

# Engagement: the Inputs and the Outputs – Conference Overview

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## ABSTRACT

The Inputs-Outputs interdisciplinary conference on engagement (and related terms) was structured to cross-fertilise the relevant researchers from the arts, sciences and engineering on the causes, consequences and assessment of engagement. The goal of the conference was to encourage interdisciplinary research and collaboration on engagement, presence, immersion, interest, cognitive absorption, motivation (educational), vigilance and user-experience. Three themes emerged from the juxtaposition of this broad group of academics and practitioners: 1) Challenge, in many cases, aids the creation of engagement. 2) The consequences arising from engagement are often fundamentally social. 3) The measurement and assessment of engagement is advancing via engineering and computer science.

## Categories and Subject Descriptors

H.1.2 [Information Systems]: User Machine Systems – *software psychology, human factors*. H.1.5 [Information Systems]: User Interfaces – *Evaluation Methodology*. K.3.1 [Computers and Education]: Computer Uses in Education – *computer uses in education*.

## General Terms

Measurement, Design, Experimentation.

## Keywords

Engagement, immersion, presence, cognitive absorption, interest, boredom, usability, user experience, motivation, action inhibition, autistic spectrum disorders, immersive theatre.

## 1. INTRODUCTION

The Inputs-Outputs interdisciplinary conference on engagement (and related terms) was structured to cross-fertilise the relevant researchers from the arts, sciences and engineering on

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*Inputs-Outputs '13*, June 26 2013, Brighton, United Kingdom  
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<http://dx.doi.org/10.1145/2557595.2557596>

three questions:

- What causes people to become engaged
- What are the consequences of their being engaged
- How do we assess / measure engagement or its effects

Engagement has much in common with related terms such as presence [1], immersion [2], interest [3], cognitive absorption [4], motivation (educational) [5], vigilance [6], and (aspects of) user experience [7]. However, each of these terms is rooted in one discipline's academic literature that may not be read by academics in the other disciplines. By juxtaposing academics and practitioners from such diverse backgrounds as theatre, electrical engineering and brain scanning, and providing them with a forum to communicate with each other in language that all could understand, many surprising and counter-intuitive themes emerged.

The goal of the conference was to encourage interdisciplinary research and collaboration. This brief conference overview is meant to introduce the casual reader to the main ideas of the conference, with enough information to follow the conference documentation (as well as the academic literature) in order to understand and follow up on the many exciting contributions of the conference. This introduction will have two parts. In this first part, some of the fundamental questions of engagement will be listed, including what is suggested by engagement and why we chose not to define the term. In the second part of this paper, we show how the contributions of the speakers answer (in part) the conference's original questions. These answers appeared in three counter-intuitive themes:

**1) Challenge, in many cases, aids the creation of engagement.** While this may seem obvious to artists and gamers, after 30 years of digital research on usability, the repercussions for digital designers and assessors is almost unimaginable.

**2) The consequences arising from engagement are often fundamentally social.** While this may seem obvious in the case of speed dating, previously it was certainly not obvious in the context of human-computer interaction in autistic spectrum children.

**3) The measurement and assessment of engagement is advancing via engineering and computer science.** The unshakable idea that engagement may not be easy to define, but "I know it when I see it" has not lent itself well to self-assessment [8]. There are examples when experiences may be immersive but not characterised by presence; rather than say that one construct or instrument is better than another, we need to go back to first

principles and ask, “What is it we are really looking for?” If it is “interest”, we need to be able to recognise that interest (and engagement) manifests in different forms. When faced with these difficult definitions, various engineering methods are appearing that can transcend both self-report instruments and personal biases [9].

