Insect Behaviour as Source of Inspiration for Designing Intuitive Human-Computer Interaction

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1. Introduction – Design of Intuitive Use

For centuries, humans have been creating ever-more complex technical systems. Today users have more choices and are confronted with more features than any time before. This trend of increasing sophistication of technology goes hand in hand with the need of human-machine interfaces that are still easy and intuitive to use (Mohs et al. 2006). Intuitive use can be defined as the extend to which the users’ subconscious application of prior knowledge leads to effective interaction (Hurtienne & Blessing 2007).

One strategy to create user interfaces that are intuitive to use is to build up on prior knowledge of the users (Blackler et al. 2006). Hurtienne & Blessing (2007) proposed a continuum of knowledge sources where prior knowledge can stem from. The authors distinguish between innate and sensorimotor knowledge, cultural experience, areas of expertise and interaction with tools. Many examples can be thought of when prior knowledge, gained through interaction with the environment and technology itself, is (re-)applied in user interface design to create interfaces that are intuitive to use. For example, in skeuomorph design, objects from the real world (knowledge on tool level) are imitated in graphical user interfaces to create a feeling of familiarity with its functionality (Blackwell 2006). So far, the prior knowledge used for the design of intuitive-to-use user interfaces mainly draws upon knowledge gathered through the interaction with inanimate objects. However, humans also possess profound knowledge from the interaction with animals, like their pets or wild creatures (e.g., Giffin et al. 2011), which can be potentially used to inspire user interface design.

2. Related Work – Animal-Inspired Design

As one example in this new field of research, Singh & Young (2012) followed an animal-inspired methodology and mapped a robot’s state to its doglike tail to unobtrusively communicate a range robot states. Following this approach of leveraging people’s existing knowledge of and experiences with animals can be promising for the design of human-computer interaction (HCI) as well. Insects constitute a promising subject of investigation, because insects are the most diverse living species on earth (Stork 1993). Insects show a huge variability both in behaviour and appearance, making them ideal candidates as source of inspiration for visual, audio and haptic feedback in HCI. Additionally, humans frequently come into contact with insects and developed profound knowledge about them, making them idea candidates for the design of intuitive and inherently informative notification cues that communicate high-level state information without requiring the user to read complex sensory information.

3. Method and Results – Qualitative and Explorative Interviews

In order to leverage people’s knowledge and associations of insects to counteract technological impenetrability, a semi-structured interview study was conducted to identify visual, acoustic and haptic characteristics, as well as emotional responses to and associations of insects that form peoples’ image of an insect specimen. 20 Japanese adults (mean age = 22.5 years, 11 female) volunteered in the study and were asked to describe nine different insects (ant, bee and wasp, butterfly, caterpillar, cockroach, fly, locust, mosquito, moth) verbally, acoustically and by using gestures. Their qualitative answers and gestures were video recorded, transcribed or described, respectively, and ordered into inductively developed categories by two independent raters following the qualitative content analysis procedure according to Mayring (2000). The resulting categories were: appearance, movement, emotional reaction and general associations. Since no a-priori hypothesis was formulated, results are described by descriptive statistics. Each insect differed in the amount of reported visual/acoustic/haptic features, movement style and intensity as well as valence of the emotional reaction. For example, while the ant was mainly described through associations (powerful, goal-oriented, collaborative, steady), the wasp was described by intense negative emotional reactions (danger,
poison, urge to avoid) and appearance (black-yellow stripes, sting). The movement of the moth was one of the key features participants mentioned (attracted by light but still uncontrolled, hectic).

4. Conclusion and Future Work

In a next step, the characteristics of each insect need to be mapped to functions, system behaviour and other bits of information that needs to be communicated in HCI. For example, the continuous moving path of ants can inspire the design of a digital process indicator, because visual similarity to moving ants in a row evokes the association of a continuous process, as indicated by the results of our interview study. Instead of designing arbitrary signals that users have to learn by heart, insect-inspired signals have the ability to intuitively convey information without putting high learning requirements onto the user. According to the definition of intuitive use, insect-inspired notification cues and insect-inspired user interface elements should be quickly understood by the user, create a sense of familiarity other than familiarity with technology (Raskin 1994) and reduce errors. One well-known example of the successful employment of insect features in HCI is the black-yellow striped pattern of wasps for warning messages that need to attract the users’ attention and require immediate action.

In the future, we intend to design user interface prototypes that exhibit insect specific behaviour and conduct user evaluations to investigate how the behaviour is perceived, interpreted and how useful it can be as a mechanism to communicate a system status. We also want to investigate the importance of particular visual/acoustic or even haptic attributes for eliciting insect-specific associations. An additional field of investigation would be cultural research about whether there are some differences in terms of human-insect interaction in different cultures and resulting implications for HCI design.

Overall, we believe that our insect-inspired approach opens a new perspective on interface design and can provide an effective, intuitive to understand way of conveying information to the user.

References

Mayring, P. Qualitative Content Analysis, Qualitative Social Research 1, 2 (2000).