

EVALUATION FOR ATTRACTIVENESS OF ANIMATED PAGE TRANSITIONS ON SMARTPHONES

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Abstract: Nowadays, advances in technology have made smartphones equipped with high performance chips and high resolution displays. The overloaded data displays are increasingly complex in user interface and exceed human perceptual capacity to efficiently interpret them. Consequently, animated transitions in user interface play a fundamental role of supporting the user in integrating and relating information across displays and representations. In fact, judiciously applying animated transitions can make the user interface easier to understand, feel smoother, more natural, and be more appealing. In general, animated transitions are frequently and broadly applied in reader applications on smartphones, because the screen size of smartphones is limited so that users have to frequently switch different contents and categories between screens. In this way, the form of animated page transitions crucially affects the reading experience, and helps to create the uniqueness and appealing of reader applications. This paper describes how the constituent elements of animated page transitions affect user emotions, and clarifies the relationships between different types of page transitions and users reactions. The goal of this paper is to build an interface design principle of animated page transitions on smartphone for helping mobile application developers to select the suitable page transitions according to user emotions. This study applied Evaluation Grid Method and Quantification theory type I to figure out the attractiveness of various types of animated page transitions.

Keywords: Animated Page Transitions, Attractive Factors, EGM, Quantification Theory Type I, Interaction Design

1. INTRODUCTION

Nowadays, advances in technology have made smartphones equipped with high-performance chips and high-resolution displays. The overloaded data displays are increasingly complex in user interface and exceed human perceptual capacity to efficiently interpret them [1]. According to Shneiderman (2009)'s "Eight Golden Rules of Interface Design" [2], the good user interface not only offer informative feedback but also reduce short memory load of users. Consequently, the great user interface should provide subtle feedback according to the user's actions, and display multiple contents in one single view to reduce the memory loading of users. However, the screen size of smartphones is limited so that users have to frequently switch different contents and categories between screens. In order to provide good user experience and smart interaction in such frequently view switching, animated transitions play a fundamental role of supporting the user integrating and relating complicated information across displays and representations.

In fact, judiciously applying animated transitions make the user interface easier to understand [3], feel smoother, more natural, be more appealing, and of high quality. For instance, when the user simply deletes an object from the menu, and the object just disappear abruptly without any transition effect. It seems to be unnatural because the result is a loss of context. Relatively, subtle animations of transitional interface help users to comprehend the changes of current state and old state, and able to reliably expect how to perform next action by the form of transition. Furthermore, well-designed animated transition make up the lack of tactile feedback on current touch screen and make the interaction more natural and realistic [6].

In recent years, reader applications have been accounted for a great proportion of mobile app markets. Diverse animated transitions are frequently and broadly applied in reader applications on smartphones because the screen size of smartphones is limited so that users have to frequently switch different contents and categories between views. In this way, the form of animated transitions crucially affects the reading experience, and helps to create the uniqueness and appealing of reader applications. Such as the famous reader application, Flipboard, has exceeded 50 million downloads. The unique and memorable page transitions of flip not only provides users great reading experience but also echoes its brand name, which enhancing the brand popularity.

However, from literature review, current research mostly focus on the animated transitions of overall interface on smartphone, the page transitions of specific browsing behavior is relatively unexplored. This paper determined user's feelings while operating a smartphone; which is the attractive factors of animated page transitions on smartphone.

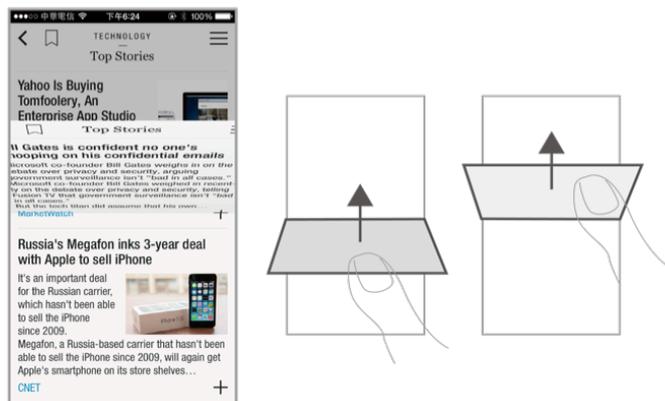


Figure 1: Flip transition effect in Flipboard

2. LITERATURE REVIEW

2.1. Animated Transitions

Animated transitions can build a clear causal connection between the old state of the screen and the new state of the screen [6]. Furthermore, animations provide the appearance of motion or change over time. It plays multiple role such as to giving feedback, indicating actions, showing the relationship between objects, drawing attention to change, or extending / hiding spaces. Wise use of animated transitions can make the user interface more natural, feel smoother, and be more charming. Oppositely, unnecessary and excessed use of animated transition makes users feel annoying and disturbing.

