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ORIGINAL ARTICLE

Hearts in their hands—Physicians' gestures embodying shared professional knowledge around the world

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Abstract

The biomedical approach to medical knowledge is widely accepted around the world. This article considers whether the incorporated aspects of physician-patient interaction have become similarly common across the globe by comparing the gestures that physicians use in their interactions with patients. Up to this point, there has been little research on physicians' use of gestures in health-care settings. We explore how—in four university hospitals in Turkey, the People's Republic of China, The Netherlands and Germany—physicians use gesture in their discussions with simulated patients about the condition of heart failure. Our analysis confirms the importance of gestures for organising both the personal interaction and the knowledge transfer between physician and patient. From the perspective of global comparison, it is notable that physicians in all four hospitals used similar gestures. This demonstrates the globality of biomedical knowledge in an embodied mode. Physicians used gestures for a range of purposes, including to convey the idea of an 'anatomical map' and for constructing visual models of (patho-)physiological processes. Since biomedical language is rife with metaphor, it was not surprising that we also identified an accompanying metaphorical gesture which has a similar form in the various locations that were part of the study.

KEYWORDS
gesture, global diffusion, heart failure, medical knowledge, patient communication, physician-patient interaction

INTRODUCTION

Biomedicine has 'achieved an unprecedented global dominance' (Lock & Nguyen, 2018, p. 79). It has evolved into a global health system, based on scientific knowledge, technologies, standards and organisational networks (Inoue & Drori, 2006). Yet from a social practice perspective (Maller, 2015), whether and how globalisation shapes more practical and embodied ways of doing and knowing biomedicine remain intriguing questions. When inspecting audio-visual data from a previous project (Weiß et al., 2022) in which we conducted 'quasi-experimental' (Heath & Luff, 2018) research with physicians and simulated heart failure patients in four different locations around the world (Sommer et al., 2021; Weiß, Sommer, Chen, et al., 2021; Weiß, Sommer, Merse, Störk, et al., 2021; Weiß, Sommer, Merse, Weingartz, et al., 2021), our attention was drawn

to the gestures that accompanied physicians' talk about heart failure.[1] We realised that physicians used some gestures in strikingly similar ways in all four locations. This was surprising to us, since scholars of gesture have shown that gestures are highly contingent on culture (Efron, 1972 [1941]; Kendon, 1997). Consider the work of Archer (1997), who, after having observed a diversity of gestures across cultures, remarked:

> Verbal and substantive content—e.g., what Clint Eastwood says in an American movie, the fact that there were four members of the Beatles etc.—diffuses across cultural boundaries with relative ease ... But if we have learned anything since the publication of Edward Hall's pioneering works on cultural differences ..., it is that non-verbal behaviours are different.
>
> (p. 103)

How, then, can we explain the gestural similarities that we observed in medical consultations across culturally diverse contexts?

In this article, we subject to a secondary analysis the data from our project on physicians' knowledge in university hospitals in Turkey, China, The Netherlands and Germany. We focus on how physicians from different cultural background used gestures when explaining a heart failure diagnosis to simulated patients (SPs). Physicians' gestures provide us with a window onto knowledge that is of a tacit, primarily unconscious and embodied nature but—as we shall argue—is nonetheless shaped by processes of globalisation. We first review the existing research literature on gestures in physician-patient interaction. We then present the design of our study, the results of our study, our discussion and our conclusions.

Gestures in physician-patient interactions

Communicative strategies that increase comprehensibility while improving patients' health literacy (Glaser et al., 2020) have been the focus of a large body of interdisciplinary research. This research focusses primarily on physicians' verbal behaviours—for example, avoiding jargon, using a simple sentence structure or limiting the amount of information verbalised to patients (Oates & Paasche-Orlow, 2009). Yet the role of non-verbal communication also 'plays a significant role throughout the medical interview' (Silverman & Kinnersley, 2010, p. 76). One area of study in the domain of non-verbal communication is gestures. Current scholarship on gestures in physician-patient interaction, however, focusses primarily on patients' use of gestures rather than on the use of gestures by physicians. For example, Heath (2002) demonstrates how patients in primary health consultations use gestures to visualise symptoms and express pain. Similarly, Beach (2019) shows how cancer patients paired verbal utterances with gestures and facial expressions during oncology consultations, conveying their subjective experience and emotional state. And Sowińska and Boruta-Żywiczyńska (2020) argue that detailed and systematic analysis of gestures used by patients with medically unexplained symptoms can reveal how these patients interpret their own symptoms.

Few researchers have investigated the role of physicians' gestures. Little et al. (2015) studied general practitioner consultations in southern England and found that physicians' use of gestures, particularly in the beginning of a consultation, contributed to patients' satisfaction, arguably, at least in part, because gestures can convey empathy and caring. Morris et al. (2015) found that other non-verbal modalities (e.g., physical contact, backchannelling and a forward lean) also mattered, but gestures were one of the three communicative strategies that patients with

aphasia mentioned when asked how physicians could improve their communication skills. In general, studies of gesture in physician-patient interaction underline the likelihood that insights by researchers on the communicative function of gestures (Goldin-Meadow & Alibali, 2013; Kendon, 2004; McNeill, 1990, 2000) can be important for improving physician-patient communication. That is, by using gestures effectively, health-care providers may facilitate patients' comprehension of medical information and increase patients' satisfaction with the physician-patient interaction (Stevenson, 2014).

