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Exploring emotional response to gesture in product interaction using Laban’s movement analysis

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Abstract
This paper explores the use of Laban’s effort actions from the field of dance and drama as a means to document user responses to physical product interaction. A range of traditional and modern product pairs were identified and reviewed in two workshops, where participants were asked to discuss and complete worksheets on their emotional response. The results provide qualitative feedback on their reactions to the different movements, and form the beginnings of an ‘emotional vocabulary’ that we plan to use in the development of semantic differentials for future studies. Key factors in emotional response to gesture have been identified, including aligning movement to product function, emotional conflicts in movement, and user readiness and framing a sequence of movements.

Keywords: Design research; gesture; human factors; interface design
1. Introduction

As products become ‘dematerialised’ (Dunne, 2008) through the use of electronics, physical operation has in many cases been replaced by control through software – for example, televisions, vending machines, and smartphones are experienced primarily as an interface rather than a physical entity. Despite the emergence of interaction and interface design to address the cognitive problems posed by often complex menu systems (Moggridge, 2007), many find the experience of using contemporary products unrewarding and in the worst cases emotionally upsetting (Norman, 2004). This is perhaps less surprising when viewed from an evolutionary perspective: for two million years humans have interacted with their environment through physical manipulation. From the earliest stone tools, our physiology has adapted and improved to provide us with the motor skills to perform operations of great complexity (Lancaster, 1968; Susman, 1998) and has long been discussed as a key factor in the development of human intellectual capacity (Skoyles, 1999; Stout & Chaminade, 2007).

In the comparatively rapid progression through the Agricultural and Industrial Revolutions, many major technological innovations were made that coupled increasingly sophisticated mechanical properties with scientific breakthroughs of the time, such as the iron plough, the printing press, and the steam engine. In the late 19th and early 20th century, a plethora of now iconic products became part of everyday life, evoking a sense of excitement and wonder in users of the day (Williams, 1987). These products retain a sense of poetry in their operation to us now when compared to their modern equivalents. For example, the reassuring clack of a Single Lens Reflex (SLR)
camera shutter – audibly mimicked by today’s digital cameras – and the subsequent
camera shutter – audibly mimicked by today’s digital cameras – and the subsequent
resistance of the thumb lever used to wind the film forward that signpost the
resistance of the thumb lever used to wind the film forward that signpost the
photographic process. Similarly, the mechanical typewriter’s tangible thwacking of
photographic process. Similarly, the mechanical typewriter’s tangible thwacking of
metal to paper, framed by the emphatic swipe of the carriage return that makes modern
metal to paper, framed by the emphatic swipe of the carriage return that makes modern
camera keyboards seem tame. Similar comparisons can be made with sewing
camera keyboards seem tame. Similar comparisons can be made with sewing
machines, radios and many other products of this era, all of which require movement in
machines, radios and many other products of this era, all of which require movement in
use and return significant tactile and audible feedback, engendering a sense of
use and return significant tactile and audible feedback, engendering a sense of
satisfaction through their operation.
satisfaction through their operation.

While it is recognised that all of the senses play an important role in the experience of a
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product (Hekkert, 2006), the work presented here focuses specifically on the role of
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movement. What is it about particular movements and actions that appeal to us? Is a
movement. What is it about particular movements and actions that appeal to us? Is a
flick or swipe more intrinsically satisfying than a press or squeeze? A language of
flick or swipe more intrinsically satisfying than a press or squeeze? A language of
kinaesthetics is required to better understand and describe the types and combination of
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movements that trigger different emotional responses in users. The work draws
movements that trigger different emotional responses in users. The work draws
specifically on the world of theatre to aid developing these correlations. Laban’s
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Movement Analysis (Laban, 1960) is an established educational tool for dance and
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drama teachers to help students understand how movement can be a powerful tool for
drama teachers to help students understand how movement can be a powerful tool for
the expression of character. This includes the use of props in performance, and
the expression of character. This includes the use of props in performance, and
encompasses issues to do with time (speed of engagement), mood (the reaction to use of
encompasses issues to do with time (speed of engagement), mood (the reaction to use of
product) and costume (constraints of environment). In this research, it provides a
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vocabulary of eight basic movements, or Effort Actions, that we have applied to the area
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of product interaction.
of product interaction.
Movement was identified as an area of particular interest due to recent technological developments in motion capture and gesture recognition. Games consoles, TVs, smartphones, water faucets, light switches and many other products are utilising sensor technologies to provide physical interaction experiences. The aim of this research is therefore to examine the role of kinaesthetics in user response to better understand what can make physical interactions with products more or less satisfying. The objectives include: to review Laban’s vocabulary of movement; to assess the applicability of Laban to the product domain through physical product interactions; to develop an experiential workshop based on the use of Laban with a range of products; to document the reactions of workshop participants to discern movement preferences and emotional reactions; and to identify key considerations for the incorporation of physical movement in product interaction.

