

CHAPTER TWENTY-NINE

Activity and Designing Pleasurable Interaction with Everyday Artifacts

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ABSTRACT

The paper addresses some issues of pleasurable interaction with everyday artifacts. It covers artifacts and their contextual environment of interaction. It stands on the premise that dynamic interaction between human artifacts and their contextual environment is essential. Its theoretical construct is based on Popper's theory of objective knowledge. The paper suggests an approach for user-designer-artifact interaction that is able to support the design of everyday artifacts to be pleasurable to use. It emphasises that the activity and user-artifact interaction are the foci of the design.

29.1 INTRODUCTION

The interaction between people and artifacts has existed for centuries. Its complexity has increased in parallel with the development of human civilisation. The number of activities humans make influences this. This means that designers need to understand the nature of the activity and its participants. In order to do this they need to share the knowledge about the activity with people.

It is possible to link the artifact-human-designer interaction with Popper's theory of objective knowledge. In his philosophical approach to knowledge, Popper (1989; 1989b) suggested a pluralistic view of *three worlds*. These are (a) the world of physical objects or the world of physical states, (b) the mental world or the world of mental states and (c) the world of objective content of thought or the world of ideas. The correspondence of the three worlds with human expertise and knowledge engineering is outlined by Gaines (1987), who delineated three environments that correspond with Popper's worlds: (a) the physical environment, (b) the social environment and (c) the knowledge environment. These three environments, or three worlds, are linked with an artifact interface that is the main communication channel between them.

For the purposes of this paper this scheme is epitomised as follows:

- World 1, the world of physical objects (artifacts) or physical states or *the artifact*

environment. World 1 is a product of Worlds 2 and 3.

- World 2, the world of states of consciousness or mental states or behavioural disposition to act. *The social environment* 'subjective experience of people and their mental experiences and feelings'. Artifact designers and human users are part of this environment. The second world represents their thought processes through which they grasp third world contents.
- World 3, the world of 'objective content of thought' which is a natural product of humans. It interacts with the first and second worlds. This is the *knowledge environment* of theories and their 'logical development'. Users' and designers' knowledge and problem situations belong to this environment.

These three environments correspond with the contextual environment of artifact interaction at the appropriate levels. Each contextual environment consists of three environments that correspond with Popper's three worlds (1989; 1989b). In his study, Gaines (1987) applied Popper's theory of three worlds to explain relationships between knowledge engineer, expert and environment. A similar analogy can be drawn to explain relationships between designers, artifact users and the contextual environment of their interactions (Figure 29.1) (Popovic 1998; Popovic 1998b).

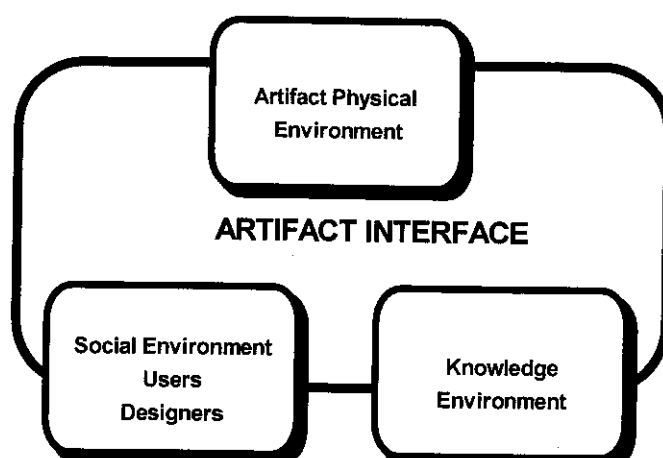


Figure 29.1 Artifacts' contextual environment (after Gaines 1987; Popovic 1998)

Figure 29.1 illustrates the contextual environment of an artifact which includes:

- *The artifact's physical environment*, which consists of the artifact's technical context, function and life cycle. In this context, they have their behaviour and function.
- *The social environment*, which consists of the artifact users who use them and the designers who design them. In this context, a user's experience and a designer's expertise need to interact. The role of the designer is to understand the *activity* and artifact users' concepts and, through design, to support them.
- *The knowledge environment*, which consists of a user's and a designer's knowledge. The designer is an expert who knows about design and knows how to respond to design constraints. She has design strategies, general design knowledge and domain-specific design knowledge relevant to the design task. Knowledge about the human users belongs to domain-specific design knowledge. Users possess the knowledge in

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the domain of their expertise and experience and have concepts about the artifacts. The user's concept and the designer's concept should be compatible. The knowledge environment exists within artifacts (interactive devices) but it depends on the user's expertise and experience within the activity. The designer attempts to represent this through her knowledge of the second and first worlds. Therefore, designers' models and users' models are part of the third world (Thimbleby 1990).

