

An Ethnographic Study of a High Cognitive Load Driving Environment

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Abstract

This poster outlines Ethnographic research into the design of an environment to study a land speed record vehicle, or more generally, a vehicle posing a high cognitive load for the user. The challenges of empirical research activity in the design of unique artifacts is discussed, where we may not have the artefact available in the real context to study, nor key informants that have direct relevant experience. We also describe findings from the preliminary design studies and the study into the design of the yoke for driving steer-by-wire.

Keywords: Yoke, Steering, Ethnography, Cognitive Load

1 Introduction

The task for the research team was to create an environment to undertake research on the cockpit design of a Land Speed Record vehicle, this being inspired by the public launch of the New Zealand “Jetblack” land speed record project, and our growing awareness of numerous land speed record projects sprouting up around the globe. We have conceptualised this research project slightly more broadly as ‘undertaking research on vehicle user interaction in a high cognitive load environment’. This gives us a unique environment, in contrast to the majority of current research that concentrates on what is considered a normal cognitive load, and the focus is then on attention, fatigue, and distractions (Ho & Spence 2008). In contrast, our focus is on an innately higher risk activity with a cognitive load that is bordering on extreme.

So how do you go about researching artifacts that don't exist? Every method for undertaking empirical research is a limited representation of reality, a simplification, and for a reality that is hypothetical this potentially exacerbates these limitations. We have predominantly been using an Ethnographic process (Wellington 2011) to gather data from participants and experts about the elements we have been designing. The specific design is only the focus of the context that we are interested in. Too much emphasis has been placed on the role of Ethnography to provide sociological requirements in the design process (Dourish 2006). The objective here is also to explore

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Figure 1: A still extracted from video of a participant's run. Note the right thumb activating the button for additional thrust.

the HCI theory related to this context and activities in an analytical way.

For our project, having its foundations in a Land Speed Record vehicle, the cohort of potential drivers has traditionally come from available and willing air force pilots. Therefore, we interviewed actual air force pilots in the cockpits of various military aircraft, and were able to discuss the design of the control systems, as well as the potential concepts a land speed record vehicle driver would need to be aware of in controlling his or her vehicle. We used an ethnographic data collection method for gathering the knowledge of experts, where a conversational style is preferred over structured questions, and the researcher / interviewer says as little as possible to make sure that they are collecting the interviewees 'truth' rather than confirming their own.

Later in the research, once we had built our simulator, the research participants were informed that we were interested in any of their opinions on any aspect of the simulation or the design, we can place more significance on anything they volunteer specifically about the yoke or steering, as this then suggests it had some importance to their experience, rather than something they had to come up with since they were prompted. When participants then start discussing something they felt in the steering we then have to restrain ourselves from asking too many questions, or explaining the technical details of the device, and simply try to capture what they are saying.



Figure 2: Representation of finger positions on the yoke

2 Findings

Our initial yoke design was a consequence of the first round of Ethnographic research involving; two 'in cockpit' interviews with senior military pilots, and several meetings with another senior pilot, along with conversations with landspeed record vehicle designers and engineers. Since this initial data collection we have also interviewed racing car drivers and drag race drivers in the process of gathering data in the simulator. Specifically, for a land speed vehicle, the preference of military pilots interviewed, is that thrust controls are on the right, and inhibition controls are on the left, aligned with the habituated use of an accelerator and a brake pedal in a domestic vehicle.

The initial design of the yoke was also constructed as a synthesis of available yoke designs with a major consideration to minimising the use of space and giving an uninterrupted view forward, see Figure 1. The buttons for the yoke are standard components from a local electronics store, and are reticulated through the back in a groove, held in with insulation tape. An unintended benefit of the tape was to give a better indication of finger position from video footage, without giving a cue that we were focussing on hand position. The yoke is connected to a Logitech G27 steering wheel, and the other components of the steering wheel controller are employed for the accelerator and brake pedal, although these have been removed from their casing and the casing flipped, and then the pedals mounted on the underside, to give a good angle of operation in this seating position.

The significant difference between a circular wheel and the yoke – given similar configurations of limited steering angle – is that the participants are more likely to attempt to turn the circular steering wheel through a greater range of motion. We can tell from direct observation (for an example see Figure 1), that there is greater uniformity of the positioning of the minor digits in comparison to the index finger, as is shown in Figure 2. There are fewer data points for the index finger shown in this diagram, as many drivers wrapped their index finger around the back of the grip and it was not visible in video footage, or the position was not able to be predicted with any degree of confidence.

Although there were also other odd behaviours, such as holding the yoke by the 'spoke' held lightly between one participants index finger and thumb, these odd behaviours were often ephemeral as the partici-

pants realised the difficulty of the task and began to concentrate, and to hold the yoke by the handles. The person's thumb then typically attained one of four positions: hovering over the primary buttons, hovering over the secondary buttons, settled between the buttons, or wrapped – opposing the finger grip.

The thumbs of each hand could be matched or in a combination of these positions, with no single position dominating through the observations. The 'naturalness' of these different positions is reassuring, as the degree of turbulence and vibration of a real vehicle is unknown at this stage, it is unknown whether the driver can maintain a light hold of the yoke, or whether on occasion they will need to hold on tight.

There was a noticeable difference in the position of the left and right thumbs, where the right thumb was often placed above or adjacent to the button for firing the solid rocket booster, the left thumb was often placed quite some distance away from the primary button position – which in the case of the left yoke control was for the parachute. This would suggest that the space between the buttons is insufficient to give the drivers confidence that they could rest their thumbs there, and the limited number of observations of the right thumb in this position would reinforce this observation.

After these two phases of research we are comfortable that the overall yoke design is suitable for the application, but the arrangement of the buttons, and the haptic feedback from them, can be improved, and we have data to suggest the direction this improvement should take. Furthermore, we will continue to collect observational data of the evolving simulation and be as unstructured as possible to allow for Ethnographic data to lead us into areas the users perceive as useful.

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