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QUALITATIVE CONSIDERATIONS FOR KINAESTHETICS IN HCI

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ABSTRACT

With recent technological developments in motion capture there is an opportunity to redefine the physical interactions we have with products, considering human needs in movement at the forefront rather than subservient to the machine. This paper reports on the exploration of emotional reaction to gestural interface design using Laban's Movement Analysis from the field of dance and drama. After outlining the current status of Gesture Controlled User Interfaces and why the use of Laban is appropriate to help understand the effects of movement, the results of a workshop on new interface design are presented. Teams were asked to re-imagine a number of product experiences that utilised appropriate Laban effort actions and to prototype and present these to the group. Several categories of devices, including direct manipulation, remote control and gesture recognition were identified. In aligning appropriate movements to device functionality, utilising culture and analogy and where necessary increasing complexity, the interfaces embody a number of concepts relating to gestural interface concepts.

KEYWORDS

Interaction design, emotional design, Laban Movement Analysis, dance.

1. INTRODUCTION

This paper explores how we can balance, extend and if necessary complicate user interfaces to make better use of the human body. In product design, physical interaction with products has been dominated by the field of Ergonomics, which aims to ensure that all products are dimensionally fit for use and do not induce injury. Despite this, in many cases the physical operation of products is subservient to the technology behind them. For example the trend for continuing reduction in mobile phone size led to buttons that were difficult to operate

(Balakrishnan & Yeow, 2008). Interface Design, the other main user-centred field in design, has come to focus on the use of software in our electronic devices (Raskin, 2000). And while touchscreens are currently dominant (Zhai & Kristensson, 2012), the next generation of devices will make use of gesture recognition technology to allow more than a finger to be used in the control of our product and environment.

While Gesture Controlled User Interfaces (GCUIs) have been around for the last 30 years (Bhuiyan & Picking, 2011; Buxton, 2012), recent developments in motion detection and analysis (Figure 1) have made the hardware and software more widely available for researchers. This has resulted in an increase in attention to the applications and possibilities of such technology beyond its original use in gaming. For example, Kuhnel et al (2011) have conducted studies on the use of three dimensional gestures using a mobile phone to control a smart home environment. This utilises the motion sensors in the phone to detect basic swipes, tilts and points to control various devices. In revisiting the workstation interface, Bhruguram et al (2012) have suggested replacing a mouse with camera and motion detection technology while retaining the conventional movements associated with a mouse. This retains the familiarity of a known paradigm rather than reinvent it from first principles. When attempting to define a new, hands-free system for basic interactions with a CAD system, Jeong et al (2012) utilised simple static gestures based on a number of fingers for selection, translation, etc. but these cannot be considered to be intuitive. Despite research on set-ups and applications of GCUIs, there is less understanding as to what gestures should be employed and why.

Figure 1. Emerging generation of gesture recognition technology, including the Nintendo Wii, the Sony Playstation Move, the Microsoft Xbox Kinect and the Leap Motion Controller

There are many precedents for satisfying physical interaction with products: we have all experienced objects, such as SLR cameras or musical instruments, containing mechanisms or actions that are a delight to use. What is it about particular movements and actions that appeal to us and how do they relate to the human body? A language of kinaesthetics is required to understand and describe the combination of movements and sensory feedback that trigger different emotional responses in users. Malizia and Bellucci (2012) advocate the use of participatory design to align gestures of the interface with cultural factors, and also personalisation for individuals to make it as ‘natural’ as possible – rather than a proscribed set of movements that must be learnt. In this work we therefore present a workshop where design students were invited to reimagine product interfaces. To achieve this we utilised Rudolf Laban’s (Davies, 2001) movement studies, which are widely used in the field of dance and drama, to help quantify and understand physical product interactions.

2. QUALITY OF USE

We have named this more holistic approach to movement ‘quality of use’. This deliberately challenges the ‘ease of use’ maxim which, while opening up new levels of design inclusivity (Clarkson, Coleman, Keates, & Lebbon, 2003), has in many cases stripped away interaction to the point of invisibility without considering the emotional vacuum this leaves (Lee, Harada, & Stappers, 2002; Norman, 2004). For example, using an old fashioned typewriter with its careful paper feed, swinging key presses and swiping carriage returns provides a much more vivid experience than the limited experience of typing on the latest tablet. We contend that while the number of steps, sequences or motions may seem beyond the minimum required, it may in fact be desirable to improve the feel, whether through balance, symmetry, speed or quality of motion. Examples of the issues that affect quality of use are outlined below.

