

# Meaning in Movement: A Gestural Design Game

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## ABSTRACT

This paper describes a design game that we called 'Meaning in Movement'. The purpose was to explore notions of professional dental practice with dental practitioners in terms of gestures, actions, and movements. The game represents a first step towards involving gestures, actions, and movements in a design dialog with practitioners for the purpose of designing future interactive systems which are more appropriate to the types of skilful actions and richly structured environments of dentists and dental assistants.

## Categories and Subject Descriptors

H 5.2 [Information Interfaces and Presentation]: User Interfaces – *Input devices and strategies, Interaction styles, Prototyping, User-centered design*

## General Terms

Design, Human Factors.

## Keywords

Gestures, gesture interfaces, embodied skill, user centred design.

## 1. INTRODUCTION

In a dental surgery, a dentist and assistant work together in close cooperation with instruments specially designed and an environment carefully structured to support them in their task. Given the cooperative nature of this workplace and its richly structured environment, it is difficult for dental practitioners to appropriate into their work current computer interfaces which are more suited to a single user who must focus on a narrow area and employ a restricted range of movements.

Yet increasingly, despite the difficulties, dentists and assistants *are* using computers to support aspects of their work. Computers are being used to maintain patient records and treatment plans, provide support for billing and scheduling, and aid in patient education. That dental practitioners have been able to successfully employ these technologies is however, more a testament to their abilities as 'artful integrators' [6] rather than the technology's own qualities of appropriateness and responsiveness to the context.

The aim of our research is to create computer interfaces that have

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a better fit with dental work than those currently available. As part of this undertaking, we are investigating the possibility of using gestures as a way for dentists to interact with computer systems. We see gestures as attractive for one part of an interactive system in the dental surgery for a number of reasons. Expressed as goals for our design, we hope that using gestures as a mode of interaction might;

- Allow more freedom for dentists in terms of how they move and arrange themselves in space
- Be responsive to the dentist's abilities for skilful action
- Allow dentists to interact with computers without violating infection control procedures

In this paper, we describe the results of a design game in which we invited participants to explore notions of professional dentistry through movement within the context of a dental surgery. Rather than approaching the problem of designing a gesture interface for the dental surgery as a technical challenge, we have chosen to first explore with dental practitioners what different types of movements mean to dentistry. Our aim has been to involve gestures and movements in a participatory design dialog from early in the design process.

In the next section we provide a sketch of the kinds of work that dentists do in the dental surgery and outline some of the reasons that we feel a gestural interface is worth pursuing as a design possibility. Following from this, we explain how we view gestures before describing a design game in which we used gestures to explore and express aspects of dentistry with dental students. The paper finishes with a reflection on our experiences of running the exercise and some thoughts on areas that we intend to improve and explore further in future.

## 2. DESIGNING FOR DENTAL PRACTICE

Dental surgeries are fairly well ordered information rich spaces. The patient is seated in the chair and the dentist manoeuvres around the patient often on a wheeled stool in order to readily access the bracket table, light table, the light, foot-pedals for chair control and the patient record, be it in paper or digital form.

Dental work involves selection, orienting and very fine manipulation of instruments and materials, social interaction with the assistant and patient and the access, reading, editing and creation of patient records, among other activities. The digital manipulation of a keyboard and mouse is cumbersome in this environment and appears to interfere with the practice of dentistry. The dentist or assistant has to down instruments and shift their focus and posture towards the computer screen, while bringing keyboard and mouse to an orientation on a flat surface

that allows them to type, select and watch the screen. They then concentrate on driving the interface by selecting menu items within a narrow range of pixels. These movements stand in stark contrast to other movements in the surgery.



**Figure 1: A dentist and assistant work together around a patient**

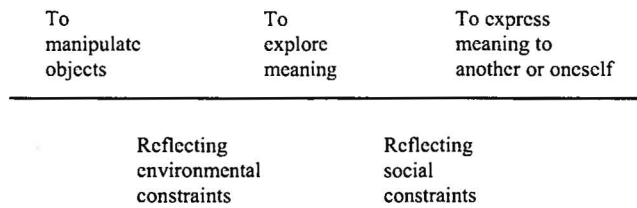
Given the cumbersome interactions, the extent to which the dentist has to shift focus and the problem of infection control, which means that gloved hands cannot touch the keyboard or mouse, we began to explore forms of multi-modal interaction that might provide for better interactions with information in dental surgeries. We considered gesture, instrument manipulation and speech technologies, possibly augmented by keyboard, mouse and pedals. Dentists that we consulted were interested in the possibilities offered by gesture and speech and encouraged us to pursue design explorations in these areas. We had previously built a small wireless device in the form of a ring and watch that detected a limited gesture set as a proof of concept for camera free gesture detection. The device contained only two two-axis accelerometers for sensing gesture data, meaning that it was amenable to repackaging as a pen or some form of dental instrument. While dentists could not wear rings in practice, the possibility of manipulating a sealed sterilisable instrument similar in form to other dental instruments seemed worth exploring.