These three environments or three worlds are linked with an artifact interface that is the main communication channel between them (Popovic 1998). Consequently, this paper is going to suggest an approach for user-designer-artifact interaction that will be able to support the design of everyday artifacts to be pleasurable to use. The design of artifacts should be able to provide understandable devices and systems with interfaces that bridge the gap between people and products and are pleasurable to use during an interaction.

29.2 DESIGNING PLEASURABLE INTERACTION

Traditionally, task analysis conducted in Human Factors and Ergonomics and HCI (Human-Computer Interaction), is based on the idea that a description — containing all the necessary information to understand the use of an artifact (or device) — can be made of the sequences of steps that it takes for human users to conduct tasks within an activity. This analysis thus contains a description of each step required by an individual user for successful interaction. However, during the observation of people interacting with the artifact, it is possible to capture some of the knowledge that they require in order to perform skilled activities in the actual work process. Nevertheless, it is not possible to accurately predict their performance in future situations. People do not react until the situation occurs and the context and conditions of the environment trigger their actions. What makes a good artifact interface is often a good *conceptual model* behind the system that is reflected by the 'system image' (Norman 1986). This requires an understanding of the activity and its context (Popovic 1998).

The process of designing is an activity itself. It can be seen as the discovery of new ways to improve the quality of human life by exploring and designing new artifacts by applying knowledge and the designer's imagination. Design concerns with the ways of how things ought to be. It aims to change an existing situation into a preferred one. Designers attempt to predict the behaviour of an artifact using their knowledge and expertise (Popovic 1998). The inner system of any artifact can be predicted accurately (Alexander 1973). The most difficult part to predict is the interface of interaction, as the environments in which the artifacts are used are very often ignored. Human beings, during their interaction with artifacts, cannot envisage all obstacles that may occur. This is very significant when they interact with complex systems in order to achieve the desired goal. In this case, one has to use one's knowledge about the artifacts (systems) and adapt to the contextual environment of its operation. The adaptation is achieved through the process of learning and transmission of knowledge about the requirements of the task. To enjoy an interaction, the human has to understand it. To achieve this, designers have to understand what is the knowledge structure domain that people have about activity, artifacts and their contextual environment and how this knowledge is exchanged in order to support interactivity (Figure 29.1). This requires the inclusion of the activity into the design process.

Technologically interactive devices or cognitive artifacts (Norman 1991) that are with us everyday, impose another constraints to both — users and designers. According to Norman (1991), cognitive artifacts are 'devices designed to maintain, display, or operate upon information in order to serve representational function'. However, little is known about the 'information-processing role by artifacts' and their interaction with human

information processing (Norman 1991). The whole contextual environment of artifacts affects levels of interaction and artifacts use. The way they are used and level of interaction which is to be achieved depend on users' tasks and expertise. This remoteness of an artifact and its contextual environment generates conflicts between people and artifacts.

Norman (1991) proposed two views of artifacts: the systems view and the personal view. The systems view consists of the person (user), the tasks (tasks within an activity) and the artifact. Here, the artifact is enhancing the performance of its user. The personal view consists of the task and an artifact. According to this view, the original task is changed; a new task is introduced, and it has a different cognitive capacity. The user has to face new and different cognitive requirements.

Human interaction with artifacts can be direct, remote or virtual. All these three levels of interaction occur in their contextual environment (Popovic 1998). The term *direct interaction* refers to a user's direct engagement during the activity, such as using a hammer or screwdriver, or chopping vegetables. A direct relationship exists between the user's movement of the device and the task outcome. *Remote interaction* occurs when a task within the activity is done either by instructing someone else to do it, or by controlling it remotely, such as in some surgical procedures. *Virtual interaction* occurs in a virtual environment in which an artifact is present, such as the monitoring of a plant through a computer display or a building simulation using a computer interface.

