

## The User Experience of Smart-Phone Information Hierarchy and Screen Transition Patterns

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### Abstract

*This study aims to clarify the relation between the information hierarchy and screen transition as a feedback element for user experience in terms of user sensitivity and presence in a user-centered design environment of smart-phone visual perception based on theoretical researches. The result shows that the information hierarchy includes transitions from top to bottom, return, and transitions in the same hierarchical structure. As for tasks depending on the information hierarchy and transition styles, most tasks are sequential movement for depth entry, movement from top to bottom, and return to the previous screen. In a mobile device environment, since containing and structuralizing certain information on a small screen is important, the sequential structure needs transition effects for instant movement within the same configuration. As for tasks depending on the information hierarchy and transition styles, most tasks are sequential movement for depth entry, movement from top to bottom, and return to the previous screen. In a mobile device environment, the flip transition effect based on slides that feature the high transition rates is frequently used. Besides, transition from top to bottom and 'Move' and 'Scale' that have the concept of 'Layer' are also often utilized. As such, screen transition mainly for inter-depth movement is the major usage, but it is affected by the types, specifications of the used devices, internet access means and speed, etc.*

**Keywords:** smart-phone, information perception, screen

### 1. Introduction

Today's development of hardware and information expressing technology has enabled to embody dynamic interface using multimedia in delivering and searching for information. This dynamic multimedia based interface has been widely applied to mobile interface as well as website. Recently, a lot of efforts have been put forth into maximizing user sensitivity and presence in the area of smart-phone GUIs and UXs. Users desire intuitive interactions that go beyond existing interfaces. In particular, the advancement of multimedia technology and various contents require of users more efficient and intuitive interactions. Display types of smart-phones such as touch-screen make possible signal transference and manipulation on the screen through certain physical objects such as fingers or touch pens on graphical elements. The contact with physical objects such as fingers on the screen lead to executing a certain application or a hyperlink, which initiates a feedback or a screen transition. In terms of usability and sensibility, the 'feedback' is a vital concept, and smart-phones in the recent touch-screen environment pursue user-centered designs of visual perception accordingly.

In an interface, screen transition is a process of moving from one information page to another, and this is an essential element for contents presented by a smart-phone. Especially in interfaces of a small screen such as smart-phones, screen transition plays an important role as a feedback in perception of information system changeover. As hardware in the area of smart-phones advances recently, the use of not only 2D but also 3D screen transitions is accelerating. Upon touching certain information in a smart-phone, screen transition provides a feedback based on sensitivity, which is a subjective element, but the understanding and use of interfaces is determined exclusively by the user. Feedback elements preferred by users may be varied depending on the events that are used, and perception errors may occur due to the difference from a user's expectation depending on the situations [1]. Hence, this study classifies the types of screen transition and examines effective applications of screen transition based on the patterns in order for efficient information structure design and visual perception in the use of smart-phones.

## **2. Theoretical Background**

### **2.1. Movement and Perception**

Movement causes a visual stimulation that leads a user's gaze from one position to another consecutively. Visual stimulation does not continually follow the movement but keeps the gaze at a certain position for a relatively short time, which is called 'fixation.' At the moment of fixation, the user pays attention to the object, processing information in a way of visual and cognitive thinking [2]. Such a moment of information processing may be called perception, and perception is interpreted as a significant stimulation according to the principle of systematization as part of the unified system. Reeves & Tholson (1986) state that movement is related to a higher level of attention or excitement of the cerebral cortex [3]. They also point out that movement of images on a digital screen affect sensuous processing rather than semantic processing. According to one experiment of Sujin Lee (2006) regarding video perception, about 70 to 80% of the objects viewed the perception of movement as an important clue of grouping in the formation of semantic structures [4].

In 1866, Helmholtz emphasized the importance of experience in terms of perception, claiming that people would utilize their existing knowledge or experience regarding environments in understanding of certain stimulations. Based on such existing knowledge or personal experience, people go through a process of inference to interpret the meaning of sensuous experiences (meaning of stimulations recognized by sensory cells. The theory of Helmholtz assumes that experience plays a role of setting up a hypothesis about the object to be recognized in interpretation of daily sensory stimulations.

An interface functions to connect interactions between a human and a computer or between devices. It is also used as a means for humans to acquire information, achieve goals, and enhance understanding. The area of HCI (Human-Computer Interaction) has long conducted researches on applications of human characteristics of perception into designing interfaces. User-device interfaces bear practical and functional spaces visual to users, and user perception occurs in these conceptual and logical spaces in the system where operations are implemented. This type of spaces may be different in terms of structure and formation depending on what the user intends to achieve through the device system or commands it do to. Thus, human reactions of thinking may be different depending on the interface formation or structural perception as well as the resulting behaviors.

