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TWO CONCEPTUAL DESIGN TOOLS AND AN IMMERSIVE EXPERIENCE

Beyond the pragmatic-pleasurable split in UX

ANNEMARIE LESAGE[1] and TOMÁS DORTA[2]
Université de Montréal, Montreal, Canada
1. annemarie.lesage@umontreal.ca, 2. tomas.dorta@umontreal.ca

Abstract. In a recent study, we compared two conceptual design tools supporting collaboration, a whiteboard software accessed through Internet, and a hybrid immersive system, the Hybrid Ideation Space (HIS). The result of the study appeared to favour the HIS because of its immersive qualities. In this paper, we seek possible explanations as to why immersion delivered a better experience, by looking at the mental workload in relationship to the experience. For the workload we rely on Wickens' four-dimensional multiple resource model, specifically processing codes (verbal/spatial) and visual channels; and for the experience, Csikszentmihalyi's concept of flow and our own concept of Design Flow. The designers seemed to be responding to different styles of information processing required of them by each tool, one being more experiential and the other requiring a heavier mental workload. Insight in the cognitive underpinning of a strictly pragmatic immersive experience suggests that UX has also to do with how the information is received and processed by users, without isolating the functional from the rest of the experience.

Keywords. User experience; immersion; flow; mental workload; Hybrid Ideation Space.

1. Introduction

In a recent study on the impact of immersion on ideation (Dorta et al, 2011), we compared two conceptual design tools supporting collaboration, an immersive system and a non-immersive whiteboard application. The results favoured the immersive system as it delivered better performance. But why exactly did

immersion deliver better on ideation in this case? Furthermore, the *quality* of the participants' experience with each tool appeared to have been very different, although they said, in exit interview, they felt both tools worked "well". In this paper, we seek to provide an explanation for this difference in experience quality beyond stating that one tool is immersive and the other is not. We based our analysis on Wickens' (2002) four-dimensional multiple resource model, specifically the processing codes (verbal/spatial) and visual channels. We looked at the way information reached the participants and what channel they respond with in relation to their psychological experience as assessed with Csikzentmihalyi's (1988) concept of flow.

In this case study we compared a whiteboard application accessed through Internet (Vyew™), and a hybrid immersive system (the Hybrid Ideation Space or HIS) (Dorta, 2007). These were chosen because they both have intuitive interfaces supporting freehand sketching over real-life images or photographs. The study followed a team of two landscape architecture students, collaborating on the conceptual design of two slightly different ad-hoc landscape design projects. The study ran over two days, using Vyew on the first day, and the HIS on the second. During the protocol the experience was assessed using Csikzentmihalyi's (1988) concept of flow and the NASA TLX workload, while the recorded videos of the protocol were coded using a processing codes analysis grid we developed. The results show a noticeable difference in the balance between verbal and spatial processes involved in each experience, one being polarised toward verbal processes and the other being distributed between the two. We feel this approach can shed a new light on immersion in design tasks, and ultimately contribute another puzzle piece to the general understanding of what user experience (UX) is made of.

1.1 UX AND THE PRAGMATIC / PLEASURABLE SPLIT

In the past decade, much research has been done on UX, trying to observe it, define it and measure it. Although there is considerable receptivity towards the concept of UX, there is no consensus on a definition yet. Some models have more currency than others, such as a vision of the experience extending from a core pragmatic interaction into ever widening contexts of use (e.g. physical settings, technological, psychosocial, or cultural contexts) or Hassenzahl's (2007) hedonic/pragmatic model, which posits that within a single experience there are two sets of goals: the pragmatic goals, extrinsically motivated ("do-goals"), and the hedonic ones, intrinsically motivated (or "be-goals"). In either model, the pragmatic and pleasurable are seen as distinct and cumulative. But this split is not always clear in real life. In this particular case study there is positive subjective user experience as attested by the flow results, and

no divergent be-goals or added on contexts (due to the ad-hoc nature of the project) bearing on the experience of these participants. The positive user experience sprang from the pragmatic interaction and goals. Perhaps seeing the experience in layers (pragmatic or pleasurable) may not be the best way to approach UX, since it is far from clear that it is experienced in layers. Actually, optimal experiences are said to be holistic (Csikszentmihalyi, 1988) such as the concept of flow, an experience where the subject experiences a deep sense of control, altered sense of time, loss of self-consciousness, and a merging of action and awareness. Flow is holistic (not layered) and takes over our full attention.

