Chapter 24

Iconicity chains in sign languages

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Stephen Anderson warns that approaches to linguistic universals that derive facts about language from the structure of the Language faculty or from external forces shaping the Primary Linguistic Data— where these two sources must be taken as mutually exclusive – not only are difficult to support since the two modes of explanation are entangled, but wrong (Anderson 2008). External forces shaping the Primary Linguistic Data can result in grammatical regularities – true properties of language – but, in order to recognize them, we must "take into account the filtering role of the perceptual systems through which these [brute physical facts] are presented to the mind for interpretation" (Anderson 2016: 13). In the communication systems of other species we find that particularities of biology are connected to pathways for messages. The same should be true for humans. "Why, in fact, might we be tempted to believe otherwise?" (Anderson 2011b: 364). Why, indeed? This paper argues for iconicity chains in sign languages, chains consisting of mappings from various perceptual systems into a visual realization and then into a semantic sense, allowing insight into why unrelated languages might exhibit similar signs for abstract concepts.

1 Introduction

Stephen Anderson has always been a brave intellect. He eschews theoretical blinders when he faces data. Had he been among those to investigate sign languages at the start, perhaps the present revolution in sign language analysis would never have needed to occur or would have occurred decades ago. For we are, indeed, in the middle of a revolution. Much of the early work in sign language linguistics was dedicated to showing how much sign languages are like spoken languages, in order to establish beyond a doubt that sign languages are *bona fide* languages (Vermeerbergen 2006). Having established that, present research is paying significant attention to modality-driven phenomena (Meier 2002; Woll 2003). In particular, the existence and extent of iconicity can now be studied outside the closet.

The number of investigations on iconicity in language is increasing exponentially, with international conferences occurring multiple times a year for the past few years. Given that iconic signs quickly get conventionalized to the point where they are processed by the brain in the same way as bundles of arbitrary features (Emmorey et al. 2004;

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Fabisiak & Rutkowski 2011), there may be little cognitive difference between iconic and non-iconic signs. However, the recognition of iconicity is critical to understanding how it interacts with grammar (Meir et al. 2013). While many avenues of inquiry into iconicity are presently being explored, this paper is a call for scholars of sign languages to delve more deeply into the possibility of synesthesia as a source of iconicity. As Anderson (2011a; 2016) so rightfully alerts us, our perceptions can act as filters in communication systems. Here I propose an example: iconicity chains that map from any perception or other somatosensory information into a visual realization and from there into a semantic sense.

Sections 2 through 4 are a whirlwind introduction to iconicity in general. They are far from exhaustive, though I have attempted to be representative with respect to sign languages. References, in particular, are only a sampling, and I apologize to all the fine work I do not mention. §5 is an outline of the kinds of questions involving synesthesia that I hope to direct more attention to and an introduction to the notion of iconicity chain.

2 Background on iconicity

The term *iconicity* as it pertains to language was originally applied to non-arbitrary mappings from form to meaning; at the lexical level, essentially a sign that looked like what it meant, or a word that sounded like what it meant was labeled iconic. For example, with respect to action, in many (all?) sign languages the sign for 'eat' involves moving hand to mouth; the movement of the sign imitates an essential act in eating for humans (in most situations). The signer embodies the actor in the event. Likewise, with respect to concrete objects, the sign for 'deer' in many (not all) sign languages involves hands on either side of the head with one or more fingers extended (antlers as identification). The signer again embodies the referent, here mapping relevant parts of a deer onto the human body of the signer. For spoken languages, iconic words include imitations of animal sounds (*moo*, *peep*) and words whose sound evokes the sound of their sense (*bell*, *slam*). This phenomenon is labelled *onomatopoeia*, about which a great deal has been written.

Recent work gathers within the iconicity aegis a wider range of structural alignments – thus a sign/word can be called iconic if its articulation brings to mind its sense – that is, it is motivated (Russo 2004; Perniss, Thompson & Vigliocco 2010), where this extension of the concept is often culture-based (Adam et al. 2007). For example, joined arms swinging in front of the torso form the sign for 'baby' in many languages – bringing to mind rocking an infant. Again, we have embodiment – but not of the referent 'baby', rather of someone doing a typical action regarding a baby. Perhaps the long-recognized phonesthemes among the IndoEuropean languages (recognized for hundreds of years, in fact; see Drellishak 2006) should be included here. For example, words that start with the fricative [s] followed by the voiceless stop [t] often deal with lack of motion, including figurative motion (*stay, stand, stupid, stymie, stammer, stuck, stagnant, stutter*, …), but not always (*start, stamp, stuff, stag*…), while words that start with the fricative

[f] followed by the liquid [l] often deal with quick motion, again including figurative motion (*fleet, flit, flick flow, fly, flutter, flame, floozy, flip …*), but not always (*floor, flat, flab, flacid…*). This more catholic approach to iconicity allows one to assess its role in language development and language processing (Emmorey 2014; Perniss & Vigliocco 2014).

3 Iconicity involving the perception of vision only

3.1 Mappings outside language proper

Iconic mappings from a visually perceived message to meaning can belong to non-verbal communication (Argyle 1975; Knapp, Hall & Horgan 2013) or to language proper.

With respect to visual communication outside language proper, much gesture that accompanies speech (co-verbal gesture) or that occurs independently of speech communicates information of a general sort (such as attitude or emotional/intellectual involvement), or information supportive to the speech material (such as gesturing the shape of a vase as one talks about arranging flowers) (McNeill 1992; 2000; Goldin-Meadow 1999; Kendon 2004; Özyürek 2014), or information that promotes discourse coherence (Lascarides & Stone 2009). While typological categories for gestures can help us get a sense of the complexity involved in studying gesture, they are not discrete (Streeck 2009). And there are areas of gesture use that have been examined only briefly with a linguist's eye, but with such insight that they beg for further comparison to other uses, such as gestures in conducting orchestras (Boyes Braem & Braem 2000).

