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Chapter **9**

Usability and Systems Intelligence

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Excellent user interface design makes instruments and everyday things usable and creates an enjoyable user experience. It can not only ease our mundane work, but also improve our mood and make tasks easier to accomplish. With future technological breakthroughs, we will increasingly interact through computational systems, often even non-consciously. When these systems work as a whole, they support the actions taken within them. A systems intelligence perspective on user interface design highlights the possibilities of systems performing miraculously well. It examines what the systems generate, how they mould us as human beings, what kind of interpersonal communication they support and how they can develop.

Introduction

Our working memory is awfully limited; in general we can keep about four (e.g. Jonides et al. 2008) or seven (e.g. Miller 1956) items in our conscious mind. In order to act efficiently in the complex world, we need to expand our thinking capacity. By using exterior memory provided by different tools and devices, we can increase our memory capacity and utilise the tools adopted as extensions of our mind. Unlimited possibilities of new technologies awaits us – if we know how to use them. User interface is the composition by which users interact with artefacts. Their usability can be enhanced by designing them by means of design principles given in usability literature. Expanding the design thinking to larger instrumental systems can make it easier for us to perform in future technological environments.

Systems intelligence, a concept developed by Esa Saarinen and Raimo P. Hämäläinen in 2002, is about intelligent and successful acting within complex systems (Saarinen and Hämäläinen 2007, p. 51). When systems intelligence is applied in user interface design, the viewpoint is broadened to concern higher-level systems and their flourishing possibilities. Systems including human actors have sensitivities that can make them blossom. Systems intelligence (SI) and usability share the emphasis, where practical issues are concerned. Both accentuate the functioning of a system, which can work almost miraculously well. SI is intelligence in acting through systems. It connects usability to the basic purpose of technology – of producing something. SI considers the context, the possibilities that can be achieved and reveals the points of systemic intervention that can improve the system tremendously.

Usability in Everyday Life

Usability has a peculiar nature of being invisible. When a device or an object you are working with is functioning, you can feel like operating through it. An object can be attractive even though it may not be that aesthetic.

My tape holder presents a wonderful example. From a set of everyday objects on my desk, it is absolutely one of my favourites. Even though it is the right colour and therefore matches the interior decoration of our study, its most important property is how enjoyable it is to use. The use of the tape holder is so pleasant that I am always looking forward to the next gift-wrapping opportunity just to use it. The holder contains sand and is therefore heavy enough so that taking the tape with only one hand is possible and easy, and the roll-out of the tape breaks neatly when needed.

A banana offers another example of nice usability. Eatable without cutlery, good biodegradable package, somewhat durable, and the opening mechanism is far better than in many vacuum packed groceries.

Even though we have marvellous usable artefacts as a part of our everyday lives, it is the awkward and malfunctioning designs that attract our attention and make us frustrated and stressed.

When usability is poor, users normally feel annoyed and might even blame themselves for not knowing the proper way to use the artefact. However, if a user cannot or does not know how to use certain artefacts, the fault is in the non-functional design, not in the user. (Norman 2002, p. 36) Everything in the surrounding environment has user interfaces. Tools, artefacts, grocery packages, furniture, rooms, facilities, infrastructure. Their level of usability varies from extreme cases of working easily and consistently with the user to in the worst case, preventing the use. We have all experienced the frustrating situation with difficult-to-use objects. The non-functioning word processor may generate cursing around the open-plan office, when refusing to work the way we want it. It is quite common to hate the technology we in any case need to work with (Norman 2004, pp. 7–8). On the other hand, there are those particular ballpoint pens that are in constant use because of their wonderful functionality that makes their users happy.

User interfaces should be understandable for everybody. If a user cannot understand the tool in the first place, working with it is impossible. As Donald A. Norman emphasises in his books, with good design, instructions are not necessary. Functioning with the artefact is intuitive and correct, since the design guides the user towards its proper use. (Norman 2002, p. 10) Usability research shows that people are quite eager to use artefacts very differently from the ways manuals are guiding us (Dourish 2001, p. 19). Additionally manuals are looked only after trying out various ways and still not achieving the wanted results.