1.2 THE FOUR-DIMENSIONAL MULTIPLE RESOURCE MODEL

Wickens' (2002) four-dimensional model was originally developed to avoid dire multitasking scenarios (such as may occur when driving in heavy traffic on unfamiliar roads while trying to activate a newly purchased GPS). Instead of using this model to improve the experience by reducing risks and issues, we are using it to analyse a full attention, non-critical situation, namely collaborative ideation.

Wickens distinguishes four distinct dichotomous dimensions that have an impact on time-sharing performance, associated with distinct physiological mechanisms. We will focus on the processing codes (verbal / spatial) and the visual channels. Processing codes define the distinction between verbal, linguistic, analytic, abstract on the one hand, and the spatial, analogical, concrete processes on the other. This verbal / spatial dichotomy apparently is responsible for the high degree of compatibility of the manual and vocal responses, the manual usually responding to visual, both spatial in nature, and vocal to auditory, both verbal. There are two visual channels: focal and ambient vision. Focal vision will operate as a verbal/abstract process if it narrowly focuses on fine detail and pattern recognition, and as a spatial process when the focus is wide and all encompassing. Ambient vision relates to peripheral vision, and is used for sensing orientation and motion. Collaborative ideation can be seen as leaning on the verbal processes since it is the act of collaboratively exteriorizing abstract mental images first through words then through visual representations.

1.3 IMMERSION

Boellstorff (2008, 112) defines it as a state of consciousness where "sensory experience of the actual world is sufficiently muted, and the sensory experience of the virtual world is sufficiently heighted, that persons felt they were no longer in the actual world". This general definition relates to virtual reality as

found in 3D virtual worlds, but not to an augmented reality approach. In this study, the immersive experience was had no loss of awareness of the actual physical body, as the HIS is a life-size immersive system where the designers can move, gesture, physically turn around as they are surrounded by their conceptual representation. This kind of immersion is closely related to the sense of spatial presence, which is generally understood as "the subjective experience of being there" (Balakrishnan et al, 2007). In this case study, we understand this *subjective experience* as being the result of the psychological and the physical experience from interacting with the interface and virtual information as the designer is engaged in the ideation task.

2. Assessing processing codes and responses

We developed an analysis grid to capture the verbal / spatial processing codes and responses based on Wickens (2002) and on our observations of the collaborative ideation activity with each tool. The first category is visual processing, we note where they look: 1) *on the tablet PC*, narrow focus on detail and pattern (verbal processing); 2) *scoping the immersive representation*, (wide focal vision including some ambient vision, spatial processing); 3) *not looking at any representation*, usually looking at each other when discussing (mixed processing); 4) *staring reflectively at the representation*, this kind of absorption happened mostly in the HIS (wide focus with strong ambient vision, spatial processing). We noted the use of the pen tool: for drawing (spatial) or writing (verbal); the use of the body as tool when pointing with finger or laser pointer, or by gesturing with arms (both spatial). Lastly we also noted the body posture because it was strikingly different with either tool, as fluid and at ease (spatial), often accompanying less stressful states, or strained (taxing the process).

2.1 ASSESSING THE EXPERIENCE

To assess the experience, we use the concept of flow, which is a complex psychological state that describes a perceived optimal experience characterized by engagement in an activity with high involvement, concentration, enjoyment and intrinsic motivation. Flow state is determined by the balance between challenges and skills (Csikszentmihalyi and Larson 1987). The relation between perceived skills and challenges gives rise to eight possible dimensions (Massimini and Carli 1986): apathy, worry, anxiety, arousal, flow, control, boredom, and relaxation.