## 2.2. Memory and Perception

Human memory is divided to three steps: sensuous memory, short-term memory, and long-term memory. These three steps are viewed as an information-processing model or a macro model in the area of cognitive psychology. Among these, it is short-term memory that plays the most important role in the design of an interface because the structure of knowledge stored in long-term memory consistently changes and new relations between encoded data inputs and existing knowledge continue to be formed. Short-term memory is determined by encoding in long-term memory.

Humans can recognize something because they have sensory organs. Sensory organs inform the brain of events that have occurred outside, and the information is recognized after the brain judges it. In this process, objects that exist outside are not accepted as they are, but merely their certain tendencies may be recognized regardless of individuals' intentions. Hence, psychological elements of perception are quite valid in clarifying the principles of GUI design and seeking the methods. Particularly, as recent smart-phone environments pursue user-centered designs of visual perception, the degree of visibility affects perception significantly. To enhance visibility of certain information, the amount of information needs to be adjusted by controlling the indication density as well as grouping properly.

Perception of movements in smart-phone screen transition is in relation to the principle of grouping in Gestalt's perspective: Gestalt psychology, which was founded in the 1920s, claims that psychological phenomena are not divided to one dimensional perceptual elements but should be viewed as a whole that is systematized and structuralized [6]. Humans tend to group objects when recognizing them. In other words, objects that are adjacent to one another are recognized as one group or one formation, and similar stimulations are grouped and recognized as of the same pattern. According to 2014 Survey of Mobile Internet Service Use conducted by Korea Internet and Security Agency, the accumulated rate of users who have used smart-phones since 2009 is 75.7%. Smart-phone users may be classified to beginners, intermediates, experts, and masters depending on the level of use proficiency. As the smart-phone environment is currently in the stage of maturity, most users can be classified as at least intermediates. Thus, smart-phone users would group and recognize touch gestures and screen transitions when using mobile applications based on their accumulated experiences.

It may be varied depending on the experience, frequency, and period of using smart-phones, but most users familiar with smart-phones may possibly fail recognizing screen transitions as they are so much engrossed or involve cognitive errors due to mistaken recognition of touch gestures and screen transitions. In particular, the directional nature of screen transition is likely to cause grouping according to the design patterns of significant similarity. According to Seow (2008), Feelings of a user about the system reaction rates is not only affected by the response time but also relative depending on the type of interactions [7]. It may be also subjective depending on users. It is highly probable that existing guidelines fail to reflect the high expectancy of response time of users familiar with smart-phones, and thus there is no standard for various types of touch-screen manipulation and appropriate changes or reactions as they focus on physical button manipulations.

## 2.3. Screen Transition

'Transition' is a term used in the area of media. A dictionary definition of it is a shift to another status or condition. It also means to "change" [8]. The most fundamental function of transition is to link scenes. It may bring in a visual shock by changing or combining formative elements. As interfaces have changed from text-based to graphic-based, the use of transition is increasing in interfaces as well. Particularly, graphic user interfaces in screen display take into consideration both distinction and consistency between

information factors in utilizing screen transition effects. Interface objects are user-oriented and subject to direct interactions with users. Transition effects help users more readily understand the information structure of an interface and thus result in a higher level of satisfaction with sensuous aspects.

In the context of interfaces, 'transition' means to move from one information page over to another, which are essential for contents of digital devices. Especially for small screen interfaces such as those of mobile gadgets, transition effects play a vital role in the information system.

Applying transition effects to user interfaces is advantageous mainly in two aspects: First, it is possible to recognize the relation before and after transition. In a sequential progress of an animation, for example, a transition effect makes a cognitive distinction between the current scene and the following one, and the reason of using it is intuitively recognized. In addition, such transition effects in terms of sequence can attract more visual attention in an interface. Second, continuous motions produce a feeling of realistic movement [9]. According to the 'checklist for user interface evaluation' proposed by Jacob Nielsen (1993), 'system designing should correspond to the real world.' This principle aims to provide information in a natural and logical manner according to customs of the real world so that users can easily understand the structure of a system. Movement in the real world is not separated before and after. Rather, feelings of the real world are created by applying a process in between. As a motion or a shape is close to that in the real world, it creates familiar feelings, and the interface can be handled with no separate learning to the user.







