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9

Gesture Studies and Semiotics

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Introduction

As semiotic beings, we build our understanding of the discourses we participate in, and more generally of the world around us, by integrating signs in different modalities into dynamic meaningful ensembles. From the first exchanges between infants and caregivers, dialogue typically involves articulations in multiple modalities such as vocalizations, spoken or signed language, manual gestures, eye gaze, body posture and facial expressions. While listening to our conversational partners, we observe their facial expressions; we sense emotional qualities and inner dispositions in the ways they articulate themselves – both verbally and gesturally – and we might respond to them – both verbally and gesturally – or hold ourselves back. Put differently, spontaneous interactive discourse typically consists of concerted multimodal semiotic acts of contextualized meaning-making. In this chapter, we place the human body and its communicative behaviour at the centre of studying multimodal processes of semiosis (e.g., Peirce (e.g., Peirce 1875: CP 1.337; 1907: 5.472, 5.484). We characterize various ways in which the human body functions as sign and sign-creator, bringing together semiotic and related accounts that help us understand how interlocutors gesturally indicate objects, ideas, locations, or events and enact physical habits such as interpersonal interaction, movement patterns, or object manipulation, as well as more abstract, yet deeply embodied, schemata of experience.

Gestures here are broadly understood as discourse-embedded, kinesic actions that are performed with the hands and arms, head, shoulders, torso or entire body, and have semiotic function(s). Imagine a conversation in which a friend explains to you that her plan for the weekend is to work. While she speaks, she performs a typing action in mid-air, simulating typing on an imagined keyboard. From her gesture you will likely infer that she will spend her weekend typing on an actual keyboard at an actual desk: i.e., you will infer that, here, “working” means on a

computer. You may also imagine the written text that will result from the work, as well as other ideas and states (e.g., your friend's future mental or emotional state when she submits her final manuscript) resulting from her weekend of writing. This decontextualized example nonetheless shows how a gesture can evoke not only an implied object or tool, but also the associated pragmatically structured context of experience.

In this chapter, we focus on aspects of the study of gesture most highly relevant to semiotics. After an overview of pioneering research in modern gesture studies, we provide a semiotic characterization of gesture, especially as compared to more highly codified linguistic signs. Drawing on Peirce, we then demonstrate how in gestural signs basic semiotic modes such as iconicity, indexicality, and conventionality/habit interact in modality-specific ways. We further highlight the inherently metonymic nature of gestures and their tendency to schematize experience. We close the chapter with a forward-looking perspective on the field and an overview of new technologies being put to use in semiotic gesture analyses.

Background: Three waves of modern gesture studies

Over the past five decades, modern gesture studies has developed into a flourishing interdisciplinary field that intersects semiotics, linguistics, anthropology, philosophy, psychology, and neurology, among other disciplines (e.g., Müller et al. 2013, 2014). While gesture was acknowledged as part of the act of oratory by Greek and Roman rhetoricians (Hall 2004), it wasn't until the seventeenth century that a truly scholarly interest in gesture emerged that motivated a descriptive, naturalistic account of gesture (though still tied to rhetorical purposes as well). For example, Figure 9.1 features an illustration by seventeenth century physician and philosopher John Bulwer of a gesture signalling antithesis.

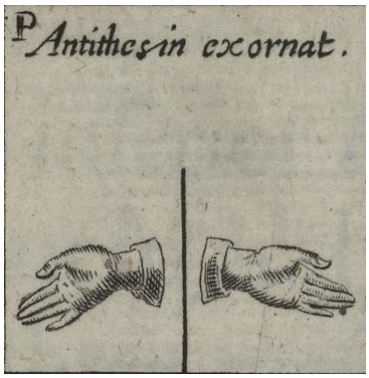

Figure 9.1. A seventeenth century illustration of a gesture signalling antithesis (Bulwer 1644).[1]

In this section, we present the past century as three "waves" that constitute modern gesture studies. These waves are intended to be understood as time periods with unifying developments, rather than as discrete periods. (For a more complete history of gesture studies, see Kendon 2008, 2017; Müller 1998a; Bressem 2013a).

The first wave: Founding treatises

Founding treatises that could be considered a "first wave" of the modern field include those of Wilhelm Wundt (1921, 1973), George Herbert Mead (1934, 1938); David Efron ([1941] 1972), Charles Morris (1946), Leroi-Gourhan (1964), Desmond Morris (1979), and Paul Ekman and Wallace Friesen (1969) *inter alia*. Here we briefly introduce the foremost contributions of several of these scholars.

German psychologist Wilhelm Wundt (1921, 1973) viewed language as an interactive practice in which non-verbal behaviour played a role. His semiotic classification system emerged from his studies of the hand movements of deaf people, and co-speech gestures of Indigenous people of North America, Cistercian monks, and Neapolitan speakers and featured a tertiary division between demonstrative/pointing, descriptive, and symbolic gestures. Wundt's classifications were foundational to later typologies (e.g., Efron's and Ekman and Friesen's).

Efron's ethnographic research ([1941] 1972) was part of the small ripple in the Zeitgeist that ran counter to linguistic structuralism, which viewed language as an abstract system and had little interest in gesture as a linguistic phenomenon. Efron addressed the question of whether different

[1] This image is in the public domain and was accessed online: https://publicdomainreview.org/collection/chirologia-or-the-natural-language-of-the-hand-1644

cultures use gesture differently. In his study of gestures of traditional and assimilated Italian and Yiddish speakers in New York, Efron found distinctive gestural characteristics between the traditional groups, but also concluded that the traditional gestures disappeared upon the speakers' assimilation into the wider community. He thus suggested that gestural actions are socially shared beyond the individual and that different cultures and social groups have different patternings. Efron also presented a classification system ([1941] 1972), later refined by Ekman and Friesen (1969).

Ekman and Friesen (1969) developed their classification system by investigating the full repertoire of bodily movement beyond the hands (facial expressions, posture shifts, etc.). It was based on three fundamental considerations: "how a [non-verbal] behaviour became part of the person's repertoire, the circumstances of its use and the rules which explain how the behaviour contains or conveys information" (1969: 49). They further distinguished between *affect* – displays of emotions largely in facial expressions; *adaptors*, e.g., scratching an itch or adjusting one's glasses; *regulators* – now known as interactive gestures (Bavelas et al. 1995); *emblems*, such as the "victory"-sign; and *illustrators* – which portray speech content. Later typologies (see below) relied heavily on these distinctions.

The second wave: 1970s–1990s

In what could be considered a second – and pivotal – wave, the pioneering research of linguistic anthropologist Adam Kendon (e.g., 1972, 1980, 1988, 2004), psycholinguist David McNeill (e.g., 1985, 1992, 2000, 2005), and others (e.g., Calbris 1990), has greatly shaped our understanding of manual gestures as an integral part of thought processes, utterance formation, and communicative interaction.

Kendon presents comparative semiotic studies of the role of the body in interaction, or, to use his term, *visible action as utterance* (2004). His research brings together a structuralist approach to the form and function of kinesic utterances; ethnographic methods inspired by Efron ([1941] 1972) and Wundt (1921); and a focus on social interaction (Goffman 1955; Schegloff 1984) (Seyfeddinipur and Gullberg 2014: 2). His studies of Indigenous sign languages of Australia (1988), gestures of Neapolitans in Italy (1995, 2004), and *gesture families* (2004) are among his most significant contributions and led to many original observations regarding different kinds of multimodal language (i.e., co-speech gestures and signed languages) (see also subsection entitled

"Multifunctionality and polysemy of co-speech gestures" below and contributions in Seyfeddinipur and Gullberg's (2014) *Festschrift* in honour of Kendon's work).