2.1 Ergonomics

Ergonomics and human factors are critical in ensuring that products are easily used by as many members of the population as possible. In addition, it is concerned with ensuring that the physical demands will not cause stress or injury over a period of time. These principles should apply to the design of any gestural interface: in reintroducing larger motions there is a danger of fatigue. For example, consistent use of a swiping gesture could cause shoulder pain if it causes the arm to be raised for a prolonged period of time. In encouraging more intuitive gestures and phrasing movement, however, it may be possible to avoid the kind of repetitive strain injuries caused by the constricted positions and repetitions demanded by current computer workstations.

2.2 Gesture

Gesture is closely associated with speech and communication – it is used for emphasis, inflection and explanation. In this sense it is something that we do unconsciously and is associated with our intentions. Prescribed gestures should therefore align with the intended or desired emotional reaction of the user: you do not open your arms to danger or smile when something is sad. These universal gestures or motions are fundamental and should be considered in relation to the functionality of the product interface.

2.3 Culture

As well as communication, gestures are closely related to culture. Some authors advocate that preset gestural vocabularies are not appropriate in the development of ‘natural’ interfaces as the cultural differences between groups can mean that a gesture in one location has a completely different meaning from in another (Liebenau & Backhouse, 1992). Similarly, different cultural groups can be more or less expansive in their use of gesture. For example, Latin and Mediterranean countries are often more expressive than northern Europeans and this can be observed in the number and size of gestures during conversation. These variances should be considered when prescribing gestures that may be used across cultures, or accommodating the development from within different cultural groups.

2.4 Complexity

Complexity is the most counter-intuitive of the themes we have identified for quality of use. A gesture might be simple and ergonomically sound, but there may nevertheless be an opportunity to make it more physically or culturally rewarding by extending it. There is a danger that if something is too difficult to complete then it undermines usability, but if by complicating an interaction it puts the user in touch with themselves or the functionality of the product then it is worthwhile. For example, getting water from a faucet at a basin could be a more rewarding experience. Often hands are slippery, dirty or cold when trying to turn or press the required tap, and current motion detectors can result in a frustrating waving of the hands. With more sophisticated motion detectors, water streams could be teased out in fun and evocative ways that may involve an element of learning but be ultimately more satisfying and provide greater control.

3. LABAN STUDIES

To understand more deeply the nature of movement in relation to the human body, we have looked to the field of dance. Rudolf Laban's (Laban, 1960; Laban & Lawrence, 1974) movement studies are one of the most widely used and cohesive theories of human movement, recognising the physical and expressive variations behind human motion. Laban's life and work has been comprehensively documented with many accounts of his theories and practices provided by those who worked directly with him. Valerie Preston-Dunlop's (2008) noteworthy text Rudolf Laban: An Extraordinary Life authenticates much of what has been written of his life and work through the interviews she conducted with students of Laban. Elderly Labanites in their late eighties and nineties. Born in Bratislava in 1879 to an affluent military couple Laban found himself often separated from his parents as his father fulfilled the duties of a military governor of Bosnia and Herzegovina (Partsch-Bergsohn & Bergsohn, 2002). By the age of twelve he was able to visit where his father had been posted and these visits to distant parts of the empire were filled with a myriad of experiences from witnessing military parades to the Dervish dancers who, through continuous spinning, induced a trance-like state. In this condition dancers could insert long needles and nails into their bodies with no sign of pain, blood loss or trace of a wound (Preston-Dunlop, 2008). These experiences were enriched by the political and religious practices of the western and eastern cultures he encountered in his travels contributing to his fascination of human behaviour and movement. This fascination for movement led him to create, with his associates, a language and movement notation that could record the pattern of human movement, named Labanotation (Hodgson & Preston-Dunlop, 1990).

Laban was a man of great vision, passion and determination and in 1933 while head of ballet at the Berlin Staatsoper he was faced with his role coming under the scrutiny of Joseph Goebbels, Adolf Hitler's appointed leader of the Reich Chamber of Culture (Doerr, 2007). He tried to pay little attention to politics and continued to promote dance within a strict Nazi regime. When Laban's contract at Staatsoper expired in August 1934 Gobbels named him the director of the Master Academy for Dance, giving Laban the responsibility of arranging the entire German dance programme. For the first time in his career he now had position and income (Bradley, 2010). His work on movement choirs (groups of people moving in unison in choreographed dance form) was an ideal medium to celebrate the opening of a new theatre situated at the corner of the Olympic stadium. The performance, The Warm Wind and the New Joy, was part of the dance festival for the opening of the 1936 Berlin Olympic Games (Hodgson, 2001). This was a movement choir of epic proportions with 41 movement choirs in 27 cities, two thousand dancers led and rehearsed by specialists in Labanotation. The performance would be an artistic triumph for Laban. In June 1936 Goebbels attended the grand preview and from that moment Laban was relieved of his post. The performance gave too much emphasis to the individual in contrast to the standard Nazi catchphrase "You are nothing; your nation is everything" (Doerr, 2007, p. 169). This was the first of Goebbels' actions against Laban. By November 1937 Goebbels had accused Laban of engaging in homosexual practices, his papers were seized and his travel limited. This led Laban to escape to Paris where, depressed and ill, he was visited by Kurt Jooss a colleague and choreographer of great merit. He convinced Laban to join him in Dartington and organised Laban's successful escape to England, arriving in February 1938.

