face of an addressee's skepticism about a factual claim, for example, *see?* (Kendrick forthcoming; Mushin 2012); or redirecting a sequence of talk, such as turn-initial *look* (Sidnell 2007). From the perspective of language acquisition, Edwards and Goodwin (1985) suggest that children initially learn the verbs *look* and *see* as part of a particular interactional routine, the directing of attention, and that actual 'vision' semantics are mastered later in development.

Although the visual dominance hypothesis was strongly supported by our data, we did not find a universal hierarchy of the senses. The remaining senses were more variable in terms of frequency of form and of reference. There was a trend for references to hearing to be second place in many languages, but this was not always the case (see below). The dominance of hearing over touch, taste and smell could thus be posited as a probabilistic, but not absolute, universal trend. In most languages the most common percept for verbs with a hearing

meaning was speech. This is in line with Buck's (1949) observation, as discussed by Sweetser (1990: 34–35), that "nominals derived from European verbs of hearing generally do not denote sound (the physical thing heard); rather, they almost invariably denote the content of heard speech". Our results support the notion that, for many languages, speech is a prototypical aural percept and that an important reason we talk about hearing may be so we can hear about talking.[12] That is, a social appetite for 'talking about talking' may contribute to the high frequency of hearing verbs in many languages, just as a universal drive to justify claims in conversation may contribute to the high frequency of sight verbs.

In Semai, references to olfaction outstripped references to hearing. Smell references appeared in a number of different conversations, in different contexts. Semai's 'olfactory dominance' is in accordance with what we know about the importance of olfaction in Aslian languages and cultures (Burenhult and Majid 2011; Majid and Burenhult 2014; Wnuk and Majid 2014). Jahai and Maniq, languages closely related to Semai, both have a preponderance of verbs dedicated to expressing specific types of odors, a semantic domain that is under-elaborated in most languages (Plank and Plank 1995). For example, the verb *p?us* in Jahai refers to musty smells typical of old dwellings, mushrooms and stale food; *pl?eŋ* refers to smells such as blood, raw fish and raw meat, etc. Semai also has dedicated terms for specific odors (typically encoded in expressive forms), but these do not figure in our counts. It is intriguing to witness, nevertheless, that odors appear to be of sufficient salience in the Semai perceptual world that the general odor term turns up with such high frequency in this language.

The proximal senses jostled for third, fourth, and fifth positions in terms of how often they were referred to. Touch was in third place in Whitesands, Avatime, and Mandarin, for example, but olfaction came third in Cha'palaa and Duna, while taste rose in the ranks in Italian and Spanish. So, it appears that the non-visual senses are more variable cross-linguistically, and their rank order may reflect specific cultural beliefs or practices. However, the data set for touch, taste and smell were admittedly small, making it difficult to get a clear picture of their relative 'weighting' in conversation, or even whether some languages may show 'equal' ranking for certain senses. To further explore these possibilities requires more conversational data as well as detailed and comprehensive studies of sensory vocabulary and language use in different cultural niches.

12 Signed languages may be particularly interesting in this regard. In American Sign Language it is possible to use a verb that means 'hear' to frame reported speech (Shaffer 2012), even where the percept is visual rather than aural. This could be viewed as a sort of calque on the use of 'hear' to frame reports in spoken English. (Anecdotally, English speakers also do something similar when they refer to having 'heard' something that they have actually read in an email, etc.)

To summarize, talk about vision dominates conversation across diverse cultures, followed closely, but not universally, by hearing. The remaining senses vary in their rank order from language to language, perhaps reflecting specific cultural preoccupations. The frequency of perception terms in everyday conversation reflects both universal and culture-specific forces.

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Appendix. Conversations sampled for the database of perception terms

Language		Description
Avatime	1	Two women, a hairdresser doing a client's hair at a salon
	2	Three men chatting outside a house
	3	Two men chatting at a meeting place
	4	Group of approximately five women chatting at a social gathering
	5	Group of approximately five women chatting at a social gathering
	6	Group of approximately three women chatting and selling food on the street
Cha'palaa	1	Two adults and several children in a household environment, resting and conversing
	2	Three adults and several children in a household environment, getting ready to leave for a day's work
	3	Three adults and several children in a household environment, cooking and having breakfast
	4	Two adults in a household environment, resting and conversing
	5	Eight adults in a public area having a discussion about community land issues
	6	Two adults and several children in a household environment, eating and taking care of the small children

