

1 **Exploring emotional response to gesture in product interaction using Laban's**  
2 **movement analysis**

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34  
35 **Abstract**

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

46  
47 **Keywords:** Design research; gesture; human factors; interface design

## 48 **1. Introduction**

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50 physical operation has in many cases been replaced by control through software – for  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

62  
63 In the comparatively rapid progression through the Agricultural and Industrial  
64 Revolutions, many major technological innovations were made that coupled  
65 increasingly sophisticated mechanical properties with scientific breakthroughs of the  
66 time, such as the iron plough, the printing press, and the steam engine. In the late 19<sup>th</sup>  
67 and early 20<sup>th</sup> century, a plethora of now iconic products became part of everyday life,  
68 evoking a sense of excitement and wonder in users of the day (Williams, 1987). These  
69 products retain a sense of poetry in their operation to us now when compared to their  
70 modern equivalents. For example, the reassuring clack of a Single Lens Reflex (SLR)

71 camera shutter – audibly mimicked by today’s digital cameras – and the subsequent  
72 resistance of the thumb lever used to wind the film forward that signpost the  
73 photographic process. Similarly, the mechanical typewriter’s tangible thwacking of  
74 metal to paper, framed by the emphatic swipe of the carriage return that makes modern  
75 computer keyboards seem tame. Similar comparisons can be made with sewing  
76 machines, radios and many other products of this era, all of which require movement in  
77 use and return significant tactile and audible feedback, engendering a sense of  
78 satisfaction through their operation.

79

80 While it is recognised that all of the senses play an important role in the experience of a  
81 product (Hekkert, 2006), the work presented here focuses specifically on the role of  
82 movement. What is it about particular movements and actions that appeal to us? Is a  
83 flick or swipe more intrinsically satisfying than a press or squeeze? A language of  
84 kinaesthetics is required to better understand and describe the types and combination of  
85 movements that trigger different emotional responses in users. The work draws  
86 specifically on the world of theatre to aid developing these correlations. Laban’s  
87 Movement Analysis (Laban, 1960) is an established educational tool for dance and  
88 drama teachers to help students understand how movement can be a powerful tool for  
89 the expression of character. This includes the use of props in performance, and  
90 encompasses issues to do with time (speed of engagement), mood (the reaction to use of  
91 product) and costume (constraints of environment). In this research, it provides a  
92 vocabulary of eight basic movements, or Effort Actions, that we have applied to the area  
93 of product interaction.

94 Movement was identified as an area of particular interest due to recent technological  
95 developments in motion capture and gesture recognition. Games consoles, TVs,  
96 smartphones, water faucets, light switches and many other products are utilising sensor  
97 technologies to provide physical interaction experiences. The aim of this research is  
98 therefore to examine the role of kinaesthetics in user response to better understand what  
99 can make physical interactions with products more or less satisfying. The objectives  
100 include: to review Laban’s vocabulary of movement; to assess the applicability of  
101 Laban to the product domain through physical product interactions; to develop an  
102 experiential workshop based on the use of Laban with a range of products; to document  
103 the reactions of workshop participants to discern movement preferences and emotional  
104 reactions; and to identify key considerations for the incorporation of physical movement  
105 in product interaction.

106

107 The research was carried out using two groups of participants from different  
108 backgrounds: one was a class of Theatre Studies students and one Design Engineering  
109 students. The participants were asked to review ‘pairs’ of older and newer products –  
110 for example a typewriter and a laptop – for the differences in interaction. By using  
111 Laban’s system as a framework for these investigations, the emotional reaction to  
112 different gestures for each product was documented. Similar to the participants, the  
113 authors have a background in theatre studies and product design, and this work draws  
114 on their combined experience of interface design and drama to suggest new  
115 considerations for physical interaction design. Given that the workshops were  
116 experiential in nature, the results presented are qualitative. A combination of content

117 analysis of worksheets and observation has been used to interpret the participants'  
118 experiences and reactions to the products. The emerging themes have been used to  
119 identify and discuss considerations for the design of future physical product  
120 experiences.

## 121 **2. Documenting physical motion**

122 While a number of recognised systems exist, such as Meyerhold's (1969) biomechanical  
123 exercises to develop and release the emotional potential through movement and the  
124 Feldenkrais Method (Feldenkrais, 1972) for learning movement and enhanced body  
125 function, in the field of dance and drama Rudolf Laban's (Laban, 1960; Laban &  
126 Lawrence, 1974) movement studies are widely used, identifying the physical and  
127 expressive variations behind human motion. Despite being based in the arts, Laban  
128 worked with engineers to analyse the movement dynamics of industrial workers in the  
129 1940s (Davies, 2001). He further collaborated to develop an approach for assessing  
130 movement (gesture and posture) in senior management (Moore, 2005). Widely known  
131 as Movement Pattern Analysis (MPA), this continues to be used and explored in  
132 management training and assessment techniques (Moore, 2005).

