Available online at www.sciencedirect.com
ScienceDirect
Int. J. Human-Computer Studies 67 (2009) 382–393
International Journal of Human-Computer Studies
www.elsevier.com/locate/ijhcs

Effect of evaluators' cognitive style on heuristic evaluation: Field dependent and field independent evaluators

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Received 1 February 2006; received in revised form 4 June 2008; accepted 12 November 2008
Communicated by S. Wiedenbeck
Available online 18 November 2008

Abstract

Heuristic evaluation is a widely used usability evaluation method [Rosenbaum et al., 2000. A toolkit for strategic usability: results from workshops, panels, and surveys. In: Little, R., Nigay, L. (Eds.), In: Proceedings of ACM CHI 2000 Conference, New York, pp. 337–344]. But it suffers from large variability in the evaluation results due to differences among evaluators [Nielsen, 1993. Usability Engineering. Academic Press, Boston, MA]. The evaluation performance of evaluators with two types of cognitive styles—ten field independent (FI) subjects and ten field dependent (FD) subjects were compared. The results indicated that the FI subjects produced evaluation results with significantly higher thoroughness ($t_{18} = 3.49$, $p = 0.0026$), validity ($t_{18} = 4.26$, $p = 0.0005$), effectiveness ($t_{18} = 5.14$, $p = 0.0001$), and sensitivity ($t_{18} = 3.16$, $p = 0.005$) than the FD subjects. When assessing their own evaluation experiences, the FI subjects felt it was easier to find usability problems than the FD subjects ($t_{18} = 2.10$, $p = 0.049$), but the FD subjects felt more guided during the evaluation than the FI subjects ($t_{18} = 2.28$, $p = 0.035$).

Keywords: Heuristic evaluation; Cognitive style; Field dependency

1. Introduction

Individual difference has been studied in the human–computer interaction field since 1980s (Egan, 1988; Dillon and Watson, 1996). The performance difference ratio on common computer tasks between human operators can be as large as 20 to 1 (Egan, 1988). Dillon and Watson (1996) drew on a century's worth of work in the fields of differential and experimental psychology and thoroughly reviewed how individual differences in perceptual, psychomotor, and cognitive conditions affect people's performance while interacting with computers. The differences in the cognitive conditions are of special interest to researchers, and many studies have been conducted on the effect of various cognitive aspects such as working memory, spatial ability, cognitive speed, logical reasoning on human–computer interaction tasks. Understanding individual differences can help researchers gain insight to, and possibly predict human performances (Dillon and Watson, 1996; Cegarra and Hoc, 2006), which in turn could lead to coming up with ways of accommodating different user groups and reducing the performance gap. For example, Parkinson and Redmond (2002) observed the performance differences among users with two cognitive styles when they interacted with web- and text-based interfaces. Subsequently, they continued to research on how to accommodate the users and reduce such disparity in performance. It was found that providing navigational aid and imposing structure on the materials helped the field dependent users without adversely affecting the field independent ones (Parkinson et al., 2004). Similarly, Sein et al. (1993) discovered that the performance gap between people with different visualization abilities could be reduced by using the direct manipulation interfaces instead of traditional interfaces.

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doi:10.1016/j.ijhcs.2008.11.002

One of the key areas in human–computer interaction, usability evaluation, is affected by individual differences. The evaluator effect—where evaluators with similar background produced different evaluation results—was noted as a problem that most usability evaluation methods suffer from (Hertzum and Jacobsen, 2001). It is imperative to gain more understanding of this phenomenon before usability evaluation methods can be fully trusted to derive reliable results. But there is a lack of systematic study of the individual differences in the usability evaluation area. The existing studies on individual differences primarily focuses on differences across people's expertise levels, mainly comparing novices to experts (Cegarra and Hoc, 2006). More studies on differences in evaluator's cognitive characteristics may help account for the variability in the evaluation results and help derive more accommodating evaluation processes for all types of evaluators.