McNeill's research into the interrelation between speech and gesture and on the cognitive function of gesture has formed the basis of much of his work. McNeill suggests that speech and gesture are "part of the same psychological structure" (1985: 350; 2005 on "growth points", dynamic units of online verbal thinking that combine imagery and linguistic content). Furthermore, McNeill's (1992) Peirce-inspired gesture typology now represents one of the most widely used categorization systems in gesture research. In it, he differentiates *beats* – rhythmic gestures aligned with speech prosody and used mainly as emphasis markers; *deictics* – pointing gestures; *emblems* – codified gestures with a stable form-meaning relation, e.g., the "victory" or "okay" signs; *iconics* – which depict a physical action or a concrete object; *metaphorics*, which portray abstract entities; and *cohesive gestures* – repetitions of a gesture form or location across a stretch of discourse. Moving away from assigning gestural signs to a single category, McNeill (2005) later prefers to speak of mixing dimensions, such as iconicity and indexicality (see also the fourth main section below) and Duncan, Cassell and Levy's 2007 *Festschrift* in honour of McNeill's work).

Geneviève Calbris (1990) offers a detailed semiotic analysis of French gestures based on her elaborate coding system. Her account of meaning is truly multimodal; she examines the temporal and semantic coordination of meaningful movements of the hands, head, torso, and facial mimics. She also highlighted gestures' capacity to abstract from the concrete and to concretize the abstract (e.g., spatial representations of time), and how the motivation for gestural forms – i.e., through iconicity and analogy – involves conventionalization, including both cultural practices and cognitive schemata (Calbris 2011).

The third wave: Gesture studies as a multidisciplinary field

In a third wave, since the late 90s, modern gesture studies has exploded into a multi- and interdisciplinary field addressing questions in semiotics, psychology, linguistics, anthropology, philosophy, neuroscience, and many more disciplines using a wide variety of methodologies. Here we briefly introduce research strands that emphasize the semiotics of gesture.

Linguistic anthropologists Charles Goodwin (1981, 2007, 2018), John Haviland (1993, 2000), and Nick Enfield (2009, 2011, 2013) as well as interactional linguist Jürgen Streeck (1993, 2009) have focused on the situated nature of meaning, i.e., that conversation is anchored in the material

world and is co-constructed dynamically by participants. Importantly, their work is also grounded in the study of a multitude of non-European languages, such as Haviland's (1993) work on pointing gestures of the Guugu Yimithirr Indigenous community in Australia and Enfield's (2009) collection of studies on Lao speakers of Southeast Asia. Streeck's ecological, conversation analytic approach employs microscopic analyses of interactions – e.g., car mechanics talking while repairing a vehicle – to study how we make meaning in and gather meaning from our environments, how we share meaning with others, and how we organize our interactions (2009: 3, 1993; LeBaron and Streeck 2000). Streeck also proposed six "gesture ecologies", or "patterns of alignments between human actors, their gestures and the world" (2009: 7) (see discussion on "Gestural practices of sign formation" below and Streeck, Goodwin, and LeBaron 2011).

Cornelia Müller's research, rooted in linguistic discourse analysis, has influenced the field in many ways. Müller (1998a, 2017a) showed how Bühler's ([1934] 1982) Organon model of communication with its three functions – expressive, referential, and appellative – illuminates the multifunctionality of gestures. She also introduced a widely-used set of gestural modes of representation (Müller 1998a, 1998bb, 2014; see below). Her work on multimodal metaphor has demonstrated how gestures may bring out the dynamic nature of metaphor (Müller 2017b; Cienki and Müller 2008) and how speech, gesture, and expressive movement are temporally orchestrated in multimodal interaction and film (Müller and Kappelhoff 2018). Furthermore, Müller (2017a, 2018) has offered insights into motivated and conventionalized facets of both gesture and sign, e.g., by introducing the notion of *recurrent gestures* (see also Ladewig 2011, 2014; Bressem 2014; Bressem and Müller 2014).

Besides the individual scholars we have mentioned so far, there are also groups of gesture researchers whose work is anchored in a shared theoretical perspective. Here we name two schools that are particularly akin to semiotics. Cognitive Linguistics (CL) was one of the first linguistic fields to embrace gesture studies, building on a shared interest in thought processes, embodiment, and multimodality (e.g., Johnson 1987; Cienki 1998, 2013; Müller 1998a; 2017b; Sweetser 1998, 2007, 2012; Taub 2001; Parrill and Sweetser 2004; Wilcox 2004; Gibbs 2005; Núñez and Sweetser 2006; Cienki and Müller 2008; Feyaerts, Brône and Oben 2017; Wilcox and Occhino 2017; Talmy 2018). There is some theoretical overlap between CL and a cognitive semiotic perspective on gesture, which similarly centralizes embodied meaning-making in the broader context of cognitive,

social, and neurobiological processes, but has a stronger anchorage in semiotic theory (e.g., Sonesson 2014; Zlatev 2015, this volume; Mittelberg 2006, 2008, 2013a; Wolf et al. 2017, 2018).

What unites these three waves is the acknowledgement that human language, whether spoken or signed, is embodied, dynamic, and multimodal and needs to be analysed and theorized as such (see also Liebal et al. 2013 for a multimodal approach to human primate communication). New interdisciplinary research strands are evolving as quickly as new technologies: e.g., the use of 3D motion capture systems, large-scale multimedia corpora, and brain imaging to study gesture. Could these methodologies be leading us to a fourth wave? We return to this question to conclude the chapter.

Gestures acting as signs

A question central to gesture research, and to this chapter, concerns the cultural, cognitive, affective, physical, material, and interpersonal factors that motivate the formation of individual gestural signs and gesture patterns, thereby lending a certain regularity to forms and functions of human communicative behaviours. In comparison to the Saussurian understanding of language and linguistic signs (Saussure [1916] 1986), most of these regularities do not rely on highly conventionalized and socially agreed upon codes. Thus, one of the most basic questions from a semiotic perspective is *how* a gesture acts as a sign.

Like any material sign carrier in any semiotic process, in order for a gesture to function as a sign, it needs to be perceived and interpreted by a human mind or some other cognitive system (e.g., a machine). According to prominent American philosopher Charles Sanders Peirce, (1839–1914), a "sign […] is something that stands to somebody for something in some respect or capacity" (c.1897: CP 2.228; see fifth main section for semiotic theory). These basic principles underlying semiotic processes require us to consider: In what ways and capacities can coverbal gestures stand for something and be interpreted as such by an addressee? Do they always clearly stand for something? And what role do the concurrent linguistic signs play?

Some prerequisites for verbo-gestural sign processes

We begin by considering some factors that condition how gestures enter multimodal sign processes for both an addresser and their addressee. When interlocutors speak in face-to-face interaction, they ensure that they can be heard and can hear their interlocutors. A not-too-noisy environment

and intact audio channel are prerequisites for the successful exchange of (verbal) linguistic signs. By contrast, with the exception of signers, interlocutors usually do not check whether they can see each other's gestures (e.g., when video-conferencing) and they gesture even when their interlocutors cannot see them (e.g., on the telephone; Bavelas et al. 2008). Regarding gesture interpretation, it is thus important to take into account that many gestures are not consciously or not fully perceived by the addressee(s) of a multimodal utterance. People's attention, rather, seems to narrow in on certain articulations (e.g., speech, head movement, gaze, gesture) in certain moments and then to change focus again to seize on others. Despite this gradient nature of gesture perception, interlocutors are clearly attending to them to some degree, as gestures enhance the understanding of oral discourse and the learning of new concepts, among other functions (e.g., McNeill 2000; Goldin-Meadow 2003).

Gesture production shows a great deal of variation depending on discourse genres, personal styles, cultural practices, and other factors (e.g., Müller et al. 2013, 2014). Speakers can be more or less aware of the gestures they make while talking. The fact that speakers are often not aware of their gestural behaviour can reveal less monitored aspects of multimodal semiosis during communication (Sweetser 2007). As meaningful bodily actions influenced by cognitive and affective states, gestures provide valuable insights into the physical grounding, emotional dimensions, and socio-cultural situatedness of the semiotic processes humans rely on for thinking, imagination, and communication (e.g., Streeck, Goodwin and LeBaron 2011; Müller 2017b).