The research was carried out using two groups of participants from different backgrounds: one was a class of Theatre Studies students and one Design Engineering students. The participants were asked to review ‘pairs’ of older and newer products – for example a typewriter and a laptop – for the differences in interaction. By using Laban’s system as a framework for these investigations, the emotional reaction to different gestures for each product was documented. Similar to the participants, the authors have a background in theatre studies and product design, and this work draws on their combined experience of interface design and drama to suggest new considerations for physical interaction design. Given that the workshops were experiential in nature, the results presented are qualitative. A combination of content
analysis of worksheets and observation has been used to interpret the participants’
experiences and reactions to the products. The emerging themes have been used to
identify and discuss considerations for the design of future physical product
experiences.

2. Documenting physical motion

While a number of recognised systems exist, such as Meyerhold’s [1969] biomechanical
exercises to develop and release the emotional potential through movement and the
Feldenkrais Method [Feldenkrais, 1972] for learning movement and enhanced body
function, in the field of dance and drama Rudolf Laban’s [Laban, 1960; Laban &
Lawrence, 1974] movement studies are widely used, identifying the physical and
expressive variations behind human motion. Despite being based in the arts, Laban
worked with engineers to analyse the movement dynamics of industrial workers in the
1940s [Davies, 2001]. He further collaborated to develop an approach for assessing
movement (gesture and posture) in senior management [Moore, 2005]. Widely known
as Movement Pattern Analysis (MPA), this continues to be used and explored in
management training and assessment techniques [Moore, 2005].

One of the authors has used Laban for many years in Theatre Studies with
undergraduate English Studies students and in Voice and Communication classes with
undergraduate and post graduate student teachers. The theatre students have explored
Laban movement as part of their approach to character development and character
response, applying the effort actions through engaging with realistic and symbolic props
With student teachers the effort actions have been used to develop clarity in their verbal and non-verbal messages in role play scenarios and through reflection, develop a critical understanding of their actions and the action of others in teacher/pupil, teacher/senior teacher and teacher/parent /guardian situations. In both learning settings Laban method gives participants a keen awareness of the impact of gesture, body language and self-expression. Given the status and the expertise of the research staff, Laban movement method was selected as a valid and unique framework to apply in the analysis of product interactions.

There have been a number of studies examining the use of Laban in the context of technology. Hekkert et al (2003) describe the development of a photocopier and scanner that uses the metaphor of dance to create a more meaningful user experience. And the use of artefacts, products or product forms in interaction design to provide a basis for the analysis of movement and user reaction is well established (Jensen, Buur, & Djajadiningrat, 2005; Ross & Wensveen, 2010; Weerdesteijn, Desmet, & Gielen, 2005). Research into using more people-orientated interactions using dance and movement as inspiration have resulted in the importance of kinaesthetics – the quality and effects of movement – being more fully considered in design. In their work on a Choreography of Interaction, Klooster and Overbeeke (2005) identify three pivotal factors as being physical involvement, dynamic quality and expressed meaning. Dynamic quality is described as ‘…the way relevant parties are involved with their physical characteristics… the way the meaning of interaction comes to expression’. This
link between physical movement and emotional response is central to much work in the area in terms of ‘inner impulses to move’ (Bartenieff & Lewis, 1980, p. 49). By developing a clearer formulation of these motivations in relation to products, the following study aims to connect existing work on dance and drama with interaction design in a way that will place emphasis on the emotional reaction of users.