There is already some research that employs an interactionist perspective in the study of gestures used by physicians in health-care settings. Mirivel (2011) shows how plastic surgeons use their hands as embodied arguments to persuade patients to proceed with surgical procedures. Nishizaka (2014) shows how gynaecologists use gestures to help pregnant women discern the organs of the foetus on prenatal ultrasound images. In situations where communication between physicians and patients is mediated by interpreters, gestures help overcome linguistic barriers (Gerwing & Landmark Dalby, 2014; Gerwing & Li, 2019). In a study of general practitioners in Denmark, Nielsen (2018) describes how physicians periodically step out of their doctoring role to become medical educators. Nielsen reports on cases in which the physician, while explaining to a patient the anatomical structure of the knee, for example, or the upper respiratory tract region, amended verbal explanations with depictive gestures to assist the patient's comprehension of a particular anatomical feature or function.

Our study of gestures in a health-care context expands on this interactionist perspective by placing a sharper focus on physicians. We contend that in physician-patient interactions, explanations of diagnoses are most frequently (but not always) a component of a series of dialogical moves, resulting over time in a common frame of reference between physician and patient. Eventually, this shared understanding enables the formulation of therapeutic recommendations that patients are ready to accept. In our study, physicians faced the challenge of explaining the condition of heart failure—and the need to communicate complex biomedical knowledge—to their patients. We analyse how physicians' use of gestures helped patients understand facts about the disease.

MATERIALS AND METHODS

This article uses archived data from a sociological study on the globalisation of medical knowledge for a secondary analysis that compares the gestures of physicians in four locations around the world. The data were originally collected for a project that analysed clinical practice guidelines (and the implementation of those guidelines) for the diagnosis and treatment of heart failure. As part of that study, physicians' consultations with SPs were videotaped to enable later analysis by researchers. Employing SPs allowed us to develop a relatively standardised scenario across different locations. At each of four well-equipped university hospitals, in Ankara, Beijing, Groningen and Wurzburg, experienced local SP actors were trained by those members of our team with a background in medical education. As the use of SPs is well established in medical schools worldwide, most physicians are used to working with SPs (Elcin, 2020).

The physicians in the original study participated voluntarily and gave their informed consent in a written and oral form. Of 71 physicians, 64 consented to secondary analyses; their audio-visual recordings of simulated physician-patient consultations were archived (Weiß et al., 2022); our analysis of physicians' gestures is based on this material (see Table 1). The sample includes a diverse group of practitioners (Weiß et al., 2022, pp. 14–16). Physician participants from

TABLE 1 Sample and data.

	Ankara (Turkey)	Beijing (PR China)	Groningen (The Netherlands)	Wurzburg (Germany)	In total
Sample size (observed interactions)	20	20	18	13	71
Hours of video data (approx.)	13	24	25	16	78

Wurzburg and Groningen were primarily cardiologists. In Ankara, participants were internists or family doctors. In Beijing, they were medical graduates preparing for residency. In most cases, consultations were conducted in the official language of the country in which the consultation took place (i.e., Mandarin, Turkish and German). However, in Groningen, the language spoken during the consultations was English, which was a second language for the SPs and physicians alike. Two native speakers of Turkish and Mandarin added English translations to the transcripts of consultations conducted in those languages. Sequences that were central for our secondary analysis of gestures included transcripts in the original language of consultation as well as the English translations of those transcripts; both were verified by two other native speakers of Turkish and Mandarin.

Over the past several decades, gestures have been studied in both experimental and laboratory settings (Bavelas et al., 2014; McNeill, 1990) and in naturally occurring social interactions (Kendon, 2004; Streeck, 2009). Our study lies somewhere in between, closer to the latter than the former. The interactions we observed took place in typical, 'natural' clinical settings; the patients' symptoms and the communication challenges that physicians faced were characteristic of those faced by physicians in the course of their daily work, as corroborated by the physicians on our interdisciplinary research team. However, we know from previous research comparing data from simulated medical consultations with data from non-simulated medical consultations that there are several key differences to keep in mind. In simulated consultations, physicians tend to overuse formulaic phrases and behaviours, perhaps in an attempt to conform to communicative practice guidelines such as the Calgary–Cambridge model for structuring medical interviews, a training tool used in medical educational settings around the world and intended to enhance the relationship between physician and patient (Atkins, 2019). These tendencies are evident in our data as well. However, most of the studies that refer to the artificiality of simulated consultations have been conducted with medical students in the role of physicians (e.g., Kurtz et al., 2005; La Croix and Skelton, 2009, 2013). Our study focusses primarily on trained physicians, many of whom have extensive clinical experience. Grießhaber (1987, p. 80) shows that agents experienced in a particular interaction are more likely to perform 'naturally' in simulations, arguably because they have achieved a certain level of comfort in their role.

Heath and Luff (2018) have recently reviewed ethnomethodological and conversation analytical studies conducted in research settings that oscillate between what they call 'experiment' and 'naturalism'. They refer to these studies as 'quasi-experiments'. These quasi-experiments:

> are not primarily concerned with the evaluation of theory or identification of causal explanation but rather with clarifying and discovering knowledge, practice and reasoning that inform the interactional production of everyday organisational activities.
>
> (Heath & Luff, 2018, p. 467).

Keeping the research of Heath and Luff in mind, our data analysis reflects approaches prevalent in the analysis of social interaction, in particular conversation analysis (Sidnell, 2010) and microethnographic and praxeological approaches to the study of the human body (Streeck &

Mehus, 2004; Streeck et al., 2011). Conversation analysis focusses on the sequential production of meaning in institutional (Heritage & Clayman, 2010) and non-institutional settings (Sidnell, 2010) of interaction. Microethnographic and praxeological approaches provide us with fine-grained accounts of the embodied practices that interactants use to organise social interaction.