There are situational contexts in which gestures may become the focus of joint attention and joint intentionality (e.g., Tomasello 1999) and thus the focus of the communicative action of all participants involved, which makes it very likely that they fulfil semiotic functions for both the gesturer and the addressee(s). Such contexts include expert explanations (e.g., Streeck 2009) and language teaching (e.g., McCafferty and Stam 2008). Among the different kinds of gestural signs, pointing gestures, or *deictics* (McNeill 1992), in particular, need to be fully perceived by the addressee(s). Speakers use such indexical gestures to purposely direct their addressee's attention and to indicate a specific object, location, or event, or less specific targets such as broad directions (e.g., north, south) or regions in space (e.g., a mountain range) (Kita 2003; Fricke 2007; Goodwin 2007; see also discussion on "Contiguity – indexicality – metonymy" below).

Emblematic gestures (*emblems* (McNeill 1992) or *quotable gestures* (Kendon 2004)) are also gestural signs that interlocutors need to attend to for a communicative exchange to be successful.

Within the spectrum of less versus more conventionalized, or "language-like", gestural behaviour, emblems exhibit a high degree of conventionalization on the basis of well-formedness conditions and culturally codified meanings (see McNeill 2005 for the so-called "Kendon-Continuum" encompassing gesticulation-pantomime-emblems-sign language). An example of an emblem is the "thumbs-up" gesture signifying (in many western cultures) approval and positive appraisal, formed with an outstretched thumb extended about 90 degrees away from the fingers, which are curled into a fist (shown in Figure 9.2). While it can signal approval without relying on the semantics of the concurrent speech, the interpreter still needs to consider the immediate discourse and situational context to understand what the speaker-gesturer is approving of. In Figure 9.2, we see a thumbs-up emblem produced with both hands by US Vice President Kamala Harris to give positive feedback to her student audience.

Figure 9.2. Thumbs-up emblem signalling approval.[2]

In light of the highly conventionalized and codified nature of emblems, they seem to be, strictly speaking, the only type of gesture that can be adequately described with Saussure's model of the linguistic sign ([1916] 1986). That is, reference is afforded via coded form-meaning pairings, i.e., between a signifier that is unequivocally assigned to a signified as in the thumbs up gesture

[2] US Vice President Kamala Harris gives thumbs up to students at Miller Elementary School, Dearborn, Michigan, Monday, May 6, 2019. Retrieved June 4, 2021. Copyright: Associated Press 2019.
Source: https://www.taiwannews.com.tw/en/news/3697138

signifying approval. For the same reason, emblems (but not all gestures) may count as symbols in Peirce's understanding of the term (see below on "Gesture and semiotic theory"). While popular understandings of the term gesture are often associated with emblems, they make up only a sub-group of gestures and subsequently also of gesture research (for cross-cultural uses of emblems, see, e.g., Calbris 1990; Brookes 2004; Kendon 2004; Müller and Posner 2004; for an overview of research on emblems, see Teßendorf 2013). This chapter is mainly concerned with spontaneously produced co-speech gestures that show a larger and more varied range of forms, functions, and degrees of conventionalization.

Multifunctionality and polysemy of co-speech gestures

Gestures typically fulfil more than one communicative function, and therefore often defy neat categorization. Hierarchical understandings of semiotic processes (Jakobson 1960; Peirce 1960; Bühler [1934] 1982) have been adapted to account for the multifunctionality of gestures, which often combine in varying degrees iconicity, indexicality, and conventionality (Peirce c.1895: CP 2.302; McNeill 1992, 2005), and pragmatic and interactive functions described beyond Peirce-based paradigms (Bavelas et al. 1995; Müller 1998a; Kendon 2004). Depending on local pragmatic forces and contextual factors, one of the modes comes to the fore, thus determining the predominant function of a given gestural sign. The non-dominant functions still contribute to the overall meaning of the utterance, e.g., referential functions may layer with the stance of the speaker towards the content of the utterance (see Müller 1998a, 2014, drawing on Bühler; Mittelberg 2013a and Mittelberg and Waugh 2009, drawing on Jakobson and Peirce; and Debras 2017 and Hinnell 2020 on the multimodal expression of stance).

The following example from a teaching context illustrates how gestures act as signs in multimodal utterances. When saying "there is the main verb", the speaker in Figure 9.3 (adapted from Mittelberg 2013a), a linguistics professor, is drawing the students' attention to the verb form "taught" written on the blackboard behind him by creating a gestural index with his right arm and hand. Here the linguistic index "there" and the gestural index pointing at the written form "taught" jointly establish reference; they are semantically integrated (e.g., Cooperrider et al. 2021). Meanwhile, the speaker's left hand exhibits basic form features of a receptacle representing "the main verb" at a higher level of abstraction. Without considering the speech content, we would not know that the cupped hand does not portray a physical object, but, rather, a grammatical category.

By representing an abstract entity through a physical structure, this form qualifies as a metaphoric gesture (McNeill 1992; Sweetser 1998; Cienki and Müller 2008; see also section on "Gesture and semiotic theory" below).

Figure 9.3. Pointing gesture ("there is") and metaphoric container gesture ("the main verb").

Notably, these gestures exhibit both similar and different semiotic characteristics and functions within the multimodal utterance. Both are polysemous sign carriers that depend on linguistic and other contextual information to assume a specific, contextualized meaning, yet different degrees of context-dependence are at work. The meaning of indexical signs is categorically highly context-sensitive, a fact well established for pronouns, demonstratives, and other function words in language (or *shifters*, Jakobson 1957). Pointing gestures similarly depend more fully on the linguistic and extralinguistic context and cause the attendee's attention to shift from the hand itself to the entity pointed at. By contrast, iconic and metaphoric gestures typically exhibit form features which, taken by themselves, evoke content, including embodied schemata (see Johnson 1987; Cienki 1998, 2013; Mittelberg 2006, 2018). Focusing only on the gestural part of the utterance above, we see that the index refers to something external to the speaker's body, while the container gesture also is what it signifies, a physical structure in the form of a receptacle (e.g., Merleau-Ponty 1962: 216; Mittelberg 2013b: 340). In the speech content, we observe another difference between these two multimodal sign processes. Whereas the referent of the linguistic deictic expression "there is" can only be identified with a simultaneous gestural index, the noun phrase "the main verb" could be understood without the container gesture illustrating it. Additional semiotic support comes from the written form "taught" that represents an exemplar of main verbs. All in all, the speech content, the visual information on the board, and the two coinciding gestures contextualize each other, thus co-constituting a multimodally performed semiotic act.

Thus far, we have introduced the semiotic complexity that characterizes dynamic multimodal sign processes. Coverbal gestures are typically polysemous and multifunctional signs that assume their local meaning based on their own semiotic characteristics and in conjunction with concurrently uttered speech and other contextual factors. While questions of referentiality (e.g., Deacon 1997) are crucial to understanding how gestures act as signs, this chapter cannot provide a full treatment of this complex issue (but see "Gesture and semiotic theory" below).

Bodily semiotic action and multimodal language

Co-speech gestures are often described as part of visual communication or visual language (e.g., Sandler, Gullberg and Padden 2019). While they clearly constitute the visible, observable part of language use in interaction, a semiotic characterization of gesture needs to account for the fact that they are, compared to static visual signs such as drawings, paintings, or hieroglyphs, more than merely visual in nature. Here, we address the role kinesic action plays in the semiotics of gesture and discuss connections to signed languages, thus broadening the scope of multimodal language.