## 2. ENGAGEMENT: A FAMILY OF COGNITIVE STATES

If we had selected a single definition for engagement, the advantage would have been to make things more clear cut — experiences would be either engaging or not engaging, according to our definition — but this would have been a disadvantage in that it is exclusive rather than inclusive. There are many conceptual frameworks that are plainly related to engagement [10]: Immersion, Presence, Absorption, Interest, Motivation (especially in an educational context), Vigilance and (aspects of) User Experience — and this list is certainly not exhaustive. Often the research communities that adopt any one of these words will be unaware of major, relevant conceptual and intellectual progress from the other communities [8]. In terms of stimulating collaboration and cross-disciplinary learning, the Inputs-Outputs Conference welcomed all these terms for engagement and suggested that they all had a *family resemblance* to each other. We invited each participant to present their own version of engagement with the caveat that they needed to explain how their engagement might be understood in a jargon-free interdisciplinary context. To aid in that endeavour, we provided a defined but open framework for understanding and describing different ways people might be engaged, immersed, present, etc.. None of these properties are *necessary* in the definition of engagement, but combining them leads to a particularly strong form of engagement. Each speaker was invited to select as many (or as few) from among these options as was relevant to their own research:

**Attendance** — physical presence at an event rather than being elsewhere [11; 12]. For digital events this translates into page views, time on page and return visits [13].

**Attention** — paying attention to a stimulus or experience includes vision and gaze, while excluding attention to other possible thoughts, stimuli or experiences [14].

**Memory** — after the event, some aspect of the experience may enter recall- or recognition-based memory [15; 16]

**Caring** — beyond showing up, watching and remembering an event, an engaged person may care about the process or outcomes of events [17].

**Emotion** — plainly some highly engaging events elicit powerful emotions, although not all engagement (which is a cognitive state) is emotional [18; 19], and not all emotional states are necessarily engaging in every way (e.g. there can be highly emotional events such as passing by a loud, aversive noise that can be forgotten in a matter of hours).

**Inhibited actions** — in many forms of engagement, the most obvious aspect of the experience is what does *not* happen. For example, students engaging with a university lecture are less likely to get up and go to the lavatory, or to update their Facebook page [20]. Plainly there are exceptions (e.g. updating one’s Facebook page to say, “I am attending the best psychology lecture

ever — sneak in the back of the main lecture hall and you will be amazed!”), but there are also much more subtle examples. Players of vigilance-based games will suppress most unnecessary (and often non-instrumental) movements, in order to focus on maintaining visual contact with the relevant aspects of the game [21; 22].

**The Urge to Share: Promotion, Recommendation, and Edurability** — for advertisers and commercial web developers, this is the holy grail of engagement, but this fundamentally social activity is based on a deeper human-centred need to share what we find wonderful or meaningful with our loved ones and our wider social circle [23; 24].

In addition to these well-defined manifestations of engagement, there are more complicated and nuanced concepts that are essential to our inclusive approach:

**Understanding** — this implies having a structure of related knowledge that “fits together”. Understanding can manifest a) subjectively such that the perceiver feels strongly that they understand, or b) objectively, when the perceiver can answer complex questions about the system of knowledge [25; 26].

**Taking Action** — the engaged person takes action that is relevant to the affordances of the experience or stimulus. Breathing is not an action in a business meeting, but it is an action in a yoga class [27].

**Willingness** — this means that the person *voluntarily* takes an action that arises from their willingness to do something that they might reasonably refuse to do. That is, the action incorporates volition and is not primarily motivated by punishments or consequences of loss [28].

**Active Participation** — this may go beyond willingly taking action, with the participation being ongoing and social. Some might call this a pro-active state [29].

**Investment** — this means that the ongoing participation becomes connected to the person at the level of values or identity, such that the participation is not only ongoing, but is also future orientated. In such a situation challenges and difficulties to progression are met with a stronger response possibly motivated at the emotional level (e.g. renewed vigour or disappointment) [30].

## 3. CONFERENCE PRESENTATIONS OVERVIEW

The research of our speakers ranged from working with interface design for autistic children through to arts audiences, via classic usability. Hence, the answer to the question ‘what causes people to be engaged’ varies, according to the specific audience. What did emerge is that we cannot expect one particular type of interface to work for all audiences.