Language		Description
Chintang	1	Two men and two women chatting on a porch, tending a baby
	2	Three men chatting on a porch
	3	Three men chatting on a porch (about halfway into the sample, a woman joins the group and one of the men leaves for work)
	4	A man and woman chatting in a courtyard, joined occasionally in conversation by two other women
	5	Up to six people chatting on a porch, relaxing from work
	6	Two women chatting on a porch, joined sporadically by a third woman walking around doing various chores
Duna	1	Five people sitting outside discussing a dispute situation
	2	Group of adults and children sitting outside preparing food, chatting, playing, coming and going.
	3	5–7 men discussing animal behavior
	4	Two women and a child sitting underneath a house playing and weaving
	5	Five women and 2–3 children sitting outside preparing food
	6	Three men sitting outside weaving a mat and discussing a compensation payment, onlookers also present
English	1	Three students sitting at a table in an apartment and chatting
	2	Four people, two couples, having dinner together at home
	3	Four people, friends and family, sitting at a table in a house and chatting
	4	Three friends sitting at a table in a house and waiting to play a board game
	5	Three people, a couple and a friend, sitting at a table in an apartment and chatting
	6	Five members of a family sitting at a table and having dinner together at home
Italian	1	Two brothers and the girlfriend of one of them eating leftovers in a kitchen
	2	A group of friends (4–7) chatting and doing the crossword at a kitchen table
	3	Four friends sprawled on their inflatable bobsleighs at the bottom of a sledding slope admiring the panorama
	4	Four men waiting to start cooking in the kitchen of a mountain chalet
	5	Six friends (plus a child) having drinks and snacks after choir rehearsals
	6	Seven friends having drinks in the living room of a mountain chalet on New Year's Eve

Language		Description
Lao	1	Two young women (former colleagues and good friends) who have not seen each other for a while catching up
	2	Two men (father and son) and a woman (daughter/sister), talking with each other waiting to begin an elicitation task
	3	Two elderly couples and occasional others talk informally during a family visit by one couple to the other (in-law relations)
	4	Two and then three men talk informally standing outside a house as they are waiting for food to be prepared
	5	A group of several middle-aged women (all neighbors) talking as they sit around a table eating, on a break from weaving reed mats
	6	Three women (related as in-laws and neighbors) talking with each other while waiting to begin an elicitation task
Mandarin	1	A mother and her son preparing food in the kitchen of their home
	2	Two friends sitting on the couch in an apartment, eating noodles and chatting
	3	Three friends playing ping pong and chatting in a classroom of a language school
	4	Five women and one boy eating and chatting in a meeting room in the office of a bank
	5	Two teachers sitting in a classroom, drinking tea and chatting.
	6	Five people sitting at a table in an office building, eating lunch and chatting.
Semai	1	Three adults and 2–3 children at home (sitting area) chatting, discussing lottery and betting money
	2	Group of adults (4–5) at home (cooking area) preparing ingredients for cooking
	3	Three adults at home (sitting area) chatting, discussing whereabouts of people
	4	Two adults at home (sitting area) discussing a trip to be made, as well as material for house construction
	5	Three adults and a child at home (eating area) eating; discussing whereabouts of people
	6	Group of adults (6–7) outside, sitting making ceremonial dresses
Siwu	1	Two people chatting outside a house
	2	Three people chatting outside while one is making gunpowder
	3	Four people chatting outside while shelling corn by hand
	4	Three people chatting outside while one is shelling corn by hand
	5	Three people chatting outside while two are making palm oil
	6	Four people chatting outside while two are making palm oil

Language		Description
Spanish	1	Three friends preparing food together in a kitchen
	2	Five extended family members sitting together in a living room chatting over coffee
	3	A husband and wife sitting at the table eating breakfast together
	4	A mother helping her adult daughter get ready for a party
	5	Two women chatting while one receives a pedicure from the other
	6	Four friends chatting over coffee
Tzeltal	1	Two speakers chatting casually at one of their homes
	2	Two speakers on a visit, chatting
	3	Two speakers chatting casually at one of their homes
	4	Four speakers talking together on a visit to someone's home
	5	Two speakers talking together on a home visit
	6	Two speakers chatting casually on a visit to someone's home
Whitesands	1	A group of men and boys debate a local team's recent match and the recent World Cup results.
	2	A group of men talking about kava preparation and how their fathers used to drink it
	3	A group of men talking about kava preparation and how their fathers used to drink it (half an hour after the first segment)
	4	Casual chats with various people as a man walks between his house and his piggery
	5	A group of men discuss stolen pigs and who is responsible
	6	Two men discuss the traditional chiefly structure on Tanna and how it is changing