Kinesic, visual, and imagined facets of gestural signs

Kendon's (2004: 7) term *visual action as utterance* highlights the fact that gestures are dynamic bodily *actions*. While *utterance* stresses gestures' affinity with verbal expression, here the term suggests that gestures can also be seen as utterances in their own right (Seyfeddinipur and Gullberg 2014). Drawing on Jakobson's notion of *motor signs* (1972: 474), Mittelberg (2019a) recently introduced the notion of *visuo-kinetic signs* to capture the fact that gestures – as well as the various articulations in signed languages – are conditioned by the kinesic and sensory affordances of the speaker's body and its interactions with the environment. In this understanding of gestures, semiosis (Peirce 1907: CP 5.472, 5.484), and embodiment (Varela et al. 1991) are intimately linked: Experientially grounded embodied schemata and force dynamics (Johnson 1987) are assumed to underpin both the mindful production and interpretation of bodily signs, thus allowing for (inter-)subjective understanding (see Mittelberg 2013a on the *exbodied mind*). Honing in further on bodily articulations, Boutet, Morgenstern, and Cienki (2016) proposed a fine-grained kinesiological account of gestures in their examination of gestures reflecting grammatical aspect.

Gestures' deep grounding in physical actions and social interactions explains why speakers readily and effortlessly use their hands to hold or move around real or virtual objects (see, e.g.,

Kita 2000; studies in Streeck, Goodwin and LeBaron 2011). Participants further co-construct *contextures of action* with their conversational partners (Goodwin 2011, 2018). In principle, however, a gesture is a gesture – i.e., a reduced and more schematic bodily action with semiotic function – precisely because gesturers typically only pretend to be manipulating objects, touching surfaces, tapping on someone's shoulder, etc. (see Clark 2016 on depictions; Hostetter and Alibali 2008 on simulated actions in gesture and Müller 1998a/b, 2014 on acting). When speakers do "pull" real persons, physical objects or tools into their gestural actions, these elements become part of the respective visuo-kinetic sign process and thus themselves fulfil semiotic functions: They stand for someone or something else. Although the verbo-gestural co-expression of propositional content has always been a focus of gesture research (e.g., McNeill 1992; Kendon 2000, 2004), the action affinity of gestures has also offered insights into how gestures may do something in their own right. Examples include brushing away an argument (e.g., Bressem and Müller 2014), fending off a rhetorical attack (e.g., Wehling 2017), or inviting an interlocutor to take the floor (e.g., Holler and Bavelas 2017).

Despite gestures' visual and bodily mediality, a challenging factor in gesture interpretation and analysis resides in the fact that the "semiotic material" we are looking at often provides rather sparse and short-lived imagery (e.g., Arnheim 1969). Gestures often consist only of quickly performed motion-onsets or furtive schematic figurations abstracted from, for example, the full action routine, object, or spatial constellation (e.g., Müller 1998a, 2014; Mittelberg and Waugh 2014). Moreover, while a gestural form description starts with the observable physical components such as body posture, hand shape, palm orientation, finger configuration, and the position and action of gesturing hands (e.g., Bressem 2013b), gestural sign carriers also tend to involve facets that are not directly observable, yet are also signifying. These may include the imaginary interlocutors, objects or surfaces mentioned above, but also invisible movement traces or points set in gesture space, all of which need to be metonymically inferred from the visible, physical elements and actions (Mittelberg 2019a; see also below). For instance, the typing gesture described earlier necessarily implies an imagined keyboard. A thorough gesture analysis thus needs to include elements of multimodal sign processes that are not visual, or visible, but still contribute to a gesture's form, meaning, pragmatic function, and kinesthetic feel.

Gestural practices of sign formation

We now turn our attention to how communicating hands create gestural signs. Rudolf Arnheim gives a succinct impression of the "intelligent" abstractions speakers perform with their gestures:

> By the very nature of the medium of gesture, the representation is highly abstract. What matters for our purpose is how common, how satisfying and useful this sort of visual description is nevertheless. In fact, it is useful not in spite of its spareness but because of it. Often a gesture is so striking because it singles out one feature relevant to the discourse. […] The gesture limits itself intelligently to emphasizing what matters. (Arnheim 1969: 117)

Spontaneously produced gestures like the ones described by Arnheim, particularly those that portray an aspect of an object, action, or idea, may take shape through employing different kinds of semiotic practices. Kendon (2004), for example, distinguishes between different techniques of representation, namely modelling a body part to stand for something else, enacting certain features of an action pattern, or depicting objects through hand movements recognized as sketching or sculpting the shape of something. Müller (1998a, 1998b) introduced four modes of representation in gesture, drawing on tools, media, and mimetic techniques stemming from the visual arts: *drawing* (e.g., tracing the outlines of a picture frame); *molding* (e.g., sculpting the form of a crown); *acting* (e.g., pretending to open a window); and *representing* (e.g., flat open hand stands for a piece of paper; Müller 2014).

Some gesture scholars specifically differentiate between gestures that carefully depict a particular space or referent object from those gestures that seem to reflect a concept or an idea, for example via metaphor (e.g., Calbris 1990; McNeill 1992; Fricke 2012). Streeck (2009: 151–152) distinguishes between *depicting* (e.g., via a gesture portraying a physical object) and *ceiving* (e.g., via a gesture conceptualizing a thematic object, such as an experience or idea), among others, attributing the latter mode to a more self-absorbed, conceptually driven way of finding a gestural image for an emerging idea. Clark (2016) presented a detailed multimodal account of three main modes of communication including *depicting*, *describing* (with arbitrary symbols such as words) and *indicatin*g (using indices such as pointing and placing). See Ferrara and Hodge (2018) for a review of the techniques addressed in this section.

Comparative semiotics: Co-speech gesture and sign language

Reflecting on semiotic action and the multimodal nature of language leads us to consider, though briefly, how co-speech gestures relate to signed languages. In a historical context in which sign languages were long not accorded the same status as spoken languages, original accounts of signed languages comprised phonological descriptions in the structuralist approach that characterized linguistics at the time (e.g., Stokoe [1960] 2005 on ASL). The theoretical "*rapprochement*" (Wilcox and Occhino 2017: 111) between the study of signed languages and gesture studies has occurred over the last twenty-five years (Kendon 1988, 2008; Armstrong, Stokoe and Wilcox 1995), a period in which cognitive approaches have come to play a greater role in studies of signed languages (Wilcox and Occhino 2017). This, in turn, has brought into focus the semiotic mechanisms that play a role in both gesture and signed languages.

Gestures and signs in signed languages share similarities, yet also differ, in how they act as signs (e.g., Goldin-Meadow 2003; Liddell 2003; McNeill 2005; Sweetser 2009; Perniss, Thompson and Vigliocco 2010; Goldin-Meadow and Brentari 2017; Müller 2018; Perniss 2018). Regarding their semiotic status, signed languages compare to spoken languages in that they are highly conventionalized sign systems, each with a coded phonology, lexicon, and grammar (e.g., Wilcox and Occhino 2017). With respect to their semiotic resources, gesture and signs share largely the same set of kinesic articulators and the same primary lieu of meaning making, namely, the body-centred, three-dimensional signing/gesture space. However, in contrast to spoken discourse and concurrent 'co-speech' gestures, sign languages are entirely visuo-kinetic multimodal sign systems. The hands do most of the semiotic work, but in a composite manner with other articulations such as facial expressions. In every instance of signed interaction, several symbolic signs thus need to be simultaneously visually perceived by the addressee and semantically and grammatically integrated. The study of emerging sign languages, or *homesign* (e.g., Morford and Kegl 2000), can help us better understand how physical semiotic resources are dynamically coded by their users and thus develop into a multimodal language.