2.1 Laban’s effort actions

Laban uses the ‘motion factors’ of Weight (W), Time (T), Space (S) and Flow (F) to describe movement sensation. Each has opposite polarities that reveal the subtleties of movement, e.g. punching someone and reaching for an object may be mechanically similar but use of movement, strength and control in each case is very different. These can be notated in Laban Effort Graphs, as shown in Figure 1.

Figure 1: Laban Effort Graph for describing quality of effort (Laban, 1960, p. 81)

‘Effort’ is the inner attitude towards a motion factor and is applied to (or through) eight basic Effort Actions. These are descriptively named Float, Punch, Glide, Slash, Dab, Wring, Flick, and Press, and have been used extensively in acting schools to train the
ability to change quickly between physical manifestations of emotion. Figure 2 shows the eight effort actions and how emphasis on different qualities can change their nature. The effort actions have been organised radially with direct effort actions towards the top and sudden actions towards the right.

Figure 2: Laban’s eight Effort Actions, with notation and examples of use. Laban, 1960
To illustrate how these effort actions can be used to capture product interactions, an example has been included for the use of an SLR camera (Figure 3). To complete the sequence of movement, transitions occur between the basic actions and, in employing the ‘effort’, or the ‘quality of movement’ of Time, Weight, Space and Flow, these transitions occur with basic actions becoming grouped or forming a sequence, enabling the photographer to fulfil his or her intention. The effort of Time, Weight, Space and Flow are integral to the eight basic Effort Actions. Each of the Effort Actions can change: speed can be quick or sustained; weight can be strong or light; space can be direct or indirect; and flow can be bound or free. The effort applied to each of the movement actions and sequences provides the key to the emotional response within the movement sequence.

Figure 3: Storyboard illustrating the application of Laban’s effort actions to the use of an SLR camera
3. Workshop set-up

Two workshops were organised where different groups of students had the opportunity to use products and consider their interactions in relation to Laban. It is usually suggested that Laban movement exercises are undertaken without actual products present to focus on the quality of the movement and avoid any ‘consideration of circumstances or (as in the case of the actor) characterisation’ (Newlove & Dalby, 2004). In this instance, however, it was desirable to elicit these kind of reactions. The unfamiliar nature of some of the products as well as the importance in the subtle differences between the interactions led to the decision to have the physical products present to ensure the experiences were vivid and unequivocal for all. Both workshops followed the same format:

- 30 minutes: Introductory talk on Laban
- 30 minutes: Preparatory physical exercises
- 1hr 30 minutes: Review of product pairs
- 30 minutes: Reflection

Each team was asked to complete a worksheet for the different product pairs they reviewed. A sample is shown for the assessment of old and new coffee cups (traditional cup and saucer and a disposable cardboard cup respectively) by Group 1, Workshop 2.

<table>
<thead>
<tr>
<th>Product</th>
<th>Breakdown of movements</th>
<th>Effort Action</th>
<th>Emotional Response to each gesture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Old cup</td>
<td>A – lifting cup</td>
<td>Plucking-gliding</td>
<td>Delicate-controlled</td>
</tr>
<tr>
<td></td>
<td>B – drinking</td>
<td>Turning</td>
<td>Slow, purposeful</td>
</tr>
<tr>
<td></td>
<td>C – Placing cup</td>
<td>Gliding</td>
<td>Controlled</td>
</tr>
<tr>
<td>New cup</td>
<td>A – lifting cup</td>
<td>Grabbing-whipping</td>
<td>Casual, careless</td>
</tr>
<tr>
<td></td>
<td>B – drinking</td>
<td>Turning</td>
<td>Inconsiderate</td>
</tr>
<tr>
<td></td>
<td>C – Placing cup</td>
<td>Whipping</td>
<td>Fast, hurried</td>
</tr>
</tbody>
</table>