One of the commonly used usability evaluation methods, heuristic evaluation, also suffers from hard-to-explain variability in the evaluation results (Nielsen, 1993). In heuristic evaluation, a small set of evaluators examine a user interface and judge its compliance with a set of recognized usability principles (the heuristics). Different evaluators with similar educational backgrounds and experiences can produce very different evaluation results (Nielsen, 1993). Because the usability evaluation is a cognitive activity that involves detecting and assessing usability problems with a system (Hertzum and Jacobsen, 2001), differences in evaluator's cognitive styles may contribute to the variability in the evaluation results. It has been determined that people stay quite stable in their cognitive styles (Witkin et al., 1977). Therefore, research on understanding the impact of cognitive style and studies of deriving accommodating designs and processes for different individuals are important.

2. Background literature

2.1. Cognitive style

Different people have different cognitive styles. Cognitive style refers to an individuals' habitual way of perceiving, remembering, thinking, problem solving, organizing and representing information (Allport, 1937; Riding and Rayner, 1998). Many cognitive styles have been defined and studied in the literature, such as holistic–serial (Pask and Scott, 1972), reflective–impulsive (Kagan et al., 1964), verbalizer–imager (Riding and Cheema, 1991), wholistic–analytic (Riding and Cheema, 1991), and field dependency (Witkin et al., 1977). Riding and Cheema (1991) identified 30 different cognitive styles in the literature. Among these, field dependency is the most widely studied (Ford, 1995). Because this style directly deals with how people perceive information and solve problems (Witkin et al., 1977), and is closely related to hypermedia navigation (Chen and Macredie, 2002), it is deemed especially relevant to usability evaluations of websites, and is therefore investigated in this research study.

In the earlier experiments of studying field dependency (Witkin et al., 1977), two types of tests, the rod-and-frame test and the body-adjustment test, were used to see how people located the upright position in space. In the rod-and-frame test, subjects were seated in a dark room, and asked to rotate a luminous rod to the upright position within a tilted luminous frame. Subjects demonstrated two types of performance on this test. One group of subjects tended to use the information from their visual fields and aligned the rod with the surrounding frame. The other group of subjects, however, relied on the senses from their bodies and placed the rod in the position that was closer to true upright. In a similar body-adjustment test, the subject sat on a chair in a tilted room, and was asked to adjust the chair that they sat on to the upright position. Again, two types of subjects' performance emerged. One group tended to rely heavily on the dominant visual field, and aligned the chair with all other titled furniture in the room, whereas another group depended on the senses from their bodies and rotated the chair to a position that was closer to true upright. The degree of dependence of the subjects on the dominant visual field (i.e. the surrounding frame or room) to determine the location of a sub-element (i.e. the rod or body) formed the basic term of field dependence. In both tests, the differences between the groups depended on whether an individual differentiated an item (e.g. rod or body) from its surrounding stimulus fields (e.g. frame or room). The two types of subjects were believed to have different types of cognitive styles in terms of field dependency. Based on this study, individuals may have one of two types of cognitive styles: field dependent (FD) or field independent (FI) (Witkin et al., 1977; Witkin and Goodenough, 1981). The FD individuals tend to be greatly influenced by the dominant visual field whereas the FI individuals tend to be less influenced by the information from the visual fields and consider all the other information gleaned from senses. Underlying the differences between the FI and FD individuals is their different tendencies to deal with a stimulus field (Witkin and Goodenough, 1981). The FI individuals deal with the stimulus field in a more active manner whereas the FD individuals use a more passive manner, and tend to leave the stimulus material just as it is. The FI individuals tend to differentiate, analyze, and structure a stimulus field, whereas the FD individuals tend to globally perceive a stimulus field (Witkin and Goodenough, 1981).

A person's tendency in perception was found to manifest in their cognitive functioning as well (Witkin and Goodenough, 1981). Much research has been conducted in the past 30 years on the differences between FI and FD individuals in performing many types of cognitive tasks. The FI individuals were found to be able to solve problems analytically (Witkin et al., 1971; Antonietti and Gioletta, 1995). When dealing with ambiguous and demanding problems, they used approaches of hypothesis testing and