Sign languages also comprise gestural strata and components (Liddell 2003; Kendon 2008; Wilcox and Occhino 2017). For example, some signs enter a sign language as a gestural form, e.g., as the *substrate* for lexical signs (Janzen and Shaffer 2002), which can grammaticalize to grammatical signs, such as is the case with modals (Wilcox and Shaffer 2006). By the same token, co-speech gestures may exhibit various degrees of grammaticalization (e.g., Fricke 2012;

Mittelberg 2017b; Zima and Bergs 2017; Müller 2017a, 2018; Harrison 2018; Hinnell 2019, 2020; Ladewig 2020).

There are also less codified articulations in sign language that may be ascribed a gestural quality. Constructed action, for example, is a widely used strategy for reporting narratives and for event enactment in which signers "encode different perspectives, either simultaneously or sequentially relaying information about referents by pivoting their gaze, shoulders, or bodies or by changing facial markers" (Kurz, Mullaney and Occhino 2019: 90). Some sign linguists have also argued that certain sign forms are blends of conventional signs and gestural locations, given that the locations are not codified and are therefore part of gesture (e.g., a point in space to index a discourse referent) (Liddell 2003).

We now turn to the basic semiotic modes that are at work in both co-speech gestures and signed language.

Gesture and semiotic theory

In this section, we hone in on one of the fundamental semiotic theories applied to gesture and multimodal sign processes, namely, Peirce's semiotic. We also draw connections to Saussure and Jakobson, as well as to the fields of cognitive linguistics and cognitive semiotics, which share basic assumptions with Peirce regarding embodied patterns of experience and expression. A Peircean perspective on multimodal interaction can account for both highly symbolic sign systems, such as spoken and signed languages, and less codified, dynamic visuo-spatial modalities, such as coverbal gestures. In Peirce's pragmatist doctrine of signs, semiosis and cognition are tightly intertwined: "we think only in signs" (Peirce c.1895: CP 2.302). Given the central question in gesture research of how gestures partake in expressive and cognitive action during communication, Peirce's semiotic has informed work done in several intersecting fields. These include cognitive semiotics (e.g., Mittelberg 2006, 2008, 2013a, 2019a, 2019b; Sonesson 2007, 2014), linguistics (e.g., Fricke 2007, 2012; Andrén 2010; Bressem 2014), anthropology (e.g., Haviland 1993, 2000; Enfield 2009, 2011, 2013), philosophy (Maddalena 2015), psycholinguistics (e.g., McNeill 1992, 2005), psychology (Clark 1996, 2016), and social neuroscience (e.g., Wolf et al. 2017).

Peirce's triadic sign model applied to gesture

Peirce's widely-cited definition of the sign reads as follows:

> A sign, [in the form of a] *representamen* is something which stands to somebody for something in some respect or capacity. It addresses somebody, that is, creates in the mind of that person an equivalent sign, or perhaps a more developed sign. That sign which it creates I call the *interpretant* of the first sign. The sign stands for something, its *object*. It stands for that object, not in all respects, but in reference to some sort of idea, which I sometimes called the *ground* of the representamen. (Peirce c.1897: CP 2.228; italics in original)

The term *Representamen* refers to the material form the sign takes, e.g., a spoken word or a gesture; *Interpretant* refers to the response evoked in the mind of the sign receiver. Sign interpreters are seen as agents actively involved in meaning-making. Whether one recognizes a gesture as a sign and what one sees in it depends on one's semiotic history, notably, socio-cultural knowledge, code(s), and other patterns of perception and interpretation, including both coded and less symbolic gestural practices (e.g., Mittelberg 2006, 2019b; Fricke 2007; Enfield 2013, Wolf et al. 2017).

Peirce's wide understanding of a semiotic *Object* encompasses both physical objects/actions and abstract entities/processes, including qualities, feelings, relations, concepts, mental states, and possibilities. As is true for any semiotic material or system, in gesture, too, the medium-specific affordances of the hands, arms, and other physical articulators determine what may be represented or indicated, and how (see discussion on "Gestural practices of sign formation" above). Imitating manual typing on a keyboard comes naturally. Whereas a hand can readily become a small receptacle (e.g., Figure 9.3), huge Objects such as buildings need to be cognitively and physically brought down to human scale in order to describe them with gestures. Some Objects thus do not lend themselves well to depiction or enactment via gesture; colours, for example, may be gesturally represented in terms of their vividness rather than actual colour (for how Peirce's notions of the immediate and dynamic Object apply to gesture, see, e.g., Mittelberg 2006, 2013a; Enfield 2013).

Peirce's concept of the *Ground* highlights the fact that sign vehicles represent Objects not in their entirety, but only with respect to some perceptually salient and/or pragmatically relevant aspect. By entering the semiotic process, these abstracted and foregrounded features of the Object function as the Ground of the Representamen ((Peirce c.1897: CP 2.229; Sonesson 2007: 40). Accordingly, gestural sign processes have been devised based on different semiotic grounding mechanisms following Peirce (e.g., Mittelberg 2013a; Mittelberg and Waugh 2014; Sonesson

2014). In what follows, we will discuss how the basic Representamen-Object correlations *icon, index,* and *symbol* (Peirce 1893: CP 2.275) have been described in relation to coverbal gestures.

Similarity – iconicity – metaphor

Similarity generally builds the basis for iconic signs. According to Peirce (1903: CP 2.276), "icons have qualities which 'resemble' those of the objects they represent, and they excite analogous sensations in the mind." Although there is a visual bias in the term *icon*, it encompasses a multimodal understanding of iconicity and thus also includes those "sensations" that cause something to feel, taste, look, smell, move, or sound like something else. A gesture with a highly iconic ground gives a partial image of its Object based on a perceived or construed similarity (e.g., Andrén 2010; Lücking 2013; Mittelberg 2014; and Sonesson 2014 for more theoretical insights into gestural iconicity). In gesture, similarity may reside in structural resemblance, which has also been described in terms of isomorphism (e.g., Kita 2000; Mittelberg 2006; Fricke 2007). Similarity may also motivate how speakers foreground an expressive quality of a movement or a phase of an action routine (e.g., Müller 1998b; Mittelberg 2019a; also below). For example, in McNeill's (1992: 12) well-known example of a speaker retelling the action of a cartoon character in conjunction with the utterance *He grabs a big oak tree and he bends it way back,* the gesturer first performs a grabbing action and then a pulling backward action with his right hand and arm. As McNeill (2005: 6–7) points out, "the gesture has clear iconicity – the movement and the handgrip; also a locus (starting high and ending low) – all creating imagery that is analogous to the event being described in speech at the same time." In the McNeillean tradition, one focus of analysis has been on how speech and gesture encode different aspects of motion events, e.g., path and manner of movement, and how these strategies reveal patterns that correlate with typological differences (e.g., studies in Duncan, Cassell and Levy 2007; for an overview of work on iconic or representational gestures see Mittelberg and Evola 2014).

Iconic gestures also reflect the viewpoint strategies speakers adopt when describing events or experiences (e.g., McNeill 1992). A speaker can describe a scene from the inside, imitating the actions of a character (*character viewpoint*), or adopt an external viewpoint on the event and describe, for example, the motion path of a character (*observer viewpoint*). Speakers may also express multiple viewpoints on the same experience by employing several bodily articulators (see Calbris 1990 on *body segments*; Dudis 2004 on *body partitioning* in ASL; Parrill 2009 on *dual*

viewpoint; and Stec 2012 for an overview). From a semiotic perspective, viewpointed iconic gestures are indexically conditioned, as they reveal the conceptual anchorage and/or physical perspective from which the gestural sign is created (e.g., Sweetser 2012; Mittelberg 2017a).

