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Method for Analyzing Affordances in User-Product Interaction

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Abstract

The notion of affordability has evolved into one of the most essential concepts in promoting user-product engagement, and it has several definitions in design. In this article, affordances are defined as a product's -ability. Designers should make certain affordances for user-product interaction visible on purpose. As a result, the goal of this work is to investigate how affordances might be provided in various situations, such as visible, concealed, and false, and to suggest an analysis process of affordance condition for user-product interaction. The affordance condition analysis technique consists of four phases, which are as follows: 1) Task analysis, 2) Affordance analysis, 3) Perceptual information analysis, and 4) Affordance-information analysis are the four types of analysis. Furthermore, a method of assessing product parts' needed affordances for user-product interaction is given in the technique.

Keywords: *Affordance, User-product interaction, Product design*

INTRODUCTION

Gibson's word affordance refers to the matching relationship between animal and item in the ecological environment. The affordance idea, as a design idiom, is frequently referenced in interface design to describe how it works in user-product interaction. In the physical world, availability is an obvious concept that can be simply stated and understood through examples. Plates, for example, may be pushed with hands, and knobs can be twisted with fingers. However, affordance is not fully mature and lacks a formal-agreed-upon concept in design. The ability to perform anything with an object is

referred to as its affordance. That is, affordance relates to an object's function or usefulness. In this perspective, affordances may be thought of as an object's -ability, such as press-ability, grasp-ability, assembly-ability, and so on.

Affordance conditions in the affordance-information framework suggested by Gaver illustrate affordance could be perceptible, hidden or false in terms of existence or absence of perceptual information. Based on Gaver's framework, the aim of this paper is to develop an analysis procedure of affordance conditions. The analysis procedure could serve designing process as design references.

Perception of affordance

Affordance exists whether it is perceived or used or not. Affordance is independent of perception and information. Moreover, affordance of an object can be specified by perceptual information. Perception of affordance refers to a process of picking up information directly. Mc Grenere & Ho clearly illustrated the affordance-information relation and the way of perception of affordances in their study (see Figure 1).

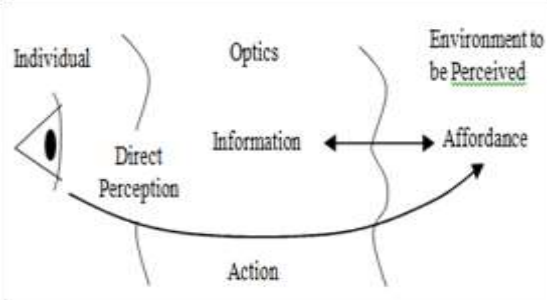

Figure 1: Direct perception is the act of picking up information to guide action

Direct perception is possible when there is an affordance and when there is information in the environment that uniquely specifies that affordance. Human vision plays an important factor for picking up environmental information. Thus, visual-perceptual information is the important element for perception of affordances.

Gaver's affordance-information framework

Gaver [7] further stated the affordance-information relationship to illustrate the affordance conditions, as shown in Figure 2. Affordance is perceptible if there is available perceptual information for it; affordance is hidden if there is no information for it and must be inferred from other evidence; Affordance is false if information suggests a nonexistent affordance that might lead users to operate it incorrectly; Finally, users might usually

not act on an object when there is no affordance and no information for it.

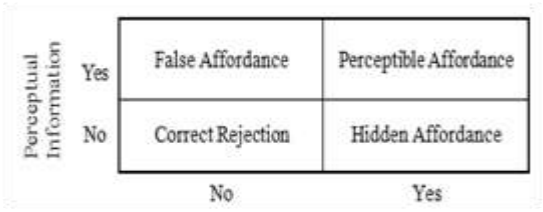

Figure 2: Affordance-information frameworks [7]

Analysis procedure of affordance condition

In this section, an analysis procedure of affordance conditions is suggested based on the extent-absent relationship between affordances and perceptual information. The analysis procedure contains four steps, task analysis, affordance analysis, perceptual information analysis and affordance-information analysis.

