Wriggle: An Exploration of Emotional and Social Effects of Movement

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Abstract
Wriggle is a research prototype game that can be played either with or without movement as input. We conducted an experiment to see whether movement adds emotional impact and increases social connectedness. We found effects on arousal and results approaching significance for social connection, demonstrating the potential for this approach to help us better understand the impact of movement on user experience.

Keywords
Movement mechanics, emotion, social play, games.

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

General Terms
Design, Human Factors

Introduction
Gesture and motion are becoming an increasingly common mode of engaging with computers. The dream of using sweeping gestures and movements to communicate with machines is now a commercial

Figure 1. Screen shots of Wriggle's first and second stages.

reality, primarily in the realm of digital gaming, but also in other categories (e.g. the iPhone and iPad).

HCI practitioners caution that movement-based interaction could lead to worse usability [11], but these systems also offer exciting possibilities. Greater range of motion, if it leads to more nuanced physical expression and interaction, could expand options for communication and response, allowing richer emotional engagement and social connection [14].

HCI researchers have been heralding the return of embodiment to engagement with interface for some time now [e.g. 2], and the discussion of how best to design for these contexts is ongoing [7, 5, 16, 10]. There have been notable experiments with creating new forms of emotional and social engagement through movement [e.g. 9, 17, 19], from which valuable insights can be derived. However, these efforts do not isolate movement as a variable in interaction sufficiently to allow confidence about exactly which aspects of the design are causing which responses.

We are interested in finding a way to generate replicable and extensible knowledge about how movement contributes to the user experience, particularly in terms of how it may heighten and broaden emotional and social experience. Toward this end, we have begun a series of experiments in which we craft research prototypes which are sufficiently tuned and engaging to allow us to conduct design research [3], without being end use artifacts in and of themselves. We believe this strategy is a fruitful one for pinning down effects in such highly dynamic systems [7]. This writeup describes work in progress in which we are using a research prototype to isolate and examine the emotional and social effects of movement as a game mechanic (versus keyboard input). The most closely related approach to ours from the HCI community would be that of [8], which compared engagement and degree of social interaction between groups of players who either used the Nintendo GameCube's custom Bongo drum input device, or the standard game controllers. We have also conducted a controlled comparison of a single game with different input devices. Instead of using an off-the-shelf game, we designed our own research game, with movement mechanics we crafted to alter emotional state and feelings of social connectedness between players. We designed these mechanics based on prior analysis of existing Wii games, and a review of relevant Social Psychological findings [6]. The benefit of our approach is that it is more targeted and more extensible. Essentially, we have created a research testbed that can be adapted and adjusted to conduct an ongoing series of experiments that isolate different design factors (rather than seeking extant comparable example systems to ask each question).

Method

We began with the observation that movement profoundly impacts player experience with Wii games. We saw heightened emotional response and dynamic and highly engaged social interaction among players (something also noted by others who have closely observed Wii play, e.g. [18]). We conducted a series of observations of Wii games across a range of genres [6], examining emotional and social impacts of various movement styles. Working from these observations, we designed a simple game called Wriggle (figures 1-3).

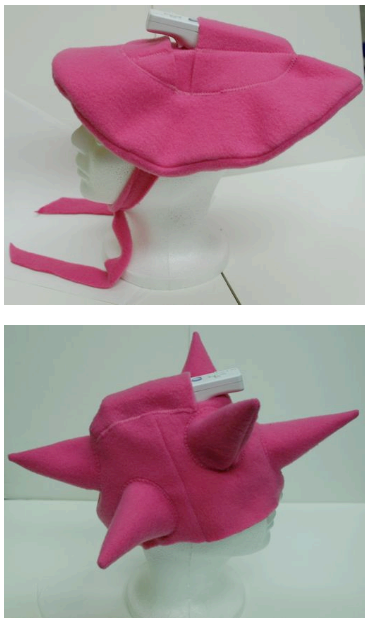

Figure 3. Wiimote hats for playing the movement variant of Wriggle. Note that hat characteristics map to visual appearance of avatars' hats on-screen (see Figures 1 and 2).