It was there he met the management consultant Frederick Lawrence. Lawrence was impressed by Laban's approach to movement analysis and his ability to notate movement patterns on paper (Preston-Dunlop, 2008) and by 1941 Laban was involved in workforce training programmes in factories. With women taking on the heavy manual work of men, Laban introduced different movement sequences where a swing of the body and a sense of rhythm were used by the women to operate heavy machinery where previously the men had used a levering action. His partnership with Lawrence had a remarkable impact on the production output and the health of the workforce (Davies, 2001). Laban and Lawrence worked with a number of companies – W.D. Holmes & Co. Ltd, Hoover Ltd, St. Olave's Curing and Preserving Co. Ltd – and from these industrial ventures they produced the Laban/Lawrence Industrial Rhythm booklet bringing together Laban's method of movement and Lawrence's ideas on management (Moore, 2005).

More recently, there have been a number of studies examining the use of Labanotation in the context of product interaction (Loke, Larssen, & Robertson, 2005; Loke & Robertson, 2010). 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. Such research into using more people-orientated interactions using dance and movement as inspiration (Bull, 1987; Kendon, 2004; Sheppard et al., 2008) have resulted in the importance of kinaesthetics – the quality and effects of movement – being more fully considered in design (Moen, 2005, 2006). Laban knew that it was important to study the whole body, examining the function of the body, legs for locomotion, transferring of weight, hands for grasping, touching releasing but he realised that it was important to look at the body in action in space and gave the name 'choreutics' to the study of spatial form (Hodgson & Preston-Dunlop, 1990). With his collaborator Mary Wigman they created a basic terminology for the space of the individual, calling this the 'kinesphere' or 'reachspace' (Partsch-Bergsohn & Bergsohn, 2002). The space was then divided up into high, middle and low with Laban focusing on the space aspect and Mary Wigman on the energy aspect of tension and release. Through the use of geometric shapes he attempted to identify common routes in space using this knowledge to discover something of 'the body in space' and 'space in the body.' By developing a clearer formulation of the motivation for movement in relation to products, we aim to connect existing work on dance and drama with interaction design in a way that will place emphasis on the emotional reaction of users.

3.1 Effort Actions

'Effort' is the inner attitude of the person involved in a movement bringing colour and shape. If we take an example from the world of acting and consider the use of properties as part of the punctuation of the language, the effort used in handling the property informs the atmosphere of the scene (Harrop, 1992). Effort 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 develop the ability to change quickly between physical manifestations of emotion. Laban uses the 'motion factors' of Weight (W), Time (T), Space (S) and Flow (F) to describe movement sensation in each effort action. Each has opposite polarities that reveal the subtleties of movement, e.g. pushing forward a mouse and punching someone may be mechanically similar but the use of movement, strength and control in each case is very different. Figure 2 shows the Laban Effort Graph which allows motion factors to be documented. For the two examples, the different qualities of motion result in different effort actions even though they are mechanically similar.