When usability is good, we can experience ourselves as acting through the artefact. After years of using computers, a mouse and the hand using it become coupled and the attention moves to the cursor on the computer display (ibid., pp. 138–139). The coupled use is so intuitive that what becomes focal is the functioning rather than the artefact itself. Natural interaction between humans and artefacts takes place on subconscious level, so that the use is increasingly effortless (Norman 2007, p. 18). Proper eyeglasses afford this natural interaction. When the lenses are correcting the vision properly, when they are beautiful and comfortable to wear, they disappear from our consciousness, yet ease the everyday life tremendously.

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Design Guidelines

In order to enhance the usability of artefacts, certain design guidelines have been given in usability literature. As everything in the environment can be considered from a usability point of view, the design guidelines are quite general and try to especially facilitate first-time use. From the systems intelligence perspective, it is essential to utilise the following somewhat overlapping design guidelines.

Affordance is a term introduced by psychologist James J. Gibson and widely used in design thinking, especially by Donald A. Norman in his writings. Affordance-based designing method identifies the possible actions users can perform with an object (Sheridan and Kortuem 2005). Affordance informs where to grab, which parts of an object are moveable and which are fixed. For instance, chairs afford sitting, scissors afford grabbing, slots in a machine afford putting money in them, handles on a door afford pulling, and so on. With affordances users can be guided towards proper use intuitively without labelling objects with instructions. (Norman 2002, pp. 9, 82) Klemmer et al. (2006) discuss affordances as signals especially relevant for the human hands, which are suitable for complicated movements but still have the property of tactile acuity. In computing, tangible user interfaces can for instance be such that by moving a physical object in space the virtual object moves. At the moment the best tangible interfaces can be found in the computer gaming systems, where game controllers, such as joysticks or wheels, can be grabbed, and where they can give physical feedback to the user as well. (Klemmer et al. 2006, pp. 142–144)

According to Norman (2007) *natural mapping* makes human-machine interaction understandable and effective (p. 152). It helps the user to connect the controls and the results. When the wheel is turned left, the car turns left as well. Actions close in time are perceived to be connected, and therefore the feedback is readily understandable. Natural mapping can be done by using physical, semantic, cultural and logical constraints (Norman 2002, pp. 85–86). *Physical* constraints make sure that a key can be placed in a lock properly and, like floppy disks, can be inserted only in the right alignment. *Semantic* constraints rely on the meaning of the context, and thereby guide the use. If the text on the side of a shampoo bottle is upside-down, a user will probably place it so that the text can be read, allowing the liquid to slide near the cap, so that it will come out more easily. *Cultural* constraints are based on the cultural knowledge users have of the object. As an example, all Finns know to throw water on the sauna stove. Consequently, a sauna, where water-throwing is automated and water need not be thrown, makes Finnish sauna users confused. Finally, *logical* constraints guide designers to, for instance, place the light switches to a congruent order as the lights are placed. The connection can be made by using equivalent colours in the controls and in the objects to be controlled.

Feedback indicates the previous actions made, and helps the user by increasing awareness of the usage (Norman 2002, pp. 27–28). Designers should aspire to a system that provides continual awareness without annoyance. Feedback reassures, makes time estimates, helps user to learn, indicates special circumstances, confirms actions made and governs expectations. (Norman 2007, pp. 138, 141) This can be provided by visible, auditory, tangible or olfactory signals. For instance the odour in gas cookers has been added so that users can more easily recognise leaking gas. The sound of the indicators inside modern cars no longer signals the frequency that the light is flashing, and the sound might indeed come from the car stereos. The function of the sound is to indicate to the driver that the turning signal is on. If the feedback can be given from multiple sensory sources, it is easier recognised and a user can act accordingly faster. This is especially useful in critical situations, where rapid responses are needed to avoid danger and accidents (Norman 2007, p. 43). If a driver is falling asleep, and is drifting away from the driving lane, the noise and trembling indicate that the car is on top of the side line. With multi-sensory signals the attention of the driver is caught fast.

Visibility makes these actions observable. In computer interfaces the turning hourglass tells us that our click was noticed and something is happening. Visibility means also enabling users to see the current state of a system and possible actions to be chosen (Norman 2002, p. 52). Visibility helps especially new users in learning the proper use. It is closely related to the feedback the system gives its user, which eases the control (Dourish 2001, p. 166). A device that does something without indicating it somehow, can make users frustrated, even though something would actually be happening. Clear visual or audio signals implemented in the user interface improves the usability.