133

134 One of the authors has used Laban for many years in Theatre Studies with  
135 undergraduate English Studies students and in Voice and Communication classes with  
136 undergraduate and post graduate student teachers. The theatre students have explored  
137 Laban movement as part of their approach to character development and character  
138 response, applying the effort actions through engaging with realistic and symbolic props

139 (Newlove & Dalby, 2004). With student teachers the effort actions have been used to  
140 develop clarity in their verbal and non-verbal messages in role play scenarios and  
141 through reflection, develop a critical understanding of their actions and the action of  
142 others in teacher/pupil, teacher/senior teacher and teacher/parent /guardian situations. In  
143 both learning settings Laban method gives participants a keen awareness of the impact  
144 of gesture, body language and self-expression. Given the status and the expertise of the  
145 research staff, Laban movement method was selected as a valid and unique framework  
146 to apply in the analysis of product interactions.

147

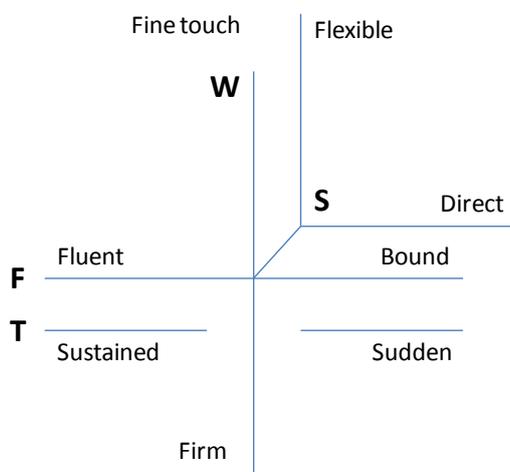
148 There have been a number of studies examining the use of Laban in the context of  
149 technology (Loke, Larssen, & Robertson, 2005; Loke & Robertson, 2010). Hekkert et al  
150 (2003) describe the development of a photocopier and scanner that uses the metaphor of  
151 dance to create a more meaningful user experience. And the use of artefacts, products or  
152 product forms in interaction design to provide a basis for the analysis of movement and  
153 user reaction is well established (Jensen, Buur, & Djajadiningrat, 2005; Ross &  
154 Wensveen, 2010; Weerdesteijn, Desmet, & Gielen, 2005). Research into using more  
155 people-orientated interactions using dance and movement as inspiration (Bull, 1987;  
156 Kendon, 2004) have resulted in the importance of kinaesthetics – the quality and effects  
157 of movement – being more fully considered in design (Moen, 2005, 2006). In their work  
158 on a Choreography of Interaction, Klooster and Overbeeke (2005) identify three pivotal  
159 factors as being physical involvement, dynamic quality and expressed meaning.

160 Dynamic quality is described as ‘...the way relevant parties are involved with their  
161 physical characteristics... the way the meaning of interaction comes to expression’. This

162 link between physical movement and emotional response is central to much work in the  
163 area in terms of ‘inner impulses to move’ (Bartenieff & Lewis, 1980, p. 49). By  
164 developing a clearer formulation of these motivations in relation to products, the  
165 following study aims to connect existing work on dance and drama with interaction  
166 design in a way that will place emphasis on the emotional reaction of users.