Reflection on difference between product pair: The china cup is a far more delicate object which demands manners and etiquette when in use. The disposable cup is just a pure drinking utensil, maximum efficiency.
Table 1: Sample worksheet response (Group 1, Workshop 2 for old and new coffee cups)

3.1 Products for analysis

The range of product pairs [Table 2] was intended to provide a range of different movements and sequences. It was the older products that dictated this selection: since the modern equivalents generally had fewer or less vivid gestures associated with them, they were secondary in providing a range of different movements for analysis and were principally included to provide a counterpoint for each product. The authors therefore reviewed the action sequences associated with the older products according to Laban’s eight Effort Actions to ensure an adequate range of movements were included.

Table 2: Full set of product pairs selected for gestural analysis based on range of movements

<table>
<thead>
<tr>
<th></th>
<th>Opening briefcase</th>
<th>Drinking coffee</th>
<th>Taking photo</th>
<th>Lighting cigarette</th>
<th>Reading newspaper</th>
<th>Making phone call</th>
<th>Typing</th>
</tr>
</thead>
<tbody>
<tr>
<td>New</td>
<td><img src="new.jpg" alt="Image" /></td>
<td><img src="new.jpg" alt="Image" /></td>
<td><img src="new.jpg" alt="Image" /></td>
<td><img src="new.jpg" alt="Image" /></td>
<td><img src="new.jpg" alt="Image" /></td>
<td><img src="new.jpg" alt="Image" /></td>
<td><img src="new.jpg" alt="Image" /></td>
</tr>
<tr>
<td>Old</td>
<td><img src="old.jpg" alt="Image" /></td>
<td><img src="old.jpg" alt="Image" /></td>
<td><img src="old.jpg" alt="Image" /></td>
<td><img src="old.jpg" alt="Image" /></td>
<td><img src="old.jpg" alt="Image" /></td>
<td><img src="old.jpg" alt="Image" /></td>
<td><img src="old.jpg" alt="Image" /></td>
</tr>
</tbody>
</table>

3.2 Workshop 1

Workshop 1 took place with a group of eleven 4th year undergraduate Theatre Studies students, with a background in English, who were preparing for the performance of
‘The Magic Suit’ by Maurice Moiseiwitsch (Bourne, 1938), a play set in the 1930s. The old and new product pairs meant the students would review products that would be used as props in performance. Having been provided with an overview of Laban’s effort actions and undertaking preliminary exercises to familiarise themselves with their nature, the participants were asked to review the physical interaction with four product pairs and discuss their emotional reaction to the gestures used in the operation of each. Each team was situated at a table on which they could manipulate the products and typically took 20-30 minutes to discuss each product pair over the course of the two hour session. Staff were on hand to clarify how to use the different products and to facilitate discussion where necessary, but the teams were generally free to manage their time and discussions as they wished.

3.3 Workshop 2

Workshop 2 took place with a group of twenty nine undergraduate Design Engineering students who were completing a module on Design Experience and Emotion. It followed a similar format to Workshop 1: the students were provided with an introduction to the fundamental concepts of Laban and completed a number of warm-up exercises. They were then asked to review four products in teams over a two hour period.
4. Results

Given the practice-based nature of the workshop experience, each team was asked to keep worksheets analysing the movements associated with each product and detailing their emotional reaction. While self-assessment (rather than, for example, observation by a trained Laban specialist) may introduce an element of unreliability, the participant interpretations of the interactions form an important part of the analysis. Having already reviewed and discussed the sequences with respect to Laban, the worksheets demanded the participants consider how the different effort actions elicited different responses.