Poor feedback mechanisms can make users confused. After having a new mobile phone for a few months, I realised that these loud sound signals appearing every once in a while were coming from it, and not from some other devices in our home. I did not know what the signals were for, because after noticing the beeping, it always took me a while to get the mobile out of my purse and see the display. It never showed any visual signals whatsoever indicating that anything would be wrong. Then, I had an idea, and made an experiment. I opened an application from the mobile phone and did not close it. After an exciting fifteen minutes it beeped loudly. I looked at it and saw that the application had closed itself. The meaning of the sound was finally found. Still, I saw no notification on this. After a month of on and off reasoning, I found out the purpose of the signal, but not once did I look it up from the manual.

Using sound as feedback is an effective way to indicate actions and signal error situations, but it needs to implicate distinctly what the warning or indication concerns (Norman 2002, p. 102). Sound needs to be informative, yet minimally annoying (Norman 2007, p. 64). A better-functioning example of sound signals I can find from our kitchen. The microwave oven signals with different sounds every few minutes or so, if the food has not been removed from it after being heated. As the signal alters every time, it is not that easy to ignore it. Very efficient and not too irritating either.

Artefacts can be designed so that making errors will be almost impossible, and actions can be *undone* (Norman 2002, p. 131) so that no big harm is done when for instance your cat walks over the keyboard, or a child tries out the DVD-player when the parents are not watching. Also, if the device and its functionalities cannot be tried out, the variety of elaborately developed functions will not be used. People learn by doing and the more physical acting can be utilised in the interfaces, the better they are internalised (Klemmer et al. 2006, p. 141). Annoying slips in the use and accidental misuse can, and should, be prevented (Norman 2002, pp. 112–114). In many keyboards for instance the Caps Lock -key still remains as a relic from typewriters. Just compare how often you accidentally press it, and how many times you actually use it. Nowadays there are some keyboards, where the Caps Lock has been removed, but still the majority have it. Surely there are some design cases that after being standardised, are extremely difficult to change, but maybe the Caps Lock -key is not one of these.

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Due to the adjustments to the standardisation, the order of the QWERTY-keyboard would be quite impossible to change radically. Similarly, turning the hands of clocks to revolve counterclockwise would cause quite a strong opposition (Norman 2002, p. 201). In some cases standardisation in similar objects is surprisingly different. Just think about the number orders in a mobile or an ATM compared to the numbers on a computer keyboard or a calculator. Similar systems, but still the numbers are in different orders.

> *Just compare how often you accidentally press the Caps Lock -key, and how many times you actually use it.*

Because of adjusting to a certain design, a change of the brand of a mobile phone or a keyboard causes confusion, and users tend to stick with the brand they have chosen before. Similarly, a renovation of a corner shop nearby can annoy the people who are used to a different order of groceries. In order to minimise the annoyance, bigger groceries actually use the same organising style in most of their premises.

Good design has its emotional side that makes objects desirable and delightful (Burns et al. 2006, p. 9). Attractive design has been found to function better (Norman 2004). Apart from the principles mentioned above, Jakob Nielsen adds following heuristics especially for computational user interface design: The system needs to speak understandable language to the user thus creating a match between system and the real world; experts and beginners alike should be able to work with the system according to their abilities; minimalist design is recommended so that users find the relevant information to proceed on desired tasks; and even though the systems should work without manuals and documentation, the possibility to find help on problematic issues should be supported (Nielsen 2005). Additionally systems predictability is recommended to be visible in user interfaces, so that users can anticipate what will happen next (Hollnagel and Woods 2005, pp. 90–91). Lucy A. Suchman (2007) points out that self-explanatory interfaces guide users intuitively towards the intended purpose of an artefact. This can be further developed so that computational tools explain themselves for users by advising or coaching in a suitable manner for each user towards the desired direction. As technology becomes more complex, it should still be usable with a decreased amount of training. (pp. 43–45).