Other methods of visual communication can give precise information, including quantitative, though usually it is very limited in range, such as baseball signals (Komissaroff 2016), diving communication (Recreational Scuba Training Council 2005, and described in Mišković et al. 2016), and gestural systems used in hunting (Hindley 2014). Relevant mentions of systematic iconic mappings are found in work on semiotics with regard to flag signals, comics, the visual arts (all discussed in Berger 1984), auditory signals in military aircraft (Doll & Folds 1986), and others.

My call to arms in this paper is directed at scholars of language proper. Still, it might be relevant also to scholars of two other areas. One is mime, where the new and intriguing initial comparisons to sign languages in Sutton-Spence & Boyes Braem (2013) are suggestive. The other is gesture, for which there are multiple reasons to suspect that the directions of investigation suggested in §5 might be relevant. First, much research shows alignments between sign languages and gestural communication (such as Hall, Ferreira & Mayberry 2013). Second, home sign has many similarities to sign languages (Goldin-Meadow 2005, among many), and homesigning children at first base much of their communication on iconic gestures, but tend to modify them over time in much the same way that iconic signs change (such as going from two-handed gestures to one-handed ones; see Tomaszewski 2006). Third, emergent sign languages tend to quickly move from elaborate gestures to simplified signs (Kocab, Pyers & Senghas 2014), but iconicity manages to persist (Hwang et al. 2016). Fourth, children go through an in-

termediate stage in which they use gesture-word combinations as they transition from single-word utterances to more complex phrases (Capirci et al. 1996). And, fifth, there are arguments for a gestural origin of all manual linguistic systems (Ortega & Morgan 2015).

3.2 Mappings within language proper: Sign languages

Here we look at sign languages. There are also interesting observations to be considered about language represented in text, as noted briefly in the next subsection.

Meaning-form relationships are apparent across the grammar in sign languages, so much so that sign languages do, in fact, have much in common (Woll 2003). The discussion that follows is generally informed by the foundational work on metaphor of Wilcox (2000) and Taub (2001), both of whom suggested analyses that are only recently finding confirmation in the experimental work of others. For example, Meir (2010) shows that conceptual metaphors involve double mappings, one between source and target domains and the other between form and meaning iconicity – and both must "work" in order for the entire metaphor to "work". The pervasiveness of iconicity develops meta-linguistic skills that have been argued to be behind the fact that deaf people who use different sign languages can establish rich communication with each other much faster than hearing people who use different spoken languages (Zeshan 2015). Below I focus on the manuals, but the nonmanuals are often iconic, as well (as in Pizzuto et al. 2008).

In some signs the shape that the manuals assume mimics the shape of the referent or some visual form peculiar to the referent (Pizzuto et al. 1995; Pietrandrea & Russo 2007); in others the manuals draw outlines of the shape of the referent; in others the size of articulation corresponds to the size of the referent. The number of hands in a sign can be iconic: signs tend to recruit two hands for senses that encode relationship types (interaction, location, dimension, and composition) (Lepic et al. 2016). Lexical items cluster into families, with an under-specified meaning conveyed by the parts of the signs that are in common, which is typically iconic, and specific information added by the variable parts of the signs, which might or might not be iconic (Fernald & Napoli 2000). Lepic and Padden (this volume) go so far as to say that iconicity is morphology; internal structure of signs might be obfuscated by phonological change, but it will still be reinforced by the signers' knowledge of multiple related signs.

Sign languages vary in many ways on how they encode space (Perniss, Zwitserlood & Özyürek 2015), yet repeatedly the encoding is iconic (Vermeerbergen 2006). Point of view is expressed iconically through spatial alignments and relationships (Pyers, Perniss & Emmorey 2015). While there is debate over whether spatial loci are logical variables (Lillo-Martin & Klima 1990; Neidle et al. 2000) or purely iconic mechanisms that are not linguistic at all (Cuxac 1999; Liddell 2003), recent work allows insights from both camps in a formal semantics that "makes provisions for iconic requirements at the very core of its interpretive procedure" (Schlenker, Lamberton & Santoro 2013: 91, and see Giorgolo 2010). Likewise there is debate over whether agreement is morphological or, instead, iconic and non-linguistic, since locations in space represent locations in mental

space, numbers of extended fingers can indicate numbers of referents, and direction of movement can indicate direction of change of transfer (Meier 1987; Janis 1995; Mathur 2000, vs. Liddell 1995; 2003; and for discussion relevant to this issue based on an atypical child signer, see Quinto-Pozos et al. 2013). Again, an appropriate formal semantics can make a comprehensive analysis based on the insights of both camps (Schlenker 2016).

Iconicity plays a role in delivering information about event structure, such as telicity (Wilbur 2003; 2008; Strickland et al. 2015; Schlenker 2016), and whether and at what rate an event is repeated (Kuhn & Aristodemo 2016). Path shape, speed, and other dynamics of movement can indicate location and dynamics of the action, particularly in classifier predicates, where languages can vary on how iconic they are (Aronoff et al. 2003; Tumtavitikul, Niwatapant & Dill 2009). Temporal ordering of signing corresponds to temporal ordering of visualization of the participants and action in events (Napoli & Sutton-Spence 2014; Napoli, Sutton-Spence & Quadros Forthcoming). Since there are multiple articulators in sign languages (that is, two manuals plus a variety of nonmanuals), more than one message can be conveyed at once (Vermeerbergen, Leeson & Crasborn 2007; Napoli & Sutton-Spence 2010). Simultaneous articulation of two events that occur simultaneously is a further kind of iconicity. Additionally, a signer can embody a participant in the event being conveyed, which is an iconicity similar in ways to pantomime (Metzger & Bahan 2001).