Wriggle can be played using either hats (see figure 3) or keyboard input—here we'll describe the hat version. (It's best to see a video, to really grasp game play: http://socialgamelab.bxmc.poly.edu/projects/emotionandmotion/.) Both players put on hats with Wiimotes in them (see figures 2 and 3), and then they enter the game's first stage, where they try to attract onscreen 'critters' into their avatars' bodies (figure 1, top). To do so, they must perform the same movements the critters are making (by rapidly bowing or leaning side to side). These movements are rhythmic and vigorous, like movements we observed in commercial games that seemed to promote positive and high-energy affect, and social interaction.

In the second stage, the players' avatars are standing outdoors on a windy day, trying to keep their 'hats' on (figure 1, bottom). Players must tilt their heads from side to side to adjust the position of their avatars, so that the hats stay on. The critters that the players managed to collect in the first phase modulate the responsiveness of their avatars a bit, adding to the game's challenge (one kind makes the avatar more responsive, the other kind makes the avatar less responsive). The first player to lose their avatar's hat loses this round. The player who wins two rounds first, wins the game.

We mounted Wiimotes in hats for the movement version, to ensure that players would really use broad, vigorous movement (sometimes players who hold Wiimotes in their hands move just a little, once they figure out this is enough to get accelerometers to work). In the keyboard version, players share a computer keyboard and each has a set of 4 keys that correspond to up/down and left/right movement.

We hypothesized that playing the Wiimote-enabled game would lead to increased positive valence and arousal in emotional state (a commonly accepted dimensional model of emotion—see [13]), based on the physical feedback loop effect [15]. We also hypothesized that playing the movement condition would lead to a greater sense of connectedness between players, which we operationalized using a scale from Social Psychology, the Inclusion of Other in the Self Scale [1].

Figure 2. Players wearing the hats, getting ready to play.

Procedure

We designed a between-subjects study in which pairs of players either experienced the movement or keyboard version of the game. There were 28 participants; 19 male, 9 female. All were students at a Northeastern university, offered the chance to win small prize if they took part. Each player completed a brief pre-survey, with questions about gaming experience as well as three pre- and post- test questions focusing on arousal level, positive or negative valence of emotion, and social connectedness to their playing partner. These were Likert-scaled ratings from 1 to 5.

To train the participants on the game controls, we asked them to copy their responses to the three pre-questions into an on-screen version of the questions within the game. Participants who used the hat thus learned how to perform the two main game movements: bending forward and backward and bending their bodies from left to right. Participants who were chosen to use the keyboard thus learned their 4-key combination. Test subjects trained once and then played 5 win/lose cycles of the game. Participants were filmed during play, and the game output was captured, for later analysis. We also recorded accelerometer data from the Wiimotes and key presses from the keyboard.

Results

Descriptive statistics for the two conditions are shown in Table 1. Because participants completed the experiment in pairs, each individual's score is added to his or her partner's to account for variance bases on pairings. Condition represents which form of input a pair was using to play. Mean scores represent score for the pair, with two ratings on a scale of one to five combined.

We analyzed results using an Independent Samples T-tests of change scores. Change scores were a pair's post-test score minus the pretest score. Descriptive statistics for this analysis can be seen in Table 2.

Results of Independent Samples T-tests are shown in Table 3. Column t represents the t score while the p value represents the significance. As shown, the independent samples t-test was significant for arousal ($t = 2.91$, $p<.05$) and approaches significance for social connectedness ($t = 1.99$, $p<.10$).

Question	Condition	Means		N
		Pre	Post	
Arousal	Keyboard (K)	6.33	6.17	7
	Hats (H)	5.71	8.29	7
Valence	K	7.83	8.50	7
	H	7.29	8.00	7
Social connectedness	K	7.33	7.50	6
	H	6.00	7.86	7

Table 1. Univariate statistics for variables in the analysis. See also figs 4-6, for graphs of this data. (One keyboard participant failed to answer the social connectedness question, hence the N of 6).

