Enacted schematicity:
Image schemas and force dynamics operating in gestural (inter-)action

Irene MITTELBERG

RWTH Aachen University, Aachen, Germany

Abstract. This short paper provides a synopsis of a recently proposed body-centered, dynamic systems approach that aims to account for how embodied image schemas and force dynamics jointly operate in – and also guide the interpretation of – gestural (inter-)action. The proposed tendencies are illustrated with both video and motion-capture (MoCap) data. It shows how numeric kinetic data allow gesture researchers to measure the spatiotemporal dimensions of gestural articulations and render movement traces visible. MoCap may thus offer new insights into the dynamic, gestalt-like nature of gesturally enacted schematicity.

Keywords. Image schemas, force dynamics, gesture, multimodality, embodiment, motion-capture technology

1. Introduction

Embodied schemata of experience have been shown to play a fundamental role in structuring our perception and bodily being-in-the-world. They also underpin language development [1] as well as both literal and figurative meanings in language and other modalities (e.g., [2] [3] [4] [5] [6] [7]).

Image schemas are generally understood as dynamic, embodied patterns of recurrent physical and cognitive experiences such as visual perception, sensorimotor routines, and interactions with the physical and socio-cultural world (e.g., [8] [9]). Examples of pervasive image schemata are PATH, CONTAINER, STRAIGHT, BOUNDARY, CYCLE, OVER, and CENTER-PERIPHERY (e.g., [4]). *Force dynamics* (e.g., [10]) are equally instrumental in how humans structure and understand experiences: They are involved in sensing FORCES within one's own body or acting on it, for example, when trying to keep one's BALANCE while riding a bike, pushing a bike uphill (GRAVITY), or making efforts to PUSH a heavy door open (BLOCKAGE, RESISTANCE). Importantly, they cut across physical, cognitive, emotional, kinesthetic, social, and aesthetic domains of experience (e.g., [5] [8]).

Since the human body functions as the living medium through which such dynamic processes of internalization, structuration and expression are channeled, it might not come as a surprise that gesture research, in particular, has evidenced pragmatically driven manifestations of image schemas, force gestalts, and less abstract mimetic schemas in hand gestures, body postures, and whole-body enactments (see [11] [12] for overviews;

see also [13] [14] [15] [16] [17] *inter alia*). However, it yet needs to be better understood how and to what extent such embodied structures and principles drive on-the-fly as well as regulate communicative action and intersubjective understanding in the multimodal give and take of *face-to-face* interaction. In what follows, this short paper provides a synopsis of a recently proposed body-centered, dynamic systems approach ([18]) to how embodied image schemas and force dynamics may be said to jointly structure and guide the interpretation of gestural (inter-)action ([19]).

2. Schematic meanings inherent to gestural action and interaction

2.1. Embodied correspondences between conceptual and gestural schematicity

The present view of schematic meanings deeply embodied in co-speech gestures and whole-body enactments [19] argues that there are structural similarities between dynamic image schemas and force gestalts, on the one hand, and hand shapes and gestural movements, on the other. Such flexible correspondences between conceptual and gestural schematicity (ibid.) here are assumed to partly stem from experiential bases shared by incrementally internalized conceptual structures and the repeated gestural (re-)enacting of bodily actions.

Many gestures typically only consist of evanescent, metonymically reduced hand configurations, motion onsets or movement traces that minimally suggest, for instance, a PATH, the idea of CONTAINMENT, an IN-OUT spatial relation, or the idea of physical or emotional BALANCE ([20], ([21]). That is, although they are physical in nature, gestures often emerge as rather schematic gestalts, which nevertheless have the capacity to vividly convey essential semantic and pragmatic aspects of high relevance to the speaker and thus to the unfolding discourse.

A crucial aspect in this context is that image schemas have been found to be at the root of polysemy not only of specific lexical items in language (see, e.g., [22] on literal and metaphorical meanings of the English verb 'stand'), but also of recurrent gestural forms whose local meaning is disambiguated by the concurrent discourse context (e.g., see [23] [24] [25] on *recurrent gestures* in German, and [15] on geometric and image-schematic patterns found in meta-linguistic gestures). Furthermore, several image schemas and force gestalts tend to interact and blend in multimodal instances of meaning-making, thus propelling a specific, contextualized meaning of a given linguistic or gestural form (e.g., [18]). It is further posited here that gesturally instantiated image schemas and force gestalts tend to underpin, as inherently meaningful structures, more complex, multimodally achieved semantic and pragmatic processes involving metonymy, metaphor, and frames (e.g., [26]).

