

Disappearing Icons: *Informative Effect Through Changing Color Attributes of App Icons*

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Abstract-- This study investigates the informative effect that color attributes (hue, saturation, lightness, and opacity) of smartphone application icons have on users' perceptions when presented in unusual ways. Two empirical studies were conducted: First, we focused on which changes draw eye attention more efficiently than others; Second, we attempted to observe whether participants perceive any status change of the application by viewing the change. Three overruling tendencies were observed: First, changed hue and lightness of icons were most noticeable. However, both changes sent unclear message to users; Second, decrease in saturation or opacity of icons were perceived as the apps being used less; Last, excluding hue, all attributes need to have dramatic changes in order to let users be aware of the both change and informative effect. Based on empirical results, we propose Disappearing Icons in which smartphone icons become transparent/greyscale over time to inform users of app usage patterns.

I. INTRODUCTION

Nowadays, smartphones are not just used for practical purposes, but also for connecting with friends and playing games [1]. As the role of smartphones in people's lives becomes bigger, the number of apps (applications) users download on their smartphones is no smaller than the number of programs people install on their personal computers. Due to smartphones having much smaller displays compared to common monitors, a more versatile method to intuitively send users the necessary information regarding their usage patterns is needed for organizing their smartphone screen. Research by Shin [2] proposes a context-aware system that analyzes users' smart phone app usage patterns to show the next most probable app that users will use on their home screen. Among the different methods of informing users of their app usage patterns, changing color attributes of icons is a more suitable way compared to changing their physical shape or position. This is because it is easy for users to notice the difference in color, yet not be too distraught by the change. Research on controlling the users' attention of focus through changing the opacity of icons exists [3]. However, the emotional aspects of functionalities of such changes are not yet explored. If such data on this matter is provided, designers and developers can find various ways to send users more functional messages by simply changing the appearance of app icons.

II. OBJECTIVE

In this study, we aim to evaluate the informative effect that changes in color attributes of smart phone app icons have on users.

III. PLAN FOR USER STUDY

Smartphone users, comprised of 15 male and 15 female college students in their 20s, were recruited. For the stimuli, 4 images of a generic smartphone screen based on the Samsung Galaxy S3 interface were made displaying 16 app icons. For the change of color attributes, 16 variations were made. There are 5 variations for hue (+90°, +45°, -45°, -90°, ±180°), 3 for saturation (-100: grayscale; -66, -33), 3 for opacity (75%; 50%; 25%: almost transparent), 4 for lightness (+70: almost white; +35; -35; -70: almost black), and 1 for the default case. Examples of how the icons were changed are shown in Table II. The position of each app icons and the changed color attributes were decided randomly for each 4 images as shown in Fig. 1.

The images were shown to participants using Samsung Galaxy S3. Participants weren't shown the original versions of app icons, and were asked recollect from their memory or use common sense to evaluate the change.



Fig. 1. Image shown to participants through a smartphone

IV. USER STUDY I: EVALUATION OF ATTENTION GRABBING ABILITY OF STIMULI

The goal of User Study I is to investigate which stimulus draws more attention than others, thereby identify which color attribute change is most noticeable. As shown in Table I, icons with changes in lightness and hue were most noticed by participants with an average of 8.25% for individual lightness-changed icons, and an average of 6.60% for icons with hue-changed icons. Looking at individual icons, the most noticed icons were those with lightness level of -70. In case of opacity and saturation, the parameter had to be greatly lowered in order for people to take notice.

TABLE I
NOTICED RATE (%) OF STIMULI IN USER STUDY I

	Change level	Chosen times	(%)	Average (%)
Hue (Scale: 0°~360 °)	+90	34	11.33	6.6
	-45	19	6.00	
	±180	18	6.00	
	-90	14	4.67	
	+45	14	4.67	
Lightness (-100~+100, 0 = default)	-70	45	15.00	8.25
	+70	27	9.00	
	-35	25	8.33	
	+35	2	0.67	
Opacity (0%~100% 0 = transparent)	75	0	12.33	5.78
	50	15	5.00	
	25	37	0.00	
Saturation (-100~0, -100 = greyscale)	-100	36	12.00	5.33
	-66	10	3.33	
	-33	2	0.67	

TABLE II
EXAMPLES OF ICONS & THEIR CHANGED ATTRIBUTES

Icons	Hue	Hue	Lightness	Lightness	Opacity	Saturation
Attribute Change	+90	-90	+70	-70	25%	-100

V. USER STUDY II: EVALUATION OF INFORMATIVE MESSAGE SENDING ABILITY OF STIMULI

The goal of User Study II is to evaluate the functional meanings that users perceived from the changes made to the app icons, and the change of emotional feelings towards the changed app icons. Participants were asked to choose app icons for which they were able to guess what the changes meant. After writing down the expected meanings, they evaluated how strongly the changes reflected those meanings, as well as their aesthetic appeal based on a 5-point Likert scale (-2: not at all; 0: neutral; +2: very much so).

TABLE III
THE EXPECTED FUNCTIONALITY OF CHANGES IN USER STUDY II

Stimuli	Written answer	(%) Within Stimuli
Saturation -100	This app is used less	31.25
	Deactivated	25.00
	Unable to use	12.50
Opacity 25%	This app is used less	46.43
	The app is hiding	14.29
	The app was deleted	10.71
Lightness -70	Use this app less	18.52
	Deactivated	18.52
	Broken	18.52
Hue +90	Broken	29.41
	Notice	23.53
	This app is used often	11.76

The answers with less than +1 for the reflection of meaning were ignored, leaving a total of 147 answers. The answers with the same meaning were grouped. The top 4 chosen stimuli and their written answers are shown in Table III. The most written answer for both saturation -100 and opacity 25% was "This app is used less".

VI. DISAPPEARING ICONS: IMPLEMENTATION FROM THE RESULTS

Utilizing the data obtained from the user study, a simple smartphone function was designed as shown in Fig. 2. This smartphone function first reduces opacity to send a message, and then lowers the saturation altogether, informing users to erase the apps they will probably not use. The opacity drops suddenly on the 4th week of non-use, and after the 4th week, saturation will also gradually decrease to the point of grey scale. The sudden drop of opacity is to prevent too many app icons from changing slightly in transparency and resulting in a screen that appears even messier or exceedingly detective. The result is an intuitive function that can help users easily find the apps not being used, and organize their home screen space of their smart phones.

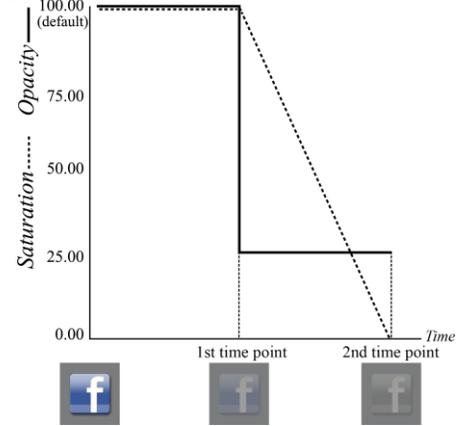


Fig. 2. Designed function's scenario of saturation & opacity change

VII. CONCLUSION

In this study, the informative effect on user's intuitive perception when the color attributes of smartphone application icons are presented in unusual ways was evaluated. Participants could easily detect the change of lightness and hue compared to changes in other color attributes. Also, decreasing opacity and saturation was found to give participants the impression the apps are not used for a long time. Regardless of which attribute was changed, most changes gave emotionally negative feedback to the participants. Through our research, we hope to give designers the necessary data for them to create various ways of changing icon appearances without using additional space on the screen.

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