## 167 **2.1 Laban’s effort actions**

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

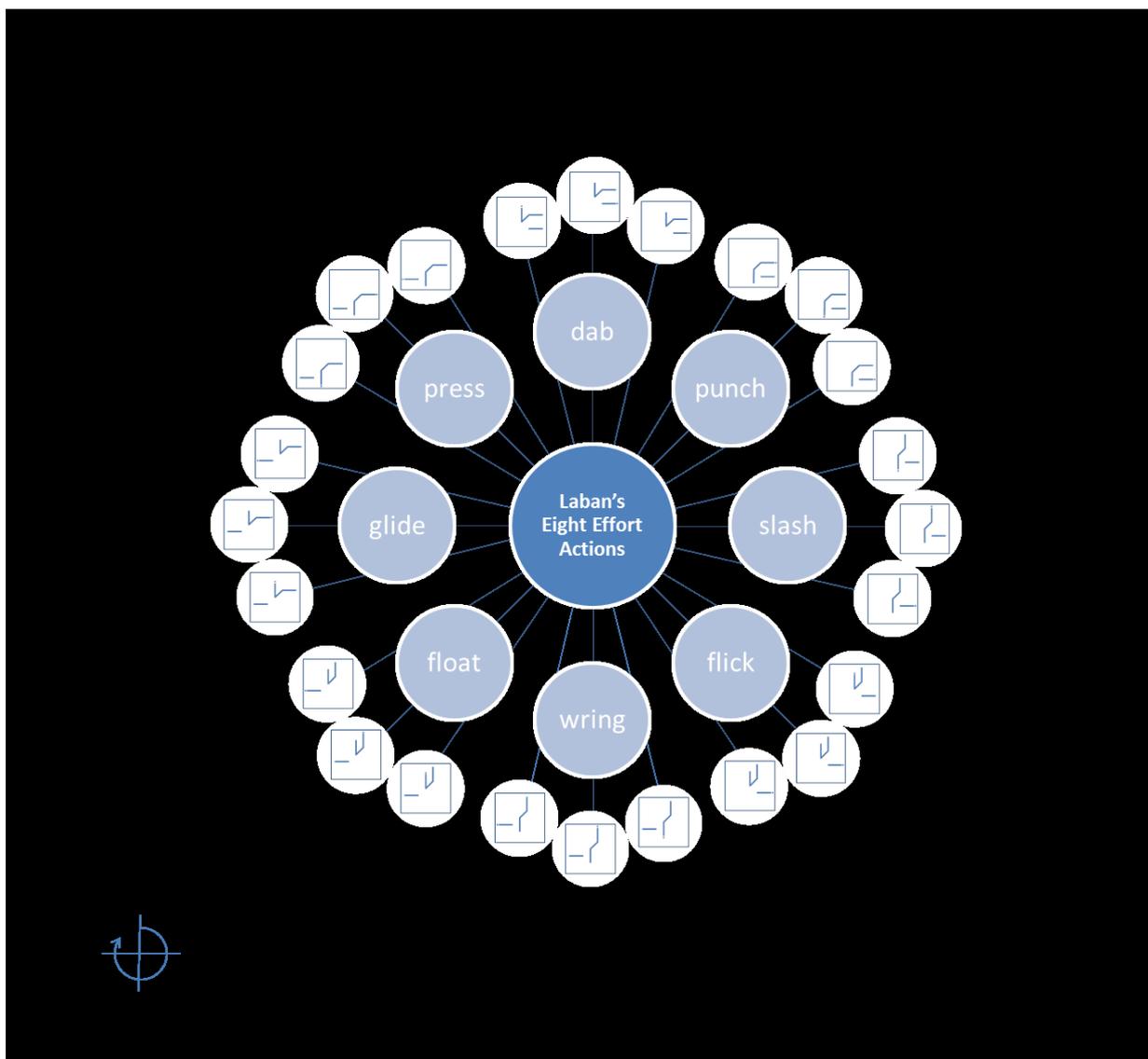


173

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

175 ‘Effort’ is the inner attitude towards a motion factor and is applied to (or through) eight  
176 basic Effort Actions. These are descriptively named Float, Punch, Glide, Slash, Dab,  
177 Wring, Flick, and Press, and have been used extensively in acting schools to train the

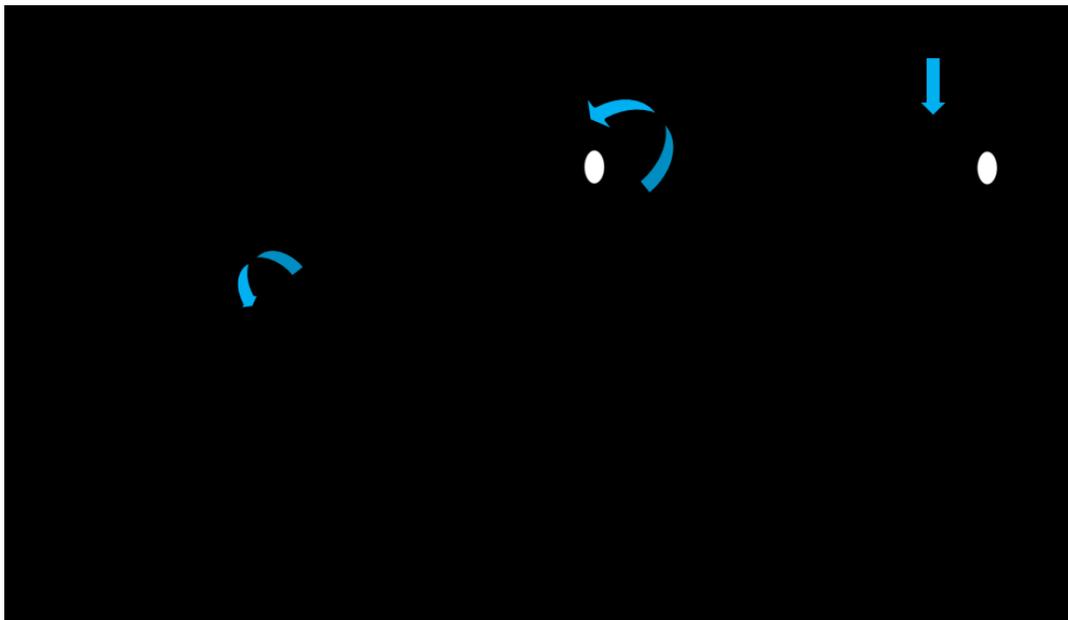
178 ability to change quickly between physical manifestations of emotion. Figure 2 shows  
179 the eight effort actions and how emphasis on different qualities can change their nature.  
180 The effort actions have been organised radially with direct effort actions towards the top  
181 and sudden actions towards the right.