Our secondary analysis of the gestures used by physicians in their interactions with SPs identified gestures of similar form and communicative function. An author experienced in multimodal conversation analysis and microethnography (BeQ) worked with the original videos and the (translated) transcripts to select salient episodes from (1) the phase of the physician-patient interaction in which patients describe their concerns and (2) the phase in which physicians present a diagnosis (Heritage & Maynard, 2006). The author then identified sequences of multimodal turns in which gestures with clearly communicative functions co-occurred with speech. Based on a close analysis of these sequences, he assembled initial interpretations and identified gestures with similar form or communicative function in the audio-visual materials from all four university hospitals considered in the study. A sample of these sequences was then presented to our interdisciplinary research team, which includes sociologists, cardiologists and medical educators. The ensuing elaboration and dialog helped the team avoid idiosyncratic interpretations and allowed us to corroborate initial interpretations.

RESULTS

In this section, we present a detailed analysis of specific cases that reveal common patterns found throughout the data. Our findings show that physicians use their bodies as self-marked 'anatomical maps' and construct dynamic visual models of physiological processes through their use of hand gestures. We also explore the relevance of physicians' gestures for patient comprehension and provide a 'proof-procedure' for analysis by using the case of a patient's repetition of a physician's gesture. Towards the end of the section, we demonstrate how a particular gesture relates to a verbally expressed metaphor, paving the way for further understanding of embodied biomedical knowledge shared among medical professionals around the world.

(1) Gestures and the physician's body as an anatomical map

Electrocardiogram images, lab reports and the other materials of the physician's tools in the physician's toolbox frequently occupy a central place in physician-patient interaction. Yet the physician's body can also be used for a range of purposes, including a kind of gestural action that Streeck (2008) calls 'self-marking'. In self-marking, the body serves as an 'annotated map', where 'a body region is inscribed with bits of meaning and this spatialised meaning-map is projected onto a semantic domain' (p. 294). We found that physicians frequently used gestures to self-mark, that is, to specify the meaning of their verbal utterances.

In many cases of self-marking, physicians projected meaning onto (an abstract model of) the body. Self-marking often occurred when physicians referred to experiences and symptoms associated with heart failure, for example, chest pain. In the example shown in Figure 1,[2] the physician had just asked the patient about her symptoms, whereupon the patient started talking about her shortness of breath. In line 01, the patient ponders whether her shortness of breath may be caused by high blood pressure. The physician then taps on the left side of his chest and asks if the

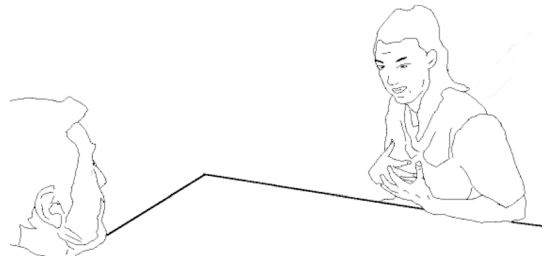
01 Pat Acaba bu tansiyondan olabilir mi, [( ) olabilir mi.
Could this be due to blood pressure? Could this be ( )?

02 Doc [Hı hı. **Göğüs** ağrınız var mı?
*Uh huh. Do you have **chest** pain?*

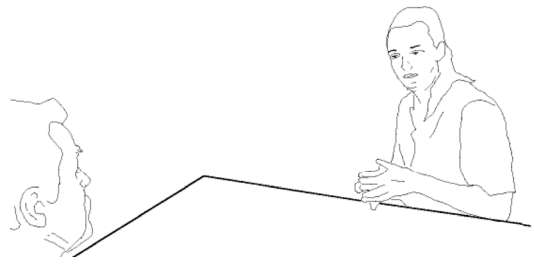
03 Pat Göğsümde hafif bir sıkışma oluyor ama yani,
There is a slight tightness in my chest but well ...

FIGURE 1 Physician using self-marking to illustrate the typical experience of chest pain (Ankara).

01 Doc We made an **echo** of the heart.



02 So we looked with uh: with a special **device** at at what the heart actually is doing.



03 And we did some lab **work**, so we drew some blood

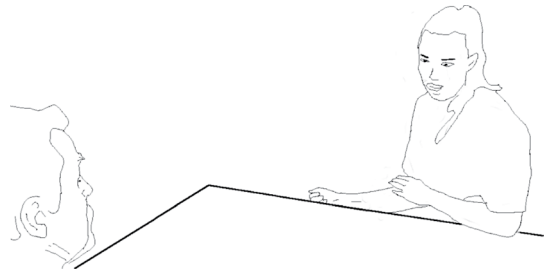


FIGURE 2 Physician using gestures to explain diagnostic procedures (Groningen).

patient suffers from chest pain. The physician's gesture suggests the approximate location that a patient would typically experience pain should she suffer from angina pectoris.

As analysts of multimodal interaction have shown, gestures are typically coordinated with speech, and other communicative modalities, in sequentially organised patterns (e.g., see Goodwin, 2018, p. 13). Figure 2 shows a series of self-marking gestures made by the physician during a history-taking in the diagnostic phase of the physician-patient interaction.

While the physician discusses the different diagnostic procedures, her hands perform a series of gestures. When she refers to the procedure used to produce an electrocardiogram (ECG) image, both of her hands quickly touch the ECG printout positioned on the table in front of her

(not visible in the figure). Then, as the physician speaks of the ultrasound (line 01), she puts both hands on her chest, indicating the part of the body on which a cardiac ultrasound is usually performed. She goes on to explain the ultrasound procedure (line 02), apparently looking for the right term to help specify the way an ultrasound is performed. Eventually, she settles for a rather general description: 'a special device'. During her search for terms, however, her hands enact a series of gestures that mimic the movement of an ultrasound scanner over the chest, suggesting the probe of the ultrasound device. Then, after a short pause, she turns to the last item on her 'unwritten list' (Jefferson, 1990) of diagnostic procedures that have been performed on the patient: The 'lab work' (line 03). Concurrently with her utterance of the term 'work', the physician places her left hand on the crook of her right arm, indicating the spot where blood samples are usually drawn. Notice also how she clenches the fingers of her right hand and makes a fist, adopting the typical pose of a patient having blood drawn from a vein on the forearm.