Future Technologies

The landscape of computing is in a state of change once again. The mainframe era of single computers shared by hundreds of users is long gone, and the time of personal computers on every desktop is changing to expand computation throughout the environment surrounding us. Computation will spread to help us act in everyday life. (Dourish and Bell 2007, p. 414) Portable technology becomes wearable (Suchman 2007, p. 223) and it will integrate with the environment. Artefacts will have knowledge about their location and owners, and they can communicate with other artefacts and the environment (Norman 2007, p. 44).

Regardless of all the changes, certain aspects of computing have actually remained quite the same during the personal computer era. Even though the present capacity of computers is enormously larger than with the first personal computers, concrete human-computer interaction is still the same in certain respects. The user sits by a desk, uses both hands to type with the keyboard and watches the screen. (Dourish 2001, pp. 25–27) We get high-fidelity data out of the computers, but the input is very restricted. As Scott R. Klemmer et al. (2006) point out, physical use of computer interfaces has been quite far away from the richness, subtleties and coordination of physical tasks that for instance cycling can offer. The homogenised physical performance with constrained gestural movements in computing is the same for any action we do from writing to composing music and interacting with friends. (pp. 140–141) It is as if computation interfaces have understated the human way of acting. Fortunately this has recently begun to change with all the innovative gaming applications as pioneers. When computing is expanding beyond the desktops, tangibility and thinking-by-doing mentality can be better utilised by tangible interactions and performance-based acting within system. The human body is quite capable of acting extremely rapidly, if it can be used more holistically. (ibid., p. 140)

Lucy A. Suchman (2007) describes the critique towards the term *user*, since it refers to a single user who acts in standard ways (p. 188). People will be surrounded by intelligent interfaces that respond in a customised manner for every individual. Computation and technology will become increasingly embedded in the environment, and users will not even be aware using them. This *ambient* *intelligence* is intended to bring about greater usability, user-empowerment and support for human interactions. (Ducatel et al. 2001) The possibilities of this technology are vast, but this research area introduces completely new social, economic and ethical implications that need to be considered. Ambient intelligence brings forth issues concerning reliability, manageability, delegation of control, social compatibility in questions of privacy and universal access, and acceptance with questions about impact on health and environment. (Bohn et al. 2005)

Paul Dourish (2001) introduces the term *embodied interaction* in his book "Where the Action Is". By embodiment he means "the property of our engagement with the world that allows us to make it meaningful" (p. 126). It is acting within the world that truly have significance to us. We encounter phenomena with embodied properties in direct rather than in abstract ways within everyday experiences (ibid., pp. 100, 189). As our environment develops technologically to become filled with embedded systems, computation becomes the central mean of functioning. In this world we operate with artefacts through computation to reach the goals we are aiming at. New technology is bringing forth novel ways of functioning and acting within technological systems (Klemmer et al. 2006, p. 146). Embodiment is about *how* the technology is being used to enhance interaction with the environment (Dourish 2001, p. 188).

Dourish (2001) emphasises that embodiment is a fundamental part of interaction (p. 102). He introduces embodied interaction to mean "the creation, manipulation, and sharing of meaning through engaged interaction with artefacts" (ibid., p. 126). He comments that embodied interaction is not a specific form of technological design, but rather a viewpoint that can be introduced to the design (ibid., p. 145).

Our desktop computers and mobile phones are becoming more and more powerful with an increasing amount of possible tasks for them to perform. Still they are frequently used for simple tasks such as sending email, checking something from the internet, sending a text message or calling and receiving calls. At the same time we are surrounded by quite different conventional devices that are highly specialised on single tasks, such as microwave ovens, vacuum cleaners and hairdryers. These specialised devices can be designed to fit the actions they are used for perfectly. Dourish points out that when computers enable users to use them in multiple ways, they can no longer specialise in any particular area. (ibid., pp. 194–195) On one hand this property enables users to do different tasks quite freely, but then again this makes the simplest tasks somewhat awkward especially for the novice users to perform.

Future technology is predicted to become filled with robots and homes that predict our intentions, recommend a healthier way of living and try to guess our emotions and play music to suit each mood (e.g. Norman 2007, Suchman 2007). When introduced to intelligent technology, perceivable affordances reveal us, how to interact with the devices and where to start (Norman 2007, p. 68).