Meaning-form relationships are exploited across all components of the grammar in innovative creative language (Sutton-Spence & Kaneko 2016), as in poetry (Bauman, Nelson & Rose 2006; Sutton-Spence & Napoli 2010; Sutton-Spence & Napoli 2013), humor (Sutton-Spence & Napoli 2009), and taboo expressions (Mirus, Fisher & Napoli 2012; Napoli, Fisher & Mirus 2013). Much of this iconicity is founded on the cognitive topology involved in mapping the parts of a non-human entity onto the signer's body, since the poet/humorist will typically embody in turn the major characters in order to show how each referent's experience can be revelatory of the human (usually deaf) experience. Often attention is directed to the physical realities of the articulators. For example, one American Sign Language (ASL) joke concerns a woman on a diet tempted by a cookie. The sign TEMPT is made on the non-dominant elbow and the sign COOKIE is made on the non-dominant palm. In the joke the dominant hand "runs" from the elbow, along the forearm, to the palm of the non-dominant hand –exploiting the physiological connectedness of the two locations to show us the easy path from temptation to sweets.

Certainly, with respect to sign languages, the judgment of whether a sign is iconic or not can be so particular to a culture that it is non-obvious to those outside the culture. (Here and throughout this paper I offer speculative remarks on signs from different countries. If I do not cite a source, my information comes either from personal knowledge or from the website spreadthesign.com.) Iconic handshapes used in handling classifiers and object classifiers (otherwise known as entity classifiers), for example, express an agentive/non-agentive distinction in many sign languages; if the event is agentive, the handling classifier is used, and if it is non-agentive, the object classifier is used, where a recent comparison of the sign languages of Italy and America shows that cultural factors contribute to the conventionalization of which type of handshape will be used to convey

a given event (Brentari et al. 2015). Iconicity involving temporal succession and cyclicity reflects cultural conceptions of time and thus presents similarities and distinctions across sign languages (Kosecki 2014).

A single example can help seal the point about culture. The sign for 'rent' in the sign language of Portugal (ALUGAR) is related to the sign for 'pay' (PAGAR) with an aspectual marker for repetition. Both are iconic. In the sign PAGAR the dominant hand taps the palm of the nondominant hand. This brings to mind putting payment in someone's waiting palm. In the sign ALUGAR the same handshape on the dominant hand makes a repeated circle going toward the addressee, bringing to mind paying repeatedly. Now let's compare to the sign RENT in America; it is morphologically related to the sign MONTH, neither of which at first looks iconic. In the sign MONTH a 1-handshape on the dominant hands move down the back of a 1-handshape on the nondominant hand. Only if you know that we read down the calendar's representation of the months in America and Canada (where this sign language is used) do you see the iconicity. The sign RENT is the sign MONTH with reduplication, so that the dominant hand circles back to repeat that downward motion. Only if you know the further fact that rent is generally paid on a monthly basis do you see the iconicity.

An additional complication to recognizing iconicity is that one language's sign may focus on certain visuals of the meaning while another's may focus on different visuals. Again, those visuals might be culture-based or not. The sign for 'dance', for example, can focus on movement of the torso (in the sign languages of Italy and Turkey, among others), of the legs (in the sign languages of America and Japan, among others), of the arms (in the sign languages of Germany and India, among others), of the whole person in relation to another person (in the sign languages of Austria and Estonia, among others), or maybe just on general movement (in the sign language of Iceland). Without knowing what the sign means ahead of time, one may be at a loss to guess its meaning just from seeing it, but once the meaning is given, one might quickly recognize its iconicity.

3.3 Mappings within language proper: Print

Written/print representations of spoken languages can use visual information iconically, as in concrete poetry, popular in Greek Alexandria during the Third and Second Centuries BCE and intermittently up to modern times (Newell 1976). But there are other, less obvious ways that print/writing can be iconic. Verbal constructions used in writing affect readers' ability to understand discussions of spatial relationships, the account being that the order in which verbal material is presented on the page can help or hinder as one tries to mentally construct spatial models (Moeser 1976; Morris & Bransford 1982; Ehrlich & Johnson-Laird 1982; Louwerse 2008; Zwaan & Yaxley 2003). In a reading test that involved static spatial relations, Zwaan (1993: 119) found, "If a text presents spatial information in a scattered way, spatial representations are relatively weak, even for subjects who are instructed to form spatial representations." When people read, they make a mental representation of the orientation (Stanfield & Zwaan 2001) and shape (Zwaan, Stanfield & Yaxley 2002) of objects. Readers "mentally simulate the visibility

of objects during language comprehension" (Yaxley & Zwaan 2007: 229). Additionally, in understanding referents in reading, it appears that, if too much verbal material intervenes between two mentions of a referent, interpretation is hindered; again it looks like mentioning a referent foregrounds it in one's mental representation of the text (Sanford & Garrod 1981).

4 Iconicity involving the perception of sound only

Iconic mappings from an aurally perceived message to meaning are used in spoken languages, of course, but they are also used in Morse code (a code based on written language) and sound signals (whistles in baseball, sirens, melodies). Studies of iconicity in spoken language are experiencing a renaissance, just as studies of iconicity in sign language are (Perniss, Thompson & Vigliocco 2010). There is a growing consensus (Vigliocco, Perniss & Vinson 2014; Goldin-Meadow & Brentari 2015) that with respect to iconicity in order to really understand the extent of it in spoken language we should be considering speech plus gestures, not just speech. In this section, however, I discuss only mappings from auditory form.

