Grammar, meaning and movement-based interaction

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ABSTRACT
Human movement is rightly seen as a rich and under-explored resource for the design of novel interaction modalities. In this paper, I briefly explore some of the difficulties inherent to harnessing what seems to be the limitless potential of human movements as a means of interacting with systems. In particular, I treat these difficulties as a symptom of the fact that movement (generally conceived), unlike language, does not have a grammar. Some implications of this for the promise of human movement as interaction design material are then discussed.

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H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

INTRODUCTION
Anyone who has played ‘charades’, where one has to silently act out words or phrases (e.g. movie titles or figures of speech) to an audience who guesses what is being acted out, is familiar with the vast variety of interpretations that can be ascribed to human movements. Indeed, it is exactly that variety that makes possible the fun (and/or frustration, novelty, surprise, ridiculousness, humiliation, discovery) of the game. But this example alone reveals some of the difficulties inherent to the adoption of movement as a resource for interaction designers. If, for instance, movement is so ambiguous even to human interpreters with (presumably) common frames of reference, how can it be harnessable as an input modality for interactive technologies?

In this paper, I discuss some difficulties inherent to the utilisation of movement as an interaction modality. This is argued through a discussion of the necessity of grammar (i.e. standards of correct use) to forms of intelligible communication. From this excursion, it will be possible to speculate on some fruitful possibilities for making use of movement, and to suggest limits to the ambitions designers might set for them. This paper is structured as follows: The centrality of grammar to shared forms of communication is briefly introduced, forming a contrast to the inherent ambiguity of movement. Some preliminary options that have been available to designers interested in making use of movement in interaction design are then surveyed. This leads to a discussion which critically treats the hope that movement-based interaction might lead to ‘more embodied’ systems. The paper concludes with five directions that this critical exploration may recommend to designers and researchers interested in understanding the potential of human movement as interaction design material.

SOME INITIAL DISTINCTIONS
It may seem self-defeating to look to language as a means of elucidating an understanding of movement. At first glance, there appears a huge discongruity between the nature of human language and movement, and to treat one in terms of the other seems prone to mischaracterise them both. However, there is reason to suspect that the differences between movement and language may not be as fundamental as one might initially suspect. One of the legacies of Wittgenstein's later thought concerns a radical reconsideration of the place of language in human life, and more tellingly, the role of human life in the very possibility of language. On this view, language is not merely layered on top of our social actions in the world, but is one with them. Nevertheless, it is not my aim to make a strong claim as to the nature of human movement, (i.e. that it actually is language-like); I only wish to see how viewing it in this way (c.f. Woolgar's 1990 discussion of the 'machine as text') might help designers see some of the options available to them in making use of movement for the design of interactive systems.

When talking about movement in interaction design it may also be important to clarify that virtually all interaction with technology makes use of human movement1, whether the keyboard-mouse interface, eye-tracking interfaces, virtual reality systems, or the buttons and displays found on most handheld devices. However, when speaking of making effective use of human movement as a way to interact with systems, I am primarily concerned with cases where human movement constitutes the interaction with the system; this can be contrasted with movable systems (e.g. buttons, joysticks etc.). This is a distinction between systems which permit a vast degree of freedom of interaction (for example, gesture-based or whole-body movement interfaces) and interfaces that are themselves move-able (where, for instance, novel human movements are required to interact with appropriately scaled physical interfaces). However, if the promise of the notion of embodiment as a resource for design consists in taking advantage of our ordinary,

1 With the arguable exception of speech interfaces and passive input devices (e.g. skin conductivity sensors).
bodily, lived experience of the world (Dourish 2001, pp.17-18), it is clearly the first kind of interaction (i.e. movement-as-interaction) that appears to offer the greatest potential. But it is also this promise that will be scrutinised in this paper.