2.2. A body-centered, dynamic systems approach to image schemas and force gestalts operating in gesture

Drawing on Gibbs' [18] dynamic systems account of image schemas, Mittelberg [20] recently proposed the following set of tendencies in gestural enactments of image schemas and force dynamics:

- *body-inherent/self-oriented* (the human body as image-schematic structure; forces acting within and upon the body and body parts);
- *environment-oriented* (reflecting interaction with material culture including spatial structures);
- *interlocutor-oriented* (social, conversational, and intersubjective interaction).

This body-centered account of how embodied schemata operate in multimodal interaction still needs to be fully fleshed out. Yet, these considerations give us a first idea of how adopting a dynamic systems perspective (e.g., [18] [27]) allows us to focus on how image schemas and force gestalts function as pragmatically grounded, cognitive-semiotic organizing principles that underpin several dimensions of multimodal communicative action and interaction: the physical and cognitive self-regulation of speakers; how interlocutors (pretend to) interact physically with the environment while talking; and the coming about of intersubjective instances of understanding and affective-cognitive resonance between interlocutors (see also [25]).

Making use of an optical VICON motion-capture (MoCap) system at the Natural Media Lab, RWTH Aachen University, the account presented here is enriched by numeric kinetic data. MoCap allows gesture researchers to visualize movement traces and to measure in great detail spatial-temporal dimensions of gestural articulations. In this way, motion-capture technology may generally provide fresh, three-dimensional insights into the dynamic, gestalt-like nature of bodily enacted schematic meanings (e.g., [21]). Another asset is the possibility to use this kind of data for quantitative pattern analyses involving computational modeling ([28] [29]).

With respect to the first tendency of gestural image schema enactments mentioned above (*body-inherent*), one may, for instance, search a kinetic data corpus for all the gestural forms that exhibit a figure curvature close to zero. In this way, one may identify all occurrences of flat, extended hands and see how the image schema STRAIGHT interacts with other image schemas to motivate various palm orientations, as well as certain kinds and directions of incorporated movements. From such schematic embodied meanings, more complex meanings may be derived. The latter typically involve, for instance, metaphor and semantic frames ([30]; [19] [26]; see also [11] [23] [24] [25]).

The second tendency listed above (*environment-oriented)* concerns some of the principled ways in which speakers analyze, and interact with, the environment, including their use of their personal gesture spaces to communicate. The third tendency (*interlocutor-oriented*) pertains to how speakers interact with their interlocutors, thus setting up and structuring shared gesture spaces. The present view holds that these different spaces have a virtual, inbuilt structure that is organized, at least partly, by spatial-relation-schemata (UP-DOWN, LEFT-RIGHT, NEAR-FAR, CENTER-PERIPHERY) which also underpin metaphorical uses of certain regions of gesture space (e.g., [19] [20] [31] [32]).

3. A sample analysis of multimodally instantiated, interacting image schemas

In this short paper, only one example of a multimodal image schema instantiation will be discussed in detail (for additional examples and analyses the interested reader is referred to [19] [20] [21]). Figure 1 shows a spontaneous gestural enactment of the PATH

schema, integrated in a multimodal discourse sequence in American English:[1] The speaker is talking about watching her favorite sitcom, verbally specifying a certain time period within a given season as follows: "*from the point of where I was till like the end of the season*." Note that the blue line superimposed on the video-still represents the gestural movement trace. In this multimodal description, several image schemas jointly convey the idea of an activity that continued during a confined time period. First of all, the PATH schema underlies the portrayal of a bounded temporal phase (BOUNDEDNESS; BOUNDARY) reaching out from one point (SOURCE) to a subsequent point in time (GOAL). In the process, the metaphor TIME IS SPACE is manifested as a HORIZONTAL, comparatively STRAIGHT movement EXTENSION evolving from the speaker's LEFT to RIGHT. The dynamic nature of the gestural movement further invokes the idea of time passing and thus feeds into the conceptualization of TIME (as activities consuming time) as movement through SPACE.
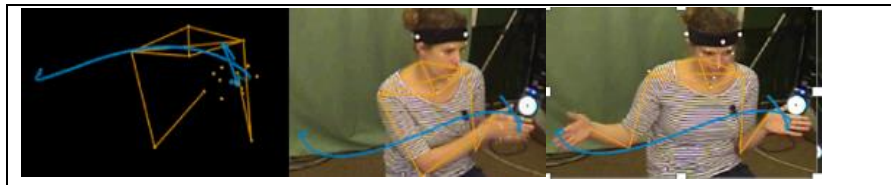
Figure 1. Gesture integrating the image schemas PATH, EXTENSION, STRAIGHT, BOUNDEDNESS, CONTAINER, HORIZONTAL, and LEFT-RIGHT
("*from the point of where I was till like the end of the season*")