In here falls onomatopoeia, mentioned in §2. Spoken languages can also play with intensity, duration, and pitch in iconic ways (say *angry* in a loud, angry voice; say *slow* with a drawn out syllable nucleus; say *little girl* with a very high pitch). But spoken languages can move beyond that to sound articulations that bring to mind a meaning – that is, associative iconicity (in the sense of Fischer 1999) – just as sign languages do (as in the discussion of signs meaning 'baby' in §2). In this regard, sometimes particular features of sounds are associated with meaning in a relatively stable way across several languages (Sapir 1929; Taylor 1963; Werner & Wapner 1952; Wertheimer 1958, among early studies, and Hinton, Nichols & Ohala 1994; Voeltz & Kilian-Hatz 2001, among more recent studies). For example, in many languages high pitch is associated with small size of referent, whether the referent be entity or action (Jespersen 1922; Nuckolls 1999). Perhaps a high pitch brings to mind the voices of smaller people (Evans, Neave & Wakelin 2006), and so the size association spreads from people to any referent. For English, some claim a back rounded vowel is gloomy while a front low vowel is brash – compare English *drip* (a relatively high pitch vowel) to *drop* and both to *droop* (a back rounded vowel); and *slip* (a relatively high pitch vowel) to *slap* (a front low vowel). Correspondences can be so strong that manufacturers capitalize on them when naming products (Spence 2012). Additionally, it's been shown that prosody works together with segmental information as cues for iconic interpetations of words (Dingemanse et al. 2016).

Just as in spoken languages, iconicity can be felt beyond the lexicon, where the discussion here is generally informed by Fabisiak & Rutkowski (2011). For example, morphology can be iconic: reduplication (Moravcsik 1978) can indicate plurality (Macdonald 1976) or intensification (Murane 1974). We can witness iconicity even in syntax. Moulton & Robinson (1981) show how a radio announcer can order and pace words to reflect the order of participants in an action and the timing of that action. The order of temporal subordinate clauses within the next adjacent clause up often reflects the temporal

relationship between that clause and the action of the adjacent clause (Haiman 1985; Kortmann 1991; Diessel 2005).

Conventional judgments of iconicity in spoken languages are affected by cultural factors, just as they are in sign languages. That's obvious for things like phonesthemes, where a given speaker is making associations across multiple lexical items in a language. But it also occurs in onomatopoeia. It's instructive to peruse Derek Abbott's (2004) animal sound website in this regard. Granted, as Abbott points out, "a Swedish Vallhund is not an Anatolian Shepherd or a Japanese Spitz. But variations in dog breeds can't fully account for these differences…" (Friedman 2015). Sound iconicity runs the gamut from realistic to simply bizarre: words for animal sounds might actually ring true to a farmer (*kpok, kpok kpok kpok*) or other person with direct experience, while others don't ring true to anyone (*cockadoodledoo*). Often the same animal's sound is rendered distinctly differently in different languages. People simply somehow agree to accept a given sound in speech as the conventional rendering of the animal (or other type of) sound. Perhaps digging into the culture will allow a better understanding (as often happens in linguistic study, see Duranti 2009).

A huge gap in our discussion thus far is so-called mimetics. We now use them as a jumping off point to other types of iconicity in language in §5.

5 Cross-modal iconicity

5.1 Mimetics and iconicity chains

Mapping from a visual entity to a meaning that involves vision or from an auditory entity to a meaning that involves sound is relatively straightforward. But this is not the only kind of iconic mapping found in language. As we saw for both sign languages and spoken languages, associative (or motivated) iconicity can occur. At times these associations seem to belong fairly generally to the human experience, such as the sight of rocking layered arms meaning 'baby' and a high-pitched vowel adding small size to the meaning of a word. But, mostly, linguists seem to have assumed a cultural basis for these mappings, often pointing out how the mappings are particular to a specific language.

However, there are important challenges to that assumption. In some spoken languages recognizable patterns of sounds indicate a non-arbitrary relationship between form and sense – where the words with this property are labelled mimetic and the phenomenon is called sound symbolism. Korean, for example, exhibits correspondences between sound and subjective impressions or other modalities (smell, taste, vision) as well as "size, mood, movement, shape, and other perceptual and psychological experiences" (Cho 2006: 64), where changes in vowels and consonants systematically relate to meaning differences. Japanese, instead, uses templates (fixed patterns of consonants and vowels) to indicate mimetics (Hamano 1998) For example, the correspondence between an action (lick, roll) or a property (drunk, exhausted) and the sound of the word referring to that action/property feels non-arbitrary to Japanese speakers. Correspondences

as precise as between a sound and an emotional reaction to a taste are felt to be firm (Kagitani et al. 2014). The surprising (perhaps at first astonishing) part is that adult speakers of English and Japanese as well as Japanese toddlers are sensitive to mimetic correspondences in novel verbs (Imai et al. 2008). Thus there is evidence of something going on that is not grounded fully in culture – something that allows cross-modal iconicity.

That something may be simply the physical nature of language – something that Stephen Anderson insists we acknowledge. Language is expressed through the body and governed by the brain – both complex physical entities. It's possible to step back for a wider perspective on iconicity, a biological perspective, which has the potential to offer a more comprehensive understanding. The contribution of biology to sign language iconicity has been recognized before: Woll (2009: 150) points out that since "the visual medium affords the identification of objects and their spatial locations as a function of their forms and locations on the retina and sensory cortex, it is not surprising that cortical systems specialised for such mappings are utilised when sign languages capture these relationships." Here I widen the perspective further based on recent findings in cognition that there is multisensory integration in the midbrain and cerebral cortex of mammals (Stein & Stanford 2008, among many).