Systems Usability

Despite great usability of a single artefact in isolation, the usage of it may still be quite difficult, if the environment creates obstacles. A television remote control can be perfectly usable, but it is normally surrounded by other remote controls of stereos, DVD-players, game consoles, old VCR-sets and multiple other devices. Suddenly living room tables are filled with various remote controls that have an increasing amount of buttons and functions. When all the equipment has different signalling systems, homes and workplaces become filled with different beeps and alarms creating a cacophonic environment that distracts and irritates us (Norman 2007, p. 58). Or, imagine a perfectly usable video conference system. If it is situated in a meeting room that is poorly lighted, the user experience will be bad, and the system will not be used. Systems usability takes these contextual factors into account.

As computation moves in increasingly novel directions, where physical objects might no longer define the use, users are no longer aware of the use itself. The usage becomes linked to other actions, other technologies and other users. Usability studies take a viewpoint of a user acting in a certain context and within a certain system. Technology users cannot be considered to be in a social, cultural and historical vacuum, but the system design needs to include other elements beyond the isolated user (DePaula 2003, p. 222).

Leena Norros and her research group study systems usability and design from the viewpoint of the activities within the system. What they call systems usability is an ecological design concept for smart objects, environments and infrastructures of the knowledge society in which we work. In addition to the traditional usability concept, systems usability emphasises integration between the different design phases and levels of detail. From usability as subjective experience to a systemic notion of usability, the artefacts are considered as a part of meaningful activity within a specific context. Moreover, artefacts are assumed to support the actions they are intended for, their functioning is easily controlled, and they make sense to their users. (Norros 2005)

Design has started to extend to large scale systems and services, and to become a way of problem solving in order to find practical solutions to wide-ranging problems (Burns et al. 2006, pp. 12–13). In addition to artefact design, larger systems are beginning to be designed, and they need not necessarily be in a material form. The concept of design changes in time and the novel ways for it to develop can be considered from the systems intelligence point of view as well.

Erik Hollnagel and David D. Woods (2005) introduce the concept of *joint cognitive systems* to the human-machine systems research, where technology and its coupling with people become embedded in the system so that there are no longer different elements, but they work together seamlessly (p. 22). Joint cognitive systems (JCS) include the user in the system, as well as the contextual environment, where the system is operating. The JCS commonly has an aspect of unpredictability. The actions that control it are non-trivial, and the outcomes cannot be forecasted easily. In addition, JCS is not merely controlled by the user, but the system and the technology are part of the dynamic process (ibid., p. 23). JCS emphasises that work almost always involves the use of artefacts as an aid to accomplish something (ibid., p. 66). Joint cognitive systems perspective resembles a systems intelligence approach, but it is more focused on the definition of system boundaries described by certain criteria and effective control mechanisms (Hollnagel 2002), whereas systems intelligence emphasises the intelligent acting within a system, which can rarely be generalised or modelled.

As the focus of usability research broadens to include the context and the actions that are needed to be performed more widely, the systemic point of view is justified. The focus is no longer merely on a single artefact and its functions, but on entire systems. The good usability of a single object might not be enough, if the system does not support it. Therefore the functioning system and the actions performed within it become the centre of attention. The broadening of the perspective to include whole systems accentuates application of systems intelligence (SI) in design. When SI perspective is merged in the design process, holistic usability becomes of importance.

Systems Intelligence Perspective on User Interface Design

Systems intelligence (SI) relates to usability in a twofold manner. On one hand it is designing technological systems to support holistic use of systems intelligence within them by enhancing the functioning of the whole device-user-context-system. On the other hand it is performing within a given system in systems intelligent ways by understanding the context, systemic variables, parameters and degrees of freedom. Even though this chapter concentrates on the former SI point, it should be noted that within every operating environment there can be systems intelligent thinking, and therefore successful performing.

Systems intelligence emphasises the fact that in most actual situations, a human actor is an important part of a system in addition to the technical, constructed and artificial parts of it. SI perspective opens up themes that are quite fundamental to actual systems usability and yet often overlooked. As Robert F. Hoffman and David D. Woods (2005) point out, "the phenomena that occur in sociotechnical contexts are emergent and involve processes not adequately captured in either cognitive sciences or systems science" (p. 78). Similarly, systems intelligence accentuates the knowledge of both disciplines in a way that highlights the useful aspects of each viewpoint, as in the complex and cognitive systems approach of Hoffman and Woods. We can further on design various artefacts to our needs, refine their technology and increase their efficiency, but without users and user experiences they are merely just machines.