182

183 **Figure 2: Laban's eight Effort Actions, with notation and examples of use (Laban,**  
184 **1960)**

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



196

197 **Figure 3: Storyboard illustrating the application of Laban’s effort actions to the**  
198 **use of an SLR camera**

199 **3. Workshop set-up**

200 Two workshops were organised where different groups of students had the opportunity  
 201 to use products and consider their interactions in relation to Laban. It is usually  
 202 suggested that Laban movement exercises are undertaken without actual products  
 203 present to focus on the quality of the movement and avoid any ‘consideration of  
 204 circumstances or (as in the case of the actor) characterisation’ (Newlove & Dalby,  
 205 2004). In this instance, however, it was desirable to elicit these kind of reactions. The  
 206 unfamiliar nature of some of the products as well as the importance in the subtle  
 207 differences between the interactions led to the decision to have the physical products  
 208 present to ensure the experiences were vivid and unequivocal for all. Both workshops  
 209 followed the same format:

- 210 • 30 minutes: Introductory talk on Laban
- 211 • 30 minutes: Preparatory physical exercises
- 212 • 1hr 30 minutes: Review of product pairs
- 213 • 30 minutes: Reflection

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

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

217 **Table 1: Sample worksheet response (Group 1, Workshop 2 for old and new coffee**  
 218 **cups)**

219 **3.1 Products for analysis**

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

	<b>Opening briefcase</b>	<b>Drinking coffee</b>	<b>Taking photo</b>	<b>Lighting cigarette</b>	<b>Reading newspaper</b>	<b>Making phone call</b>	<b>Typing</b>
<b>New</b>							
<b>Old</b>							

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

229 **3.2 Workshop 1**

230 Workshop 1 took place with a group of eleven 4<sup>th</sup> year undergraduate Theatre Studies  
 231 students, with a background in English, who were preparing for the performance of

232 'The Magic Suit' by Maurice Moiseiwitsch (Bourne, 1938), a play set in the 1930s. The  
233 old and new product pairs meant the students would review products that would be used  
234 as props in performance. Having been provided with an overview of Laban's effort  
235 actions and undertaking preliminary exercises to familiarise themselves with their  
236 nature, the participants were asked to review the physical interaction with four product  
237 pairs and discuss their emotional reaction to the gestures used in the operation of each.  
238 Each team was situated at a table on which they could manipulate the products (Figure  
239 4) and typically took 20-30 minutes to discuss each product pair over the course of the  
240 two hour session. Staff were on hand to clarify how to use the different products and to  
241 facilitate discussion where necessary, but the teams were generally free to manage their  
242 time and discussions as they wished.

### 243 **3.3 Workshop 2**

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

250



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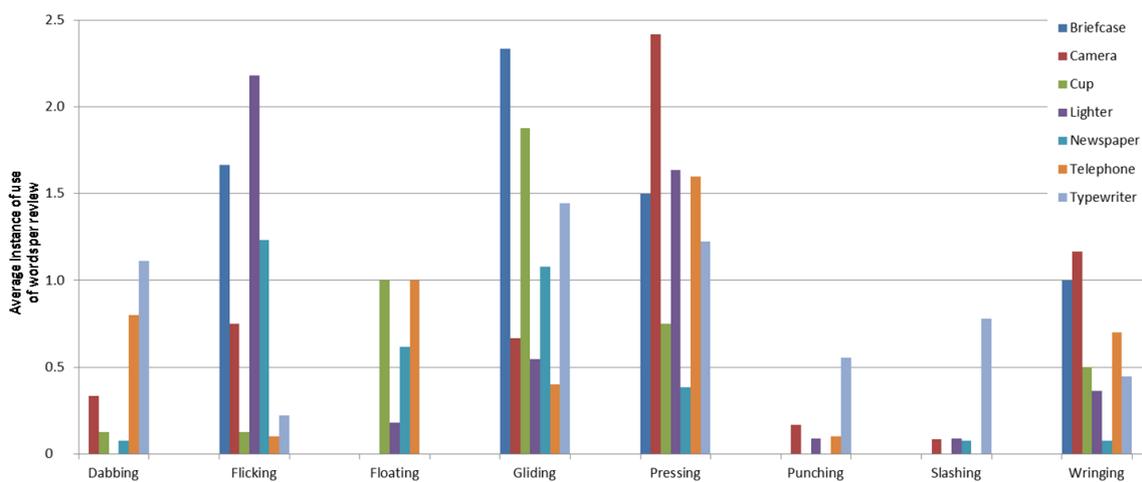
252 **Figure 4: Teams discussing product pairs in Workshop 1, with facilitation by the**  
253 **research team**

#### 254 **4. Results**

255 Given the practice-based nature of the workshop experience, each team was asked to  
256 keep worksheets analysing the movements associated with each product and detailing  
257 their emotional reaction. While self-assessment (rather than, for example, observation  
258 by a trained Laban specialist) may introduce an element of unreliability, the participant  
259 interpretations of the interactions form an important part of the analysis. Having already  
260 reviewed and discussed the sequences with respect to Laban, the worksheets demanded  
261 the participants consider how the different effort actions elicited different responses.  
262 With the worksheets used as the basis for content analysis (Hsieh & Shannon, 2005) and  
263 combined with observation by the researchers, the results are broken down into four  
264 sections: a summative overview of the Laban movements identified and used by the  
265 participants; a directed content analysis using Laban terminology with respect to old and  
266 new product pairs; a review of the variation between the two user groups using  
267 codification of responses; and a summary of participant reactions.