Norman (1986) pointed out that there are discrepancies between people's 'psychologically expressed goals and the physical controls and task variables'. Psychological variables are goals and intentions. Physical variables refer to the task to be performed. Here, people need to use physical means to achieve this — that is, controls, levers, or displays and controls concurrently. They need to translate psychological goals and intentions into physical actions (the variables are interpreted). Very often, physical variables are not the ones that the person is concerned about. For example, a person intends to withdraw money from an automatic teller machine (ATM). It is envisaged that the user will walk to the machine, insert the card and personal identification number, and do the banking. Thus the user's goals and intentions are translated into physical actions. This does not always fulfil the user's expectations, however, because of tasks that the user may have to do in order to achieve a goal. Sometimes users forget their cards, or the machine does not return them. Alternatively, the screen may be illegible or a card inserted the wrong way or the machine may work too slowly (Rogers and Fisk 1997). In this particular situation the needs within the activity are constantly changing and designers are facing two sets of needs: (a) bankers' needs and (b) users' needs. Both must be translated from psychological needs to physical needs. This requires an interface that is easy to use and interact with. The interface where the user can manipulate the physical variables in order to achieve the desired goal with a pleasure. The most common sequences of translation between psychological variables and physical variables are those in which the goal and intentions are translated into actions which consist of tasks as action paths. During use, users evaluate their tasks from the feedback received until the desired outcome is reached. In order to interact with an interface, users have to map the problem (task or sub-task sequences) by understanding buttons or other elements on the interface. For example, with ATM users, mapping is essential to distinguish where on the ATM interface the physical variables are to be used to translate the goal state into physical actions. This involves interpretation of an interface, which means interpretation of the perceived system. To match psychological and physical variables, the mapping should be simple and should convey the conceptual model of an artifact.

There are distinct approaches in cognitive sciences that are relevant to the understanding of human users. One is the traditional symbolic processing approach on which cognitive science was founded. The other is the so-called *situated action* approach

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that emphasises the context, the environment, the situation in which the activity occurs, and cultural and social settings (Suchman 1987). The third is the distributed cognition – the study of the knowledge representation on the system level and its unit of analysis is a 'cognitive system composed of individuals and the artifacts they use' (Flor and Hutchins 1991; Hutchins 1991) (in Nardi 1996). The unit of the analysis has been moved to the system and in practice is referred as 'functional system'. It is to say that distributed cognition is concerned with structure – representation inside and out side of the head. It differs from the well-established notion of an individual cognition as it is attempting to understand 'coordination between individuals and artifacts' in order to understand how task coordination is distributed (Nardi 1996).

In the field of Human Factors and Ergonomics, *situation awareness* theory has emerged with its conceptual basis ill-defined. Situation awareness theory proposes that there are aspects of situations for which awareness must be maintained – for example, cues, evolving situations and special characteristics of situations or higher-order goals (Gaba, Howard and Small 1995). However, the situation awareness approach may have an impact on an operational setting (Gilson 1995) and artifact interface design. Situation awareness is important in decision making for some tasks. It should occur simultaneously with the user's goals and intentions. This means that a user's goal directs which aspect of interface is attended to, and the perceived artifact contextual environment is brought into line with the user's goals based on that understanding (Endsley 1995) and responds to the particular situation (Popovic 1998).

In the area of human-computer interaction (HCI) activity theory has emerged as potential field that would be able to support human interaction with cognitive artifacts within the context (Nardi 1996). The field is not new and started in the former Soviet Union in the 1920s but its relevance to HCI is just recognised recently. Nardi (1996) compared activity theory, situated actions and distributed cognition in relation to studying the context. Situated actions emphasise human responsiveness to the environment and an artifact setting. The focus is on the notion that an activity will develop and grow out directly from the situation (Suchman 1987). It is said that this approach overlooked to treat an environment as an agent that shapes an activity in which people are engaged in a flexible way. Situated action approach concentrates on representation as an object of study (Nardi 1996).

Activity theory stands on the premise that the elements of the activity are not fixed. They change and transform as an activity itself evolves. The main idea is that artifacts mediate the activity as introduced by Kuutti (1991). Actions are seen here in a similar way what is referred to tasks (HCI) or Human Factors and Ergonomics. They overlap and they have operational aspects. It is understood that the operations become unconscious routines that come with practice. According to Leont'ev, 1974 (in Nardi 1996) their operational structure will change only. The activity is seen as a system consisting of objects, actions and operations which is seen as the *context*. This context is generated by people and it is 'external' or 'internal' to them. Term 'external' refers to artifacts, other people and settings; term 'internal' refers to specific object and goals. They are inseparable (Nardi 1996).

The way in which information is presented through an artifact interface will influence situation awareness by determining what kind of information is acquired and how it is compatible with users' needs. Interface design should provide needed information to the user without imposing a cognitive effort or a mental workload. During interaction, an artifact user is involved in visual search tasks through an interface. Therefore, interface knowledge is very important for directing the selection of interface cues in order to achieve the stated goals.

