Interactive Situation Models for Cognitive Aspects of User-Artefact Interaction

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Abstract. Cognitive aspects of human interaction with artefacts is a central concern for Cognitive Technology. Techniques to investigate them will gain greater significance as new products and technologies more closely customised to specific users are introduced. The study of Cognitive Dimensions is a well-established technique that can be used to support and direct empirical investigation of cognitive aspects of artefact use. This paper proposes a complementary technique, based on constructing 'interactive situation models', that applies to the study of specific user-artefact interactions. It interprets the cognitive activities of the user through interrelating situational, explicit, mental and internal aspects of state. The application of this approach in analysing, recording and classifying such activities is illustrated with reference to a simple case study based on modelling the use of an actual digital watch. The paper concludes with a brief discussion of possible connections with Cognitive Dimensions and implications for 'invisible computing'.

1 Introduction

A central concern of Cognitive Technology (CT) is the impact that the use of artefacts can have upon the mind of the user, and its broader implications for users in their social, cultural or administrative context. The study of CT demands analyses and techniques that can take full account of the interplay between human cognition and technological products. As computer-based technology advances, and new modes of human-computer interaction are being developed, cognitive aspects of human-computer interaction acquire ever greater significance.

In current practice in designing and implementing artefacts, the activities that relate most strongly to the agenda of CT are arguably the empirical studies undertaken by interface designers in developing an *information artefact* (IA) [8]. These involve monitoring the way in which potential users interact with an IA, and observing the problems they encounter. In this context, the experimenter is not necessarily explicitly concerned with what goes on in a user's mind, but sees the consequences of common mistakes and misconceptions, and explores practical steps that can be taken to eliminate them through redesign. Such empirical activity is intimately – if not necessarily directly – concerned with both human cognition and technological development.

M. Beynon, C.L. Nehaniv, and K. Dautenhahn (Eds.): CT 2001, LNAI 2117, pp. 356–372, 2001.

The informal nature of the testing activity and the nature of the insights that are gained through experiments with users pose challenges for representation. The intuitions of gifted and experienced designers typically play a crucial role. By drawing on their experience, good designers become astute at interpreting user difficulties and relating them to problems in the design of the artefact and its interface. The tacit acquisition and application of knowledge may serve the purpose in some design contexts, but requires skill and judgement that is not easy to develop and to share. This motivates the search for supporting techniques and frameworks that can make the analysis of cognitive issues in artefact and interface design more systematic, and results of the analysis more accessible for recording, exploring and communicating.

The study of cognitive dimensions (CDs), as introduced by Thomas Green in [7], is one approach to this issue. CDs provide a generic framework to guide the empirical study of IAs. This involves the identification of generic activities that are represented in user interaction with IAs, and the investigation of the cognitive demands made on the user in carrying them out. The study of CDs can inform the design of IAs, but it also serves a broader function of framing the agenda for discussion of their qualities and deficiencies from the perspective of a typical user. Knowledge about trade-offs between dimensions, for instance, is the same kind of knowledge that an experienced designer draws on when evaluating a redesign.

Human interaction with information artefacts can be conceived and viewed from two perspectives. In closed user-artefact interaction, the roles of the human user and responses of the artefact are enacted within a stable well-established context, where all instances of use are precisely identified and characterised in the user manual. The appropriate model for such use of the information artefact is as depicted in Fig. 1. The archetype for closed user-artefact interaction is provided by standard use of a device such as a digital watch that has been specifically designed to perform particular functions in appropriate situations according to preconceived conventions for interpretation.

The concept of closed user-artefact interaction implicitly imposes a stereotype upon the user. Modern developments in technology motivate a different perspective on human interaction with artefacts. As Cooper points out in [5], sophisticated computer-based artefacts take on the characteristics of the computer. This means that their behaviour can be customised, reprogrammed and reinterpreted by the user; their responses can be adapted to the user and the situation. Because individual users can directly shape the artefact, their personal experience, their competence, their knowledge and conception of the intended function of the artefact become crucially significant. Even the concept of specific uses of the artefact may be suspect, and the role of the person involved in the interaction is more aptly characterised as *user-designer* rather than mere user. Both use and experiment then feature in the interaction with the artefact and the manner in which these are to be interpreted need not be fixed in advance but can emerge from experience in the context.