Peirce's distinction between three subtypes of icons (i.e., *hypoicons*; Peirce 1903: CP 2.276) – *images*, *diagrams* (i.e., icons of relations) and *metaphors* (implying a parallelism; Peirce c.1897: CP 2.228; Mittelberg 2014) – captures the multidimensional nature of gestural imagery. *Image iconicity* resides, for instance, in iconic gestures depicting a character's actions, as in McNeill's tree example above. Full body enactments of an action or object – e.g., a child "becoming" a helicopter, with his torso representing the body of the helicopter and his arms the rotating blades (Bouvet 1997: 17) – show more iconic form substance than a virtual outline of an object, such as a picture frame sketched in the air (Müller 1998a,b). To further illustrate these tendencies, consider the gestural portrayal of a painting by Paul Klee in Figure 9.4 ("Dance of a mourning child", adapted from Mittelberg 2013b). As the video still in the center image reveals, the speaker adopts character viewpoint when imitating the figure in the painting by mirroring its posture, tilted head and downward gaze.[3] Here, the speaker's entire body functions as an image icon with a high degree of iconicity. By contrast, the motion-capture plot on the right (Natural Media Lab, RWTH University, Aachen) highlights the balanced image-iconic structures the speaker created with both hands. Visualizing and freezing the motion traces renders static iconic signs of the eye slits (at the very top of the mocap plot) and the heart-shaped mouth, which the speaker drew on her own face, as well as the stretched-out arms and the skirt flowing around her legs (for a detailed image schema analysis of the painting and the multimodal description see Mittelberg 2013b).

[3] Transcript of verbal transcription (Figure 9.4): 'I thought it was a girl, because, uhm she looked like she was wearing some sort of short flowing skirt uhm, and... uh her head was turned to this side if I were mirroring what she was doing and her arms were like this. Uhm, and... uh.. her mouth was almost in the shape of a heart and... uhm, I kept trying to see if her eyes were open or closed, and it looked like they were just slits.'

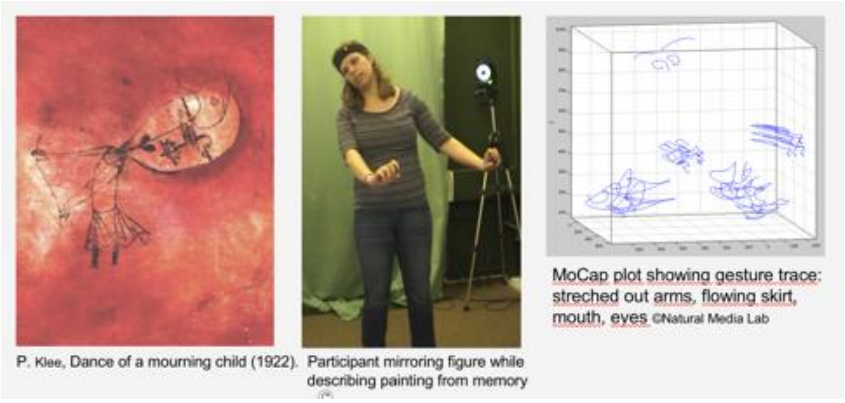

Figure 9.4. Painting (P. Klee, Dance of a Mourning Child 1922 as stimulus; speaker's body as icon of figure in painting [video still]; iconic figurations [MoCap plot]).

Diagrammatic iconicity underpins gestures that trace connections between two or more locations in gesture space, to schematically represent, for instance, kinship relations (Enfield 2009), syntactic structure (Mittelberg 2008), or a travel itinerary, as in Figure 9.5 below. Consisting of visualized motion traces, this gestural diagram is a digitally engendered iconic sign of a diagrammatic gesture (Schüller and Mittelberg 2016). The speaker on the right summarizes the itinerary of a train trip through Europe she and her conversation partner agreed upon: "I think then we'll go like this, you know, from (-) there to there across down and then to there and then back home again, no?"[4] Given the high number of indexical function words in the verbal utterance, this synopsis can only be fully understood in the context of the incrementally emerging diagram, the preceding multimodal discourse, and aspects of the common ground shared by the interlocutors (e.g., Holler and Bavelas 2017; for a detailed analysis, see Mittelberg and Rekittke fc.).

[4] German original: "Nee, ich denke wir fahren dann so weißte von da nach da rüber runter und dann nach da und dann wieder nach Hause, nein?"

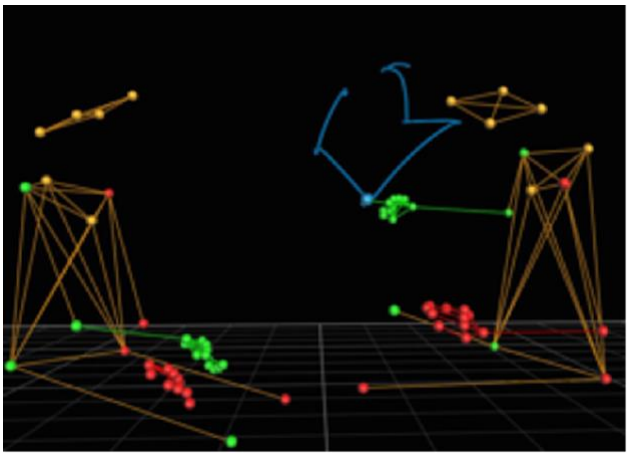

Figure 9.5. Motion-capture gesture diagram of travel itinerary: Stockholm, Prague, Kiev, etc.

An example of *metaphor iconicity* motivating a gesture is the open cupped hand discussed earlier (Figure 9.3) that represents an abstract category in the form of a small container. In Peircean terms, this metaphoric gesture represents a *parallelism* between an abstract semiotic object and a physical Representamen (c.1897: CP 2.228). According to Müller and Cienki (2009), this gesture is an instance of a monomodal metaphor, for the concurrent linguistic expression "main verb" is not metaphorical, but technical in nature (Mittelberg 2008). Put into cognitive linguistic terms, the speaker here enacts the primary metaphor CATEGORIES ARE CONTAINERS, which is deeply rooted in experience (Grady 1997). Here, the embodied image schema CONTAINER (Johnson 1987) provides structure that motivates the gestural form. (For more research on metaphor in gesture, mainly from a cognitive linguistic perspective, see, e.g., Calbris 1990, 2011; Cienki 1998; Sweetser 1998, 2007; Parrill and Sweetser 2004; Núnez and Sweetser 2006; Cienki and Müller 2008; Mittelberg 2008; Müller and Cienki 2009; Müller 2017b; Pagán Cánovas et al. 2020; for metaphor in signed languages: see, e.g., Taub 2001; Wilcox and Occhino 2017.)

Contiguity – indexicality – metonymy

Contiguity relations are born out of a factual (physical or causal) connection between the semiotic Object and the sign carrier, notably physical contact, but also temporal and spatial proximity or distance. Contiguity underpins signs with a predominant indexical Ground (Peirce 1901: CP 2.306; Sonesson 2014: 1992). According to Peirce (c.1897: CP 2.228), "an Index is a sign which refers to the Object that it denotes by virtue of being really affected by that object." As demonstrated above (see discussion on "Gestures acting as signs", also Figure 9.3), the spatial orientation of

pointing gestures is indeed affected by the location of their target Object. It is through the very act of pointing that the Object is established via a visual vector. Whereas the highly indexical gesture shown in Figure 9.3 clearly points at the intended referent located nearby, thus instigating a contiguity relation to it, other instances of pointing may be more ambiguous, evoking several possible meanings (e.g., Goodwin 2014), including abstract pointing (McNeill, Cassell and Levy 1993) and pointing at previously produced signs (e.g., Fricke 2007). Form variants of the indicating hand and arm have been shown to fulfil various pragmatic functions (cf. Clark 2003; Enfield, Kita and De Ruiter 2007; Talmy 2018; Hassemer and McCleary 2020). While pointing gestures can be observed across languages and cultures, field work in various parts of the world has demonstrated that pointing practices and conventions are not universal, but rather vary considerably and also include non-manual pointing (cf. Haviland 2000; Kita 2003; Wilkins 2003; Kendon 2004; Enfield 2009; Cooperrider, Slotta & Nuñez 2018; and Cooperrider et al. 2021).