From the Johannes's research [6], he analyzed and summarized commonly used animated transitions, and all transitions are divided into six categories in order to differentiate between their applications. All six categories are stated as follows:

Table 1: Six categories of animated transitions (Cited from Johannes's research)

Category	Icon	Explanation	Transitions
Orientation		Orientation describes the way in which a logical connection can be created and visualized between objects and object's states.	Slide / Popup / Minimize / Object Switch / Fan of Stack / Page turn / Add to List / Fixed Label / Device Rotation / Button to Label / Combine-Split / Scroll / Pan / Scroll Bar / Page Indicator / Saving Indicator
Spatial Extension Transitions		Spatial Extension reduces the complexity of the user interface by extending the virtual space.	Accordion / Flip / Popup / Preview / Half Flip / Folding / Mask Expand / Zoom / Text Truncation / Area Split / Growing Input Field
Awaking Control		Awaking Controls allows the user to focus on contextual controls.	Swipe to Delete / Mode Switch / Spring Refresh / Appealing Controls / Slide-In Control
Highlight		Highlighting is the guidance of attention by using animations.	Scale to highlight / Rotate to Highlight / Color to Highlight / Fade to Highlight / Blur to Highlight / Darken to Highlight / Flip to Highlight / Glow to Highlight / Change Depth to Highlight / Gray out to Highlight / Expand to Highlight
Feedback		Feedback comprehensively indicates what the result was of the user's interaction.	Position Accepted / Position Denied / Heal / Close / Activate-Deactivate / Invitation-Dis invitation / End of List Indicator / End of Page Indicator / Button Relabel / Progress bar / Refresh Indicator / Availability
Feedforward		Feedforward functions as a conveyor of possible interactions.	Explaining Direction / Affordance / Hidden Feature / Explaining Length / Explaining Interaction / Explaining Position / Solidarity

3. RESEARCH METHOD AND PROCEDURES

The study was designed to find out attractiveness factors of diverse animated transitions of reader application on smartphone. We investigated this question by constructing and administering Evaluation Grid Method (EGM) and Quantification theory type I. The research procedures are stated as follows:

3.1. Samples Selection

First, the leading reader applications were investigated on smartphone, and 10 commonly applied page transitions were integrated as the samples. Furthermore, Xcode (Developing software for OSX and iOS) was applied to design the testing application with CATransition to simulate the real context. 10 sample transitions were built, including Fade, Page Curl, Push Un Curl, Move In, Reveal, Push, Cube, Suck Effect, Flip, and Ripple Effect (Figure 2).