With the worksheets used as the basis for content analysis [Hsieh & Shannon, 2005] and combined with observation by the researchers, the results are broken down into four sections: a summative overview of the Laban movements identified and used by the participants; a directed content analysis using Laban terminology with respect to old and new product pairs; a review of the variation between the two user groups using codification of responses; and a summary of participant reactions.
4.1 Overview of movements

All responses recorded on the worksheets were tabulated for review. Figure 5 shows how the frequency of use of Laban terminology correlated with the different product pairs. The results were averaged for the number of teams reviewing each product to ensure the results were comparable. It was found that pressing followed by gliding were the most commonly discussed. These perhaps correspond most closely to the types of movement required by mechanical products. Pressing is generally necessary for the operation of buttons, whether they be mechanical or electronic, while gliding is fundamental to movement and manipulation of any object. Flicking and wringing are vivid movements that were also discussed significantly in the products where they were relevant. These tended to be the older, mechanically based products rather than their modern counterparts. Conversely, words associated with punching and slashing were used rarely. These are more whole body movements rather than the types of motion used for interaction. In terms of the split between old and new, the old products had more terms describing movement associated with them than the corresponding new ones (181 vs. 161).
4.2 Old/new product analysis

Next, we considered each product in more detail. Figure 6 shows the old and new versions and the terms used by each team. Each product is discussed in turn below.

4.2.1 Briefcase

The main difference between the two models of briefcase was the fine motor skills required by the older model. The flapping-flicking and squeezing-pressing demanded precise and defined motions, took more time and encouraged an element of reflection during the process that may be valuable in checking and reflection. The newer laptop bag with zip was considered far more convenient in nature. A stretching-wringing motion dominated the interaction that demanded less concentration and precision, and took less time.
4.2.2 Camera

The set of motions required by the SLR was considerably more complex than that of the digital camera, and while it was considered slower and more deliberate there was an element of excitement vocalised by participants. An example is the *plucking-wringing* of the winding on process: this is a clear demarcation between one photograph and the next. In the modern digital camera, *squeezing-pressing* is the single dominant movement. While easier to use, this also encourages a more informal approach to photography, with ‘point-and-shoot’ cameras typically aimed at users who want to document situations with less emphasis on composition.

4.2.3 Cup

The *glide* of any cup is critical. In the old model, this was considerably more focussed and concentrated, in particular because of the cup and saucer, dual component configuration. The *stirring-floating* and *smoothing-gliding* (stirring the tea or coffee and lifting the cup to the lips respectively) were felt to induce a certain tension and aligned to more important social occasions. The newer takeaway cup also used a gliding motion in carrying and lifting the cup to the lips, but the quality of the movement was different. With the security of a lid and softer, more tactile materials, the movement was considerably faster and more aggressive, and could be considered more of a *smearing-gliding* motion. This resulted in much less tension when compared with the older version.
4.2.4 Lighter

The major differentiator between the models was the use of flicking that was an integral component of the older zippo lighter. Two similar jerking-flicking motions were required to open the lid of the lighter and turn the flint wheel, and as well as being well-designed mechanisms, lend themselves to an element of play. The elongated framing of the process with multiple actions gave the lighting of the cigarette a sense of drama. In addition, there was an element of practiced skill that made the successful execution satisfying. The modern clipper lighter, conversely, was dominated by a simple squeezing-pressing motion that, while decisive and easy to use, did not evoke as much pleasure.

4.2.5 Newspaper

While the two newspapers were similar in shape and configuration, size was the main factor that dictated how their use varied. The old model, the broadsheet newspaper, lent itself to a ‘grand gesture’ in reading. The stretching-wringer motion was an expansive gesture, with discussions of the space this established and the barriers that emerged an important feature. The smaller tabloid format meant that the opening of pages became more of a plucking-wringer rather than a stretching-wringer. It was subsequently perceived as less intimidating and less important, with convenience and speed featuring more prominently in its analysis which is suited to the content typically contained within it.
4.2.6 Telephone

The way in which the product interactions are framed for the old and new models is very different. For the old model, the dialling of the number is a key preparatory gesture that creates mood and anticipation in advance of the actual phone call. The *stirring-floating* motion used for this has an appropriately ruminative quality. With the modern mobile phone, *tapping-dabbing* is the key preparatory motion and descriptors such as jerky and sudden indicate how it was perceived as being a more hurried interaction. This contrast between the interactions has an impact on the embodied cognition aspects of their use, for example remembering telephone numbers and consciousness of the infrastructure in connecting devices.