GRAMMAR

Intersubjective agreements with respect to our uses of words are what enable us to make sense with language. These agreements constitute the grammar of our language. This is not limited to the rules of grammar learned in school (e.g. conjugation of verbs, plural forms etc.) but is more encompassing than that, including the standards for what, within language, it can possibly make sense to say. A fundamental point is that while we can, in principle, say anything we like, we cannot mean anything we like (Coulter 1995). A random string of words such as “impressing open dubious if” has no meaning. While we can stipulate a meaning for it, (i.e. “When I say ‘impressing open dubious if’ I mean ‘quietly keep working’”), that meaning must be expressed in other, intelligible, terms. Grammar (as in the rules for the intelligible uses of words) determines the limits of sense” (see Baker and Hacker 1985). This point is a central one. It emphasises that it is only by following the same rules for the use of a word that we can mean the same thing by it that everyone else does. Correspondingly, when we start using a word in novel ways (i.e. according to different rules), we automatically mean something else by it—whether we want to or not. Meaning in language is not a matter of individual caprice or of subjective (‘mental’) association, but a matter of using words according to the same rules that others do. (Coulter’s (1995) discussion of the precise nature of ‘changes in meaning’ of words is important here.) And while it is commonplace that there are ambiguities in linguistic forms of communication, there is not, as some might suppose, an inexhaustibility of interpretations of a sentence (Coulter 1994). Were that to be the case, intelligibility, communication and coordination of action would be far more remarkable achievements than they already are. But when we move to consider movement as a form of interaction with technology, we encounter a different set of difficulties inherent to the ambiguity of movement as a form of communication. Since movement of itself does not have a grammar\(^2\), designers seeking to make use of movement-based interaction seem to be presented with a limited set of choices. For example, should designers specify how systems should interpret human movement as input (thereby stipulating what movements to recognise), or can they make use of a more direct translation of human movement (e.g. where users’ physical movement in a space corresponds to the movement of a perspective in a virtual space)? The challenges of taking full advantage of movement as input modality hinge on designers’ decisions in this regard. In the following section, I take a brief look at some of the options available to designers.

DESIGN OPTIONS

When we recognise the centrality of grammar to intelligible communication, several aspects of the potential of movement for interaction design come into focus. The following is by no means an exhaustive set of options; it is only intended to sketch out some of the ways in which movement has been appropriated for interaction design to provide a (contestable) framework around which discussion can take place.

Movement as communication

When the goal is for technology to respond to human movement as communication with the system, (e.g. issuing commands) then designers will be compelled to specify a grammar for movement. Failing this, users will be inexorably led into playing charades with a machine that does not share any of their forms of life. Clearly, this is a situation that does not maximise the ‘embodied’ potential of movement for interaction design, particularly as it would require users to learn another (bodily) language to interact with the system. However, this situation may still have benefits; currently, too little attention is paid to systems that may be difficult to learn but rewarding to use, particularly for their potential to build physical skills through practiced use. But importantly, this is a conceptually distinct employment of human movement for system design; one that takes advantage only of our capacity for movement and skill building, and not our embodied familiarity with the physical world.

Movement as a ‘loose’ grammar

Alternatively, designers can make use of movement as an ‘open-ended’ means of interaction, by fitting what we might call a ‘loose’ grammar onto physical actions. One example could be to imagine devices with ‘hotspots’, where it doesn’t matter how the user gets there, only that he or she is there. Sony’s Eyetoy™ Play may be illustrative here. Eyetoy™ Play is a Sony Playstation™ game that uses a video mirror. The game works by superimposing digital characters onto the (mirrored) image of the player on the screen. Thus, the player can interact (i.e. make ‘virtual’ contact) with those characters, and play the game. One can see in such a system that it does not matter how one plays, only that one finds a way to play that the system can respond to. Within the game there can be innumerable styles of play, as the system does not script how to act, only where (by use of a video mirror) action will be recognised.

\(^2\) Grammar, however, does not determine the particular sense of a locution. This point is illustrated later, with respect to ‘indexicality’ and use.