3. The experiment

3.1 TOOLS

Vyew is an Internet application for whiteboarding, supporting remote and local collaboration. It was accessed through a tablet PC with a 13" screen, shared by the two participants. They used plan view and elevations retrieved from Bing™, Google Maps™, and Google Street View™, which they used as background for their sketches.

The HIS (Figure 1) is a hybrid (analogue / digital) immersive system developed by the Hybridlab (Dorta 2007) allowing immersive, intuitive, freehand sketching on a tablet PC, and immersive physical model making, in real time and life-size. The designers stand inside their representations, which is projected on a 5m diameter semi-spherical screen surrounding them. It augments traditional tools (sketch and models) with digital capabilities. The HIS has been evaluated and compared (Dorta et al, 2009) and consistently appears to enhance collaborative ideation.

Figure 1. View inside the HIS as designers sketch over an immersive photograph

3.2 PROTOCOL

The comparison between Vyew and the HIS was done through the conceptual design of two different ad-hoc landscape design projects using the same site. The study ran over two days, using Vyew for 75 minutes on the first day, and the HIS for 49 minutes on the second. This discrepancy in time accounted for the fact that on the first day, they spent more time getting acquainted with the site, time that was an investment for both projects. On the first day, the partici-

pants went through two phases: a first one where they analysed the site from Internet map sites to identify all the variables and issues with the site regarding the given project; followed by an ideation phase where they came up with a few concepts. On the second day their work in the HIS went through three phases. First they worked from a rough physical model with enthusiasm until they realised their would-be concept was actually a dead-end; then they went through a stressful phase, accompanied by a short break down in communication as they looked for a way forward. The third phase was a good ideation session yielding a concept they were very pleased with. The participants were two 3rd year landscape architecture students used to working together.

3.3 DATA COLLECTION

Three types of data were collected: (1) workload, (2) experience and (3) cognitive processing codes and responses. The participants filled a NASA TLX workload questionnaire after each project. The experience was assessed using Csikzentmihalyi's (1988) concept of flow and Massimini and Carli (1988) 8 dimensions of the experience. Because assessing experience is a subjective exercise, we have resorted to ask the participants to review individually the videos of the each session with us and to identify their psychological states. The participants called out their psychological state more or less every 30 seconds, which we recorded on a data-sheet divided in 10-second increments. This is the best way we have found so far to measure the experience without interrupting it. Nevertheless, we are aware that not everyone would be a good participant for this type of data collection; luckily these were, although they were students. They had a keen understanding of the concept of flow and relevant other dimensions. The cognitive processing codes and responses were identified by applying the analysis grid to code the video recordings of the two sessions, making annotations for every 10-seconds increment.

4. Results

4.1 WORKLOAD

A typical workload will have matching performance and mental demand, which is the case for Vyew (Figure 2); but in the HIS the mental demand is very low while the performance is very high. Temporal demand was higher in the HIS as the participants fell pressed by time (they had less time than with Vyew), which lead to a greater effort.