4.2.7 Typewriter

The older typewriter has a number of mechanical actions that are not used in typing on a modern laptop. A forceful *tapping-dabbing* is required to depress the keys. Similarly, the carriage return at the end of each line demanded a *throwing-slashing* movement that was described as fun. Although the pace of typing was reported as frustrating, there was also a sense of accomplishment in the skilled performance of interacting with the product. In terms of physical motion, the laptop used similar *tapping-dabbing* motions to press the keys but the low profile keyboard required far less effort to operate. It was considered more relaxed and gentle, although the constricted position of interaction typically adopted by users is unnatural and potentially detrimental when maintained over a sustained period and can lead to conditions such as Repetitive Strain Injury (RSI).
4.3 User groups

The effect of the two different user groups was considered next. All words from the feedback sheets completed during this process were compiled and codified. The categories used in codification were: positive/negative emotions [Plutchik, 2001], description of movement, quality of movement, and critical reflection. These were compiled for each workshop, as shown in Figure 7. While in both workshops more positive emotions than negative were cited and the levels of critical reflection were similar, it was found that the feedback from Workshop 1 contained more narrative and description of the movements being conducted.

On further exploration of the vocabulary used, it was found that in Workshop 1 there was a greater prevalence of terms such as concentration and purposeful in reviewing the movements, while in Workshop 2 satisfaction was a dominant emotional reaction to the product experiences. Variations in mood (encompassing environment and atmosphere) and context (encompassing background and expertise) may have contributed to these discrepancies. Regarding mood, an effort was made to keep the two spaces as neutral as possible – both took place in open-plan studio type environments. One difference was that Workshop 1 was smaller and in an off-campus location, which contributed to a more focussed and concentrated atmosphere as there was a sense that a ‘special’ task was being undertaken. The second difference was in context. Similar preparation in terms of warm-up exercises and briefings for both sets of students took place. However, Laban is already well established in the performing arts and the Theatre Studies students were highly motivated to understand the use of the products (or ‘props’) for their play.
As a consequence, their documentation of reactions to the products tended to be more elaborate – an average response of 45 words per student for Workshop 1 and 10 words per student in Workshop 2. In terms of background, the Design Engineering students can be expected to be more familiar with technology and comfortable in the mechanical operation of devices. This may also have contributed to the greater levels of concentration and purposefulness apparent with the students studying English – particularly apparent in the operation of the older, unfamiliar camera and typewriter.

![Figure 7: Breakdown of responses in worksheets for (a) Theatre Studies class and (b) Design Emotion and Experience class](image-url)

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description of movement (d)</td>
<td>Description of the nature of the movement in terms of physical placement or speed.</td>
</tr>
<tr>
<td>Quality of movement (q)</td>
<td>Explanation of how movements felt, e.g. “in a rush” or “jarring.”</td>
</tr>
<tr>
<td>Positive emotion (p)</td>
<td>Joy, trust, expectation – emotions or associated reactions with positive connotations.</td>
</tr>
<tr>
<td>Negative emotion (n)</td>
<td>Fear, anger, sadness, disgust, surprise – emotions or associated reactions with negative connotations.</td>
</tr>
<tr>
<td>Critical reflection (c)</td>
<td>More abstract reflection on the experience in more abstract way using narrative, analogy or explanation.</td>
</tr>
</tbody>
</table>
4.4 Response to movement

We then considered the quality of emotional response of the participants. Products were experienced in their totality, i.e. a sequence of movements in the context of functionality, with teams highlighting a range of issues related to interaction as they reviewed them. Table 3 summarises the dominant effort actions, the major descriptions of movement, and participant reactions (incorporating descriptions of the quality of movement as well as emotional response) for each product. This highlights how the participants experienced the products based on feedback from the worksheets and observation and discussion in the workshops, but does not include the full breadth of reactions or necessarily indicate that the effort actions ‘equate’ to the reactions. For example, press and wring are used for both types of newspaper but they evoked very different reactions in participants. We discuss how the quality of movement in terms of product function, movement and sequencing can affect emotional reaction in Section 5 below.