We emphasize here that besides pointing, all gestures are, in principle, indexical to a greater or lesser extent, in that their meaning and pragmatic functions always depend on the speaker's body's spatio-temporal anchorage in a real or imagined context (Sweetser 2012). Indexicality thus conditions any gestural act of meaning-making. It also resides in interactive gestures (Bavelas et al. 1995) and environmentally-coupled gestures (Goodwin 2007). Furthermore, indexicality tends to interact with iconicity, not only regarding viewpoint (as discussed above), but also in gestural diagrams (Mittelberg and Rekittke fc.), gestural enactments of contrast (Hinnell 2019, 2020; see also below), and metonymy in gesture (Mittelberg and Waugh 2014), for instance.

Jakobson's (1956) balanced theory of metaphor and metonymy directly builds on Peirce's notions of similarity and contiguity and shows how these fundamental modes of association and signification interact in linguistic and visual signs. Jakobson's work, particularly his distinction of inner and outer contiguity (Jakobson and Pomorska 1983), is well suited to illuminate the experientially motivated and inherently metonymic nature of gestures (addressed in the third section above; see also Mittelberg and Waugh (2009, 2014). Here we only briefly treat the main principles.

Jakobson understood inner contiguity (giving rise to internal metonymy) to underlie part-whole relationships (e.g., of a physical structure such as the human body). The cupped hand shown in Figure 9.3 metonymically represents a solid container. Brief action onsets or schematic movements may further evoke the full action routine in question. For example, Mittelberg (2019a) describes a

speaker performing a swimming gesture that is metonymic in more than one respect: A stylized and reduced iconic movement of her arms evokes a full-fledged swimming action, with the leg movements left out. Outer contiguity (giving rise to external metonymy) holds among elements that are spatially, temporally, or pragmatically correlated within a situational or semiotic context (Jakobson 1956). Let us consider Figure 9.6, which shows the same linguist as in Figure 9.3 continuing to explain the relation between main verbs and auxiliaries. Here, he stresses that the auxiliaries "*have, will, being* and *been* […] must all belong to some subcategory."

Figure 9.6. Metonymy: Contiguity relations between hands and the virtual object they seem to be holding. Metaphor: Imaginary object represents the abstract entity ("subcategory").

To interpret this gesture, we must first see the speaker-gesturer as a dynamic image icon of someone holding something (based on internal metonymy) and then draw on the outer contiguity relation (contact/adjacency) between the vertical palms of the hands (i.e., the source of the metonymic mapping in cognitive linguistic terms) and the virtual object between them (i.e., the metonymic target). Here we witness an instance of cross-modal metonymic inferencing, for the verbal expression "subcategory" causes our attention to shift from the manual action of holding something (not referred to verbally) to the imaginary object being held. This gesture thus enacts a frame-metonymy (Dancygier and Sweetser 2014) and, more specifically, the metonymic mapping ACTION-FOR-OBJECT INVOLVED IN ACTION or PRESENTATION-FOR-PRESENTED (e.g., Panther and Thornburg 2003). Further examples of external metonymy in visuo-kinetic signs include speakers presenting reified discourse contents to be imagined on a palm-up open hand or between a hand's index and thumb (Mittelberg 2006). (Re-)creating contact with the environment, these kinds of

gestures exhibit comparably low degrees of indexicality, yet "point" to the virtual object, tool, surface or space "at hand". Depending on their respective shape, size, and affordances, the (imaginary) elements resonate in a gesture's particular hand shape and action pattern. Hence, such signs hence are — to return to Peirce's notion of an index — dynamically affected by the Object.

Finally, to arrive at the abstract grammatical category of the multimodal explanation in Figure 9.6, it is crucial to realize that metonymy leads into metaphor (Mittelberg and Waugh 2009, 2014) in such gestural actions that intuitively draw on familiar scenes of experience (Fillmore 1982). In short, the imaginary object functions as *both* the target of the metonymic mapping as explained above and the source of the interlaced conceptual metaphor IDEAS ARE OBJECTS or CATEGORIES ARE CONTAINERS (Lakoff and Johnson 1980; Dancygier and Sweetser 2014). Hence, the metaphoric target, i.e., the subcategory, is construed as a tangible object that can be intersubjectively shared with the student audience (see Mittelberg 2019a; for comparable processes in signed languages see, e.g., Taub 2001; Wilcox and Occhino 2017).

Conventionality – symbolicity – conceptual schemata

According to Peirce (1903: CP 2.249), "[a] symbol is a sign which refers to the Object that it denotes by virtue of a law." Strictly speaking, only codified emblematic gestures are, as noted earlier, truly symbolic signs, which is also why Saussure's ([1916] 1986) model of the linguistic sign seems far too rigid when it comes to gesture. Rather, different levels and sources of both conventionality and iconicity tend to interact in communicative actions of the human body, thus driving the emergence and routinisation of motivated signs (e.g., Calbris 1990 on cultural *clichés* in French gestures; see also Posner 2004). These gesture-based insights are valuable in the context of the long-standing debate regarding the structural integration of iconicity in predominantly symbolic linguistic signs. As Jakobson ([1966] 1990) claimed in his work based on Peirce, and as subsequent work on spoken and signed languages has clearly shown, iconicity is a general feature of language at all levels of linguistic structure (Jakobson and Waugh [1979] 2002; Perniss, Thompson and Vigliocco 2010; also above). As far as symbolic indices in gesture are concerned, they occur mainly in the form of pointing, which, as Peirce (c.1903: CP 2.262) maintained, may build a constitutive part of a (symbolic) proposition (e.g., Stjernfelt 2014).

Compared to law-like conventionality, Peirce's notion of *habit* (e.g., Peirce 1902: CP 2.170; Nöth 2016) seems particularly suited to accounting for gradually routinized correlations between

recurring gestural forms and their functions (Mittelberg 2006). Peirce's *universal categories* of perception and experience have been shown to illuminate the multidimensionality of gesture (e.g., Fricke 2007, 2012) and, particularly, the *habit*-based emergence of different kinds of gestural patterns and schematicity: Mittelberg (2019b) distinguishes between gestural enactments of habits of feeling (*Firstness*), habits of acting (*Secondness*), and habits of thinking (*Thirdness*) (see also Sonesson 2014; Nöth 2016). Accordingly, thirdness-laden properties of gestures should allow interpreters to discern some of their semantic/pragmatic functions without considering the concurrent speech (see also Wolf et al. 2017 on perceived conventionality).

Embodied image schemas and conceptual metaphor (e.g., Johnson 1987) mediate between experience, thought, and expression and have thus been shown to motivate the schematic form and meaning of many iconic and metaphoric gestures (e.g., Cienki 1998, 2013; Mittelberg 2008, 2013a/b, 2018, 2019b; Ladewig 2011; Wehling 2017). Besides the basic schemata CONTAINER (Figure 9.3) and OBJECT (Figure 9.6) illustrated above, and BALANCE, to be discussed below, further schemata prone to manifest – and interact – in gesture include PATH, BOUNDARY, and CYCLE, the spatial relation schemata UP-DOWN, NEAR-FAR, and LEFT-RIGHT (Lakoff and Johnson 1999) and force schemata such as RESISTANCE and BLOCKAGE (Johnson 1987; Talmy 1988). Compared to these abstract schemata structuring certain gestures in adult speakers, the mimetic schemas introduced by Zlatev (2005) – such as jump, kick, grasp, push, and hit – are anchored in specific physical actions. They play a fundamental role in the cognitive and linguistic development of children and "help explain most literally the grounding of both communication and thought through action and imitation" (Zlatev 2014: 2; see also Andrén 2010; Cienki 2013).