The conference went beyond analysis of the topic, to be a living example of what it means to be engaging. From the first session the conferees were in no doubt that they were going to be challenged to see things in a unique (and engaging) way. The challenges began when Senior Producer Colin Nightingale described Punchdrunk’s recent immersive augmented-reality theatre piece *The Borough*, in which an individual (i.e. an audience of one) begins the artwork in Aldeburgh -- on a lounge chair listening alone to headphones -- and ends up within an hour

being chased by an angry mob (of actors) through a swampy field [31].

This was followed by Steve Benford from the Nottingham Mixed Reality Lab, who described how challenging experiences have been shown to create deeper engagement. Benford showed examples of people interacting with a ‘bucking bronco’ machine akin to fairground rides, where the “user control interface” was their breathing rate [32]. While using deliberately challenging experiences to create compelling narrative trajectories may seem trivially obvious to artists and games designers, after 30 years of digital research on usability, the repercussions for digital designers and assessors are profound.

Tassos Stevens of Agency of Coney followed on with a presentation about their working process, which entails audience participation and co-creation to a significant degree. Echoing Steve Benford and Colin Nightingale, Carina Westling presented a paper on the connection between disorientation and engagement, raising questions about what predisposes people to prefer challenge versus order, respectively.

Effie Lai-Chong Law presented advances on what is user experience, and how it differs from usability [7], and Judith Good gave a presentation about her work with interface design for children on the autistic spectrum [33]. In order to not overwhelm autistic children using computers, she showed that interface designers needed to avoid causing sensory overload. This stood out in clear contrast against the theme of challenge, again raising the question of when people prefer challenge to predictability. The most counter-intuitive observation of Judith Good’s presentation was the video of an autistic young child who, after interacting successfully with the interface, manifested engagement by immediately afterward turning around to the researcher (who was not a friend of the child) to share his excitement. While the observation that the consequences of engagement are often fundamentally social may seem obvious in the case of social media analysis, it was certainly not obvious in the context of human-computer interaction in autistic spectrum children.

The detection and machine-recognition of subconscious signals of cognitive states (e.g. engagement) was also a major theme. Alessandro Vinciarelli introduced Social Signal Processing, in which nonverbal behavioural cues (vocalisations, facial expressions, gestures, postures, etc.) are the physical, machine-detectable evidence of social and psychological phenomena that are otherwise not accessible to computers [34]. Fabian Ramseyer presented on measuring the consequences of engagement. His research is concerned with measuring interactional synchrony during psychotherapy, and he and his team have developed an objective, video-based method called Motion Energy Analysis, which maps and quantifies the degree of synchronicity (of gestures and unconscious postural movements, i.e. rapport) in dyadic interaction. He has shown correlations between measurable interactional synchrony and positive outcomes of the therapeutic process [35]. Jonathan Freeman introduced the Collective Experience of Empathic Data Systems (CEEDS), which will allow the amassing and averaging of the tiny, instantaneous responses of many people (using sensors) to large data sets; this approach could rapidly gather extensive information on responses to the data without necessarily reaching the conscious awareness of the raters.

These small changes that sensors and computers can measure have a neurophysiological basis in the brain. Hugo Critchley

showed that observing emotions in others evokes subtle changes in the observer’s internal (interoceptive) physiological state, motor reactivity and cognition [36]. Nick Medford discussed how dissociative disorders can make the external world seem altered and strangely unreal [37], the opposite of presence.

## 4. CONCLUSIONS

There has been much recent interest and progress in the research on engagement (and related terms). It seems unlikely that the methods and impacts of this research could be coalesced inside a single discipline; it seems more likely that the trend toward interdisciplinary collaboration in engagement from fields as far apart as art, humanities, engineering and the sciences is on the upswing. One speaker suggested, “In the future we may look back on this event as the moment when this diverse collaboration started.”

## 5. ACKNOWLEDGMENTS

We greatly acknowledge Robert Gee and Chatrin Tolga for conference administration, Carina Westling for helping to assemble the programme and funding, BSMS for provision of the event space, and funding from University of Sussex’s Doctoral School, Digital Theme, Mind and Brain Theme, and Centre for Material Digital Culture. We thank Leo Nocentelli and George Porter for the idea to combine art and exactitude in engineering.