Additionally, it has been demonstrated that a dynamic interface makes the operation pace faster than that of a static interface, and that it is more preferred in terms of emotional appeal. A dynamic interface affects user experience so significantly that users can use the interface more efficiently. Besides, movement affects sensuous aspects to a large degree, and visual information from it attracts attention [10]. This is in close relation with the locus of attention: A locus is related to location or space while attention is correlated to user reactions [11]. A locus of attention indicates things, characteristics, or ideas in the physical world where humans are awake, aware, and thinking intentionally or actively. In particular, a locus of attention for interface designing helps users focus on an intentionally chosen locus or space. According to existing researches, without a locus of attention, it is difficult to recognize an event even if there is one [12]. If there is a cognitive locus, in contrast, a user is likely to show strong reactions to it, and such attention elements bring in more powerful memory than common cognitive elements. Especially in the case of transition in an image or interface, dynamic movement causes a powerful locus of attention, remaining as memory and experience with narrative characteristics.

### **3. Analysis of Transition and Information Hierarchy**

#### **3.1. Classification of Spatiality and Directional Attributes**

Screen transition effects can be divided to various types. However, since visual formations are indefinite and highly movable, it is difficult to divide transition effects to types. Standards for attribute analysis in this study are based on the animation principles of Thomas and Johnston [13] and dynamics principles of motion graphics. Based on 3D coordinate perception and touch interface characteristics, spatiality and directional attributes are classified as follows:

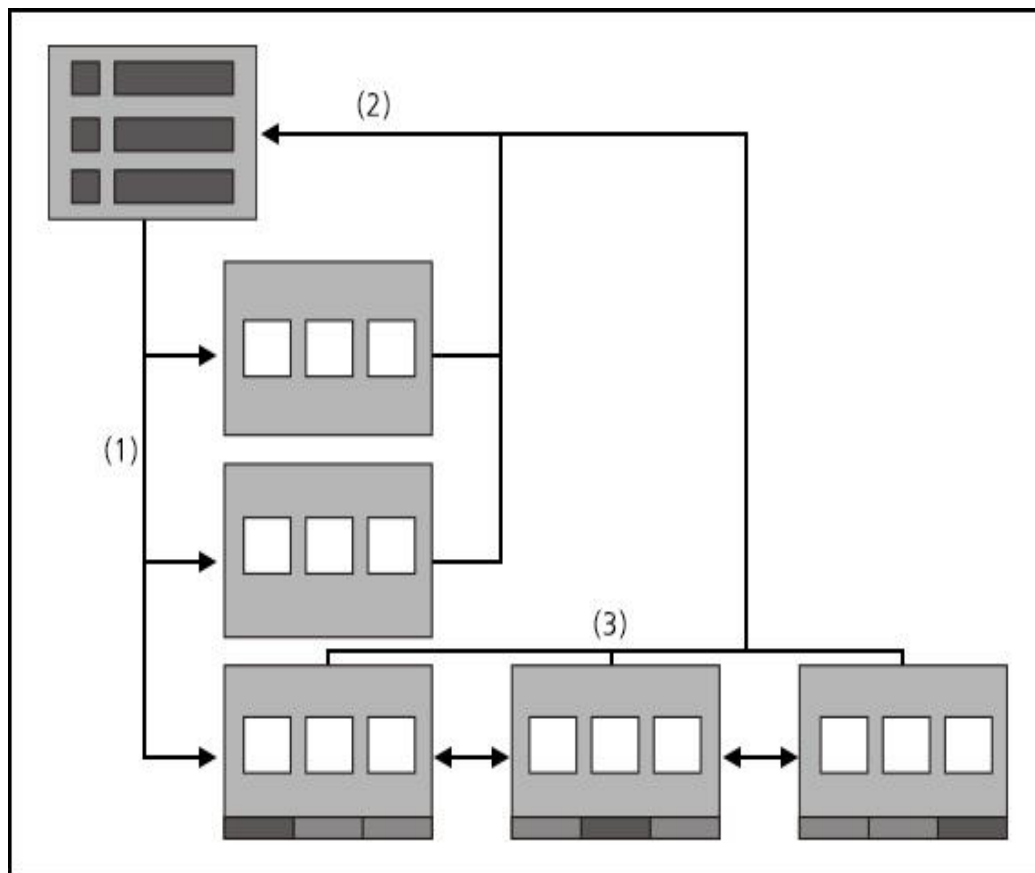
**Table 1. Screen Transition Style Classification**

Screen Transition Style		Spatiality			Directional Attribute
		X	Y	Z	
Scale in/out		O	O	O	4 directions Front-back
Flip in/out		O	O	O	Up-down rotation Left-right rotation
Reflash		X	X	X	X
Move in/out		O	O	O	Up-down overlapping Left-right overlapping
Push in/out		O	O	X	Up-down Left-right
Free		O	O	X	Variable Rotation