Task analysis

Task analysis mainly presents the subtasks corresponding to the tasks and the related product parts for the subtasks. Due to an object having various behavioral possibilities for users, to set immovable operational tasks can limit the users' behaviors and intentions for operations to the product parts.

In general, the operational tasks can be further separated into subtasks based on the data from observations made while the users completed the tasks. Each subtask was concerned with related parts (see Figure 3).

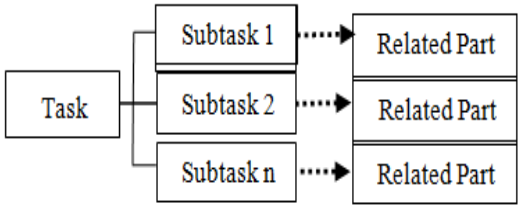

Figure 3: Task-subtask-part

Affordance analysis

The required affordances of the related parts in task analysis can be determined in terms of the task goals and users' operational behaviors for the subtasks.

Figure 4 illustrates the mode of analyzing the related parts' required affordances. In this paper, two viewpoints of affordances, operability and functionality, are suggested in terms of affordance referring to the -abilities of an object. The affordance for functionality as the intended functions of a product can be determined by the task goals; the affordance for operability can be determined by the physical- operational behaviors for the subtasks.

For example, a task goal is to turn on the power of a product, and users need to practice the operational behavior, pressing the on-off button with a finger, to

complete the task. For users, the intended function of turning on the power is the on-off button's affordance for functionality; and press-ability is its affordance for operability that affords the operation of pressing with users' fingers. Therefore, affordances for functionality and press-ability are required for the button in the task.

In general, users interact with products through an interface. The controls, as well as the labels and signs, on the product hardware are part of the user interface [10], which acts as a user-product information channel [11, 12]. This step is to analyze what visual-perceptual information the product parts would present to the users while they operate them. While designing user interfaces, designers may employ some techniques, such as form, size, icon, text or signs, as the perceptual information for cues to facilitate user-product interaction.