268 **4.1 Overview of movements**

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



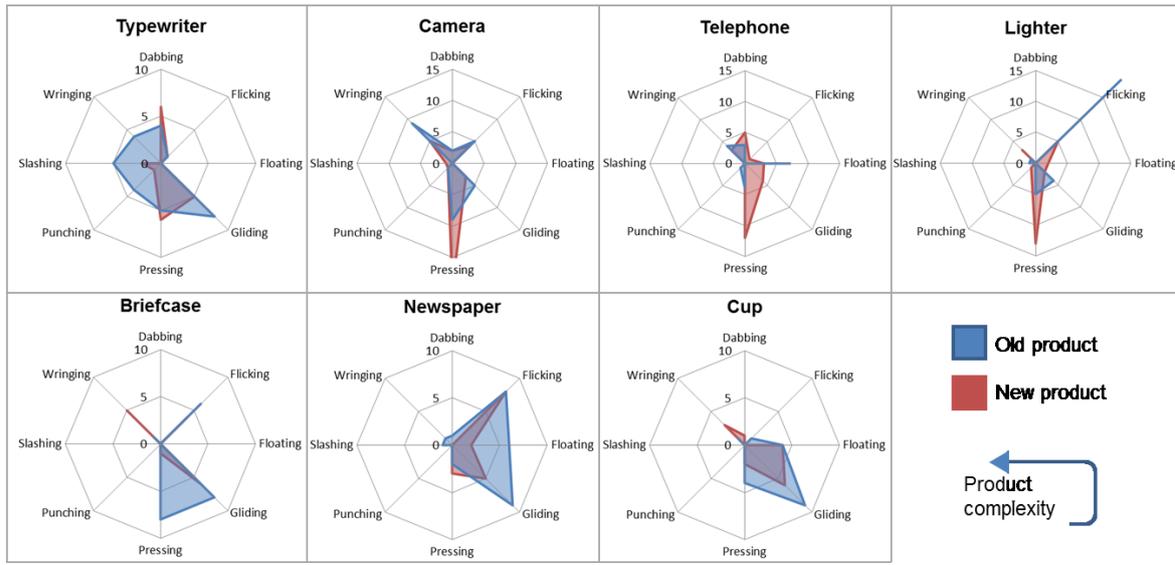
284

285 **Figure 5: References to Laban’s effort actions for each product during the session**

## 286 4.2 Old/ new product analysis

287 Next, we considered each product in more detail. Figure 6 shows the old and new

288 versions and the terms used by each team. Each product is discussed in turn below.



289

290 **Figure 6: Analysis of Laban terminology associated with old and new products**

### 291 4.2.1 Briefcase

292 The main difference between the two models of briefcase was the fine motor skills

293 required by the older model. The *flapping-flicking* and *squeezing-pressing* demanded

294 precise and defined motions, took more time and encouraged an element of reflection

295 during the process that may be valuable in checking and reflection. The newer laptop

296 bag with zip was considered far more convenient in nature. A *stretching-wringing*

297 motion dominated the interaction that demanded less concentration and precision, and

298 took less time.