Our analysis of these episodes suggests that self-marking is an important communicative means for physicians to specify components of verbal utterances, by referencing objects in the material environment, for example, but also by alluding to past experiences. Physicians' self-marking of their own bodies contributes additional information and increases the precision of what is conveyed by speech (e.g., by locating the area where a patient feels pain). Arguably, gestures like the ones described above serve as cognitive aids for patients, reminding them of procedures they may have undergone. This adds an embodied and experiential aspect to processes of meaning-making.

(2) Gestures as visual models of physiological processes

Physicians often face challenges in communicating complex knowledge about physiological processes to laypersons, as described in depth by Gülich (2003). The practice of encouraging the visualisation of physiological processes and mechanisms is used as a communication tool (Tversky, 2011). Recent research on the use of pictorial information, including physicians' drawings made by the physician in the course of the consultation with the patient (Morag Lyon & Turland, 2020), suggests that such visual communicative means can assist patient comprehension of complex explanations of medical diagnoses, procedures and processes. Our data also suggest that physicians regularly use various kinds of pictorial information to emphasise, extend or specify a verbally articulated message (e.g., to 'illustrate' blood circulation and the beating heart). Use of diagrams and illustrations made by the physician in the context of the patient interview were important tools for translating medical concepts and language within the context of the physician-patient interaction.

However, previous research on physicians' use of pictorial information as a communication tool does not consider the role of physicians' gestures. Our analysis suggests that physicians use gestures when providing medical information to patients in much the same way that a physician might use pictorial representations and drawings to illustrate spatially complex and dynamic physiological processes and mechanisms. Figure 3 shows a physician's gesturally constructed topological model of the heart. Just prior to the episode represented here, the physician had told her patient of the significance of the patient's discrete symptoms, which together led to the physician's diagnosis of heart failure.

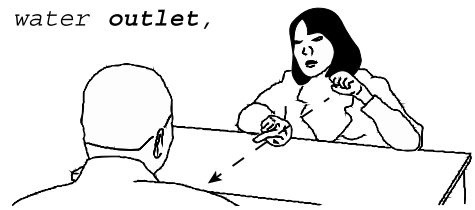
At the beginning of line 01 of Figure 3, both of the physician's hands still rest on the desk. Simultaneously with the utterance of 'another very important thing', she lifts both hands, the fingers of the right held open and the fingers of the left clenched into a fist that remains in a static

01 Doc lìngwài yīgè hěn zhòngyào de shìqíng
Another very important thing,

02 **xīnzàng** yǒu liǎng gè huán lù
***the heart** has two loops.*

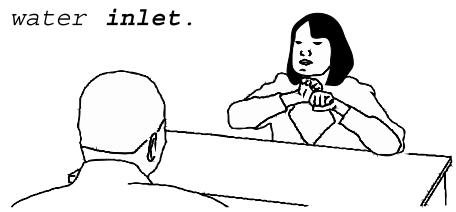
03 Pat mh ((accompanied by slight nod of the head))

04 Doc yīgè shì chū **shuǐkǒ**
*One is the water **outlet**,*



05 Pat mh ((accompanied by slight nod of the head))

06 Doc =yīgè shì jìn **shuǐkǒu**
*one is the water **inlet**.*



07 Pat mh[::

08 Doc [nàme zhège xīnzàng de gōngnéng xiàjiàng de shíhòu
When the function of the heart declines,

09 tā chū shuǐkǒu de shuǐ shǎole
there is less water in its outlet .

FIGURE 3 Physician using a series of gestures to depict blood circulation (Beijing).

position for the rest of this episode. In line 02, the physician uses her right hand to point to her left (see drawing below line 02) while saying 'the heart'. As in the episode shown in Figure 1, the physician's body provides an anatomical map onto which she can project meaning. In this case,

the anatomical heart, figuratively 'extracted' from the body, is showcased in the transactional space between physician and patient.

In line 04, the physician adds a dynamic element to her visual model, using the index finger of her right hand to trace an imagined vector located between her left hand ('the heart') and the left side of the patient's chest. This gesture is aligned with her utterance of 'one is the water outlet', that is, the aorta's origin. She then retracts her right hand, which subsequently performs a similar tracing gesture along a second imagined vector located between her chest and her left hand, which is still depicting a heart. The second gesture is made in conjunction with her utterance (in line 06) of 'one is the water inlet', that is, the ends of the venae cavae. In sum, the kinetic path of the first gesture is *away* from the gesturally depicted heart and that of the second gesture is *towards* it. Together, these gestures create a dynamic visual model of the heart in the context of blood circulation.

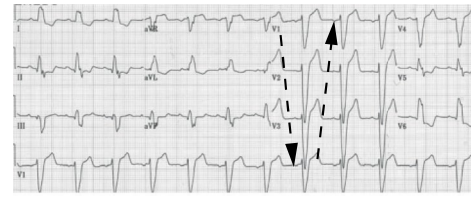
In the consultations we considered, physicians not only make use of their body to communicate information; patients and physicians both made use of many different objects. In their interactions with patients, physicians incorporated various materials and used various types of communication in their explanations of a diagnosis of heart failure. This included carefully timed hand gestures, as the analysis of Figure 4 shows. In this particular case, the physician was talking about left bundle branch block (LBBB), a condition in which the electrical signals in the heart are not moving as quickly as they should, an abnormality visible on the ECG and frequently observed in the context of heart failure.