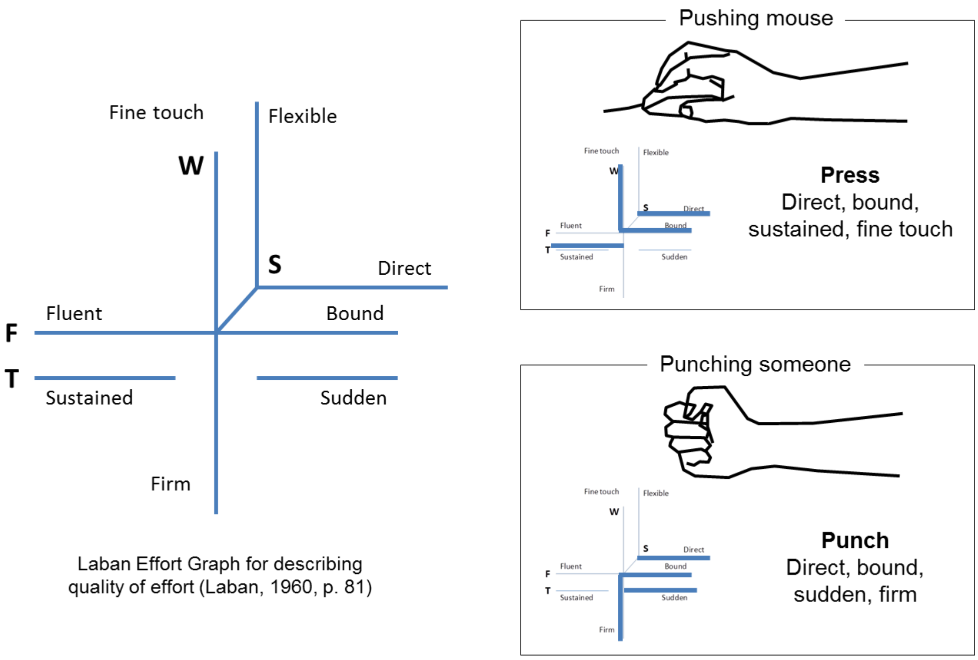

Figure 2. Laban Effort Graph for describing quality of effort (Laban, 1960, p. 81) and illustrating how motion factors can affect mechanically similar movements

We can therefore use motion factors to describe variations in effort actions: Figure 3 shows how the eight basic effort actions can change with different emphases on the motion factors. The effort actions have been organised radially with direct effort actions towards the top and sudden actions towards the right. This framework is useful in considering how movements relate to different Laban effort actions.

