The Role of Physical Affordances in Multifunctional Mobile Device Design

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ABSTRACT

As designers of mobile/media-rich devices continue to incorporate more features/functionality, the evolution of interfaces will become more complex. Meanwhile, users cognitive models must be aligned with new device capabilities and corresponding physical affordances. In this paper, the authors argue that based on HCI design theory, users approach objects by building mental models starting with physical appearance. Findings suggest that users who embrace a device’s multifunctionality are prevented from taking full advantage of an array of features due to an apparent cognitive constraint caused by a lack of physical controls. The authors submit that this problem stems from established mental models and past associated behaviors of both mobile and non-mobile interactive devices. In conclusion, users expressed a preference for immediate access and use of certain physical device controls within a multi-tasking environment, suggesting that as mobile computing becomes more prevalent, physical affordances in multifunctional devices may remain or increase in importance.

Keywords: Affordances, Cognitive Models, Human-Computer Interaction, Interaction Design, Media, Mobile Devices, Multifunctionality

INTRODUCTION

The cell phone and other small mobile devices are rapidly becoming the preferred access points to, and storage repositories for, personal messages and media, such as music, photos, and video. Such devices are transforming person-to-person mobile communication into a convergence of voice and media sharing communication via devices with multifunctional capabilities (Heo, Ham, Park, Song, & Yoon, 2009; Monk, Fellas, & Ley, 2004). The functionality of these devices is further enhanced by the possibility of transferring media content to a fixed interface display, such as a personal computer (PC), TV, or stereo system. The emergence of such multimedia-enabled mobile devices creates a number of physical and conceptual design challenges that revolve around two issues.

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The first issue is related to the fact that commercial devices are relatively shrinking—even the iPad is smaller than a typical laptop, yet they continue to incorporate more features and functionality. Consequently, controls and interfaces have either become more crowded or have been buried in complex hierarchically structured graphical user interfaces (GUIs) (Vivrou & Kabbasi, 2002). The second issue is that the ever-increasing functionality offered by these novel technologies is limited by the socio-cultural maps and cognitive models that users and designers carry in their minds about mobile and non-mobile device capabilities and their corresponding physical affordances (Faiola, & MacDorman, 2008; Gibson 1977, Hartson, 2003, Norman, 2002).

The concept of affordance designates the capacity of a device to suggest a particular kind of use by virtue of some physical attribute. For example, a cell phone’s most significant affordance is related to voice calling, as an object made to be grasped with one hand and positioned between the ear and mouth. This affordance is reinforced both by the physical design of the device and its controls (softkeys, menu options, hardwired buttons, etc.), as well as the way in which people approach it cognitively.

Physical affordances are extremely effective when they are incorporated into simple/unifunctional devices with limited functions (Norman, 1998). However, problems often emerge when these multimedia devices additionally serve as gateways and transfer devices for video, photos, text, and various other types of information and media content between different types of platforms. For example, how should the device make its non-talking affordances visible and immediately understandable to the user who associates the device with a more basic cell phone or home phone that only makes calls? The process of “unveiling” the functional potential of the multimedia device relies heavily on creating features and interface and interaction design solutions that suggest the idea that the device is not just a cell phone, but also a vehicle for content capture, storage, and transfer between various platforms.

The study described here suggests that users approach such multifunctional devices with cognitive models derived from their prior experiences of using phones, cameras, camcorders, PDAs, and PCs. A directive principle should be that industrial and interaction designers must consider the users’ prior experience with media devices, in order to avoid conflicts with existing cognitive or mental models associated with the use of these single appliance interactive devices. Forlizzi (2007) specifically recommends thorough examination of prior subjective experiences with mobile products, which can lead to generalizable knowledge for design activities. At the same time, the design process should not be dogmatic. Ecological, participatory design is preferable. Prototypes that reflect a combination of existing and novel features and practices need to be continuously tested and “winning” features sorted out in the process of actual usage. Patterns of use need to be monitored and the conclusions of such monitoring fed back into participatory design activities (Forlizzi, 2007).

This paper, which is theoretically informed by affordance theory (Norman, 2002), addresses the role that particular affordances and cognitive models play in facilitating or hindering the use of the cell phone as a gateway for multimedia content generation, transfer, and visualization. More specifically, we reconsider the role of the touch screen interface and the physical device affordances in such multifunctional mobile devices.

**MULTIFUNCTIONAL DEVICES AND AFFORDANCES**

Discussions about how new audio and video technologies and information management should be embedded in the mobile communication environment and assimilated by users go back to the 1980s and to Xerox’s Palo Alto Research Center (Abowd & Mynatt, 2000; Dourish, 2001). Nevertheless, the practical integration of multimedia functionality within a mobile device is an evolving concept (Gold-
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