It is important to recognize at the outset that abstract entities can have physiological effects on the human body. Our own emotions, for example, trigger bodily sensations through the somatosensory systems, including activation of cardiovascular, skeletomuscular, neuroendocrine, and autonomic nervous systems (Nummenmaa et al. 2014). Additionally, visual recognition of another's emotions (through observation of their facial expressions and body postures) can trigger somatosensory reactions (Rudrauf et al. 2009; Sel, Forster & Calvo-Merino 2014). This is why, all other things being equal, we smile when someone smiles at us (Niedenthal 2007). Additionally, emotions have a wide range of effects on our behavior and psyche, including our moral judgments (Charland & Zachar 2008), which might offer another way to recognize emotions in others.

For our purposes, the entities of the world can be organized into three groups:

- those that have a realization apparent in any way (to any part of the somatosensory system – such as wind or respect)
- those that have a realization apparent to sight (you could draw them, for example – such as cars)
- those that have a realization apparent to hearing (you could record them, for example – such as rain)

These three groups are not discrete; they relate as in the schema in Figure 1.

All iconic mappings between distinct entities rely on metaphor, metaphony, and/or analogy, all filtered through experience, so all of them are complex. However, some of the mappings are more complex than others. With respect to Korean and Japanese mimetics, for example, we can find mappings between a sound on the one hand and a taste or a mood on the other (Garrigues 1995; Iwasaki et al. 2013). That is, we have

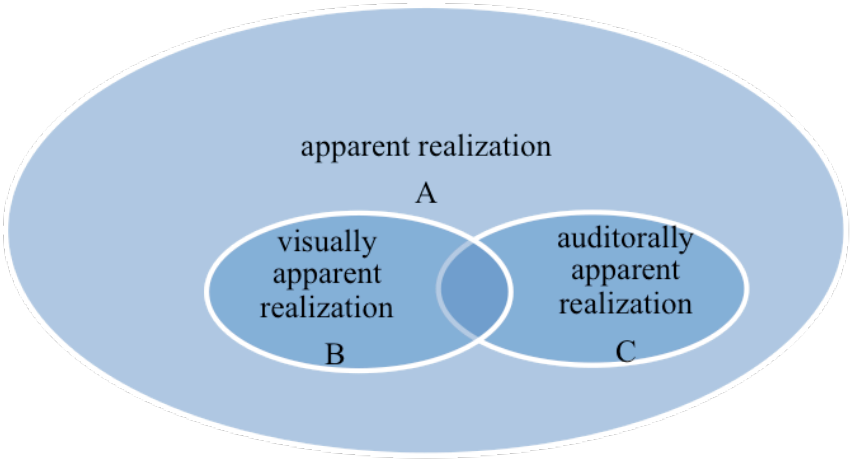


Figure 1: Entities of the world organized by type of realization

a mapping between something in the area C and something in the area A–C. So the mapping is cross-modal.

Iconic mappings in speech or sign into abstract meanings (which have neither visual nor auditory realizations) are necessarily cross-modal since they are mapping between elements in B or C and elements in A – (B ∪ C). Metaphor is the key mechanism used in sign languages for this kind of conceptual mapping (Borghi et al. 2014). Many conceptual metaphors hold both in spoken and sign languages (Roush 2016).

Metaphoric mappings that cross perceptual modalities are labeled synesthesia (Cytowic 1989, among many). We find mappings between many different senses, where a given sense S_1 can elicit a different sense S_2, and vice-versa. For example, texture can elicit visual forms (Simner & Ludwig 2012; Ludwig & Simner 2013) and visual forms can elicit textures (Albertazzi et al. 2016).

Many instances of synesthesia map a variety of senses onto auditory forms. Thus the odors of perfumery are mapped onto pitches (Belkin et al. 1997) and food smells are mapped onto the sounds of musical instruments (Crisinel & Spence 2012). Likewise, we find mappings from a variety of senses onto visual forms. With regard to odor again, Demattè, Sanabria & Spence (2006) examine odors mapped onto color hue, and Kemp & Gilbert (1997) show that intense smells are associated with darker colors. Hanson-Vaux, Crisinel & Spence (2013) look at the mappings from odors onto visual shape entities, where intense, unpleasant odors elicit angular shapes and other odors elicit rounded shapes.

Importantly, both hearing and deaf people can smile when a child says, "This tastes green." In fact, congenitally blind people and congenitally deaf people are sensitive to synesthesia, and in the same ways as sighted, hearing people (Ittyerah & Mitra 1988). A recent study shows that color-shape associations, in particular, are consistent across

deaf and hearing people (Chen et al. 2014). Further, sign recognition involves reference to sensory-motor properties of one's own body (Corina & Gutierrez 2016), which would be compatible with sign formation likewise involving such reference. In sum, there is every reason to expect to find the effects of synesthesia in sign languages as much as in spoken languages.

Cross-modal mappings can have multiple layers of complexity. Let's say that we want to convey the sense of 'happy' in a sign language. What visual representation might we appeal to? A smile might come to mind. And some languages use the smile, though they draw it (in a variety of ways) rather than have the signer actually smile (such as the sign languages of Italy, Latvia, Portugal, and Turkey). The problem with using an actual smile is that that affective facial expression might conflict with other information in the message. If we ask in a sign language, "Are you happy?" we might well not smile, but use a neutral mouth as other nonmanuals articulate (such as the eyebrows raising). If we say in a sign language, "I'm not happy," it might be odd to smile (except in contrived circumstances). So the sense 'happy' has to be conveyed some other way. I conjecture that this way is through a chain of mappings, a chain which necessarily has precisely two cross-modal links – one from an entity that has a somatosensory realization other than visual to an entity that has a visual realization, and the next from that visual entity to a third entity that has a somatosensory realization other than visual (and see the distinction between two types of icons in Peirce 1932). An iconicity chain has complexity similar to that of the double metaphors of Meir (2010), but iconicity chains are culture independent, since they are grounded in biological properties.