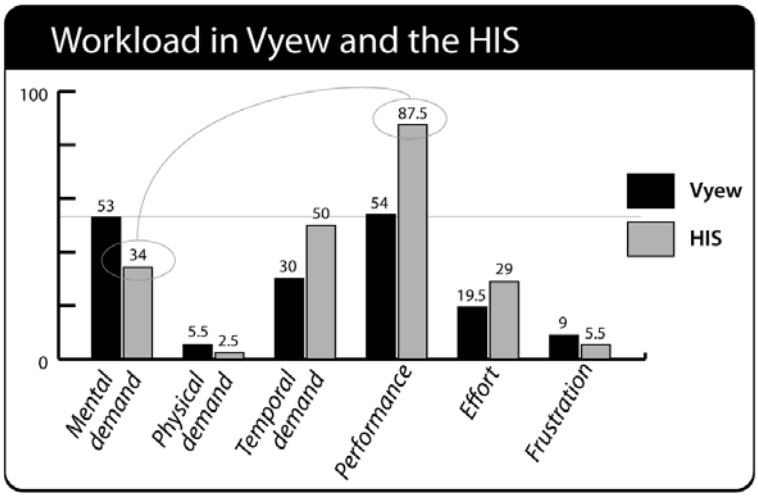

Figure 2. Workload for the two tools

4.2 THE EXPERIENCE

The experience with Vyew (Figure 3, top left graph) is marked by a large band of alert state running throughout this project. The participants said they were in flow a number of times, particularly in the second phase (ideation) but these episodes were short. The experience in the HIS (Figure 3, top right graph) did not have this constant alert mixed in with every other state and it shows a strong, unmitigated flow at the end.

4.3 PROCESSING CODES AND RESPONSES

In Figure 3 the results of the assessment of verbal processing codes and responses are shown in a black line and the spatial processing codes and responses are in grey volumes. On the whole, the HIS called for more spatial processing, especially during the strong flow phase.

In Vyew, the visual processing (Figure 3, graph A Vyew) was dominated by a complete focus on the tablet PC. The participants did not have a wider representation to look at from time to time, but they did look up at each other, away from any visual representation (Figure 3, graph B Vyew), to discuss their ideas. This allowed for wider focal and ambient vision (spatial processing). They made most use of this in the peak of the flow zone. Perhaps this released some mental workload associated to the continuous narrow focus (analytic/verbal processing) on the tablet PC. Doing so meant getting away from the visual representation and relying on words, abstract mental images

(linguistic/verbal processing) and gestures (spatial processing; Figure 3, graph D Vyew) to continue the reflective conversation. Graph C (Figure 3) shows and even use of the pen tool for drawing (spatial), as well as for writing (verbal). The two participants have shown signs of discomfort and straining as they sat in front of the tablet PC (holding their back, crouching over the tablet PC to see better, etc), which have put a strain on them. Towards the end of the session, when they started looking up and using arm gestures, their body posture showed signs of ease and fluidity.