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By systems intelligent usability I mean such a relationship between a human agent – a user – and an instrumental object system that supports intelligent use within the whole system, but also supports the intelligence of the higher-level system that the user and the object system constitute together in the course of their interaction. As Paul Dourish (2001) accentuates embodiment between a user and an artefact, systems intelligent perspective describes this connection as an essential part of a larger system.

Systems intelligence is fundamentally about practice and not about theorisations. In the world of artefacts, SI thinking is focused on practicalities, and therefore on usability and user interfaces. SI is all about situational performing, and therefore it cannot be measured objectively. As Kirsten Boehner et al. (2007) point out, an objectively approached view on emotions limits and distorts emotional experience (p. 280). This can similarly happen to systems intelligence if it is perceived merely objectively. Boehner et al. question who gets to design which emotional experiences are designed for and which are left out (ibid., p. 290).

Hämäläinen and Saarinen (2007) introduce three systems questions from a systems intelligent leadership point of view. The same SI questions can be asked of usability design, with additional systemic questions.

(1) What are the systems for?

As Hollnagel and Woods (2005) emphasise, what the joint cognitive systems do is more important than how they do it (p. 22). Similarly, it is hardly of importance, *how* systems intelligence improves the system and its functions. SI is context sensitive, and therefore actions in one system are systems intelligent but the same actions in another system or in another time have different effects. When the system design is highly contextual and individually suitable for the user, acting within it becomes natural and intuitive.

In order to facilitate the systems intelligent behaviour with a certain technological system, the user interface can guide the user towards successful and productive acting. Routine tasks can be made so easy and automated that the primary goal in acting with the system can be brought to focus.

If a system for instance restricts gestural actions, as happens when using a keyboard, the thinking process of a user and interaction between other users can be quite constricted. When bodily performance is not that restricted, thought and interaction possibilities open up. (Klemmer et al. 2006, p. 141) Systems can support users to understand, interpret and experience their own emotions so that a system encourages self-awareness of emotions (Boehner et al. 2007). The challenge for future technology is to support the activities and intentions of users, complement their skills and to entertain without stressing them (Norman 2007, p. 134).

Systems can be designed so that instead of only acting in them, users can also understand them. Consequently, systems can be used more freely, the presence of designers decreases and interaction between the system and the user can begin. (Dourish 2001, p. 173) Of course this is not necessary in all technological systems. We do not need to understand the whole functioning of a car in order to drive it. However, systems have always been designed by someone and therefore their use is part of the interaction between designer and user. The designer is communicating through the user interface to the user about how the system is intended to be used. The system itself can clarify the purpose for which it was designed. (Dourish 2001, pp. 56, 132)

Technological systems are normally made to do something. The purpose of a system can be related to a work that needs to be done by a single user or multiple users. Maini Alho-Ylikoski (2008) applies systems intelligence in workplace design and describes ways to enhance systems intelligent behaviour within it. As computation spreads throughout the environment, technological systems are increasingly used for various purposes that can be nearly anything. However, it is important to realise that in addition to reaching the intended task-related goals, the use can generate emotions in the users as well.

(2) What does the system generate?

A usable system can for instance produce feelings of capability and competence, since the tasks can be performed easily and effectively. Similarly, when a system has multiple users or otherwise facilitates interaction between people, the system has an impact on the emotions of the users. A system can endorse the feeling of connectivity within a work-group, strengthen their sense of shared vision, enhance their enthusiasm, and make it easier for users to understand the emotions of others. The user experience consists of ease of usability and the emotion generated from the use. Norman (2004) highlights this emotional part of the use. Usability losses have less importance, if an artefact looks and feels nice. On the other hand, good usability can make the use so pleasant that the appearance is almost indifferent. If both of these aspects are considered, the performance can be facilitated to become successful.

When the use of an artefact generates something in its user, *how* it is done is less important than the fact that it happens. This can be utilised in the design process by asking: What is it that we want this system to generate? Feelings of enthusiasm or boredom? Efficiency or awkwardness?

(3) How do systems mould us as human beings?