In this regard, consider the sign HAPPY in ASL in Figure 2. (Figure from Lifeprint: http://www.lifeprint.com/asl101/pages-signs/h/happy.htm)

Figure 2: HAPPY in ASL

Here the hands hit the chest then circle away and hit again repeatedly. My conjecture is that this sign is built on the fact that physical activity correlates highly with happiness (Kahneman, Diener & Schwarz 1999) and with a heartbeat that we are conscious of. So it's like our heart is hopping inside our chests. The mapping is a chain from a hopping heart (which we cannot see, but we can feel) to an external representation of that heart (the visuals in Figure 2) and then to the abstract meaning 'happy'. So we are going from one somatosensory sense to vision and then from vision to a sense that is an emotion. Both links of the chain are cross-modal and both are iconic, as shown in Figure 3.

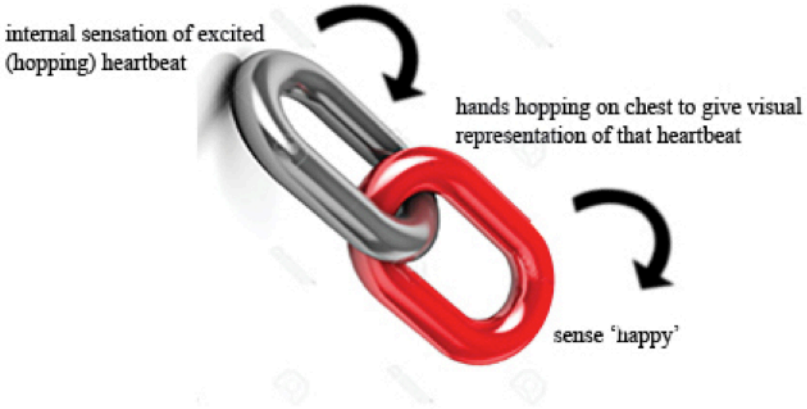


Figure 3: Schema of the iconicity chain for HAPPY in ASL

This iconicity chain between heart(beat) and happiness has its origins in our biological selves; it digs down inside our bodies. As such, it is culture-independent and we might expect to find sign languages using a chest-touching sign for 'happy' both among those that are genetically related to or have had contact with ASL (as happens in the sign languages of France and India) and among those that most likely developed independently (as happens in the sign languages of Austria, Germany, Iceland, and Sweden).

If we are alerted to likely possibilities for synesthesia in sign languages – that is, for iconicity chains – not only might we find them, but we might realize that signs we previously considered arbitrary are not. I contend this not only because of my own initial examinations, but because, on a theoretical basis, it should be true. Communication systems are subject to two potentially conflicting pressures: transmission efficiency, which drives them toward messages that are simple to produce (and perceive), and comprehension efficiency, which drives them toward messages that are semantically clear. As Roberts, Lewandowski & Galantucci (2015: 52) show in experimental work, "where iconicity was available, it provided scaffolding for the construction of communication systems and was overwhelmingly adopted." This goes hand-in-hand with work that shows that iconicity facilitates both recognition and production of signs (Vinson et al. 2015). In other words, comprehension efficiency trumps transmission efficiency. Rightly so. Non-arbitrary mappings, if they can be made, should be, since they enhance interpretability (and see Givón 1989). To do otherwise would be contrary to the overall goal of communication (and see Napoli, Sutton-Spence & Quadros Forthcoming).

In the rest of this section I briefly mention two areas for research in language synesthesia outside of speech, then focus on the area of potential sources for iconicity chains in sign languages.

5.2 Potential for iconicity chains in braille

Blind hearing people can access speech easily, thus, generally, language access is high, including access to all the mechanisms for synesthesia that speech uses. However, language represented in print is visual, thus inaccessible. The bumps in a braille cell allow print to be accessed tactilely and, because of this, a range of possibilities for cross-modal iconicity in language arise, where the connection between the two links in the iconicity chain is a tactile entity (comparable to the visual entity in sign language iconicity chains). So far as I know, such possibilities are not well-explored, though the iconic possibilities in rendering musical scores and literature on music theory are many (Pacun 2009; Johnson 2009). Given that cutaneous perception is high, it's no surprise that there's ongoing research on creating tactile icons (tactons) that include rhythm, location, frequency, amplitude, and duration of a tactile pulse, where iconicity influences the choices designers are making on attaching meaning to the various tactile factors (Brewster & Brown 2004), as well as V-Braille, a way to haptically represent Braille characters on a touch screen (such as on a mobile phone) (Jayant et al. 2010).

5.3 Potential for iconicity chains in tactile sign

The deaf-blind cannot access language visually or aurally. Thus, another area of exploration regarding synesthesia is tactile language for the deaf-blind, a complex of methods, such as fingerspelling, on-body signing, and hand-over-hand signing (Edwards 2012, and following). Research has shown that visual and tactile iconicity ratings of signs are similar across blind people, deaf people, and hearing-sighted people, allowing indications of which signs should be most salient to deaf-blind children (Griffith, Robinson & Panagos 1983).

5.4 Potential for iconicity chains in sign languages

Here I present the main course of this drawn-out feast in the form of a sampling of cross-modal associations that could serve as fertile ground for iconicity chains in sign languages. The iconic chains that interest me below involve mappings from an entity that is not visually apparent onto an entity that is visually apparent and then onto a meaning that is not visual in nature. Thus both links in these iconic chains are cross-modal. These are conceptually the most complex iconicity chains and, thus, might be the hardest to recognize.