This gesturally evoked, spatial construal of the speaker's viewing experience is rather specific. It profiles all three parts of the PATH schema, all of which are also mentioned in the concurrently unfolding verbal utterance: the SOURCE ("*from where I was*"), the PATH through time ("*till like*"), and the GOAL ("*the end of the season*"). The speaker reinforces the idea of a bounded space by designating the point of departure with her left, almost vertical, open hand, and by marking the end point with her open right hand that is also held vertically. The latter configuration can thus also be interpreted as an allusion to the CONTAINER schema. All in all, several embodied patterns here are evoked in a strikingly precise fashion. It should be noted, however, that such a full instantiation of image schemas in gesture and other modalities are the exception rather than the rule. Usually, only certain parts and gestalt aspects get metonymically profiled, thus alluding to the full schema or gestalt.

4. Concluding remarks

The present work provides further evidence that gestural action and body postures have a natural propensity to enact deeply embodied facets of image schemas and force dynamics. It has become evident that gestures play a crucial role in how "image-schematic reasoning is always being recreated by the body as people continue to engage in sensorimotor behaviors related to BALANCE, RESISTANCE, SOURCE-PATH-GOAL,

---

[1] These multimodal data (see Figure 1) stem from a joint study on aspectual framing conducted with Jennifer Hinnell, University of Alberta.

CONTAINMENT" [18: 116]. It is thus posited here that by enacting such meaningful structures, processes, and relations, gestures and postures may invoke the "kinesthetic feel" (ibid.) of schemas and other construal operations that are not necessarily identifiable in the concurrent speech. This also holds for the interpretation and understanding of the multimodal communicative behavior of others.

In conclusion, image schemas and force dynamics are central to how gestures and whole-body enactments convey essential structures and qualities of a large array of experiences, ranging from physical, social, affective and mental to aesthetic and technologically mediated domains of human activity. As the research discussed in this paper and the interdisciplinary TriCoLore workshops held in Bolzano clearly suggest, a deeper understanding of the nature and functions of embodied image schemas and force dynamics is not only of great relevance to multimodal accounts of language, cognition, and human-human interaction. It still shows a strong potential to continue to inform many areas of AI research, particularly the development of naturally communicating virtual agents and intuitive gesture-based interfaces.

Acknowledgements

References

[1] J. M. Mandler, C. Pagán Cánovas, On defining image schemas, *Language and Cognition* **6** (2014), 510–532.
[2] B. Dancygier, E. Sweetser, *Figurative language*, Cambridge University Press, Cambridge, 2014.
[3] R. W. Gibbs Jr., *Embodiment and cognitive science*, Cambridge University Press, Cambridge, 2006.
[4] B. Hampe (ed.), *From perception to meaning: Image schemas in cognitive linguistics*, Mouton de Gruyter, Berlin & New York, 2005.
[5] M. Johnson, *The meaning of the body: Aesthetics of human understanding*, Chicago University Press, Chicago, 2007.
[6] J. M. Krois, M. Rosengren, A. Steidele, D. Westerkamp, *Embodiment in cognition and culture*, John Benjamins, Amsterdam & Philadelphia, 2007.
[7] B. Dancygier, L. Vandelanotte, Image-schematic scaffolding in textual and visual artefacts, *Journal of Pragmatics* **122** (2017), 91−106.
[8] M. Johnson, *The body in the mind: The bodily basis of meaning, imagination and reasoning*, Chicago University Press, Chicago, 1987.
[9] G. Lakoff, *Woman, fire, and dangerous things: What categories reveal about the mind*. University of Chicago Press, Chicago, 1987.
[10] L. Talmy, Force dynamics in language and cognition, *Cognitive Science* **12** (1988), 49–100.
[11] A. J. Cienki, Mimetic schemas and image schemas in cognitive linguistics and gesture studies. *Review of Cognitive Linguistics* **11** (2013), 417–432.
[12] J. Zlatev, Image schemas, mimetic schemas, and children's gestures, *Cognitive Semiotics* **7** (2014), 3–29.
[13] G. Calbris, *Elements of meaning in gesture*, John Benjamins, Amsterdam & Philadelphia, 2011.
[14] I. Mittelberg, 2008, Peircean semiotics meets conceptual metaphor: Iconic modes in gestural representations of grammar. In Alan Cienki & Cornelia Müller (eds.), *Metaphor and gesture*, 115-154. Amsterdam & Philadelphia: John Benjamins.