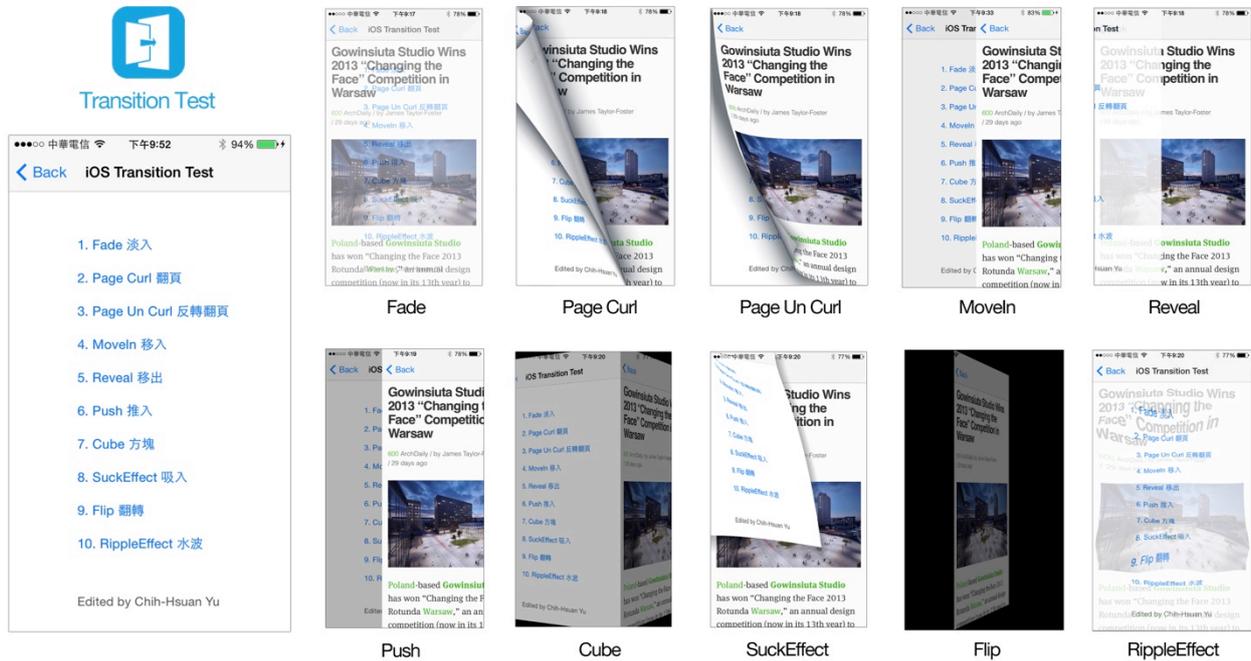


Figure 2: CATransition testing samples

CATransition is an Objective-C wrapper for creating page transitions. It not only provides an efficient way to use various styles of page transitions, but also reserves adjustable parameters for developers to conduct detailed control. In this study, key parameters of sample transitions were set uniformly as follows (Table 2):

Table 2: Key Parameters of Sample Transitions

Transition Duration	1.0 sec
Transition Direction	From Right to Left
Swipe Direction	From Right to Left

3.2. In-depth Interview

Before compiling the quantitative questionnaire for Quantification Theory Type 1 to analysis,

In-depth interview was proceeded which following the principle of the Evaluation Grid Method (EGM). EGM is a kind of in-depth interview method, which pairs comparison and interpretive structural modeling for structure identification [9]. In this study, EGM was used to figure out what the attractiveness factors of page transitions that users may like. A total of 10 experts were invited to participate in this interview, and all subjects with a minimum of five years of design or programming experience, who were proficient application programmers or user interface designers. Furthermore, most of them were heavy reader application users who using reading application 3 times per day averagely, which means their user involvement of page transitions were high. The participant structure is shown below (Figure 3):