It has been emphasised that the most important aspect of a product's design is a design of its interface. People are confronted with two different mapping stages (Norman

1986) while using interactive artifacts. These stages are: (a) mapping from the psychological variables to the physical variables and (b) mapping from the physical variables to the psychological variables. The input mechanism (interface) is a mediator between two representations. This is a key point for achieving an interaction. Therefore, the design of the interface should focus on mapping and how it can support the user to accomplish the task without difficulties. This confronts designers with many unanswered questions, as the users' requirements are variable and each user is different in knowledge level, skills, needs and artifact concepts. This leads to compromise solutions or to interface design that incorporates visual cues to help users' interactions and assist users to understand the system.

Norman (1986; 1988) suggested that a good design model and relevant system image should be provided. Human beings can change their levels of interaction with an artifact interface. One change is by design. The other is by the user's expertise and experience level. The interface design should present the appropriate 'system image' to artifact users to help them form a users' concept. Artifact users must not feel that they are out of control. On the contrary, they should enjoy interacting with the artifact and have 'a pleasurable engagement' during its use (Laurel 1986). Therefore, a conceptual model of the system is very important. It supports the user's interaction and is essential for novice users to assist them to learn how to use artifacts and to develop a user model of an artifact that is to be more consistent with the design model.

The theory relating to user involvement has expanded in the human-computer interaction community, as it has been easier to study users and involve them in the design process. The gap between users and designers still remains, but more and more user's viewpoint is taken into consideration. Nevertheless, the human user is an 'information processor' whose behaviour is unpredictable (Sutherland 1994). This is another reason why designers need to understand their users and be able to model users' activities and tasks during the early stages of the design process (Popovic 1999). Activity and task analysis are important steps in interface design and when done, should reveal various ways of human interaction. Task analysis that relies on reason only is dangerous, as any new task is evolutionary, discovering new goals as it proceeds (Hammond *et al.* 1987). Interface design does not involve task analysis only. It requires the designer to predict what users will know or be able to learn. Designers are supposed to map psychological principles into their design decisions. It is important for the designers to understand the humans and their activities and how users' social environment, artifact physical environment and knowledge environment are shared (Figure 29.1). This share of knowledge might contribute to the formulation of an activity and artifact concepts. When human interact with artifacts they have an intention. This is what guides them as they have a concept behind the activity. It is essential to discover users' intentions and incorporate them into the user's concept about the artifact.

Pleasure is not defined by rules. However, it incorporates some aspects of human factors that contribute toward humanisation of our living and working environment (Jordan 1999). Therefore, this imposes a higher level of complexity to an artifact design. To achieve pleasurable interaction an artifact design should incorporate the following process: (a) research, (b) scenario and user's concept formulation, (c) design and application of relevant research findings and (d) design development and production (Figure 29.2).

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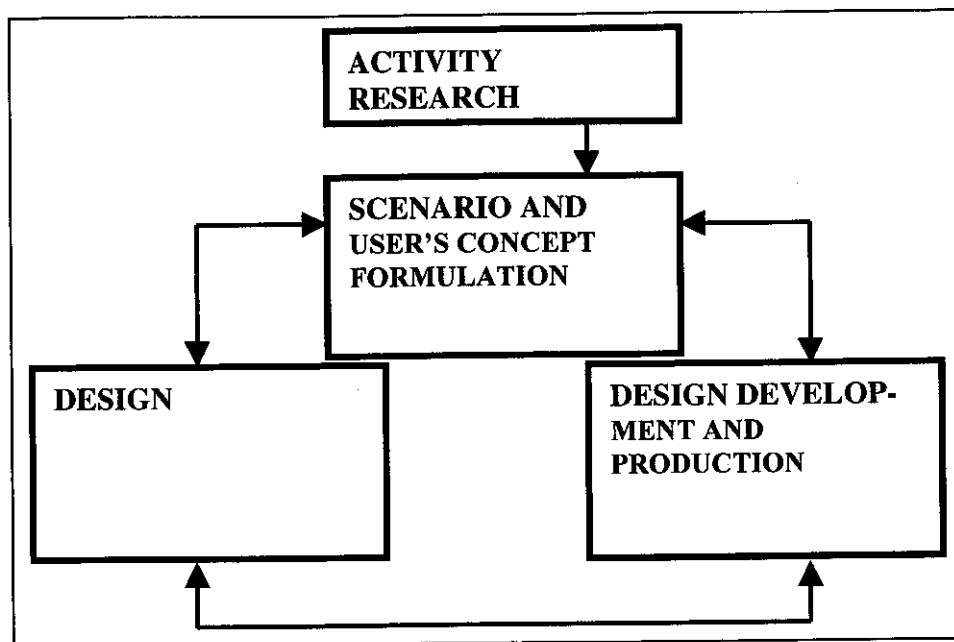


Figure 29.2 The suggested process for the study of the artifacts' contextual environment

Figure 29.2 illustrates the suggested process for the study of the artifacts' contextual environment. Its stages are explained below.