As illustrated in Figure 4, the physician explains the significance of an ECG image for his diagnosis. In line 01, he points to an area of the ECG image evidencing the LBBB pattern. While saying 'And you see it here, that this these uhm these spikes at this place', he uses the pen held in his right hand to trace the lines indicative of the LBBB pattern.[3] The act of pointing directs the patient's attention to the LBBB pattern. At the same time, it specifies what the deictic term 'here' in line 01 refers to. Without the gesture, the meaning of the physician's words would be incomprehensible. Pointing at the ECG pattern also establishes the evidence for the LBBB diagnosis, which has implications for treatment options. The pen's quick movement along the 'spikes' in the ECG image not only directs the patient's attention but provides a framework for the patient to perceive and understand the physician's diagnosis.

Earlier in the consultation, the physician had mentioned the concept of LBBB but had not explained it. For the patient, the condition likely remained a rather abstract notion. This may have been the reason for the physician expanding his discussion with a short explanation of the working of the heart chamber (see line 02). Concurrent with his verbal explication, the physician performs a modelling gesture (Streeck, 2008, p. 292) of the heart: his hands move inward, towards the central axis of his body, palms facing one another and then his hands move laterally, away from the central axis to the outer perimeter of his body. The physician repeats this movement several times, creating a visual representation of a pumping heart muscle. After having (visually) enacted and (verbally) explained the function of the heart chamber, the physician turns back to the ECG image, saying 'This is widened' (line 04). Again, the simultaneous pointing gesture helps specify what the deictic pronoun 'this' refers to, that is, the pattern representing the electric current of the heart. This time, instead of tracing the lines with his pen, the physician uses the pen to point to a segment on the ECG image that is indicative of what, in cardiological terms, is an abnormality of the heart's electric current.

In communicating parts of the diagnosis to the patient, the physician builds meaning through the sequential and incremental structuring of actions and, at the same time, through the assembly of diverse semiotic resources into a coherent action package. In this case, speech, the

01 Doc Und das sieht man hier dass **hier** dieser hm diese Zacken an dieser Stelle,
*And you see it **here**, that this uhm these spikes at this place,*



02 Das ist die elektrische, das elektrische Abbild von der **Kammer**.
*this is the electric, the electric image of the **chamber**.*

03 **Die** muss ja pumpen und das Blut reinlassen.
Pumpen, enstpannen, pumpem,*enstpannen.*
***It** needs to pump and let the blood in.*
Pumping, relaxing, pumping, relaxing.

04 Das **ist** verbreitert.
*This **is** widened.*

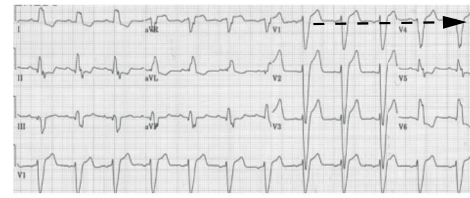


FIGURE 4 Physician illustrating a left bundle branch block (Wurzburg).

gesturing hands, gaze and the ECG image were used in concert to formulate a comprehensible verbal and visual model of the patient's (mal-)functioning heart. Such action packages (Goodwin, 2018, p. 13) are constituted interactively, and interactants 'design' (Drew, 2012) their turns-at-talk with finely nuanced considerations about their recipient. In the episode illustrated in Figure 4, the physician deemed it necessary to supplement his speech by performing a gesture representing the heart, and by sharing with the patient an ECG image, both means of showing what otherwise would remain concealed from the patient's immediate perception. Had the cardiologist been speaking with a colleague instead of a patient, he would likely have used other communicative means to discuss LBBB. In the case analysed here, however, the physician cannot assume the extent of the (simulated) patient's medical knowledge.

(3) Intersubjective meaning of physicians' gestures

As external observers, how can we validate our interpretations of the communicative function of physicians' hand gestures? In the case of a physician's verbal utterances, our understanding can be verified in a methodologically sound manner by what conversation analysts call a 'next turn proof procedure' (Sacks et al., 1974, p. 728), or a second party's responses to a preceeding (communicative) action. Early conversation analysis focussed on verbal utterances; however, conversation analysts' more recent engagement with multimodal interaction neccessitated an adaptation of the proof procedure concept (Mondada, 2016, p. 361). In particular, in the case of gestures occurring under non-laboratory conditions, it is often impossible to know if a conversation participant even noticed a particular gesture. Figure 5 illustrates how gestural action, as part of multimodal next-turn-utterances, provides a proof procedure similar to that used by conversation analysts.

In the consultation prior to this episode, the physician had discussed the values reflected in the patient's lab work and had then turned to the question of chronically high blood pressure in the patient's family. Figure 5 shows the physician explaining the implications of high blood pressure for the heart muscle. At the end of line 04, she is apparently searching for the appropriate word to finish the predicate of her sentence. In the process of her word search, her hand enacts a gesture that we found in all four settings of our study—the 'pumping heart', a visual representation of a water pump mechanism, a metaphor for the heart's primary action. The basic kinetic feature of the pumping heart gesture is the clenching and unclenching of the fingers in the form of a fist, a movement that is usually repeated several times in a regular rhythm, likely intended to represent the pumping of a normally functioning heart.

Of particular interest in the sequence in Figure 5 is that the patient repeats this gesture and provides a possible candidate for the searched-for phrase, namely *jǐnzhāng de gōngzuò* ('working intensely'). Noticeably, the patient's emulation of the pumping heart gesture starts even before she verbally formulates a description of the myocardium's condition according to the physician's assessment. The physician, in turn, confirms the patient's understanding (line 06) and then proceeds with her own explanation.