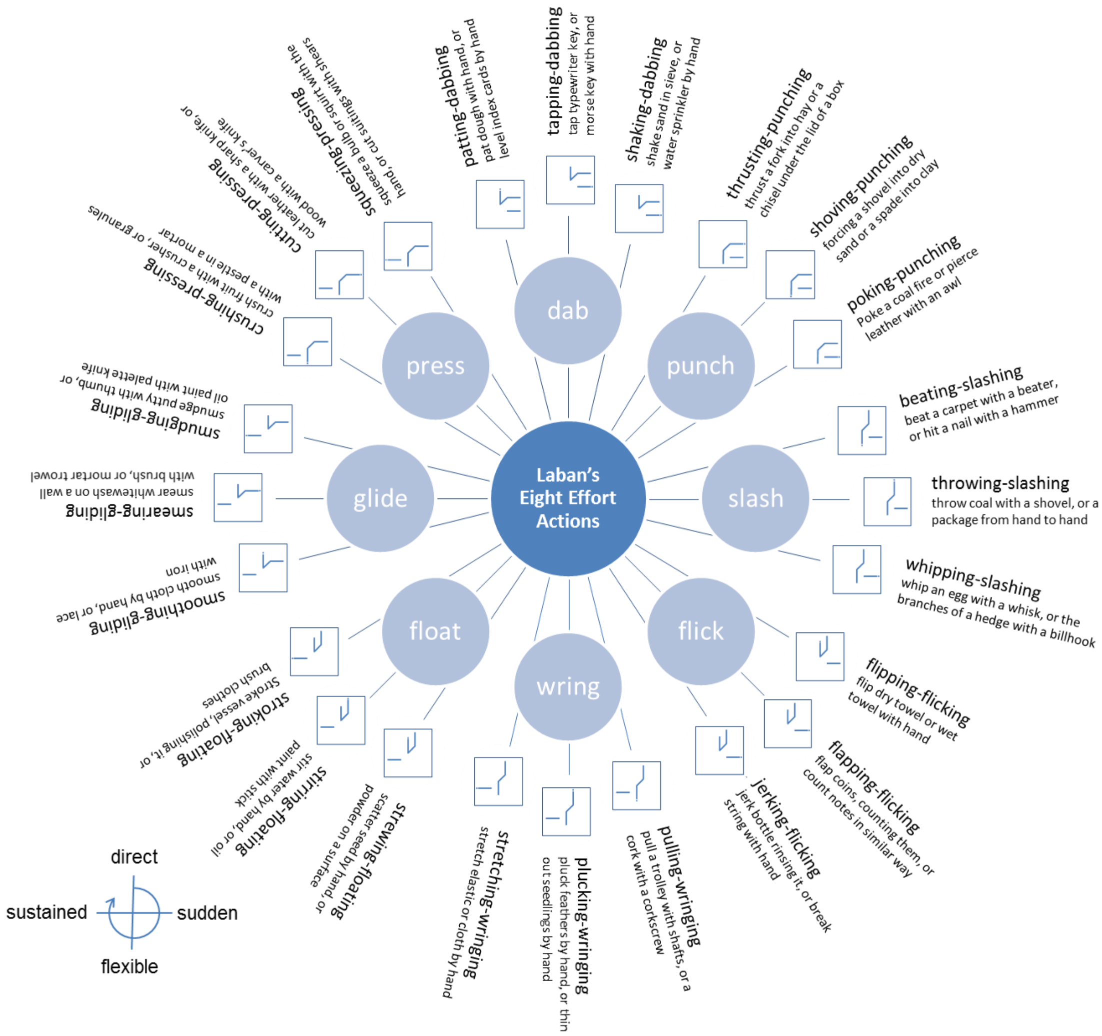

Figure 3. Laban's eight Effort Actions, with notation and examples of use (Laban, 1960)

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. For example, a direct, sustained and strong movement to crush granules with a mortar and pestle is ‘pressing’ but becomes ‘crushing’, a derivative of ‘pressing’ due to the dominance of Weight being strong in the effort to complete the task. ‘Squeezing’ is another derivative of ‘pressing’ where the dominant effort is in the use of sustained Time e.g. using scissors.

These examples are complete basic efforts i.e. all four elements of Time, Weight, Space and Flow are evident but there are also some ‘incomplete basic efforts where two elements are not used (Laban & Lawrence, 1974). This can be evidenced in connection with gripping an object whereby any movement in Space and Time ceases and the only exertion is the tension of strength to grip and support the object. We move between these ‘complete’ and ‘incomplete’ actions and it is the sequence of these effort actions that demonstrates our ‘inner attitude’ our emotional response. To illustrate how these effort actions can be used to capture product interactions, an example has been included comparing the use of a smartphone camera with an SLR camera (Figure 4). To complete the sequence of movement, transitions occur between the basic actions and, in employing appropriate effort, becoming grouped to form a sequence that enables the photographer to fulfil their intention.

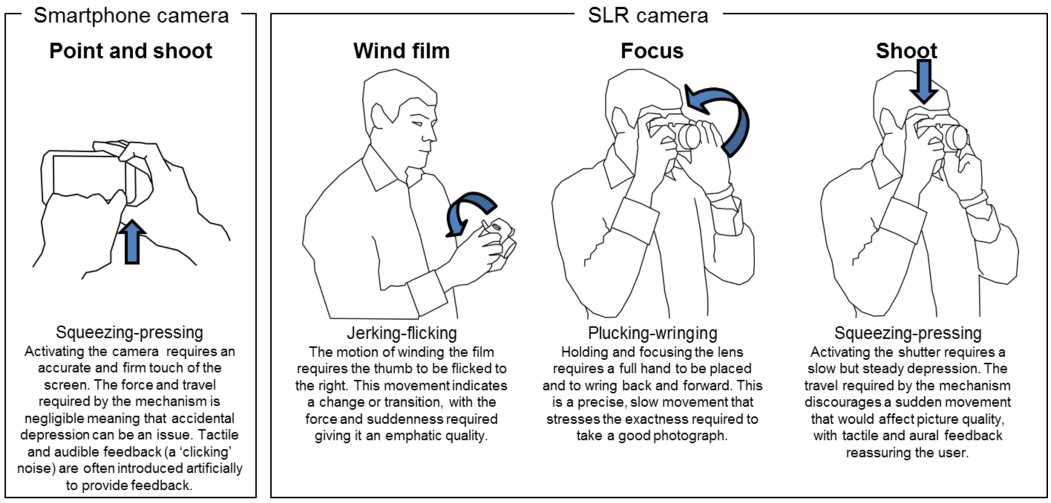

Figure 4. Application of Laban’s effort actions to the use of smartphone and SLR cameras

4. WORKSHOP

This section presents the results of a one-day workshop for an undergraduate Emotional Design and Experience class. After being introduced the basic concepts of Laban and experiencing a series of movement exercises, teams of three were invited to re-imagine a number of product experiences that utilise appropriate Laban effort actions. The themes provided for consideration included domestic, medical, industrial, commercial/office and retail use. Card, masking tape, flipcharts and marker pens were provided to allow spatial prototypes and storyboards to be constructed and demonstrated to the group.

4.1 Articulating Emotional Response

When articulating emotional reaction to the different Laban movements, it was important to encourage clarity in expression. Many models of emotional reaction exist, but a useful and easy to understand model is Plutchik's Wheel of Emotion (2001). This consists of eight basic emotions which combine to form eight advanced emotions. The emotions are co-ordinated in pairs of opposites, with intensity of emotion and indicator colour decreasing towards the periphery of the wheel (Figure 5). Teams were asked to refer to this when describing their interface, and to clearly identify any emotions not covered by the wheel.