## 6. REFERENCES

- [1] Lessiter, J., Freeman, J., Keogh, E., & Davidoff, J. (2001). A cross-media presence questionnaire: The ITC-Sense of Presence Inventory. *Presence: Teleoperators and Virtual Environments*, 10(3), 282-297.
- [2] Jennett, C., Cox, A. L., Cairns, P., Dhoparee, S., Epps, A., Tijs, T., & Walton, A. (2008). Measuring and defining the experience of immersion in games. *International Journal of Human-Computer Studies*, 66(9), 641-661.
- [3] Ainley, M. (2006). Connecting with learning: Motivation, affect and cognition in interest processes. *Educational Psychology Review*, 18(4), 391-405.
- [4] Agarwal, R., & Karahanna, E. (2000). Time flies when you're having fun: cognitive absorption and beliefs about information technology usage 1. *MIS Quarterly*, 24(4), 665-694.
- [5] Good, J., & Robertson, J. (2006). Learning and motivational affordances in narrative-based game authoring. In the *Proceedings of the 4th International Conference for Narrative and Interactive Learning Environments (NILE)*, Edinburgh (pp. 37-51).
- [6] St. John, M., Kobus, D. A., Morrison, J. G., & Schmorrow, D. (2004). Overview of the DARPA augmented cognition technical integration experiment. *International Journal of Human-Computer Interaction*, 17(2), 131-149.
- [7] Law, E. L. C., Roto, V., Hassenzahl, M., Vermeeren, A. P., & Kort, J. (2009, April). Understanding, scoping and defining user experience: a survey approach. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 719-728). ACM.
- [8] Reschly, A. L., & Christenson, S. L. (2012). Jingle, jangle, and conceptual haziness: Evolution and future directions of