Through gestures, individuals make their thoughts apparent to others, sometimes even to themselves, as gestures are visible to the person performing them just as spoken words are audible to the speaker. However, a unique feature of gestures is that it provides the gesturer with immediate kinaesthetic feedback, or sensory information, about the gesturer's own body, including the movement of muscles and joints. In this way, gestures can be actions 'by which the human organism comes to an understanding of itself, its current situation and its intentionality'

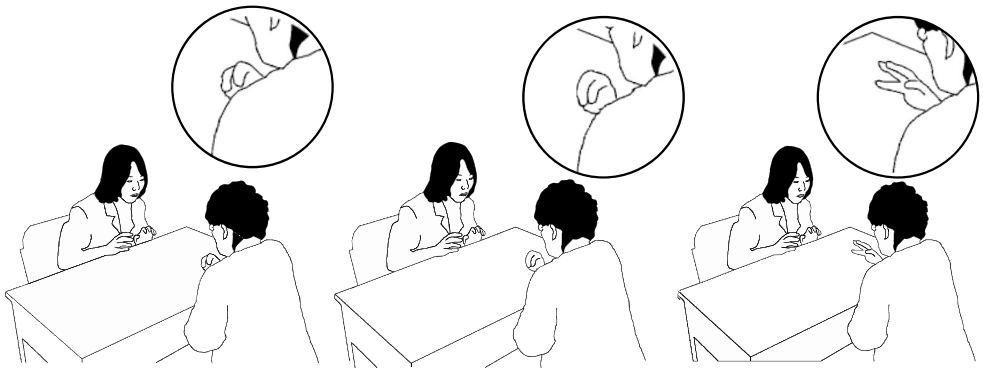
01 Doc Ránhòu hái yǒu yīgè wèntí, jiùshì jiāzú shǐ.
Then there is one more question, family history.

02 Nín bùshì shuō nín fùqīn mǔqīn dōu yǒu gāo xiěyā ma?
Didn't you say that your father and mother both have high blood pressure?

03 Pat mhm

04 Doc Xīnjī jiù yīzhí chù zài (0.3) (**xxxxxx**) (0.7) (xxxxxx)
The myocardium is always in ...

05 Pat (0.3) Yīzhí **jǐnzhāng** de gōngzuò?
*Is always **working** intensely?*



06 Doc Duì duì, fēicháng jǐnzhāng dì gōngzuò.
Right, working very intensely.

FIGURE 5 Patient emulating physician's gesture (Beijing).

(Cuffari & Streeck, 2017, p. 189). In the case presented in Figure 5, through gestures, the physician makes the intentionality of her utterance visually and kinaesthetically evident—not only to the patient but also to herself.

This episode shows how gestures can lead a patient towards understanding. We can reasonably assume that the physician's inventive use of multiple communicative modalities facilitates the patient's grasp of the medical discourse, including discussions of diagnostic and therapeutic procedures, physiological models and other health-care matters. This assumption is in line with the conclusions of researchers who have compared listeners' comprehension of speakers

who gestured versus their comprehension of speakers who did not use speech-accompanying gestures: Overall, listeners' comprehension is better when an utterance is accompanied by a gesture (Cartmill et al., 2012, p. 131).

(4) A globalised metaphorical gesture: The pumping heart

Several of the gestures used by participating physicians in a conversation with SPs on the topic of heart failure were metaphorical in character (Cienki & Müller, 2008). Our research revealed several metaphorical gestures commonly used by physicians in physician-patient interactions in various locations around the world. Discussions that compared the heart to an engine or a machine, for example, were often accompanied by metaphorical gestures. The possible reasons for this commonality are difficult to assess, but we might propose that global diffusion of biomedical knowledge has resulted in certain common metaphorical tropes in some health-care contexts. A gesture representing the pumping heart, which we described in a previous section, is one of the gestures used to accompany a verbal metaphor used by physicians in all four locations[4] that were part of our study. The illustrations in Figure 6 represent a small sample of cases, each from an interaction in which a physician used this gesture to accompany a metaphor used in speech.

In all the gestures represented in Figure 6, either both hands are pressed onto each other (Figure 6a) or the fingers of a hand are clenched into a fist (Figure 6b–d) and then immediately reopened, similar to the action of grabbing. Moreover, these gestures were almost always employed as co-speech gestures. The dialog that accompanies this kind of gesture relates to such concepts as the 'function' of the heart, the heart's 'work', the heart's 'power' or the heart's 'movement'. These are all somewhat different concepts, but what they share is an underlying conception of the heart as a mechanism. In their use of gestures, physician participants often evoked the image of a pump. It is in the metaphor of the pump that we find the common denominator of all the metaphorical descriptions illustrated in Figure 6: A pump has a 'function' ('moving' fluid from A to B) and it is doing 'work' that can be measured as levels of 'power'. A pump is simple, in the sense that its mechanics can be understood by almost everyone. In short, the metaphorical gesture of a pump seems to be an obvious candidate to convey to a patient some of the complexities involved in a better understanding of a condition such as heart failure.

As Fuchs' (2001) medical history of the heart reminds us, the prevalent mechanistic understanding of the heart is a relatively recent phenomenon. Although in a broader (non-scientific) sense the heart may not be perceived in the same way across all cultures, from a scientific and biomedical perspective, the heart and, more generally, the anatomical human body may be understood as globalising 'knowledge objects' (Rheinberger, 1992), in the sense that they are the focus of an ever growing, widely accepted body of conceptual understanding and knowledge. A mechanistic conception of blood circulation has prevailed over other historical perceptions, including, for example, those typical of East Asian medicine (Kuriyama, 1999).