<table>
<thead>
<tr>
<th>Object (old)</th>
<th>Dominant effort actions</th>
<th>Major descriptor/s of movement</th>
<th>Participant reaction/s</th>
<th>Object (new)</th>
<th>Dominant effort actions</th>
<th>Major descriptor/s of movement</th>
<th>Participant reaction/s</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slash, flick, wring</td>
<td>Fast, relaxed</td>
<td>Purposeful, effortless</td>
<td>Press, glide, flick</td>
<td>Slow</td>
<td>Satisfying, important</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Press, dab</td>
<td>Quick</td>
<td>Urgent, casual</td>
<td>Press, glide, wring</td>
<td>Laboured, deliberate</td>
<td>Relief</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Press, glide</td>
<td>Fast, instantaneous</td>
<td>Impatient, freedom</td>
<td>Press, float</td>
<td>Controlled, tentative</td>
<td>Anticipation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Press, glide, slash</td>
<td>Direct, purposeful</td>
<td>Tense</td>
<td>Press, glide, flick</td>
<td>Slow, smooth</td>
<td>Stylish, powerful</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
5. Discussion

The results presented in this paper are the initial stages in research to establish the role of movement in product interaction. While the end output of this is anticipated to be a set of ‘indicators’ for developing product interactions (see below), some initial considerations for designers can be presented.

5.1 Aligning movement to product function

The first finding of the research is that certain movements do align broadly to different emotions. It was found that the more varied and physically grander gestures of the traditional products led to more discussion. For example, many of the electronic versions of the products (telephone, typewriter, camera) were dominated by simple pressing or dabbing motions that were considered easy, convenient and quick. However, the more evocative slashing, flicking and floating motions demanded by their older, mechanical equivalents – while requiring more concentration and focus – were more rewarding and enjoyable.
As emotional reactions to different movements become more closely correlated, designers will be able to design the gestures that operate the device well and give rise to pleasurable experiences as a result. In this respect, it is important for the designer to understand product context and interpret what emotional responses are generally most appropriate with regards to functionality. For example, if a traditional light switch is replaced by a motion controller, what is the best way to physically activate the lighting of a room? It could be a more energetic action such as snap the fingers or clap the hands – similar to the flicking and plucking motions described above – to induce a happy or excited mood. Conversely, a gentle wave or patting motion – akin to the stirring and floating motions – may be selected to invoke a more relaxed feeling.

Broad correlations have emerged between certain actions and emotional responses as highlighted in Table 3. The next stage of the research will utilise emotional frameworks and semantic questionnaires to discern more clearly particular links.

Figure 8: Different gestural options for activation of a light switch
While we can assign actions to products, however, the state of mind of the user and subsequent quality of movement in undertaking these is crucial. If we take the example of the *stirring-floating* motion associated with the typical dialling a rotary telephone, we can understand this effect better. While the *space* of the dialling action is defined, there remains scope for considerable variation in the three other effort actions of *time*, *weight*, and *flow*. A person in an agitated state of mind making an emergency call is likely to be far more aggressive in dialling than someone reluctantly calling a distant relative. Such an aggressive use of the telephone would change the nature of the interaction from a *stirring-floating* motion to a *whipping-slashing* motion.