- the engagement construct. In *Handbook of Research on Student Engagement* (pp. 3-19). Springer US.
- [9] Witchel, H. J., Westling, C., Healy, A., Chockalingam, N., & Needham, R. (2012, August). Comparing four technologies for measuring postural micromovements during monitor engagement. In *Proceedings of the 30th European Conference on Cognitive Ergonomics* (pp. 189-192). ACM.
- [10] McMahan, A. (2003). Immersion, engagement and presence. *The Video Game Theory Reader*, 67-86.
- [11] Garvey, C., Julion, W., Fogg, L., Kratovil, A., & Gross, D. (2006). Measuring participation in a prevention trial with parents of young children. *Research in Nursing & Health*, 29(3), 212-222.
- [12] Traphagan, T., Kucsera, J. V., & Kishi, K. (2010). Impact of class lecture webcasting on attendance and learning. *Educational Technology Research and Development*, 58(1), 19-37.
- [13] Srivastava, J., Cooley, R., Deshpande, M., & Tan, P. N. (2000). Web usage mining: Discovery and applications of usage patterns from web data. *ACM SIGKDD Explorations Newsletter*, 1(2), 12-23.
- [14] Smallwood, J., Davies, J. B., Heim, D., Finnigan, F., Sudberry, M., O'Connor, R., & Obonsawin, M. (2004). Subjective experience and the attentional lapse: Task engagement and disengagement during sustained attention. *Consciousness and Cognition*, 13(4), 657-690.
- [15] Millis, S. R. (1994). Assessment of motivation and memory with the Recognition Memory Test after financially compensable mild head injury. *Journal of Clinical Psychology*, 50(4), 601-605.
- [16] Berka, C., Levendowski, D. J., Lumicao, M. N., Yau, A., Davis, G., Zivkovic, V. T., et al. (2007). EEG correlates of task engagement and mental workload in vigilance, learning, and memory tasks. *Aviation, Space, and Environmental Medicine*, 78(Supplement 1), B231-B244.
- [17] Linnenbrink, E. A. (2007). The role of affect in student learning: A multi-dimensional approach to considering the interaction of affect, motivation, and engagement. In Schutz, P. A. (Ed); Pekrun, R. (Ed), (2007). *Emotion in Education*. Educational Psychology Series. (pp. 107-124). Elsevier.
- [18] Matsumoto, D., & Sanders, M. (1988). Emotional experiences during engagement in intrinsically and extrinsically motivated tasks. *Motivation and Emotion*, 12(4), 353-369.
- [19] Gottman, J. M., Coan, J., Carrere, S., & Swanson, C. (1998). Predicting marital happiness and stability from newlywed interactions. *Journal of Marriage and the Family*, 60, 5-22.
- [20] Bugeja, M. J. (2006). Facing the facebook. *The Chronicle of Higher Education*, 52(21), C1.
- [21] Westling, C., Tee, J., Healy, Needham, R., A., Chockalingam, N., & Witchel, H. J. (2013, December). Cycling between action inhibition and self-adaptors during entrainment to affordances: quantifying the embodied engagement spectrum. In *Proceedings of Affective Experiences*. (London, England, December 2013).
- [22] Balaban, C. D., Cohn, J., Redfern, M. S., Prinkey, J., Stripling, R., & Hoffer, M. (2004). Postural control as a probe for cognitive state: Exploiting human information processing to enhance performance. *International Journal of Human-Computer Interaction*, 17(2), 275-286.
- [23] Attfield, S., Kazai, G., Lalmas, M., & Piwowarski, B. (2011, February). Towards a science of user engagement (Position Paper). In *WSDM Workshop on User Modelling for Web Applications*.
- [24] O'Brien, H. L., & Toms, E. G. (2010). The development and evaluation of a survey to measure user engagement. *Journal of the American Society for Information Science and Technology*, 61(1), 50-69.
- [25] Peterson, P. L., Fennema, E., Carpenter, T. P., & Loef, M. (1989). Teacher's pedagogical content beliefs in mathematics. *Cognition and Instruction*, 6(1), 1-40.
- [26] Kvanvig, J. (2009). The value of understanding. *Epistemic Value*, 95-112.
- [27] Pillemer, K., & Wagenet, L. P. (2008). Taking action: environmental volunteerism and civic engagement by older people. *Public Policy and Aging Report*, 18(2), 1.
- [28] Leach, C. W., Iyer, A., & Pedersen, A. (2006). Anger and guilt about ingroup advantage explain the willingness for political action. *Personality and Social Psychology Bulletin*, 32(9), 1232-1245.
- [29] Prutton, J., & Hales, L. W. (1986). The effects of active participation on student learning. *The Journal of Educational Research*, 210-215.
- [30] Brown, E., & Cairns, P. (2004, April). A grounded investigation of game immersion. In *CHI'04 extended abstracts on Human Factors in Computing Systems* (pp. 1297-1300). ACM.
- [31] Gardner, L. 2013. The Borough – Review. *The Guardian* (June 11, 2013). [www.theguardian.com/stage/2013/jun/11/borough-review](http://www.theguardian.com/stage/2013/jun/11/borough-review)
- [32] Marshall, J., Rowland, D., Rennick Egglesstone, S., Benford, S., Walker, B., & McAuley, D. (2011, May). Breath control of amusement rides. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 73-82). ACM.
- [33] Frauenberger, C., Good, J., Alcorn, A., & Pain, H. (2012, June). Supporting the design contributions of children with autism spectrum conditions. In *Proceedings of the 11th International Conference on Interaction Design and Children* (pp. 134-143). ACM.
- [34] Vinciarelli, A., Pantic, M., & Bourlard, H. (2009). Social signal processing: Survey of an emerging domain. *Image and Vision Computing*, 27(12), 1743-1759.
- [35] Ramseyer, F., & Tschacher, W. (2011). Nonverbal synchrony in psychotherapy: coordinated body movement reflects relationship quality and outcome. *Journal of Consulting and Clinical Psychology*, 79(3), 284.
- [36] Harrison, N. A., Wilson, C. E., & Critchley, H. D. (2007). Processing of observed pupil size modulates perception of sadness and predicts empathy. *Emotion*, 7(4), 724.
- [37] Seth, A. K., Suzuki, K., & Critchley, H. D. (2011). An interoceptive predictive coding model of conscious presence. *Frontiers in Psychology*, 2:395.