Increasingly, physicians around the world share standardised forms of knowledge about heart failure, an exchange often mediated through the spread of domain-specific clinical guidelines (Quasinowski & Liu, 2020) that are supported by the gold standard of evidence-based medicine (Timmermans & Berg, 1997). Part of this knowledge is shared beyond the medical domain. In their study of the gestures used by a Canadian secondary school teacher in his lectures on the blood circulation system, Pozzer and Roth (2020, p. 48) describe the instructor's use of exactly the same pumping heart gesture that we identified above. The fact that the gestural forms and metaphorical concepts used by a biology teacher in Canada are so similar to those used by physicians

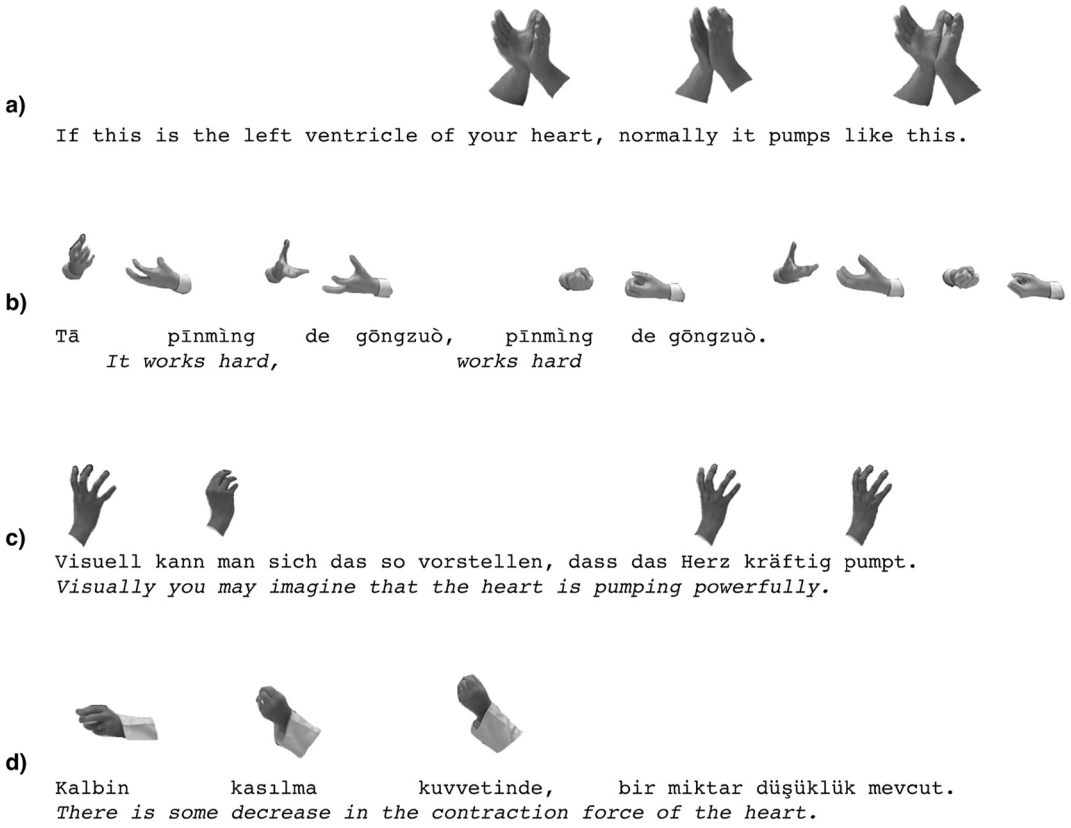


FIGURE 6 (a–d) Instances of gesture forms that signify a pumping heart, each line representing an example from Groningen, Beijing, Wurzburg, and Ankara, respectively.

from around the world supports our argument that even the tacit, embodied and practical dimensions of knowledge about human physiology have increasingly become global and standardised.

DISCUSSION AND CONCLUSION

In order to understand the apparent uniformity of gestures used by physicians in four university hospitals around the world, we conducted an in-depth analysis of physicians' gestures as an embodied practice and an expression of a presumably global infrastructure of biomedical knowledge. We considered how gestures are being used by physicians in consultations with simulated heart failure patients in four university hospitals around the world. An earlier research project had provided participating physicians with the challenge of explaining to a patient the condition of heart failure. In a secondary analysis of the data collected for that project, we were able to discern several interactional contexts in which physicians used gestures to facilitate patients' comprehension and several common gestural patterns. First, physicians everywhere used self-marking gestures to turn their own bodies into anatomical maps for use as an explanatory tool in their discussions with patients. Second, physicians often used their hands to construct visual models of physiological mechanisms and processes in their discussions of heart failure. Third, we noted a sequential pattern in which a doctor used a particular gesture and the patient

repeated it. Our analysis of this sequential pattern supports our argument that gestures are a way for people to understand each other in the context of medical interaction. The gesture that served as our example in this sequential pattern, that of the pumping heart, was used by physicians in all four participating hospitals. We analysed physicians' verbal use of the pumping heart metaphor and the accompanying metaphorical gestures, providing detailed examples from all four hospitals. The authors propose that the common use of the pumping heart gesture in such diverse locations may be explained by the fact that medical knowledge is increasingly shared around the world. The gesture's ubiquity across culturally diverse contexts epitomises the globality of biomedical knowledge. Arguably, a global biomedical infrastructure of knowledge and practice not only results in convergence and common standards in the areas of speech and discourse but also leads to what appears to be a convergence in the area of gestural practices.