As mentioned earlier, when a device is usable, we may not even be aware of the use. Easy-to-use devices actually make use of the mental models users already have. Therefore if even a completely new device fits the previous assumptions, the use becomes intuitive. Problems arise only when a system functions against our mental models and we cannot figure out its functioning principles.

The use of some artefacts can become so pleasant that we get positive energy out of them. This energy is not necessarily produced from merely the moment of the use. A user can look forward to the use, and be happy long after the use, and discuss it with others. Technical systems – like all systems surrounding us – affect users. The use can even become a part of a person's ego, raising their self-respect. On the contrary, unusable systems can create strong feelings of frustration and anxiety in the long run. People begin to avoid the use of certain devices that feel unpleasant to use. First-time use often defines the following attitudes towards an artefact. If the proper use cannot be figured out, we get frustrated and form a negative mental model about the system and the next time will hardly be any better. We do not want to use those systems that make us feel like completely different people. Even if we can feel competent, smart and capable, when we are introduced to this technical device, suddenly everything turns around. We feel like complete idiots when using them. We press a button several times and the machine still does not give any signals of working. From the VCR-users, surprisingly few knew how to set the timer. This hardly had been the purpose of their design. Most systems seem to be created so that they are giving users the feelings of humiliation and incompetence. This is not what designers want, nor users. Nobody intends it, but still it happens too frequently.

Systems often seem to have an edge over us, which intimidates users to adjust to the system. It should really be the other way around. How can systems be designed so that they would be moulded for the purposes of users, providing ease in use, generating positive emotions, and fitting to the human possibilities better?

Avoidance of a certain artefact can create a system of holding back, where a system appears to develop in unwanted directions by itself (Hämäläinen and Saarinen 2007, pp. 26–28). An inner mental model becomes distorted, we avoid the use, and no matter how the artefact behaves in the future, we have a bad attitude towards it, and this will not change. The negative loop in the usage-system grows, and it is unlikely that anything positive could be generated. The first-time use often defines the mental models users will have of the systems and the level of holding-back. There are different users and an engineer will probably look at a computational system differently than others, and a young person probably is more ready to use new technological systems than an elderly person. Technical systems are too often designed merely for advanced users, which further differentiates beginners and advanced users from each other. Systems become merely used by experienced, and new users will never have a chance to use them properly. It is clear that advanced use needs to be developed, but it should not be at the expense of the first time user.

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Artefacts should be designed with certain user groups or use cases in mind. Even when they are considered, the use cases often present too narrow set of possible functions within a system. Some of them may even remain improper for certain users, when the parameters to define the situation have been too restricted. How does the use of a system differ when the user is extremely happy or provoked? A systems intelligent designer considers different use cases: what can go wrong, how will certain functions affect people, and more importantly: how subjects can become moulded by a system, and how systems of holding back can be avoided?

(4) What kind of in-between does the system endorse?

As mentioned previously, systems intelligence is always about the human sensibility and therefore even the most intelligent artefact-systems cannot function intelligently alone. Subjective qualities and features of human agents affect systems tremendously. If user interface design has been planned separately from the actual use, usability results can be quite different than intended. The higher-level system does not work because those all-too-human features were not taken seriously, but ruled out to start with.

Dourish accentuates that computation should be primarily seen as a medium, which focuses on the communication rather than on the technology (Dourish 2001, p. 162). Therefore, the meaning is created by users rather than by designers (ibid., p. 170). Visibility, a design guideline presented earlier, can refer to visibility of the activities of other users working on the same system (Klemmer et al. 2006, p. 144). It is the awareness users have through the interface systems to the actions of others, which eases the collaboration among a work team or a study group (Dourish 2001, p. 165). Intersubjectivity of a technological system appears in the ways users communicate and work through it. In addition, it is the ways the system is accustomed to be used, when the users assume it to be useful, and to what extent the users are aware of the actions of each other. (ibid., p. 133)

Rogerio DePaula (2003) describes interaction design to be an extension of the usability-centred study, where the focus moves from efficiency and usability towards empathy, aesthetics, motivation and fun. The purpose is to combine the users, their activities and the design of the interactive technologies, whereas community-centred design focuses on the interaction between people within a certain technology. The embedded technology will increasingly be used for social purposes. DePaula describes socio-computing as the ways technology is affecting social interaction, while technology is being affected by it. From the social view, technology can be considered as a means for communication, coordination and collaboration. (DePaula 2003, pp. 219–220)

Face-to-face communication differs dramatically from interaction through conventional computation. When interacting in person, slips of the tongue cannot be undone, and therefore the interaction is more committed to the moment. Through conventional computation interaction, the sentences can be deleted before sending them, and drafts of emails can be rewritten. (Klemmer et al. 2006, pp. 145–146) On the other hand, emails and forum conversations are stored, which may prevent novice users from participating in conversations. Regardless of altering ways of interaction, it should be noted that interaction always changes depending on the media.