### 3. OUR VIEW OF GESTURES

There is already a large body of research into gesture interfaces as a mode of interaction, but most of this research has focussed on the technical challenges of gesture detection and recognition. In contrast, the challenge of designing gestural interfaces that fit with real contexts of use has received little attention.

Before moving on to a concrete description of our gesture exploration game in the next section, let us first spell out the stance we have taken towards gestures, why we have taken it, and what implications this has had for how we have tried to design.

The first question to address is one of definition. As Corradini and Cohen wryly state, “everyone claims to know what a gesture is, but nobody can tell you precisely” [2]. Despite this difficulty, most researchers into gestural interfaces will define a gesture as a movement made with communicative intent on the part of the person gesturing. While this accords with the common usage of the word, we have chosen not to distinguish gestures as purely communicative movements, but also to include other types of movement such as tool manipulations and gestures used to explore meaning and to see them as situated in a social and environmental context. Figure 2 expresses this diagrammatically.



**Figure 2: An inclusive definition of gestures**

There are several reasons for admitting more than just communicative movements as gestures when designing a gestural interface. First, following from Suchman’s observations of the computer’s fundamentally limited capacity to participate in situated human communication [7], movements used to interact with computers will not be communicative to the computer as they would be to a person. Yet these gestures will still exist in a social setting (the dental surgery), so we cannot discount their communicative role. Also, as Kendon notes, “...it is not possible to specify where to draw the line between what is gesture and what is not...” [5]. For instance, in the dental surgery we have seen how dentists fluidly move between using their instruments in the mouth of the patient and as pointers to information resources in conversation in ways that make it difficult to see where communication stops and manipulation or exploration begins [1].

## 4. MEANING IN MOVEMENT GAME

As part of our studies, we ran a design game called ‘Meaning in movement’ with dental students. Participants in the game were asked to write down words describing dentistry and then use some of these to create a sequence of gestures. Because it was early in the design process, we were not focusing on what gestures would be appropriate for a computer interface, but just trying to find inspiration in the actions that could lead us further. We also simply wanted to experience what it is like to use gestures as a resource for design and find ways of encouraging people to draw on their gestural abilities. We wanted to learn from the game how to better facilitate gesture design activities in the future.

### 4.1 Participants and Setting

Participants were recruited for the game either from contact in previous field studies, or through an email advertisement sent to all students in the class. Ethical clearance for the study was obtained from our university and participants gave informed consent before participating. Participants were not compensated for their involvement.

The game was run over a period of about an hour in clinics at the dental school where students learn and practice their skills. The dental school functions as a working surgery where students carry out procedures on real patients and is fully equipped with dental chairs, instruments, and so on. The main clinics are open plan rooms containing multiple individual work areas, but we were able to use a smaller single-chair room off the end of a larger clinic to run the game. One of the authors acted as facilitator for the game and another colleague video-taped it.

### 4.2 Description of the Game

The game is loosely based on a design exercise described by Djajaningrat, Overbeeke, et al. [3] in which design students

were asked to create a pair of three dimensional forms which were expressive of three qualities. Two of the qualities were to be common to both the forms and a third was to be opposite between them. The main difference in the 'Meaning in movement' game is that participants worked to create a sequence of movements rather than a three dimensional form. We presented the activity to the participants as the following sequence of steps;

1. Write down ten words that describe professionalism in dentistry.
2. Group into pairs and together choose 3 cards.
3. Each pair choreograph a sequence of movements that reflects the words.
4. Choose one of the words and write the opposite
5. Choreograph another movement sequence with the new set of words.
6. When all pairs are happy with their movements, they perform them for the others.
7. We will discuss how you created the movement sequence and how the audience interpreted it.
8. Each group choose one short gesture for each word from the sequences.

### 4.3 Results

We have run the game on two occasions. The first time two dental students participated and the second time one student participated. In this section we will describe the results of the first occasion where there were two participants.

First we described the purpose of the game and went through the steps we planned it to take. Then, we gave each participant some pieces of paper and asked them to write down ten words. We said not to worry about relating the words to movements at this stage, just that they should be somehow important for dentistry. After about five minutes, the participants had finished writing down the words. They laid them out on a table and spent a little time discussing them and arranging them into three groups. One group consisted of words about how the patient should feel, another had words that described how the dentist should act, and the last one had words about the atmosphere of the surgery. The words that the participants wrote down are shown in Figure 3.

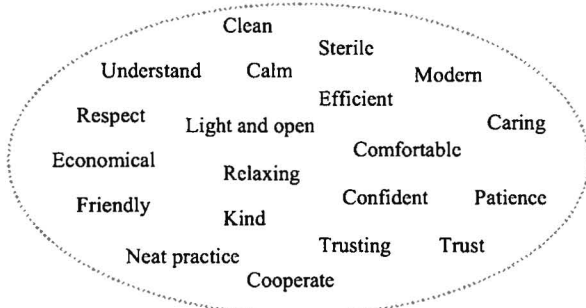


Figure 3: Participants' words about dentistry

Next, we asked the participants to choose three of the words from which they would make a sequence of movements. The participants decided to work with 'caring', 'efficient', and 'clean.'