Activity research

It is envisaged that the following research, when appropriate, should be undertaken:

- Research into the nature of the activity in order to define its relation to the three environments (Figure 29.1) that constitute the artifacts' contextual environment.
- Research into the life style of the activity players in order to define their needs and culture and how pleasure is represented within that particular activity.
- Research and understanding of users' interaction within the activity and how these correspond with the artifacts' contextual environment.
- Identification of activity players' knowledge base and how it is shared in the social context of that particular activity.

Scenario and user's concept formulation

Scenario formulation should be based on the research related to the activity, its players and the knowledge they share (Figure 29.1). The scenario developed can be used as a formulation of the project brief. It should convey a user's concept on whose basis the design is to be developed. It should convey user's intentions. An artifact should be a mediator of human thoughts and behaviour (Nardi 1996). This is where the link between psychological and physical variables (Norman 1986) is to be identified.

Design and application of relevant research findings

It is envisaged that the relevant research findings will be applied throughout the design process.

Usability of the design is to be tested in relation to a user's concept developed during the scenario formulation in order to achieve the best possible compatibility between the user's and designer's concept of the artifact and its associated activity.

The following criteria should be applied:

- compatibility between the user's and designer's concept;
- representation of physical and psychological variables that supports the user's concept;
- ease of use, interaction and support of its dynamic structure;
- simple interface design and information organisation;
- simple and logical visual organisation of information on an interface that will convey visual cues clearly;
- interface mapping;
- appropriate tactile information that evokes appropriate feelings;
- appropriate colours that evokes specific feelings;
- sound that can enhance an interaction and feelings but not to destruct them;
- olfactory information to enhance an interaction ;
- artifact form / shape that corresponds to culture and life style which conforms to the appropriate aesthetics – culture to be considered;
- artifact form / shape that conveys humour or joy when perceived – culture to be considered, and;
- flexibility and adaptability of tasks during the activity.

Design development and production

It is envisaged that at this stage an artifact will not go through the radical changes regarding its interactivity with the users. However, final test of user's concept and its compatibility with the designer's concept of the artifact and the associated activity should be done.

Many aspects listed above are influencing humans' perception of artifacts by saying, 'it feels good', 'that is right', 'cool', 'cute' or 'looks different'. These are popular attributes used by people when they see or use artifacts. Nevertheless, they convey a lot of qualitative values that make some artifacts to contribute to the enhancement of the activity and its transformation (Nardi 1996). When people see artifacts they make a 'perceptual categorization' (Clancey 1999) of visual form or an interface layout. Thus, visual aspects of artifacts play an important part in developing a user's concept and how they might contribute in achieving an enjoyment during the interaction.

29.3 CONCLUSION

Activity theory, plans, mental models, situated awareness, situated actions, distributed cognition and cognitive maps are different approaches to assist in understand activities and humans' interaction. Within any activity people have social engagement everyday, be it work or pleasure. They are linked on social and individual level (Nardi 1996). The activities are in constant change that influences an artifact transformation (Kuutti 1996). Any developmental process of an activity can generate a new activity (Nardi 1996). This

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is done through different tasks or actions. The historical evolution of artifacts and activity associated in one generation of artifacts are reflected in artifact development in the next generation (e.g. aeroplanes, helicopters, sewing machines, computers or any artifact used everyday). In this case the design can be seen as an agent for change. It is trying to change the activity by introducing a new activity, which may lead to a new design and new challenge and enjoyment.

Social structure plays an important part in any activity (Nardi 1996). These include artifact users, organisation and its culture and environmental structure. It is very important for the designers involved in artifact design to understand the process that occurs behind the activity. The user is an agent who directs the whole interaction (Laurel 1986) especially as interactive interfaces are becoming easier to use. The new designs should challenge its users to enjoy different levels of interaction. They should experience new pleasure every time they interact or use the artifacts. The design of the dynamic structure of the artifacts should support exploration, flexibility and adaptability during interaction. The concept of '*form follows function*' is evolving to '*form follows pleasure*'.

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