Dourish emphasises that interaction is closely connected with the settings and the system in which it occurs. Embodied interaction is essential in user interface design, for the designed objects are a way to interact with the world. In the use of communication devices and applications, the interaction aspect of technology can be seen straightforwardly, but other objects are closely related to interaction processes as well. There are artefacts that create environments that either support or prevent interaction within them (Dourish 2001, p. 19). Social computing can be supported by organising interaction to a more informal form, as distinct from a rote procedure that is driven by a technological system (ibid., p. 160).

Interactive systems have changed our communication, so that we have become closer to each other in the sense that we can reach everyone more easily, and we are more ready to be in touch with others. However, at the same time we increasingly assume that people are within our reach all the time. When people are increasingly communicating through technology, misunderstandings happen more often than in face-to-face interaction. (Dourish 2001, pp. 96–97) Therefore, systems intelligence considers how we can make interactive technologies diminish these misunderstandings and to improve the system in order for it to mediate the interaction correctly to the recipient.

(5) How can the systems develop?

Systems intelligence (SI) emphasises that systems have a chance to develop in various directions. Users, situations and contexts vary, and so does the need for the system to function in different ways. Even though systems are made to be used for a variety of purposes, designers have been surprised about the novel ways technology has been used (Dourish 2001, p. 171). People have adopted nice-to-use artefacts and their functionalities, and begun to use them in new situations. Even though certain settings and artefacts are designed for specific tasks or situations, designers should not restrict the actions of the users too much. On the contrary, design can encourage especially the advanced users to exploit their intuitive acting to follow the sudden inputs or systemic interventions coming from outside the system or within it. Systems intelligent actor sees the systemic points of impact and seizes the moment. User interfaces could facilitate this.

Systems can guide users and support the use to be easier and less stressful, but it is the intelligent actions user does that makes systems flourish.

A systems intelligent designer utilises the intuitive possibilities systems have. Designers can have visions about usage possibilities of the system. Still, opportunities need to be left open so that the artefact can be tailored by the user. Only users can define the best ways to use systems in their own ways – which usually differ quite a lot from the assumed ways (Dourish 2001, p. 160). There are plenty of examples of design that users further develop to their own directions. And this is where SI design should aim. Even though user interfaces can be developed to become even more usable, more attractive and more efficient, the emphasis is after all on the user. Systems can guide users and support the use to be easier and less stressful, but it is the intelligent actions of the user that make systems flourish.

Systems intelligence emphasises the fact that certain designs do work extremely well. The focus is moved from the usability faults to good examples, which can be further utilised in other designs as well.

Design can support various actions within a working system, but it can also support the user not to accidentally harm the system, and prevent wrong choices. By restricting some possibilities of acting a system can guide the user towards finding out its possibilities faster. If a system allows users to do almost anything, the actual use after several dead ends can be so frustrating that users never achieve the point of flying with the system, and will not find better ways to act.

When the culture of households is studied in order to provide assistance, designers try to find things that people have difficulties with. The focus is on larger phenomena, where simple solutions could have greater positive effects. (Norman 2007, p. 125)

Systems intelligence emphasises the fact that certain designs do work extremely well. The focus is moved from the usability faults to good examples, which can be further utilised in other designs as well. It is about the positive attitude and optimistic approach. The amount of everyday things around us is huge (Norman 2002, p. 11), some of them we have chosen to use and others we have not (Hollnagel and Woods 2005, p. 99). In addition, there are technological systems that are used as tools within different situations. These systems include artefacts that work almost miraculously well. Systems intelligence turns to these, finds out what these systems generate, and encourages the designers to utilise the positive examples in other systems as well.

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