This argument relates to the issue of intercultural understanding among professional health-care workers and to the international migration of health-care workers (Weiß, 2016). Whenever medical professionals migrate, they bring with them not only the kind of propositional textbook knowledge obtained by them during a medical school education but also tacit knowledge and practices, including gestures. At least with regard to the knowledge and practical ways of representing in physician-patient interactions, the concept of heart failure, the syndrome at the centre of this study, the fact that we observed gestural similarities across contexts may attest to the existence of transnational professional 'communities of practice' (Hindmarsh, 2010), sharing practical knowledge in an epistemic community (Coe & Bunnell, 2003). This possibility calls for further investigations of a potential globalisation of practical and implicit medical knowledge beyond the phenomenon of gestures. Comparative studies across cultural contexts should also consider physician-patient interactions about diseases or conditions other than heart failure.

The current investigation has several limitations. First, although we identified specific circumstances for the use of gestures, the gestures described in this study are not representative in a statistical sense. As mentioned above, our 'quasi-experimental' study was explorative, and we did not employ a coding scheme. Further studies may test if there are statistically significant correlations between the gestural patterns described in this article and variables such as language and speech, communicative tasks and so on. Second, and related to the first point, since the similarity of gestures was an unexpected finding during data analysis, in the interviews we conducted immediately after the consultations, we asked neither physicians nor patients about the use and effects of gestures during their interactions with each other. We therefore cannot know the physicians' intended meaning nor the patients' perceived meaning where gestures were used. Third, although we were able to demonstrate that several gestural patterns (forms and functions) resemble each other across the four contexts, a more focussed cross-cultural comparison has yet to be made. Such a comparison might include in-depth and long-term ethnographies in settings chosen strategically for their similarity to, or difference from, the locations considered in the current study.

It is widely acknowledged that a physician must be sensitive to the specifics of a patient's personal context in order for both people to reach a shared understanding of the illness and to achieve treatment success. Physician-patient communication is a challenge, given that a physician's knowledge is highly technical and elaborate and patients come from many walks of life. Apart from the expert-lay divide, the culture and native language of the physician and patient may also differ. Given these challenges, physicians' gestures play an important role that is often undervalued and should be considered more broadly in medical education and research. While the significance of gestures in human communication generally is no surprise, the universality of such non-verbal communication in the highly technical field of medicine is noteworthy.

Gestures connect material artefacts with conceptual maps and bodies. In the physician-patient interaction, when technical medical language and concepts are difficult for a patient to comprehend, a physician's gestures can aid both physician and patient in their search for common vocabulary and can serve as a visual aid for a metaphorical description. Like more explicit forms of biomedical knowledge, gestures used in physician-patient interactions seem to have experienced a similar process of global diffusion. In physician-patient interactions, as in many other forms of human dialogue, gestures create bridges between different types of knowledge: They enable understanding where words may not suffice.

AUTHOR CONTRIBUTIONS

Benjamin Quasinowski: Conceptualisation (equal); Data curation (equal); Investigation (equal); Methodology (equal); Writing – original draft (lead). **Solmaz Assa**: Investigation (equal); Writing – review & editing (equal). **Cadja Bachmann**: Investigation (equal); Writing – review & editing (equal). **Wei Chen**: Investigation (equal); Resources (equal); Writing – review & editing (equal). **Melih Elcin**: Investigation (equal); Resources (equal); Writing – review & editing (equal). **Caner Kamisli**: Investigation (equal); Writing – review & editing (equal). **Tao Liu**: Conceptualization (equal); Funding acquisition (equal); Investigation (equal); Project administration (equal); Resources (equal); Writing – review & editing (equal). **Alexander H. Maass**: Investigation (equal); Resources (equal); Writing – review & editing (equal). **Stefanie Merse**: Conceptualization (equal); Investigation (equal); Resources (equal); Writing – review & editing (equal). **Caroline Morbach**: Investigation (equal); Resources (equal); Writing – review & editing (equal). **Anja Neumann**: Investigation (equal); Writing – review & editing (equal). **Till Neumann**: Investigation (equal); Writing – review & editing (equal). **Ilka Sommer**: Conceptualisation (equal); Data curation (equal); Investigation (equal); Writing – review & editing (equal). **Stefan Stork**: Investigation (equal); Resources (equal); Writing – review & editing (equal). **Sarah Weingartz**: Investigation (equal); Writing – review & editing (equal). **Anja Weiss**: Conceptualization (equal); Funding acquisition (equal); Investigation (equal); Project administration (equal); Resources (equal), Writing – review & editing (lead).**Goetz Wietasch**: Investigation (equal); Resources (equal); Writing – review & editing (equal).

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DATA AVAILABILITY STATEMENT

We confirm all personal identifiers have been removed or disguised so the persons described are not identifiable and cannot be identified through the details of the story. Within the limits of ensuring confidentiality, our data is available for secondary research at the research data centre, Qualiservice, University of Bremen, Germany.

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ENDNOTES

[1] Heart failure is a cardiac condition in which the functioning of the heart is severely restricted. Worldwide, approximately 64 million people are affected by this syndrome. There is a sound basis of evidence-based knowledge about heart failure, including its etiology, diagnosis and treatment options (Groenewegen et al., 2020).

[2] Bold text marks the moment that is represented by the drawing below or beside the line of transcript.

[3] This movement is represented by the dashed arrows on the ECG image shown in the transcript.

[4] There were slight variations. In Ankara, a rudimentary form appeared. A lack of specialist knowledge about cardiology was probably the reason that most physicians in Ankara referred the patient to a cardiologist quite early on in the consultation, without much further explication of the condition of heart failure to the patient.

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