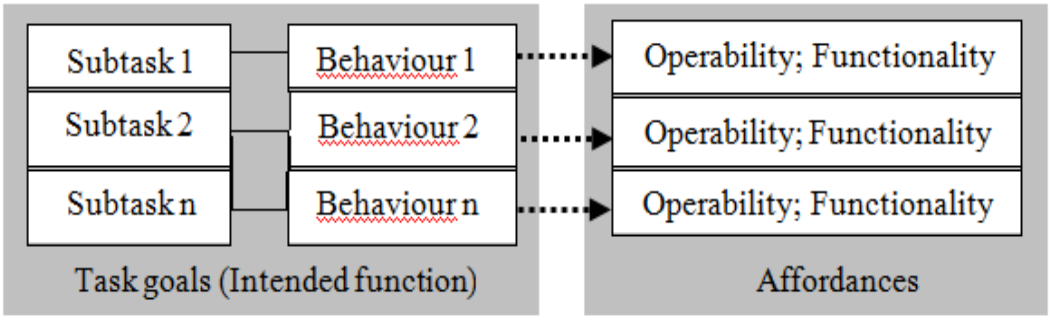

Figure 4: Affordances analysis

Perceptual information analysis

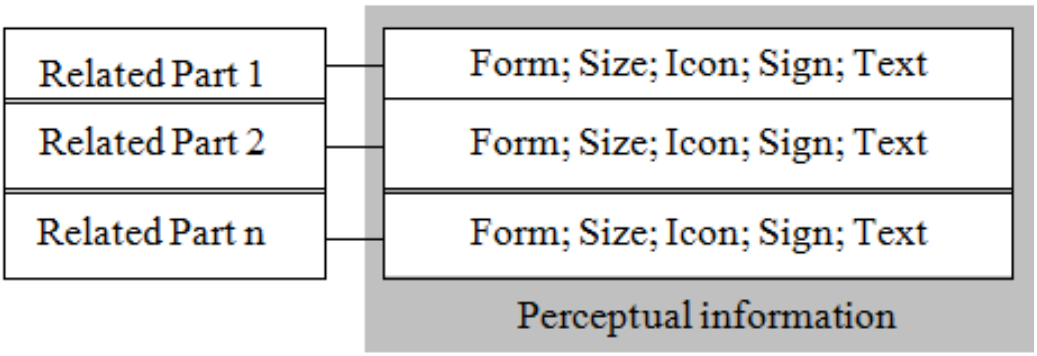

Figure 5: Perceptual information analyses

Affordance-information analysis

The aim of this step is to further interpret the relationship between the required affordances found from step 2 and the perceptual information analyzed in step 3. Based on Gaver's affordance-information framework, affordance is false if perceptual information suggests a nonexistent affordance; affordance is perceptible when there is available perceptual information for it; affordance is hidden if there is no perceptual information for it.This section further considers the corresponding relationship between affordances and perceptual information to develop an analysis scheme. As shown in Table 1, different affordances are required for different product parts for the operational tasks and their affordance conditions might be different in terms of existence or absence of affordances and perceptual information.

For example, as shown in Table 1(a), when a product part requires affordances for operability and functionality for a task and there are perceptual information, form, size and icons of the part, available for them, the affordances are perceptible. As illustrated in Table 1(b), when affordances for operability and functionality are required for the product part, but from and size of the part indicates a nonexistent affordance for operability, the affordance is false. It might lead users to act on the part mistakenly. The affordance for functionality is perceptible if there is an icon or text available for it. As shown in Table 1(c), when affordances for operability and functionality are required for the product part, the operability is perceptible if there is perceptual information, form and size of the part, available for it. However, the functionality is hidden if there is no icon or text existent. Table 1(d) shows that there usually are not any user-product interactions if both affordances and perceptual information are absent.

Table 1: Example of affordance-information analysis

Item	Affordances		Perceptual information			Affordance conditions
	Operability	Functionality	Form	Size	Icon/Text	
(a)	■		■	■		Affordance for operability is perceptible
		■			■	Affordance for functionality is perceptible
(b)			■	■		Affordance for operability is false
		■			■	Affordance for functionality is perceptible
(c)	■	■	■	■		Affordance for functionality is hidden
						Correct rejection
⋮	⋮	⋮	⋮	⋮	⋮	⋮

■ : existent

DISCUSSIONS AND CONCLUSIONS

This work proposes a four-step analysis process for affordance conditions: task analysis, affordance analysis, perceptual information analysis, and affordance-information analysis. In an analytical approach, this work attempted to determine the affordance conditions of product parts. The needed affordances of a product part can be established by users' operational behaviour toward the part and its intended function for the task objective in affordance analysis. Users can engage with an item in a variety of ways. That is, an object's affordances cannot be explicitly enumerated.

The affordance analysis seeks to determine which affordances are necessary for certain operational activities. The requisite affordances cannot be regarded as entire product affordances. For design, the needed affordances for certain operational tasks, as defined by Norman's phrase perceived affordances, are more significant than genuine affordances and must be purposefully provided for user-product interaction.

Different ways may be used to identify an object's affordance needs. For example, Galvao and Sato investigated the affordance needs of a blender by studying users' operating procedures and product architecture; Kim et al. investigated the affordance requirements of a conference room by investigating the utilisation of conference room items. Their analyses provide no recommendations for how the affordance requirements should be communicated. Based on Gaver's affordance-information architecture, these study further analyses the needed affordance conditions and determine how the requisite affordances might be conveyed for user-product interaction.

The affordance condition analysis approach suggested in this work may be used as part of a design procedure to assist designers determine what needed affordances for user-product interaction should be integrated and built in product parts throughout the design process.

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