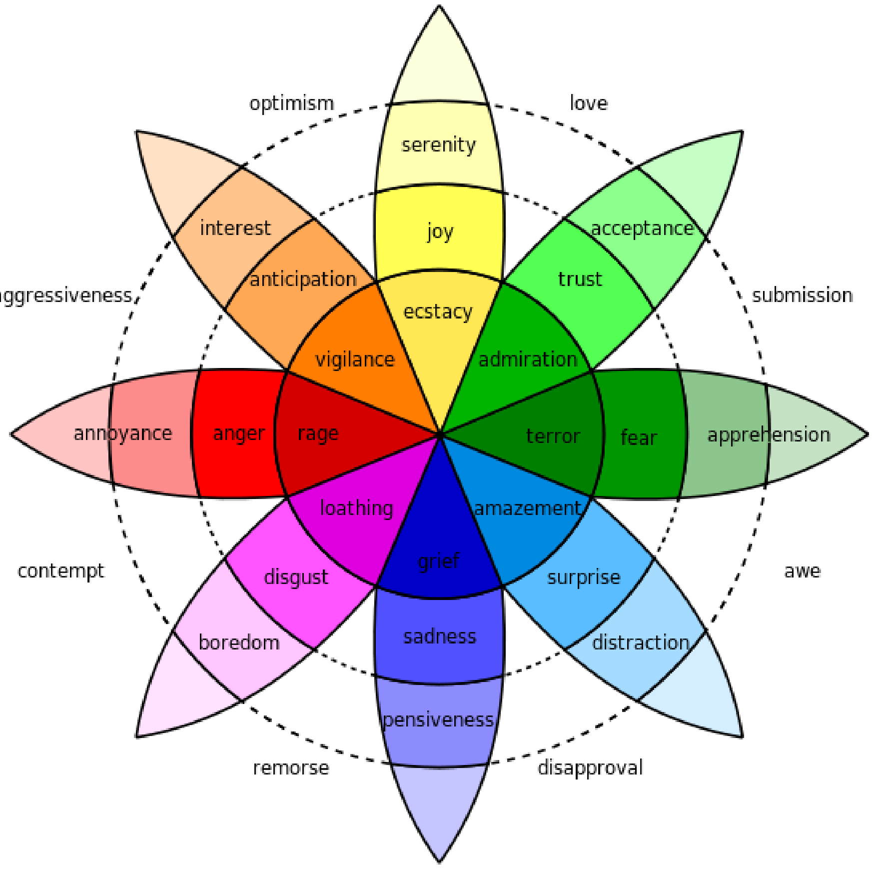

Figure 5. Plutchik's Wheel of Emotion, showing eight basic and eight advanced emotions

4.2 Output

In constructing their interface, teams were asked to identify a particular product or task within their allocated topic where the interaction could be changed through use of a more vivid physical interface. The interfaces developed by the teams included a defibrillator, a call centre telephone, a warehouse forklift, a shopping trolley, a hi-fi system, a hospital bed, and a TV.

After identifying all the functions required of the interaction, appropriate Laban motions were trialled through the use of cardboard prototypes. These were by necessity very rough and ready but allowed the teams to practically explore what the interactions ‘felt’ like. A sample of the models as used in the demonstrations are shown in Figure 6.

Figure 6. Examples of output from the workshop, utilizing cardboard mock-ups to demonstrate interfaces

5. DISCUSSION

In the demonstrations of the interfaces and through discussions, three different categories of gestural interfaces were apparent and these are addressed in turn.

Directly activated devices required physical operation and the ideas of Laban were used to focus on optimising and improving the actions used. An example of this was the shopping trolley interface. The team proposed that the trolley was split into two major areas for storage: an adjustable upper shelf where delicate items such as vegetables could be placed and a lower area for large, bulky items. The more delicate placement and adjustment of the shelf is aligned with the *dabbing* actions, which are delicate weight but focussed in direction. These were felt to align well with a sense of care or vigilance in the user. It was suggested that by including sloped or inclined shelves in the lower storage area, *punching* actions, with emphasis on firm and sudden movement, would be appropriately decisive to reinforce the secure storage of the items.