\(^3\) This is a bold claim that requires qualification. There are obvious exceptions where a grammar has been explicitly created for movement, e.g. sign language or semaphore; of course, these can only denote that which can otherwise be expressed in language. Also, some movement in human interaction has a discoverable organization (Goodwin 2000). This suggests that some movements have patterned uses, and may be situationally-relevant rule-governed practices, thus having a form of grammar.
Movement as the end, not the means

Another possibility is where systems treat movement as the end, and not the means of interaction. Here the point of the system may be to facilitate certain kinds of human movements, but not as something that the system ‘reads’ or responds to. Systems of this kind might be those that are designed to assist physical rehabilitation or to build (perhaps through imitation or instruction) specific skills or qualities of movement (e.g. dance, embroidery) in users.

Direct mapping: movement as movement

Movement can also be appropriated for design in a more ‘direct’ sense, where systems treat movement as movement. Consider a case where a user’s physical/spatial movement is mapped to movement through a virtual space. In many ways, this seems to offer the greatest potential to make use of our ordinary familiarity with the physical world. Such systems are those that attempt to couple perception and action; frequently they are immersive virtual or augmented environments (though not necessarily—consider more traditionally mechanical ‘interfaces’, such as the direct translation between the movement of a steering wheel and the direction of a car). Furthermore, they appear to bypass (or at least forestall) the difficulties raised about assigning grammar to movement; physical movement is only translated into a system-senseful correlate. Of course, it is imagined that this enables people to act within the system as they would the world; to ascribe meaning to and possibilities for interaction with objects that they ordinarily would (e.g. coffee cups, files, mailboxes, doors etc.). However, when we press the metaphor, we expose the chimera. As soon as we attempt to significantly trade on the virtuality of the environment (e.g. by permitting the manipulation of the digital properties of an object), we find ourselves back in a realm where we must spell out a grammar for the movement-based interaction. And the moment we specify a grammar for movement, we again (as in the first case) require users to learn a language of movement to interact. Once more, we are no longer making use of our ordinary familiarity with the physical world, but only on our capacity for versatile actions and our ability to learn what they mean within the system. These actions are ones to which a (new) meaning (i.e. instruction or action) must be ascribed and understood. Of course, as I have laboured to demonstrate, my point is not to argue that movement grammars are evil, but only that they appear to offer us the possibility to trade on our embodied, pre-conceptual familiarity with the physical world, but do not fulfil that promise in actuality. Movement-based forms of interaction with technology may easily exacerbate the problems they are sought to obviate when we see their dependence on grammar. Movement-based interaction of itself is not a shortcut to better, or more natural, or more embodied interaction with technology.

DISCUSSION

Of course, one of the reasons for this is that ‘virtual’ or information environments are what they are, and are not identical with (nor should/can they be) our ordinary world of practical, social, physical affairs. In the world of which we have embodied familiarity, there is no decoupling of movement and action, or of action and purposefulness, nor is there disjunction between the means and ends of interaction. The question remains: how can systems facilitate such interaction without specifying a grammar for it? If having to learn a ‘language’ in order to interact precludes us from taking advantage of our embodied knowledge (as I have suggested), then there is no straightforward solution to this problem.

Direct mapping leads towards metaphorical interpretations of objects and possibilities for action that will, as with the ubiquitous ‘desktop’ metaphor fall down in certain places (c.f. Dourish 2001 p.143). This is by virtue of the fact that we possess nearly unlimited ‘modes’ of interaction with the physical world. My coffee cup is not only a receptacle for a beverage, but, variously, a paperweight, a welcome relief from work, a hand-warmer, an informal timer (is the coffee cold yet?) etc. As has been demonstrated with respect to language many times before (e.g. Fish 1978, Wittgenstein 1958) meaning is inherently indexical. In language, meaning is derived from context, from the uses to which it is put. And this is true of a form of expression that has a grammar. The point to be stressed by repeating this truism is that the uses of things (not only language) are contingent upon the practical circumstances of the actor, and are no less varied. To use a tired example, we often open (physical) documents not to read or annotate them, but to see how they are typeset and laid out, how many images they contain, or to peruse their bibliographical details. With electronic documents, ‘viewer’ applications are often also ‘editor’ applications, and to open a document is to do much more with a system than simply opening a document (i.e. it also launches an application). This is not necessarily a usability problem, but again, we quickly come to the point where we must rely on our familiarity with the ways we have encountered computational systems, rather than the ways we encounter physical documents.