Question	Condition	N	Mean Change Score	Std. Deviation
Arousal	K	7	-.14	1.68
	H	7	2.57	1.81
Valence	K	7	1.00	1.63
	H	7	.71	1.60
Social connectedness	K	6	.17	1.72
	H	7	1.86	1.35

Table 2. Descriptive statistics for change scores.

Question	*df*	*t*	*p*	Mean Difference	Std. Error of the Difference
Arousal	12	2.91	<.05	2.71	.93
Valence	12	-.33	>.05	-.286	.87
Social connected.	11	1.99	<.10	1.69	.85

Table 3. Independent samples T-tests.

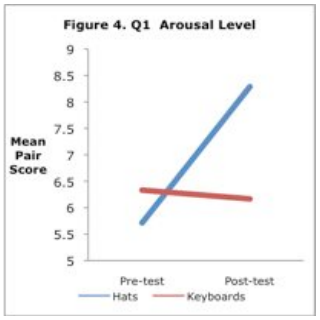

Figure 4. Q1 Arousal Level

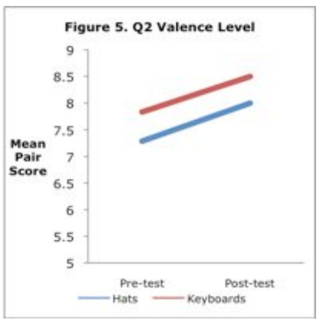

Figure 5. Q2 Valence Level

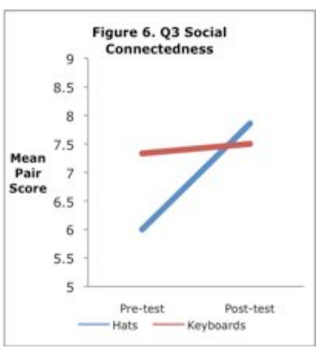

Figure 6. Q3 Social Connectedness

To gain a further understanding of the nature of the difference between conditions for each question, mean scores for each pair were graphed. Figure 4 displays the differences between groups on arousal level between pre-test and post- test. The results of question 2, which did not have a significant interaction, can be seen in Figure 5, which shows the change between pre-test and post-test scores for each condition on question 2. Question 2 measured levels of emotional valence with higher scores being more positive. Finally, the results for question 3 approached significance for the independent samples t-test. The mean scores for question 3, which measured social connectedness, are shown in Figure 6.

The results provide mixed support for our hypotheses—it seems that introducing movement definitely impacts arousal, but we did not get an increased effect in terms of positive valence of emotion. Playing the keyboard version of the game is just as positive as playing the movement-enabled version, if not a bit more so. The results for social connectedness approach significance, indicating that our hypothesis that movement can lead to greater social connectedness could have merit, and is thus worth further study. Not all player pairs knew each other, and it is hard to anticipate how individuals will get along, so this result is especially noteworthy in that it showed up through this 'noise' with a small number of participants involved.

For all three questions, initial self-rating was higher in the keyboard than in the hat condition. This was especially true for the social connectedness measure. Our group speculated that this might be due to the novelty of wearing Wiimotes (seems embarrassing and maybe produces nervousness at first, but then draws people closer). We are designing follow-up games to test social connectedness without wearing the Wiimote.

Conclusion and Next Steps

This paper presents preliminary results of our comparison of movement versus keyboard controls for a research game. We have not yet analyzed the movement data and video recordings. We plan to use what we glean from these to help guide future studies. We have also begun crafting other cooperative play games that can be played with or without movement, to further explore which kinds of movement mechanics enhance sense of social connectedness. Finally, we are exploring non-game tasks that would give us a different look at how movement affects emotional valence.

There is not yet a shared set of dimensions/analytical framework for understanding how movement impacts the user experience, though there are various forays that are quite promising (e.g. [4, 14]). We plan to continue this research with a more nuanced set of movements based upon well-researched and promising dimensions that are likely to be emotionally and socially meaningful. We would be excited to get feedback on this early work, towards refining and extending our approach. If we are invited to present our poster at the conference, we will also bring a working version of the game, with the hats, so we can share and get feedback on the details of the movement design as well.