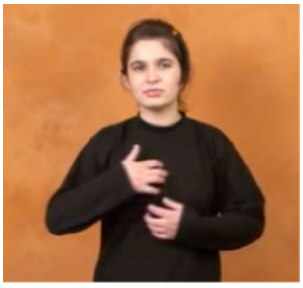
The growing literature on synesthesia includes mappings involving forms that have realizations in various aspects of the somatosensory experience, including texture, temperature, weight, taste, smell, shape, emotions – the sorts of things that many of the mimetics in Korean and Japanese are based on. For humans, "meanings" associated with

such forms, as discussed in the literature cited below, tend to be general and abstract rather than particular and concrete (to be contrasted with the "meanings" such forms might convey to nonhumans). For example, with respect to associations from a visual entity, a color might be associated with a broadly understood emotion (Johnson, Johnson & Baksh 1986), and with respect to associations from an auditory entity, pitch and tempo in music might be associated with a broadly understood emotion (Hevner 1937; Brower 2000). Often the emotion is hedonic, since the orbitofrontal cortex, which is involved in sensory integration, is also involved in hedonic experience (Kringelbach 2005). Evoking such general mappings has been claimed to be effective in psychopathology therapies (Lang 1979, and much work since).

Let's look at five potential sources for iconic chains in sign languages: mappings from texture, temperature, weight, taste, and smell.

5.4.1 Mappings from texture

Research on baby rhesus monkeys shows they choose soft models of their mothers over wire ones (Harlow 1959), which has been taken to show the importance of touch (particularly human touch) for human babies (Lynch 1970; Schneider 1996). Further, neonates in pain find comfort in skin-to-skin contact – which introduces a complex of factors, to be sure, but all transferred via that pliable skin (Kostandy et al. 2008). The potential, then, for an iconicity chain taking us from some relevant touch to the visuals related to that touch and then to the meaning 'safety' or 'love' arises. I believe that potential is realized. The sign GÜVENLI 'safe' in the sign language of Turkey uses two claw handshapes (the curled-5-handshape), which rake across the chest out to each side, one above the other (shown in the left side of Figure 4). This sign at first has no apparent iconicity. However, the sign KÜRK 'fur coat' is a compound of the sign for 'fur' and the sign for 'coat'. The sign for 'fur' has two claw handshapes raking out to each side from the center of the face (shown in the right side of Figure 4).



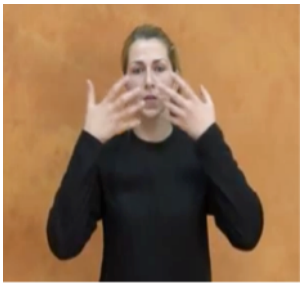


Figure 4: 'Safe' (left) and 'fur' (right) in the sign language of Turkey

The signs differ only by the parameter of location: one is on the chest, the other is on the face; one places one hand higher, the other has the hands at the same level. I suggest an iconicity chain mapping from the texture of softness onto the visual of fur or hair on

the chest then onto the feeling of security and coziness that juvenile mammals (including humans) experience as they nestle against the chest of mature mammals (including male humans; i.e., daddy keeps us safe).

5.4.2 Mappings from temperature

Research on human emotional responses to changing a hand temperature show that changes of 6 degrees centigrade are distinctly unpleasant (Salminen et al. 2013). Thus one might associate warmth with pleasure/health/life, but extreme heat or cold with displeasure/fear/death. Consider here the sign TEAMA 'fear' in the sign language of Romania. The arms are bent and held close to the body, shaking them as if in a shiver (shown in the left side of Figure 5 – this is an embodiment sign, so the signer is shivering). Certainly, humans shake not only when they experience cold (where shivers occur because the drop in temperature signals the hypothalamus to stimulate muscle contractions to warm up the body) but when they experience fear (where adrenaline causes shivers) and a number of other emotions. And the sign STRACH 'fear' in the sign language of Poland is also built on an image of shaking, but this time it's the legs that shake (shown in the right side of Figure 5 – this is a classifier sign, so the dominant hand represents two legs that shake on the palm of the nondominant hand).

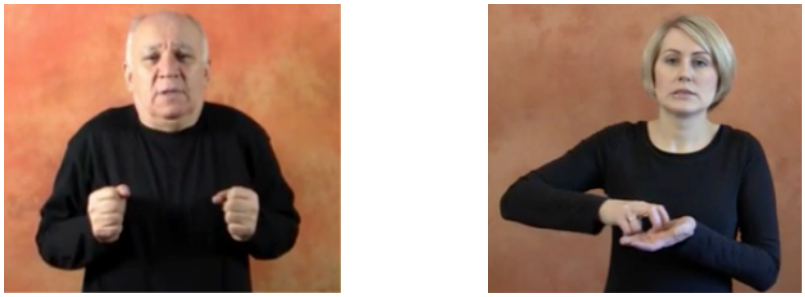


Figure 5: 'Fear' in the sign languages of Romania (left) and Poland (right)

What makes me think the shaking is related directly to coldness in the sign in Romania is that this sign is identical to the sign for 'cold' in many sign languages (such as the sign languages of America, Austria, Britain, Czech Republic, Estonia, Germany, India, Italy, Japan, Russia, Spain, Turkey – a group that has three families in it, but also several languages that are unrelated to all others in that group). So the iconicity chain in the sign language of Romania would go from the sensation of coldness to the visually recognizable action of shivering to the emotion of fear (and see discussion on spoken languages in this regard in Atkins & Levin 1995).

5.4.3 Mappings from weight

There is little work in the literature regarding synesthesia and weight, however some work suggests a synesthetic link between weight and color brightness, where the darker a color is, the heavier it is perceived to be (Ward, Banissy & Jonas 2008). Any iconic chain of this sort in a sign language would have only one link being cross-modal.