One of the UI elements utilized when a user requires screen transition in an interface is navigation. Navigation is divided to the current position, destination, and return to the original position. Clues for this division include visual clues, locational/directional clues, moving route clues, and manipulation clues [14]. Visual Cues are basic elements of screen design that provide users with information of the current position, direction, and navigation. They are substantial visual objects that help perception such as highlights and indicators [15], and Direction-Way finding provides information of the position and direction while a user is checking certain menu items so that he cannot be lost at the current location. This element helps confirm the sequential entries of the Menu-Way finding user and predict whether he will go backward or forward. This makes it easy for a user to understand the interface and move on to other positions. Besides, the control guide functions to help a user control it more easily.

Interface structures are divided into 6: sequential structure, grid structure, hierarchical structure, net structure, combined structure, and variable structure. The UI basic menu structure utilized for most smart-phone operation systems is of the sequential structure combined with the hierarchical lineal structure. Most menus are of a sorting structure that shows all information right on the main screen, but as it goes deeper, only the menu items are presented on the screen. When screen transition effects are utilized for status or

information change in an interface structure, it would be easier for the user to understand the work process if some effects are designated for the transition patterns and meaning. Transition may be used for an interface structure in the following three cases:









**Figure 1. Scope of Transition Effect Use**

(1) is a transition from top to bottom. This is used for the most fundamental hierarchy of common interfaces. This may applied to a transition from bottom to top just like (2), but (2) also has the function of Return. (3) Is used for a transition in the same hierarchical structure of a device that accommodates various types of information. This is a screen transition between interface information structures of the same nature.

### 3.2. Information Hierarchy Types and Characteristics

Major transition tasks from top to bottom among digital device operation systems include application execution, Windows execution, movement to lower level directories, *etc.* Transitions from bottom to top, or returns, include application closing and returning, discretionary exit, *etc.* The sequential structure has been a big issue as the use of multi-tasking is widely used. In particular, since mobile displays require efficient transitions between information structures within a small screen, information on the same level may be divided in a diversified manner and transferred. Some of the examples are application waiting display, transition between Windows, application status transition, and so forth. In this case, the information hierarchy of screen transitions may be divided to the entry types and progressive type. The characteristics are as follows:

**Table 2. Information Hierarchy and Screen Transition**

Class	Screen Transition Style		Interactive Type	Characteristic	Information Hierarchy
Entry Type	Scale in/out		Closed motion Open motion	Depth entry/exit Screen zoom in/zoom out	1Depth to 2Depth
	Flip in/out		Closed motion Open motion	Depth entry/exit Page turnover, etc.	1Depth to 2Depth Inter-Depth horizontal movement
	Reflash		Closed motion	Variable depending on loading rates	1Depth to 2Depth
Progressive Type	Move in/out		Closed motion	Entry to the sub-menu Entry onto the screen	1Depth to 2Depth 2Depth to 1Depth
	Push in/out		Closed motion Open motion	Album list-up Page unfolding	Inter-Depth horizontal movement
	Free		Open motion	Screen expansion & exploration	Inter-Depth horizontal movement

#### 4. Conclusion & Suggestion

This study aims to clarify the relation between the information hierarchy and screen transition as a feedback element for user experience in terms of user sensitivity and presence in a user-centered design environment of smart-phone visual perception based on theoretical researches. The result shows that the information hierarchy includes transitions from top to bottom, return, and transitions in the same hierarchical structure. Screen transitions are divided to the entry type - depth entry/exit such as application execution - and the progressive type for inter-depth transitions. The entry type according to transition styles includes Scale in/out, Flip in/out, and Reflash while the progressive type includes Move in/out, Push in/out, and Free styles.

As for tasks depending on the information hierarchy and transition styles, most tasks are sequential movement for depth entry, movement from top to bottom, and return to the

previous screen. In a mobile device environment, since containing and structuralizing certain information on a small screen is important, the sequential structure needs transition effects for instant movement within the same configuration. Thus, the flip transition effect based on slides that feature the high transition rates is frequently used. Besides, transition from top to bottom and 'Move' and 'Scale' that have the concept of 'Layer' are also often utilized.

As such, screen transition mainly for inter-depth movement is the major usage, but it is affected by the types, specifications of the used devices, internet access means and speed, *etc.* This study has limitations in that it attempts to clarify the relation between screen transition of visual perception and the information hierarchy with the factor of speed excluded.

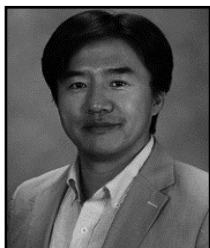
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