Remote controllers are a common for the operation of many current devices. Combined with the use of motion sensors, it is possible to incorporate aspects of gesture into the interface design. One of the teams decided to review the operation of a hi-fi and chose to utilise a stick-like device that could be bent and twisted to control the music being played. By bending, twisting or waving the stick it was possible to adjust volume, skip tracks and turn the system on/ off. While learning and executing the gestures associated with this interface could be considered more complex than the push of a button, it highlighted the increased satisfaction that can be achieved through effective physical movement. In particular, the *wringing* motion used for volume adjustment, with its firm but flexible movements, utilised the full body in a way similar to dancing. It also included an element of metaphor in turning the neutral stick into a smile, reinforcing the pleasure of music.

A *gestural recognition* interface involves no direct contact with an object and relies on movement in space. In redesigning a TV control interface with the intention of making the experience more of a cinematic ‘event’, one team described a set of gestures for switching channels, turning on/ off, and adjusting volume. Interfaces such as these require the definition of a gestural vocabulary that is easy to learn and culturally appropriate as well as incorporating motions that make effective use of the body. As well as identifying the *flicking* and *pressing* gestures that might be expected for changing channel and on/off functions, the team also identified a diagonal *slashing* motion for volume adjustment. This is a flexible and firm movement, but with different speeds can be used to change the volume either quickly or slowly. As well as incorporating much of the body in a dynamic movement that suits the change of state being induced, it also relies on a cultural analogy of the growing triangle symbol that often indicates volume pictorially.

Table 1. Different categories of movement in product control

Type of control	Issues	Examples from workshop	Embodiment
Direct activation	How physical manipulation can be made more rewarding. Quality rather than ease of use.	Supermarket trolley	Precise motions for placement of vegetables, larger punches for storage of heavy goods.
Remote controller	Mixes physical contact and movement at a distance. Paradigm for control is important.	Hi-fi remote	Manipulation of a stick-like device to mimic characteristics of dance, and utilisation of metaphor.
Gesture recognition	Control achieved entirely through movement of the body in space. Requires definition of an appropriate gestural vocabulary.	TV control	Alignment of motion with function. Incorporation of variations in magnitude and reliance on cultural analogy.

These three categories of controller have been set out in Table 1, along with the main issues for consideration and examples from the workshop. An interface which incorporated a number of different elements was the defibrillator device. It was proposed that this would consist of a pair of gloves worn by the person to administer the electrical charge for resuscitation, with an auxiliary indicator unit. Operation consisted of four distinct elements:

1. touch fingertips to switch on
2. spin hands to charge
3. press chest to administer charge
4. interlock fingers to switch off

In switching the device on by touching the fingertips, it encourages a moment of precision and poise. Spinning the hands with a *whipping-slashing* movement to charge the gloves is highly dynamic, providing the user with an increased alertness and is also highly visible to onlookers, indicating that something is about to happen. The pressing motion of administering the charge is a firm and direct movement that is appropriate for the transmission of energy from one individual to another. And by interlocking the fingers to switch the device off, there is a physical and visual sense of closure. Throughout its operation, the gestures and functionality of the defibrillator are closely interrelated, and although it is a speculative device it embodies many of the possibilities of utilising movement effectively.

5.1 Implications for HCI

The integration of functionality and movement achieved in the example above is difficult to achieve in conventional desktop HCI set-ups. The introduction of a keyboard that incorporate the characteristics of more evocative mechanical typewriters or a mouse that allows utilisation of more balanced arm movements would go some way to addressing the problems with current input devices. But it is the emerging use of gestural controllers in GCUI set-ups that provides the most significant opportunity to develop new paradigms for HCI interfaces. As set out in previous work by the authors (Wodehouse & Sheridan, 2014), the principles of movement can be used to establish gestural vocabularies that could free us from static sitting positions in the operation of not only computers but our environment and indeed any computer-controlled device. This does, however, present new challenges in usability that are only now becoming apparent. The lack of constraints associated with GCUIs – while a great asset in terms of flexibility – is a particular challenge in developing meaningful physical experiences.

Firstly, in free air movements there is a lack of resistance or feedback to the actions performed. While in dance or drama the actors are expressing feelings or emotions through gesticulation and movement, mimicking operation requires a greater degree of response and if this relies only on the correlation of visual feedback on a screen the user experiences an increased cognitive load to ascertain the result when appropriate tactile feedback would be instantly and intuitively recognised.

Secondly, there can also be poor granularity in control of GCUIs. While this is partly a technological issue as most current devices struggle to track the subtleties of finger movements, there also seems to be a tendency to focus on large, dramatic movements such as swipes, claps and thrusts. These are not appropriate for sustained, rapid or accurate use and consideration of how we can increase the subtlety of movements to accommodate this.