Figure 9 illustrates this transition. As a widely recognised framework for describing emotion, Russell’s (1980) Model of Affect has been used to plot the *slashing* and *floating* actions. Note that the three variations in each of the actions means there is scope for considerable movement across the graph. For example, *beating-slashing* is a satisfying motion (hacking through undergrowth) whereas *whipping-slashing* (whisking fast) is more agitated in nature. All three variations of the *slashing* action (*beating*, *throwing* and *whipping*) have similarly high levels of arousal. The variations of floating (*strewing*, *stirring* and *stroking*) are generally pleasant and languid. In designing gestural interactions, it is therefore necessary to consider how much variation should be permissible. If the telephone dial only permits the user who is in a hurry or in an agitated state of mind to turn the dial at a relatively slow speed, does this frustrate the user or help calm them to a state of mind more aligned with the nature of the action?
Figure 9: The difference in action and emotional response for dialling a telephone, after Russell [1980]

5.3 User readiness and framing a sequence of movements

These variations in user reaction to different movements are quantified through what we have termed *readiness*. We define this as ‘*the user’s mood in relation to the nature of the proscribed action*’. In evaluating the results of the workshops, it was found that sequences of gestures played an important role in the performance of a product operation – for example the old-fashioned typewriter entailed feeding paper, pressing keys, swiping carriage returns and releasing paper. These combined in such a way as to provide anticipation, action, punctuation and closure, helping to make the overall product use more immersive. This combination of movements within a product interaction we refer to as *framing*, and may be of assistance in addressing user readiness when interacting with a product.
Figure 10 illustrates the concepts of user readiness and interaction framing when using a Zippo lighter. This was one of the more evocative interactions in the study, eliciting a large number of mostly positive comments. One of the reasons is its sequential nature: in the case of the Zippo lighter, opening the lid and turning the flint wheel. This framing of the product activation with the preparatory opening of the lid provides an element of ritual and drama. In terms of Laban, the two actions can be identified as jerk-flicking and squeeze-pressing. Based on the results of the workshops, jerk-flicking has been identified as an action with relatively high excitement and arousal levels. Squeeze-pressing also entails a reasonable level of concentration and precision. If a user approaches the interaction in a state of relative lethargy, the initial action of opening the lighter (through transition A) may induce a certain level of engagement that moves them closer to the relatively high level of arousal associated with the action. This then means that in undertaking the second action (through transition B) they become more closely aligned with the emotional state than they would otherwise. This does not account for the tension caused by users who ‘fight against’ the natural way of operating the device, similar to the example discussed regarding the telephone. Quantifying readiness, understanding how discrepancies in mood can affect use, and the effect of framing sequences are to be the subject of further investigation.
Figure 10: The sequenced interaction of using a Zippo lighter, illustrating the effect of user readiness

5.4 Conclusions and future work

As a new generation of motion controlled products emerges, there is an opportunity to incorporate movements as appropriate for the body and emotional reaction rather than the activation of a mechanism. This paper reviews two workshops where participants experienced physical interactions with products using movement theory from dance and drama. Although there were a number of limitations to the work, in particular the two groups being from different educational backgrounds (one from the Arts, one from Design Engineering), a number of common themes emerged in emotional reaction with more dynamic and sequenced movements increasing the level of engagement and satisfaction. The work presented here provides the basis for further work in a rapidly emerging field.
The emotional reactions gathered require further expansion and refinement to ensure they cover the range of gestures described by Laban (for example, punching was not featured in the product interactions) before formalising a vocabulary. When complete, this will provide the basis for a semantic differential questionnaire. It is anticipated that this work will run concurrently with motion capture and analysis (measuring position, velocity, acceleration etc), providing the opportunity to quantify and categorise the different movements suggested. It is envisaged that this will be packaged as a set of indicators of likely emotional reactions to different movements which, along with illustrative examples, will provide a reference for designers when developing product interactions. For educationalists in the performing arts, the work points to how techniques in this area can be developed to provide drama students with greater understanding of the role props can play in performance and characterisation.

The more complex issues raised by the emotional state of mind of users and how they undertake proscribed gestures has been highlighted and discussed. This issue will be central to future work, and it is intended to perform specific tests to better understand the tensions between the proscribed gesture and state of mind using the concepts of readiness and gestural framing. This is a new level of sophistication that opens up opportunities for interaction designers to design interfaces carefully aligned to user needs and product functionality.

References