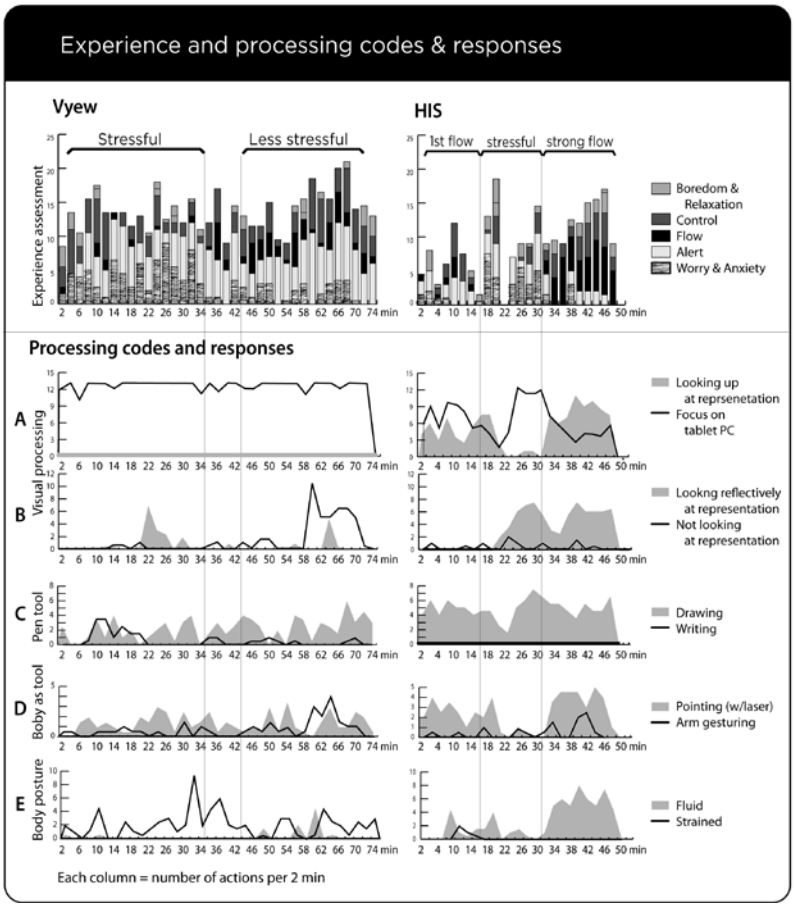

Figure 3. Comparative view of the five cognitive markers of processing codes as they correspond to the experience

In short, Vyew has supported some spatial processes (drawing, indirectly supporting communicating through gestures) and a number of verbal, linguistic, analytical processes (requiring narrow focus on the interface; encouraging

note taking; when participants seek a wider focal vision, they had to let go of the visual representation and communicate through words; being a virtual Internet interface, it had no consideration for the involvement of the body, dissociating the body from the collaborative activities).

The visual processing in the HIS is mixed, moving from a narrow focus on the tablet PC to a wider one with ambient vision when looking at the immersive representation. The focus on the tablet PC seems to parallel the state of alertness in Vyew, and alert, worry and anxiety in the HIS (Figure 3, Graph A). Perhaps the narrow focus (and analytic processing) is best suited to respond to the inherent tension of the state of alert. In the HIS, the participants have looked up and scoped the immersive representation during episodes of flow (Figure 3, graph A HIS). The HIS offered mixed visual channels serving both verbal and spatial processes, in two representations, one on the tablet PC and one on the immersive screen. In the last phase of the project (Figure 3, Graph B HIS), the participants have enjoyed standing in the middle of the HIS, taking in the immersive representation before making a new proposal. The HIS appears to encourage reflective assessment leading to new proposals during flow episodes. This is related to the fluid body posture (Figure 3, Graph E HIS) and increase in laser pointing and arm gestures to describe a design (Figure 3, Graph D HIS). The body being in the same scale as the immersive representation can thus serve to express ideas physically.

4.4 DISCUSSION

There seems to be a parallel between the focus on the tablet PC and the pattern of alertness and stressful states experienced in both tools. In the HIS, where participants had a choice between focusing on the PC or having a more spatial focus on the immersive representation, they gravitated towards the PC when they were in a stressful phase. Apparently the narrow focus responded to their need to get in control of the ideation process. But once the ideas were acceptable again, they switched to the wider spatial focus to push those ideas to their full expression, thus experiencing the strongest flow episode of the two days (low stress with a fair amount of control and relaxation). In these moments it seemed as if the HIS interface in fact extended the ideation while still stimulating it anew again. These episodes had an autotelic quality to them (were self-propelled; contained their own goal and satisfaction). With Vyew, the progression from beginning to end has been even, but the quality of the final flow was mitigated by an equal amount of tension (alert) and stress (worry and anxiety) versus the less stressful states (flow, control and relaxation). It is not clear if this is particular to this project or if it is due to a mental overload brought on by the continuous use of a tool requiring mostly verbal/linguistic/

analytic processing to do a conceptual task. It is as if the narrow focus, verbal processor was a workhorse capable of the early heavy lifting in the ideation process, and the spatial processor were the fourth and fifth gears capable of stealth and great performance, with lighter workload. This could explain why, when using Vyew, the team felt the need to discuss their ideas away from the tablet PC once engaged in the flow.

7. Conclusion

What the immersive system permits in this case study is to complement an activity relying heavily on analytical, linguistic and verbal process, collaborative conceptual design, with an interface calling for mostly spatial processes. Not only do the two types of process do not burden each other, they might stimulate each other, leaving the designer with more than enough mental workload to deliver a good ideation. Instead of doubling the efficiency by multitasking, smartly putting to work both processing codes may be setting up the conditions for potential optimal experiences, whether we are following a pragmatic or pleasurable motivation.

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