Thirdly, there are clear difficulties in assigning appropriate movements to function. We can see an analogy here with the physical signals and gestures used different cultures across the world. For example, an “a-ok” sign in America can mean “zero” in France, “money” in Japan and “I’ll kill you” in Tunisia (Liebenau & Backhouse, 1992). In addition to cultural variations, it is important to consider 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.

Finally, related to the issue of aligning functionality and from the perspective of kinaesthetics perhaps the greatest challenge to GCUIs, is the state of mind of the user and subsequent quality of movement. If we take the example of the stirring-floating motion associated with the dialing of typical rotary telephone, we can understand this effect better: while the space parameters of the dialling action are 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.

To illustrate the difficulties in an HCI context, an example is presented in Figure 7 to show how emotional state and physical movement are interdependent. During the workshop described above, it was found that Plutchik's Wheel of Emotion was of limited use in describing emotional reaction to movement as it did not obviously align to the effort actions. Additionally, a number of feelings such as pensiveness or security that were identified as desirable in the interface designs were not present in the model. To address this, a number of other emotional frameworks were reviewed, and Russell's (1980) Model of Affect selected as more appropriate. This model utilizes arousal vs. sleepiness and pleasure vs. misery as the two primary axes with compound emotions sitting between them. The model is more apt for evaluating the interaction with a product or interface as it is more experiential in the presentation and interpretation of emotional reaction Considering the vertical axis to broadly equate to engagement and the horizontal axis to enjoyment, we have plotted the use of a swipe to navigate to the next page or step in a sequence.

A person in an agitated state of mind in a hurry to reach the end of a long sequence is likely to be far more aggressive in swiping than someone in a relaxed state ponderously browsing a series. An aggressive use of the swipe would change the nature of the movement from a stirring-floating motion to a whipping-slashing motion. Figure 9 illustrates this transition. 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 and whether physical boundaries or feedback such as those provided by the switches or handles of 'real' interfaces should be emulated in the gestural environment. In other words, if we define a slow swipe as mandatory, this could either frustrate the user or help calm them to a state of mind more aligned with the nature of the action. The subtleties of these emotional states and transitions have been identified as a key are of focus for kinaesthetics in GCUI.

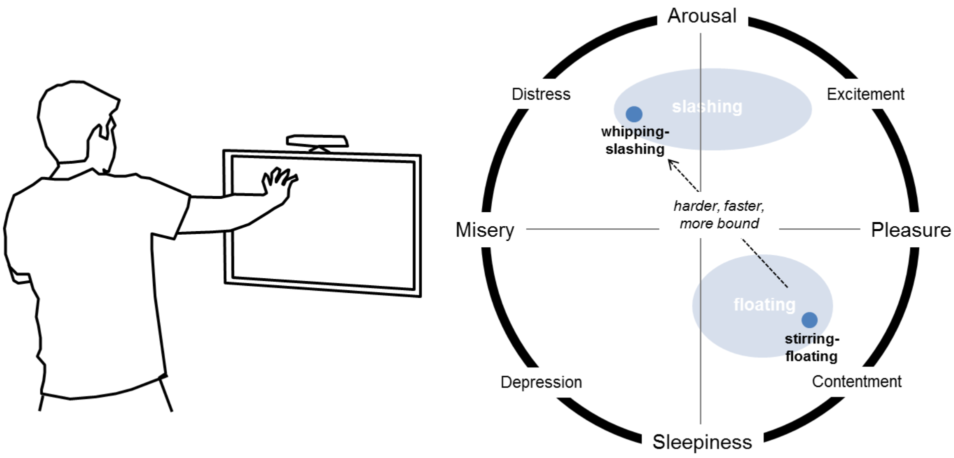

Figure 7. Emotional shift when completing gestural interaction with different effort actions

6. CONCLUSIONS

This paper discusses how Laban's effort actions can be applied to the area of GCUI, and highlights that while ergonomics are fundamental to human-machine interactions, issues such as gesture, culture and complexity can be utilised to engender greater satisfaction in the physical operation of products. The results from an exploratory workshop are presented, where interfaces were re-imagined to optimise physical movement. While the exercise worked well in understanding the role of the body in relation to operation of the interfaces, it was found that Plutchik's Wheel of Emotion did not align obviously to Laban's effort actions or include a number of feelings that are desirable for interface design. It is therefore recommended that for similar, body-orientated interface research that other emotional frameworks such as Russell's Model of Affect are explored for their suitability. Three categories of GCUI, direct activation, remote control and gesture recognition, emerged from the study to help structure further investigations into the use of gesture. Furthermore, we have identified future challenges for the use of gesture in HCI as including the lack of resistance or feedback, poor granularity, the alignment with function and critically for the user the emotional state of the user.

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