Given my own experience with the world, however, I suspect other iconicity chains regarding weight exist where both links are cross-modal. For example, heavy might be associated with strong/substantial and light might be associated with weak/insubstantial in a broad range of contexts (such as judging food sources) while in other contexts heavy might be associated with dangerous/overwhelming and light with innocuous/possible (such as in lifting objects). My speculations might find confirmation. The signs for 'heavy' and 'strong' are close to identical to each other in the sign languages of Austria and Germany (which might or might not be independent facts – see Napoli & Sanders in preparation), where the visual image is related to lifting something heavy. In Figure 6 we see the sign for 'heavy' in Austria. In Figure 7 we see the sign for 'strong' in Austria. The handshapes and locations are the same. The orientation of the palms is upward in 'heavy' and the movement is relatively slow. The orientation of the palms is toward the signer in 'strong' and the movement is rapid (which is why the screenshot is blurred).

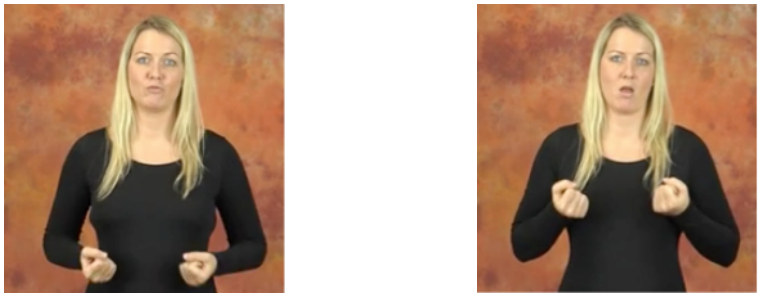


Figure 6: 'Heavy' in the sign language of Austria

Further, the signs for 'lightweight' and 'possible' are similar to one another in the sign language of India.

5.4.4 Mappings from taste

It appears that humans are born with a negative reaction (disgust) to acidic and a positive one to sweet (Fox & Davidson 1986). The sweet response is to taste rather than to a high-energy source, since neonates respond equally to sucrose as to artificial sweeteners (Ramenghi et al. 1996). The sign for 'sweet' is made at (or below or beside) the mouth in sign language after sign language, as expected (the only exception on spreadthesign.com being the sign language of Estonia, but it looks like the signer actually signed the sense of 'candy', rather than of the taste 'sweet'). Perhaps the association of sweetness with

Figure 7: 'Strong' in the sign language of Austria

goodness is behind the fact that the sign for 'good' is made at the mouth in several languages (including those of America, Brazil, and France – all members of a single family). Of course, the reason here could as easily be that food and eating in general are associated with well-being (at least in that language family).

5.4.5 Mappings from smell

Some odors elicit pleasure and some displeasure (Alaoui-Ismaili et al. 1997), which might mean 'good/come close' (the smell of a hot bowl of pasta) versus 'bad/go away' (the smell of a skunk). Recent work suggests that affective experiences induced by odors are quite general, but allow for refinement of types, involving "well-being, social interaction, danger prevention, arousal or relaxation sensations, and conscious recollection of emotional memories" (Chrea et al. 2009: 49). Iconic chains mapping from odor to a visual form to an emotion occur. The sign REPUGNAR 'disgust' in the sign language of Brazil is clearly built on the perception of a bad smell (and is similar to CHIERO 'odor'), as is the sign ASQUEAR 'odor' in the sign language of Spain. In Figure 8 we see the Brazil sign, where the hand moves to the nose, then out to the ipsilateral side, then down and across to the contralateral side.

Figure 8: 'Disgust' in the sign language of Brazil

6 Conclusion

Understanding iconicity in sign languages requires attention to cross-modal associations, which might be complex – involving an iconicity chain that has two mappings, rather than one. Thus the present work aims to alert researchers to such associations.

The benefits of a more (nearly) adequate approach to iconicity in communication are several. Understanding iconicity can help separate out what language is responsible for from what general communication is responsible for, and it might help us understand some of the more thorny areas in sign language studies, including why the signs for abstract concepts can be similar in unrelated languages.

Of particular interest to me is how languages change over time. Sign languages lack the regular changes typical of spoken language change (as discussed in any classical or more recent introduction to historical linguistics, such as Anttila 1972) but, instead, display only tendencies (Moser 1990). Thus diachronic changes motivated by the drive for ease of articulation (Napoli, Sanders & Wright 2014; Sanders & Napoli 2016b; Sanders & Napoli 2016a) apply erratically. The (near) insistence on maintaining iconicity might be at least partially responsible here, especially in light of the fact that iconic words in spoken language sometimes do not obey the same constraints that non-iconic words obey (as noted in Meir 2010). For example, well-formedness conditions and ordinary phonological rules do not always apply to Japanese mimetics (Itô & Mester 1995). And the onomatopoetic word *peep* in English (*pīpen* in Middle English) did not undergo the Great Vowel Shift perhaps because of the desire to maintain the [i] which connects to small size (Hock 1986: 294). Additionally, in West Papuan languages it looks like onomatopoeia in words meaning 'chicken' and 'cat' may have contributed both to the spread of these words among genetically unrelated languages and to their resistance to phonological change over time (Gasser in preparation). We find further evidence of onomatopoeia being ill-behaved in Italian (Marina Nespor, personal communication, December 2016). The horse in Italian goes *iiii* (that is [iiii], while the verb for this has consonants between the vowels: *nitrire*), and many parents reading to small children might enunciate four syllables here. But in the rest of the lexicon there are no words that contain a sequence of four uninterrupted vowels, except perhaps in other animal sounds. For example, the goat or sheep might go [be], [bee], [beee], or [beeee] (while the verb for this is well-formed: *belare*). Likewise, the mouse goes [skwit skwit], but elsewhere in Italian words do not end in [t], nor do syllables unless the [t] is part of a geminate (and, again, the verb for this is well-formed: *squittire*). And in the Turkic language Kazakh, we find onomatopoeic words with consonant clusters that fall outside the range of normally attested clusters (Washington in preparation). In sum, iconicity allows an alignment between form and meaning, and the pressure to establish it when it is possible and the subsequent pressure to maintain it once it is established are strong.

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