What should I expect to be able to do with a coffee cup in a virtual office? The range of my possible actions within a system is the point at issue. By design, it is necessarily limited to a degree that must, at some point, deny me the possibility of unreflectively trading on my embodied experience of the world (of, in this example, coffee cups)—yet our worldly experience is not thus limited. Interaction with a virtual coffee cup will, however, allow me to experience the system, with which I may become familiar with practiced use. But in these circumstances, we can question what the system metaphor (the representation imbedded in the interface) is actually achieving, because it is not offering us anything like ‘the same’ possibilities for action that its designers might have intended.

The contrast between the way we encounter the world and the way systems are designed to be encountered is still an invaluable distinction. (Suchman’s (1987) seminal analysis of the alien intelligibility of expert systems is no less trenchant a critique today.) But this should not be
conflated with the distinction between the way we encounter the world and the way we encounter technological systems, as though the former kind of encounter is natural and embodied, and the latter disembodied and disjoint. We encounter systems as no less a meaningful part of the world we inhabit than any other artefact, and such encounters need not be demeaned as any ‘less’ embodied, for there are no encounters of any other kind. The point is, again, that systems need to be designed to be experienced, and not necessarily designed to be experienced as ‘the world’ is experienced. As long as systems are systems, and are based on a logic different to that from which the social order is constructed and sustained, they are likely to remain poor imitators of the world of everyday experience.

**IMPLICATIONS**

I will now briefly explore some of the implications for design and research that this excursion might recommend.

First of all, we may conceive of systems that make obvious and available the ways in which they are unlike the world. What is being suggested is not to create a system that people will encounter as something other than a system (a system that people will encounter as they do ‘the world’, for instance). Rather, it is to embrace the fact that computational systems are powerful for the ways they are notably different from other artefacts. Let people develop familiarity with systems for the ways that systems are systems.

Alternatively, we can look to those who wish to invent new architectures upon which novel kinds of systems can be developed, (e.g. Winograd 2002). The attraction of these systems lies in the hope that they could enable different kinds of operations, and that they would be experienced, appropriated and enabling in new and different ways. The way one trains a neural net to recognise and respond to a user’s action is very different from the way one writes and subsequently interacts with a macro. The qualities of the experience of interacting with the system and the degrees of control afforded through those interactions are, in this case, what become important. However, it would be misleading to think of such systems as any ‘more embodied’ than their alternatives. The question of embodiment in interaction is not, in principle, one that is answerable to system architecture.

Another design opportunity is to explore the interaction ‘middle ground’ implied earlier, in our discussion of designers’ options in making use of movement. Somewhere between specifying a grammar for movement and employing a direct translation of physical movement to a virtual correlate, we find systems that have the potential to build physical skills (and/or styles of interaction) in use, or that exist for the sake of movement instead of existing to be controlled by movement inputs. This is a largely unexplored region of interaction design (but see Dijadiningrat et al. forthcoming) for some interesting directions.

With respect to research opportunities, each of these in some way highlights the need to understand how technology-in-use is appropriated. This would suggest research addresses the ‘system encounter’—how systems are experienced, both in the moment and over extended periods of time, with a view to seeing how they can be designed e.g. to engage users, develop skills, build familiarity.

Furthermore, it recommends that research turn to focus on designers themselves. If we can better understand designers’ conceptions of the world they are designing for (i.e. about use, users, users’ expectations etc.; see Sharrock and Anderson 1994) we will be better able to diagnose (and, when necessary, treat) the foundational assumptions on which systems are based.

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