Initially, the participants seemed to find it difficult to know how to begin making movements for the words. For a few minutes we just discussed the words and what they meant without taking the leap into expressing them with actions. The role of the facilitator proved important at this part of the game. In rehearsals with colleagues, we'd discovered that acting out scenarios, using the space, and tools were good ways to begin expressing movements, so the facilitator suggested that the participants try this with one of their words.

Once the participants began drawing on their own experiences, the game got moving again. The participants first acted out a scenario for the word 'caring' where one took the role of a patient and the other played the part of a dentist who was comforting them and trying to make them feel reassured. For the word 'efficient', they acted out a scenario of tool passing between the dentist and the assistant. For the word 'clean', they drew on the movements they would make when cleaning down the surfaces of the surgery. Three stills from the video we recorded of the movement sequence along with a description of the movements made are shown in Table 1. The still images also have the data from our prototype gesture sensor overlaid along the bottom of the image in graph form.

Table 1: Movement sequences and words

	<p><b>Caring:</b> One participant played the part of a patient and the other played the part of a dentist that was trying to comfort them. The dentist made slow downward motions over the arm of the patient.</p>
	<p><b>Efficient:</b> The participants mimed passing instruments back and forth between each other and performing actions with them. The jagged parts in the acceleration data are where the participant acted out using the instrument.</p>
	<p><b>Clean:</b> The participants acted out the process of wiping down the equipment in the surgery at the end of the consultation. They made steady side-to-side movements on imagined surfaces with open hands.</p>

Once the participants had developed each of these individual scenarios, we began a process of asking how the movements related to each other. So, we asked the participants to make gestures that were both caring and efficient. This seemed to take the exploration of the words to a deeper level. We began to see the complexity involved in actions that is hidden by abstract words like 'caring'. After a time, the participants would get stuck on one pair of words. It seemed that in focusing on two of the words, the participants would forget about the third. When they got stuck, the facilitator could remind them of the third word and

try to play with that against one of the other words. This worked to open up the dialog of gestures once again and move it in a new direction.

The process of developing the final movement sequence proved to be much more involved and time consuming than we had anticipated. We had intended for the final sequence to be more of a synthesis of the three words, rather than a sequential presentation of them, but we did not manage to get to this stage before our time with the participants ran out. There was also not time for the participants to construct a second sequence with one of the words switched for its opposite.

## 5. DISCUSSION

Although we didn't get as far as we'd hoped with the game in the time that we had, we still feel that the game has been a success in terms of our original aims, which were to explore qualities of gesture in relation to the work of dentistry as part of a design process and to experience what participants find difficult in using gestures in a design game and find ways of better facilitating their involvement.

One of the aspects of the game that we found interesting is that it takes words as its starting point and ends with gestures. This contrasts with other methods we have used for analysing gestures where we have tended to move in the other direction, from gestures to words. Using gestures to express and question words seemed to be a powerful tool. The process of expressing an abstract concept as a movement helped us see complexities and explore relationships that we might not otherwise have considered. At times though, we seemed to talk more than gesture. Perhaps having words as a starting point meant that we tended to fall back on them too easily rather than persisting with exploring gestures.

As far as the second of our aims is concerned, we learnt many lessons how to better facilitate the use of gestures. The first thing to note is that in spite of our inexperience and all the mistakes we made, the participants were able to undertake the difficult task we set them. They drew on their dentistry skills to draw out movements relating to quite abstract concepts. Holding the game in the dental surgery was very important for this because the space and the instruments supported participants in drawing on and their skills to inspire actions and movements. We agree with Ingold's point that skilled practice is not a quality of the individual that can be studied in isolation from its environment [4].

We also found an important role for the facilitator in helping participants to get started with the game and move past difficulties when they arose. On reflection though, there are some things we will do differently. In future we will position the facilitator at the same level as the participants and close enough that they can take a more involved rather than observational role. In this way, the language of the facilitation could itself rely more on gestures than words and the participants might feel more relaxed about expressing themselves through movements.

Another skill we need to develop as facilitators is the ability to lead the participants back to a synthesis. Where the technique of reminding the participants of the third word was good for opening up new directions, we didn't have a way of focusing back in on the goal. Although the process of the game was valuable in and of

itself, we think that it's also important to be able to draw the threads back in and end up with a result that expresses what we and the participants achieved.

## 6. CONCLUSION

This paper has described a design game called 'Meaning in Movement' in which we engaged student dentists in an exploration of notions of professional dental practice through gesture. We found that this design game gave us an initial insight into how dentists conceive of and reproduce the qualities of their movements in dental practice. The game also appeared to help the dental students reflect upon the qualities of their movements. While this exercise was not used to design specific instrument manipulations for accessing information, (this is future work), it seems to us to be a necessary precursor to such a design activity. Both dentist participants and designers need vehicles through which they can draw out, discuss and reflect upon movement qualities before designing specific instrument manipulations. In future games we will explore designing specific instrument manipulations and see whether dentists would like to use these designed manipulations for interface control.

## 7. ACKNOWLEDGEMENTS

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