299 **4.2.2 Camera**

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

308 **4.2.3 Cup**

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

319 **4.2.4 Lighter**

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

329 **4.2.5 Newspaper**

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

339 **4.2.6 Telephone**

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

349 **4.2.7 Typewriter**

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

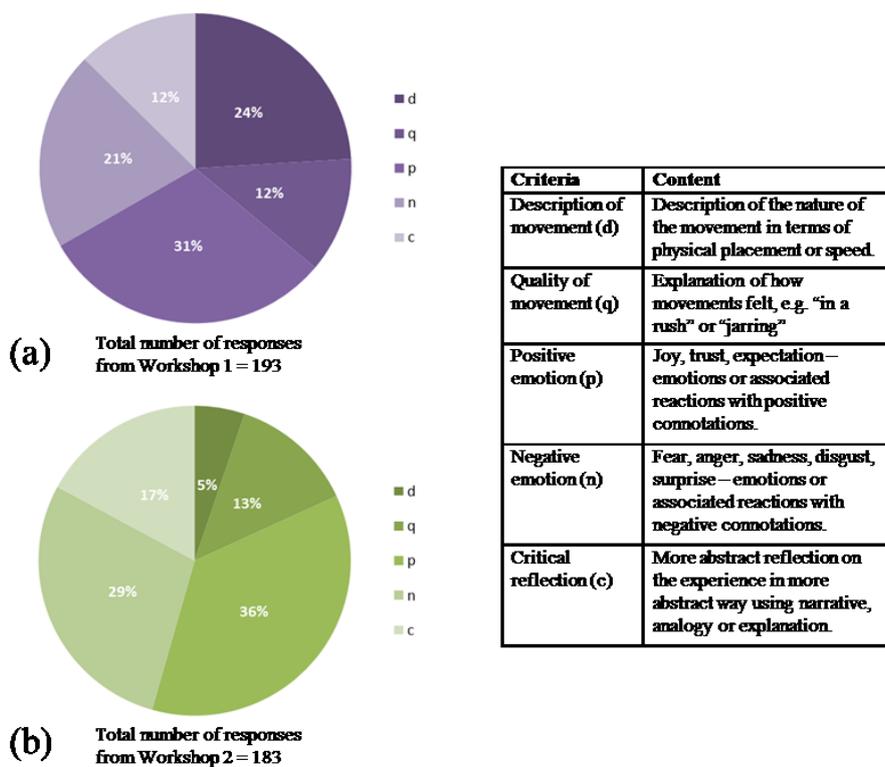
### 361 **4.3 User groups**

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

370

371 On further exploration of the vocabulary used, it was found that in Workshop 1 there  
372 was a greater prevalence of terms such as *concentration* and *purposeful* in reviewing the  
373 movements, while in Workshop 2 *satisfaction* was a dominant emotional reaction to the  
374 product experiences. Variations in mood (encompassing environment and atmosphere)  
375 and context (encompassing background and expertise) may have contributed to these  
376 discrepancies. Regarding mood, an effort was made to keep the two spaces as neutral as  
377 possible – both took place in open-plan studio type environments. One difference was  
378 that Workshop 1 was smaller and in an off-campus location, which contributed to a  
379 more focussed and concentrated atmosphere as there was a sense that a ‘special’ task  
380 was being undertaken. The second difference was in context. Similar preparation in  
381 terms of warm-up exercises and briefings for both sets of students took place. However,  
382 Laban is already well established in the performing arts and the Theatre Studies students  
383 were highly motivated to understand the use of the products (or ‘props’) for their play.

384 As a consequence, their documentation of reactions to the products tended to be more  
 385 elaborate – an average response of 45 words per student for Workshop 1 and 10 words  
 386 per student in Workshop 2. In terms of background, the Design Engineering students  
 387 can be expected to be more familiar with technology and comfortable in the mechanical  
 388 operation of devices. This may also have contributed to the greater levels of  
 389 concentration and purposefulness apparent with the students studying English –  
 390 particularly apparent in the operation of the older, unfamiliar camera and typewriter.



391  
 392 **Figure 7: Breakdown of responses in worksheets for (a) Theatre Studies class and**  
 393 **(b) Design Emotion and Experience class**

394 **4.4 Response to movement**

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

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

	Press, flick, wring	Quick, skim	Casual, relaxed		Press, wring	Grand, ritualistic	Isolated, overwhelming
	Dab, press, glide	Sudden, jerky	Frustrating, impatient		Dab, float, wring	Slow, purposeful	Enjoyment, listlessness
	Dab, glide	Soft, graceful	Relaxed, gentle		Press, punch, slash	Aggressive, intricate	Concentration, fun

408 **Table 3: Reaction of participants to different gestural interactions**

409 **5. Discussion**

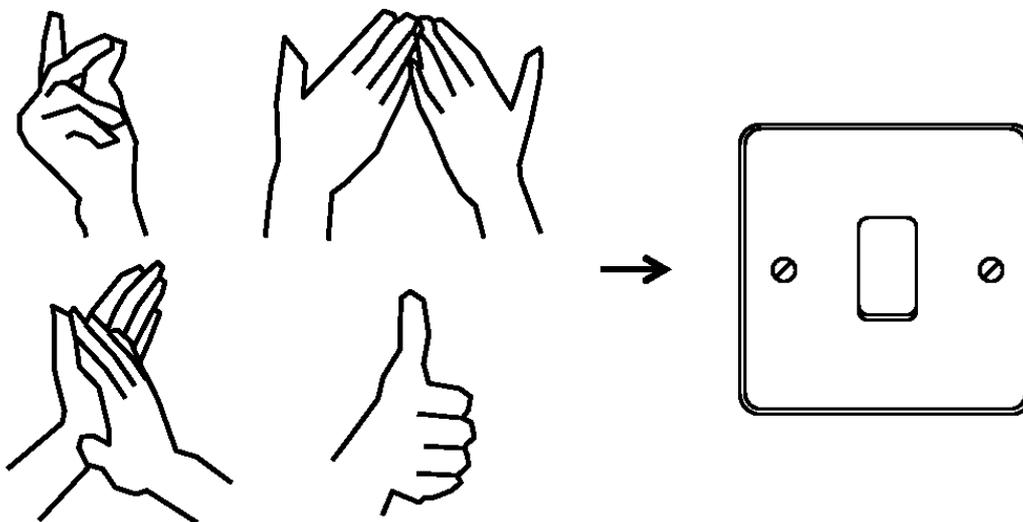
410 The results presented in this paper are the initial stages in research to establish the role  
411 of movement in product interaction. While the end output of this is anticipated to be a  
412 set of ‘indicators’ for developing product interactions (see below), some initial  
413 considerations for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