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References

[1] Aron, A., Aron, E.N., and Smollan, D. Inclusion of Other in the Self Scale and the Structure of Interpersonal Closeness. Journal of Personality and Social Psychology 1992 63(4): 596-612.

[2] Dourish, P. Where the Action Is: The Foundations of Embodied Interaction. MIT Press, 2001.

[3] Fallman, D. Design-Oriented Human Computer Interaction. In Proc. CHI 2003, ACM Press (2003), 225-232.

[4] Fogtmann, M.H., Fritsch, J., and Jortbek, K.J. Kinesthetic interaction: Revealing the bodily potential in interaction design. In Proc. OZCHI 2008, 89-96.

[5] Höök, K. Transferring Qualities from Horseback Riding to Design. In Proc. NordiCHI 2010, ACM Press (2010), 226-235.

[6] Isbister, K. and DiMauro, C. Waggling the Form Baton: Analyzing Body- Movement-Based Design Patterns in Nintendo Wii Games, Toward Innovation of New Possibilities for Social and Emotional Experience. In Whole Body Interaction (forthcoming), Springer.

[7] Isbister, K. and Höök, K. On being supple: In search of rigor without rigidity in meeting new design and evaluation challenges for HCI practitioners. In Proc. CHI 2009, ACM Press (2009).

[8] Lindley, S., Le Couteur, J., and Bianchi-Berthouze, N. Stirring up Experience through Movement in Game Play: Effects on Engagement and Social Behaviour. In Proc. CHI 2008, ACM Press (2008), 511-514.

[9] Moen J. Kinaesthetic movement interaction: designing for the pleasure of motion. Unpublished PhD, KTH, Numerical Analysis and Computer Science, Stockholm, 2006.

[10] Mueller, F. Gibbs, M.R., and Vetere, F. Towards understanding how to design for social play in exertion games. Personal Ubiquitous Computing 2010 (14): 417-424.

[11] Norman, D. and Nielsen, J. Gestural Interfaces: A Step Backwards in Usability. In Interactions 17.5 (September/October 2010):

[12] Pasch, M., Bianchi-Berthouze, N., van Dijk, B., and Nijholt, A. Movement-based Sports Video Games: Investigating Motivation and Gaming Experience. In Entertainment Computing 1(2009): 49-61.

[13] Russell, J.A. A Circumplex Model of Affect, Journal of Personality and Social Psychology 39(6), pp. 1161-1178, American Psychological Association, 1980.

[14] Sheets-Johnstone, M. Emotion and Movement: A Beginning Empirical-Phenomenological Analysis of Their Relationship. In Journal of Consciousness Studies 6 (11-12, 1999): 259-77.

[15] Strack, F., Martin, L.L., and Stepper, S. Inhibiting and facilitating conditions of the human smile: A nonobtrusive test of the facial feedback hypothesis. Journal of Personality and Social Psychology 1988 54: 768-777.

[16] Sundström, P. and Höök, K. Hand in Hand with the Material: Designing for Suppleness. In Proc. CHI 2010, ACM Press (2010), 463-472.

[17] Sundström, P., Ståhl, A., Höök, K. In Situ Informants Exploring an emotional Mobile Messaging System in Their Everyday Practice, In a special issue of IJHCS on Evaluating Affective Interfaces, vol. 65, issue 4, pp. 388 – 403, April 2007.

[18] Voida, A. and Greenberg, S. Wii all play: The console game as a computational meeting place. In Proc. CHI 2009, ACM Press (2009), 1559-1568.

[19] Zangouei, F., Gashti, M.A.B., Höök, K., Tijs, T., de Vries, G-J., and Westerink, J. How to Stay in the Emotional Rollercoaster: Lessons Learnt from Designing EmRoll. In Proc. of NordiCHI 2010, ACM Press (2010), 571-580.