It is precisely because most gestural signs are not fully coded, but combine different semiotic modes to quite varying degrees, that one of the central goals of modern gesture research has been to identify gestural forms that exhibit relatively high degrees of patterning and conventionalization. Gestures that are frequently used across individual speakers, speech genres, and situational contexts belong to *gesture families* (e.g., Kendon 2004), *gesture ecologies* (Streeck 2009), and *recurrent gestures* (e.g., Müller 2004, 2017a; Ladewig 2011, 2014; Bressem and Müller 2014). Besides their tendency to develop pragmatic functions, some of these routinized forms may become grammatical markers and/or feed into multimodal constructions (e.g., studies in Zima and Bergs 2017; Hinnell 2018, 2019, 2020).

This section has focused on how semiotic theory and gesture analysis can illuminate one other. In what follows, we provide insights into how theoretical questions and empirical work can advance each other in additional ways and on a larger scale.

Recent empirical research strands

As discussed above, we are now in what we have identified as a third wave of modern gesture studies. In this section, we introduce technologies that are being used to explore semiotically-oriented research questions in multimodal communication, such as large scale multimedia archives, fMRI imaging, and 3D motion capture and a sampling of research projects using these technologies.

Empirical gesture research depends on the time-intensive task of producing annotated speech and gesture transcripts that allow for the analysis of the synchrony of co-occurring linguistic and gestural forms. First, one transcribes the speech and segments the gestural utterance into phrases and phases (e.g., McNeill 1992; Kendon 2004). Then, gestures are normally annotated according to their form and functions as per the specific research questions driving the study (see, e.g., Kendon 2004 and Bressem 2013b for gesture annotation; Hinnell 2018 and 2020 for detailed annotations of speech, gesture, and other bodily articulators such as head movement). Video-annotation tools such as ELAN allow users to create and search utterance transcriptions and multiple annotation layers.[5] These annotation methods form the basis for a range of methodologies, from experimental to corpus-based work we have referred to throughout this chapter.

Due to theoretical perspectives informed by cognitive linguistics that focus on actual language usage in interaction (Feyaerts, Brône, and Oben 2017), as well as the availability of larger, text-searchable, multimedia databases, gesture research has recently featured a growth in multimodal corpus studies. Platforms such as Red Hen (Steen and Turner 2013; www.redhenlab.org) and the TV News Archive (www.archive.org/tv) allow researchers to harness data from publicly broadcast television and feature searchable text from television closed-captioning. Once a targeted search – e.g., for a specific linguistic construction – is complete, data are manually annotated for linguistic and gestural form and function, and then analysed using quantitative and/or descriptive statistical

[5] https://tla.mpi.nl/tools/tla-tools/elan/ (ELAN 2020)

methods (e.g., Joo, Steen and Turner 2017; Hinnell 2018, 2019, 2020; Pagán Cánovas et al. 2020; Woodin et al. 2020). The availability of interactional, multimedia data has resulted in studies featuring much larger data sets. Such studies address issues that are inherently semiotic, e.g., patterned communicative behaviour and the conventionalization of signs, including the degree and the loci of conventionality that designate components of a gestural sign as such and of multimodal sign processes.

As an example, in a recent corpus-based study aligned with scholarship on the central role of the body and our experience in the world in driving linguistic and conceptual structure (e.g., in cognitive linguistics (Johnson 1987) and semiotics (Pelkey 2017)), Hinnell (2019) investigates how speakers of North American English build semiotic environments around the construal of contrast (recall the gesture of antithesis in Figure 9.1). Using data from Red Hen, the study documents how speakers mark contrast in gesture and head movement alongside spoken utterances such as *on the one hand/on the other hand,* the conjunction *versus*, comparative expressions (*better than/worse than*), antonym pairs such as *David/Goliath, rich/poor*, opposition as negation (*should I/shouldn't I?*), and others. Hinnell argues that both iconicity and indexicality motivate the multimodal forms that characterize her data. Iconicity is seen in the symmetrical nature of the gestures (and head movements) and the use of lateral space, which embodies the BALANCE image schema that is the basis of contrast (Johnson 1987). Indexicality emerges in the handshape – frequently, but not always, a point with an extended index finger (see Figure 9.7) – and in the practice of indicating towards opposite sides of the lateral gesture space to reference opposing discourse objects. In Figure 9.7, the first line (S) signifies the speech utterance and the second (G) gesture description. Target utterances in the text search are underlined.

S: *…takes a million dollars from Bill Maher,*	*…lectures on the one hand,*	*…his surrogates attack on the other hand,*	*…he attacks on the other hand…*
G: bimanual point to speaker's right	point and head tilt to speaker's left	point and head tilt to speaker's right	point and head tilt to speaker's left

Figure 9.7. Embodied contrast: *On the one hand/on the other hand,* bilateral point sequence.

Brain imaging studies (see review in Özyürek 2014) and 3D motion capture (MoCap) also facilitate empirical investigations of semiotic and related theories. Functional magnetic resonance imaging (fMRI) has been used to investigate the neuroscientific basis for Peirce's universal categories (Wolf et al. 2017, 2018) and metonymy in gesture (Joue et al. 2018). As a digital medium, MoCap is semiotic in its very nature, given its capacity to render gesture both visually and algorithmically. Video recordings are made of dialogues in which speakers wear markers, e.g., on their hands, arms, shoulders, hips, face, etc. (for marker-less tracking see Trujillo et al. 2019). After data processing, the motion trace of a gesture as well as the skeletal morphology and position of a person's body can be viewed without seeing the person's physical body (as one can in video recordings), as in Figure 9.4 above. MoCap can serve both computational and linguistic semiotic purposes. For example, Mittelberg and colleagues (2015; building on Hinnell 2018) recorded a series of conversations among speakers of American English in a motion capture lab. Gestures marking specific event construals were identified and manually annotated. The MoCap profiles of identified gestural forms were then used to derive kinetic patterns and improve spatiotemporal similarity searching in 3D data (Schüller et al. 2017).

Semiotic understandings of gesture have an important role to play in the development of artificial intelligence (AI) and human-computer interaction (HCI). In order to render human-like dialogue in HCI applications, the quality of multimodal utterances would, presumably, need to approach human-like behaviour (see Hinnell 2020). Wicke and Veale (2021), for example, have

developed an embodied framework for the multimodal performance and interpretation of narratives within robotic storytelling. (See Bressem 2013a; Joo, Steen and Turner 2017; and Kopp 2017 for applications of gesture studies to AI and vice versa).

Returning to the wave metaphor, we suggest that such methodological and technological advances, which, importantly, are driving interdisciplinary collaborations, are also driving a fourth wave of gesture studies. To have substantial and sustainable impact, we propose that the new technologies be developed with an aim of making them available beyond individual research programmes and that results should ideally feed back into semiotic theory-building.

7. Conclusion

In this chapter, we have aimed to show that investigating gestural phenomena through a semiotic lens allows for deep insights into the specific semiotic nature of gesture. What we can draw from the expansive body of work discussed in this chapter is that gesture – at first glance a basic and natural human communicative resource – can teach us a great deal about semiosis in general, as well as about embodiment and multimodality. Gesture indeed reveals essential aspects about iconicity, metaphor, indexicality, metonymy, conventionality/habit, etc., and about the formation and functioning of signs. It is likely precisely because gestures are so essential to us as embodied social beings that they can reveal primordial, including preverbal, facets of how we experience our inner and outer world, express ourselves, and understand others.

Looking ahead, semiotic perspectives in gesture studies continue to demonstrate the potential to advance our understanding of the intricate bodily-based sign processes that underlie human cognition and communicative interaction. In order to do justice to the noted semiotic complexity of co-speech gestures, and multimodal language more broadly, the evolution of both theoretical and empirical work must feature focused studies within the intersecting disciplines, as well as interdisciplinary research initiatives that see humanities scholars, data scientists, and many others pursue truly collaborative innovation.

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