[15] I. Mittelberg, 2010, Geometric and image-schematic Patterns in Gesture Space. In Vyvyan Evans & Paul A. Chilton (eds.), *Language, cognition, and space: The state of the art and new directions*, 351-385. London: Equinox.

[16] E. Wehling, Discourse management gestures. *Gesture* **16** (2017), 245–276.

[17] R. F. Williams, 2008, Gesture as a conceptual mapping tool. In A. Cienki & C. Müller (eds.), *Metaphor and gesture*, 55-92. Amsterdam & Philadelphia: John Benjamins.

[18] R. W. Gibbs Jr., 2005, The psychological status of image schemas. In B. Hampe (ed.), *From perception to meaning: Image schemas in cognitive linguistics*, 113-135. Berlin & New York: Mouton de Gruyter.

[19] I. Mittelberg, Gestures as image schemas and force gestalts: A dynamic systems approach augmented with motion-capture data analyses, *Cognitive Semiotics* **11** (2018), DOI:10.1515/cogsem-2018-2002.

[20] I. Mittelberg, 2013, Balancing acts: Image schemas and force dynamics as experiential essence in pictures by Paul Klee and their gestural enactments. In M. Borkent, B. Dancygier & J. Hinnell (eds.), *Language and the creative mind*, 325-346. Stanford: CSLI Publications.

[21] I. Mittelberg, In press. Peirce's Universal Categories: On their potential for gesture theory and multimodal *Analysis,* special issue on 'The Extended Peirce', guest-edited by F. Stjernfelt & J. Querioz. *Semiotica.*

[22] R. W. Gibbs Jr., H. L. Colston, The cognitive psychological reality of image schemas and their transformations, *Cognitive Linguistic*s **6** (1995), 347–378.

[23] Bressem, J. & C. Müller. 2014. A repertoire of German recurrent gestures with pragmatic functions. In C. Müller, A. Cienki, E. Fricke, S. H. Ladewig, D. McNeill, and S. Theßendorf (eds.), Body – language – communication: An international handbook on multimodality in human interaction, 1575–1591. Berlin & Boston: Mouton de Gruyter.

[24] S. H. Ladewig, Putting the cyclic gesture on a cognitive basis. *CogniTextes* **6** (2011).

[25] C. Müller, How recurrent gestures mean: Conventionalized contexts-of-use and embodied motivation, *Gesture* **16** (2017), 277–304.

[26] I. Mittelberg, Multimodal existential constructions in German: Manual actions of giving as experiential substrate for grammatical and gestural patterns, *Linguistics Vanguard* **3** (2017), doi:10.1515/lingvan-2016-0047.

[27] E. Thompson, F. Varela, Radical embodiment: Neural dynamics and consciousness, *Trends in Cognitive Science* **5** (2001), 418–425.

[28] C. Beecks, M. Hassani, J. Hinnell, D. Schüller, B. Brenger, I. Mittelberg, T. Seidl, Efficient query processing in 3D motion capture databases via lower bound approximation of the gesture matching distance, *International Journal of Semantic Computing* **10** (2016), 5–25.

[29] D. Schüller, C. Beecks, M. Hassani, J. Hinnell, B. Brenger, T. Seidl, I. Mittelberg, Automated pattern analysis in gesture research: Similarity measuring in 3D motion capture models of communicative action, *Digital Humanities Quarterly* **11** (2017).

[30] C. J. Fillmore, 1982. Frame semantics. In The Linguistic Society of Korea (ed.) *Linguistics in the Morning Calm,* 111–137. Seoul: Hanshin.

[31] D. McNeill, *Hand and mind: What gestures reveal about thought*, Chicago University Press, Chicago, 1992.

[32] Priesters, M. & I. Mittelberg. 2013. Individual differences in speakers' gesture spaces: Multi-angle views from a motion-capture study. *Proceedings of the Tilburg Gesture Research Meeting* (TiGeR), June 19–21.