414 **5.1 Aligning movement to product function**

415 The first finding of the research is that certain movements do align broadly to different  
416 emotions. It was found that the more varied and physically grander gestures of the  
417 traditional products led to more discussion. For example, many of the electronic  
418 versions of the products (telephone, typewriter, camera) were dominated by simple  
419 pressing or dabbing motions that were considered easy, convenient and quick. However,  
420 the more evocative slashing, flicking and floating motions demanded by their older,  
421 mechanical equivalents – while requiring more concentration and focus – were more  
422 rewarding and enjoyable.

423

424 As emotional reactions to different movements become more closely correlated,  
425 designers will be able to design the gestures that operate the device well and give rise to  
426 pleasurable experiences as a result. In this respect, it is important for the designer to  
427 understand product context and interpret what emotional responses are generally most  
428 appropriate with regards to functionality. For example, if a traditional light switch is  
429 replaced by a motion controller, what is the best way to physically activate the lighting  
430 of a room (Figure 8)? It could be a more energetic action such as snap the fingers or  
431 clap the hands – similar to the flicking and plucking motions described above – to  
432 induce a happy or excited mood. Conversely, a gentle wave or patting motion – akin to  
433 the stirring and floating motions – may be selected to invoke a more relaxed feeling.  
434 Broad correlations have emerged between certain actions and emotional responses as  
435 highlighted in Table 3. The next stage of the research will utilise emotional frameworks  
436 and semantic questionnaires to discern more clearly particular links.



437

438

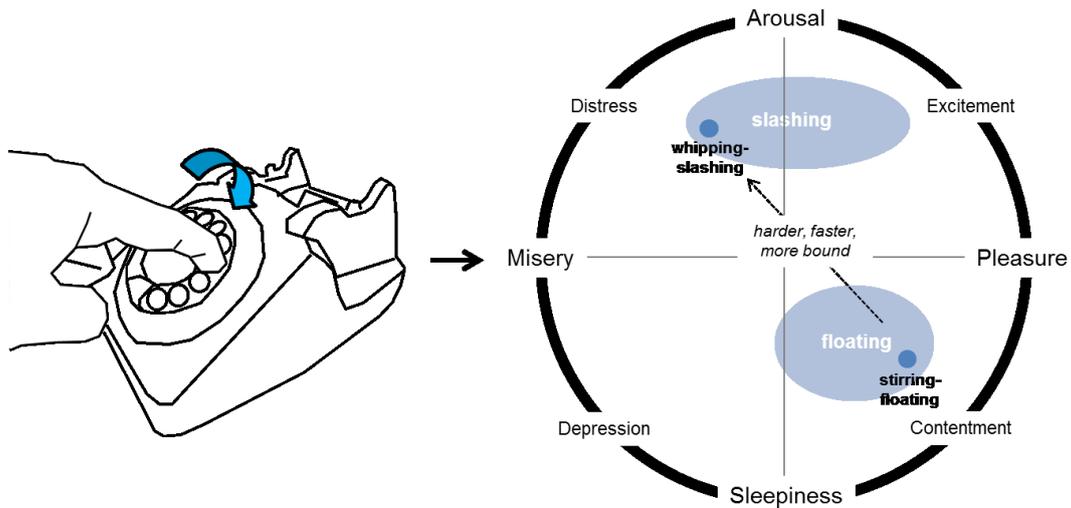
**Figure 8: Different gestural options for activation of a light switch**

## 439 5.2 Emotional conflicts in movement

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

449

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



462

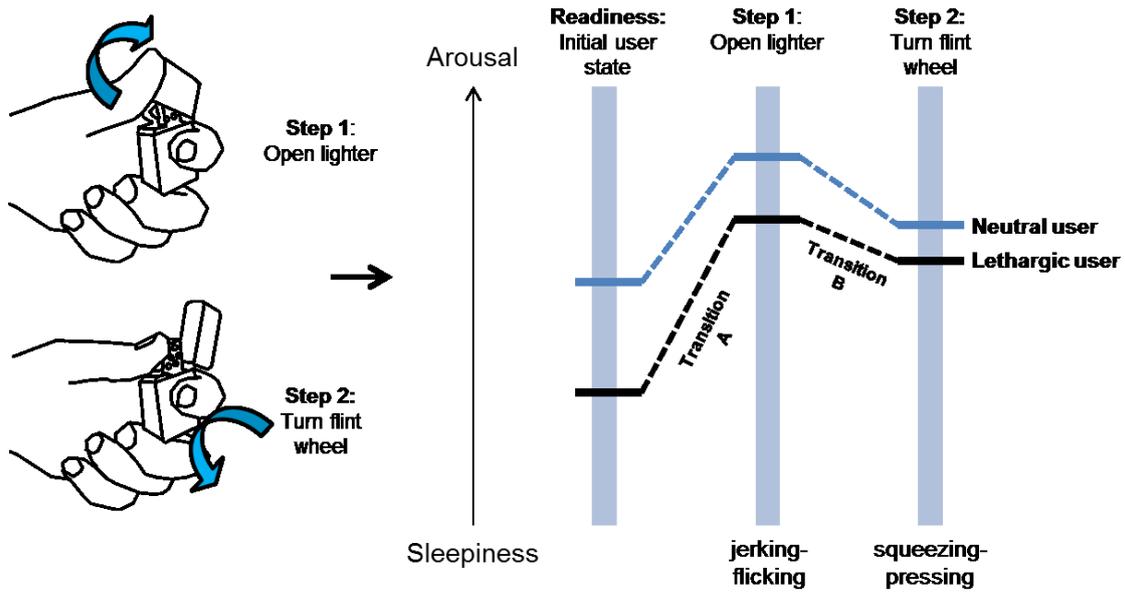
463 **Figure 9: The difference in action and emotional response for dialling a telephone,**  
 464 **after Russell (1980)**

465 **5.3 User readiness and framing a sequence of movements**

466 These variations in user reaction to different movements are quantified through what we  
 467 have termed *readiness*. We define this as ‘*the user’s mood in relation to the nature of*  
 468 *the proscribed action*’. In evaluating the results of the workshops, it was found that  
 469 sequences of gestures played an important role in the performance of a product  
 470 operation – for example the old-fashioned typewriter entailed feeding paper, pressing  
 471 keys, swiping carriage returns and releasing paper. These combined in such a way as to  
 472 provide anticipation, action, punctuation and closure, helping to make the overall  
 473 product use more immersive. This combination of movements within a product  
 474 interaction we refer to as *framing*, and may be of assistance in addressing user readiness  
 475 when interacting with a product.

476

477 Figure 10 illustrates the concepts of user readiness and interaction framing when using a  
478 Zippo lighter. This was one of the more evocative interactions in the study, eliciting a  
479 large number of mostly positive comments. One of the reasons is its sequential nature:  
480 in the case of the Zippo lighter, opening the lid and turning the flint wheel. This framing  
481 of the product activation with the preparatory opening of the lid provides an element of  
482 ritual and drama. In terms of Laban, the two actions can be identified as *jerking-flicking*  
483 and *squeezing-pressing*. Based on the results of the workshops, jerking-flicking has  
484 been identified as an action with relatively high excitement and arousal levels.  
485 Squeezing-pressing also entails a reasonable level of concentration and precision. If a  
486 user approaches the interaction in a state of relative lethargy, the initial action of  
487 opening the lighter (through transition A) may induce a certain level of engagement that  
488 moves them closer to the relatively high level of arousal associated with the action. This  
489 then means that in undertaking the second action (through transition B) they become  
490 more closely aligned with the emotional state than they would otherwise. This does not  
491 account for the tension caused by users who ‘fight against’ the natural way of operating  
492 the device, similar to the example discussed regarding the telephone. Quantifying  
493 readiness, understanding how discrepancies in mood can affect use, and the effect of  
494 framing sequences are to be the subject of further investigation.



495

496 **Figure 10: The sequenced interaction of using a Zippo lighter, illustrating the**  
 497 **effect of user readiness**

498 **5.4 Conclusions and future work**

499 As a new generation of motion controlled products emerges, there is an opportunity to  
 500 incorporate movements as appropriate for the body and emotional reaction rather than  
 501 the activation of a mechanism. This paper reviews two workshops where participants  
 502 experienced physical interactions with products using movement theory from dance and  
 503 drama. Although there were a number of limitations to the work, in particular the two  
 504 groups being from different educational backgrounds (one from the Arts, one from  
 505 Design Engineering), a number of common themes emerged in emotional reaction with  
 506 more dynamic and sequenced movements increasing the level of engagement and  
 507 satisfaction. The work presented here provides the basis for further work in a rapidly  
 508 emerging field.

509 The emotional reactions gathered require further expansion and refinement to ensure  
510 they cover the range of gestures described by Laban (for example, punching was not  
511 featured in the product interactions) before formalising a vocabulary. When complete,  
512 this will provide the basis for a semantic differential questionnaire. It is anticipated that  
513 this work will run concurrently with motion capture and analysis (measuring position,  
514 velocity, acceleration etc), providing the opportunity to quantify and categorise the  
515 different movements suggested. It is envisaged that this will be packaged as a set of  
516 indicators of likely emotional reactions to different movements which, along with  
517 illustrative examples, will provide a reference for designers when developing product  
518 interactions. For educationalists in the performing arts, the work points to how  
519 techniques in this area can be developed to provide drama students with greater  
520 understanding of the role props can play in performance and characterisation.

521

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

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