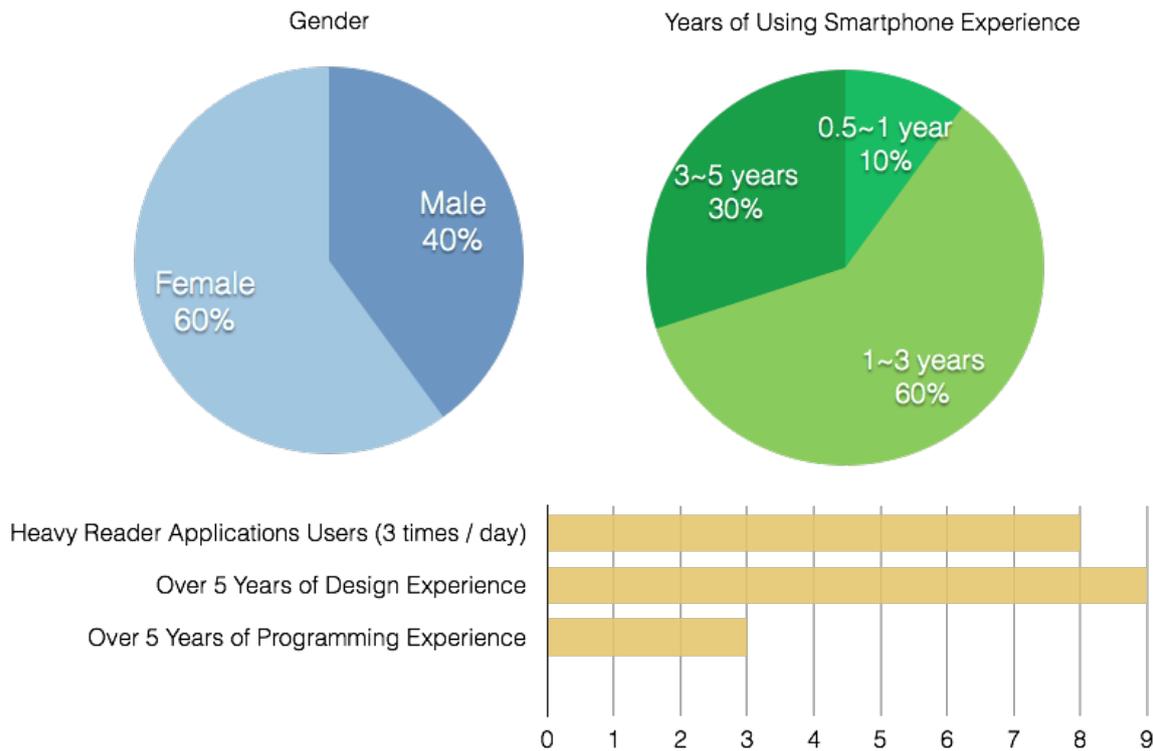


Figure 3: Participant Structure

3.3. Evaluation Grid Method

The In-depth interview took approximately a half hour spread over 2 weeks. The interview consisted of five sections, the first of which was intended to elicit demographic information on the subjects. The second section asked subjects to operate the testing application samples on smartphone, and to feel the difference of diverse page transitions while they were reading the articles. Section 3 was designed to ask subjects to classify and rank 10 sample cards (Each cards were labeled with the names of page transitions) by their preference. The fourth section focused on how they made decisions and the reason of preference through comparing different types of page transitions. Finally, the verbal data from the interview about the attractiveness factors are qualitatively analyzed with EGM, and we integrated it to draw EGM network.



Figure 4: Flowchart of the interview

4. EXPERIMENT RESULTS AND DISCUSSION

4.1. EGM Network

After integrating the verbal data from the interview, we got the EGM network as following:

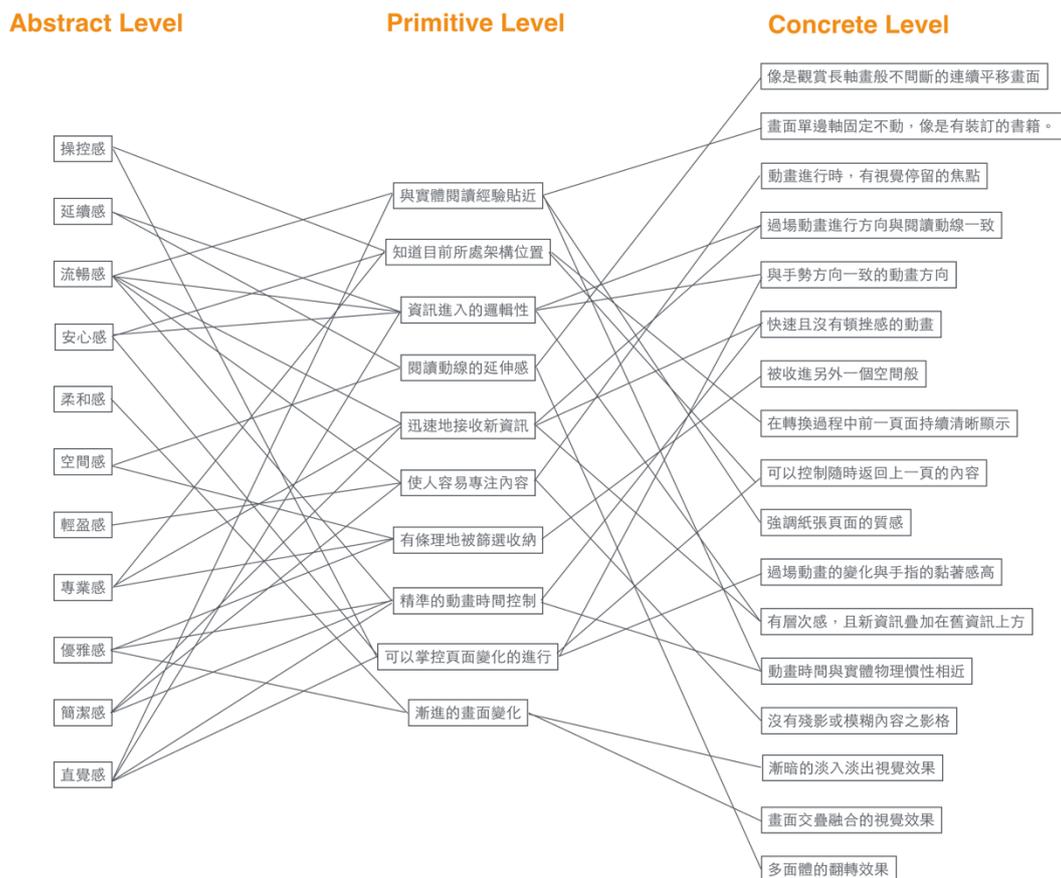


Figure 5: EGM network

According to the In-depth interview for 10 subjects, KJ method was applied to exclude the rare factors and generalize the content of the EGM network. From integrating the similar characteristics, the common names were used to replace them. This step contributed to describe each

characteristic more simple and precise, and helped researcher to observe diverse factors easily. After integrating the content of the EGM network, abstract reasons included five items, original reasons included 11 items, and concrete features included 34 items. Furthermore, the characteristics were also coded, which contributed to survey questionnaire analysis in next stage.

4.2. Quantification Theory Type I Analysis

For the purpose of analyzing the relationship between original reasons and concrete features, Quantification type I theory was used. According to the research written by Sugiyama & Inoue (1996), the relationship between Multiple Correlation Coefficient and Reliability showed as Table 3. For example, the multiple correlation coefficient (R) of “User Control” was 0.503, which means the reliability of “User Control” had strong relation.

Table 3: Range and Reliability relation table Key

Range	Reliability
0.00~0.20	Reliability shows low relation.
0.20~0.40	Reliability shows relation.
0.40~0.70	Reliability has strong relation.
0.70~1.00	Reliability has very strong relation.

After Quantification Theory Type I analysis, the experimental results included five essential dimensions (abstract reasons): “User Control”, “Fluency”, “Spatial Extension”, “Reading Satisfaction”, and “Natural and Intuitive”. The analysis results were as follows:

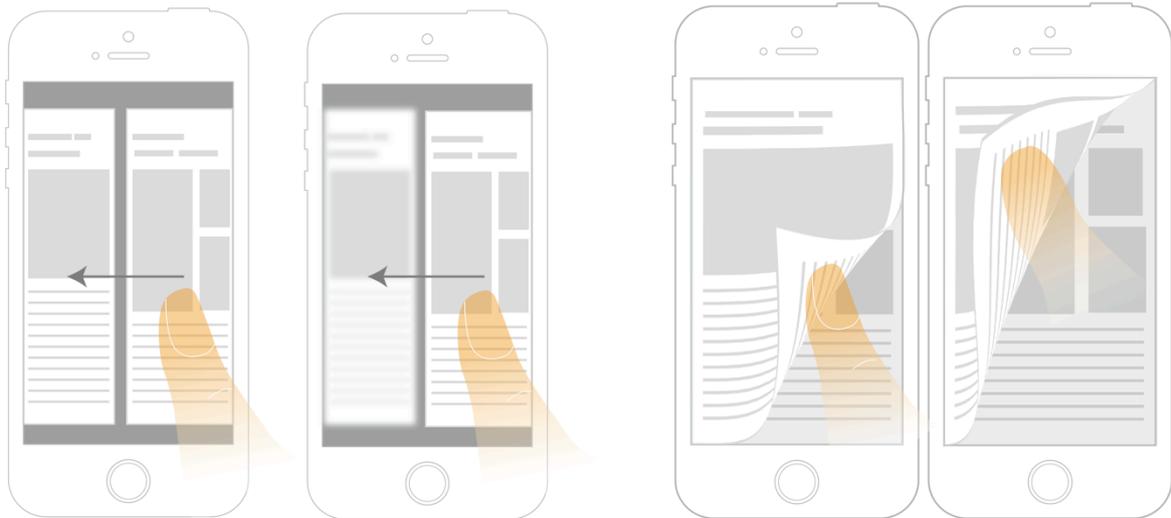
(1) User Control

There are two items and seven categories on the dimension of “User Control”. The partial correlation coefficient of “The transition provides impression of information architecture” was 0.429, which means it had the highest impact on this dimension. Among the features, “During the page transition, the previous page still clearly shows on the screen” and “Page transitions closely follow the movement of gestures to change the state” were relatively influential concrete features of attractive page transitions.

Table 4: On the part of dimension “User Control”

User Control				
Item	Code	Category	Score	Partial Correlation Coefficient
The transition provides impression of information architecture.	A11	During the page transition, the previous page still clearly shows on the screen.	0.305	0.429
	A12	The page transition hints the direction of gestures and visual movement.	0.064	

	A13	Different functionalities of transitions are clearly distinguishable.	0.008	
	A14	Page transitions are consistent in the same application.	-0.730	
Users have the authority to control the state of page turning.	A21	Using gestures to instead of buttons to backward and forward pages.	-0.361	0.281
	A22	Users can backward to the previous page anytime during the page transition.	0.150	
	A23	Page transitions closely follow the movement of gestures to change the state.	0.157	
R = 0.503, R ² = 0.253				



A11 During the page transition, the previous page still clearly shows on the screen.

A23 Page transitions closely follow the movement of gestures to change the state.

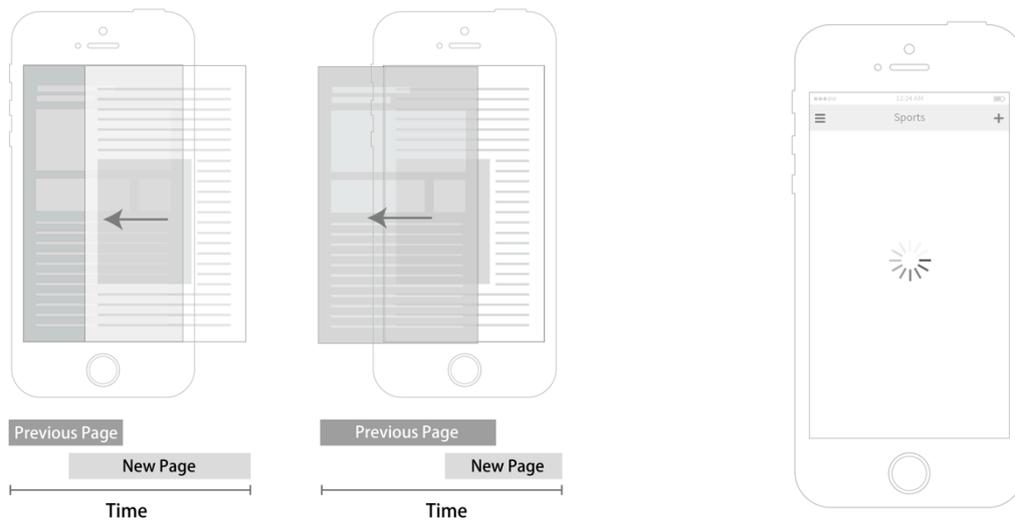
Figure 6: Influential concrete features of “User Control”

(2) Fluency

There are three items and ten categories on the dimension of “Fluency”. The partial correlation coefficient of “The page transition reduces the disturbed factors” was 0.296, which means it had the highest impact on this dimension. Among the features, “The new page stays longer than the current page during the page transition”, “The page transition applies parallel shifting instead of view scaling”, and “This transition hints users that the system is still working during a running process” were relatively influential concrete features of attractive page transitions.

Table 5: On the part of dimension “Fluency”

Fluency				
Item	Code	Category	Score	Partial Correlation Coefficient
The logicity of how new information gets into the current state.	B11	Page transitions are consistent from moving in to moving out.	-0.818	0.259
	B12	The Page transition has layers, and the new page covers the current page.	-0.085	
	B13	The new page stays longer than the current page during the page transition.	0.915	
	B14	The page turning is like a sequential view, not a loop.	0.190	
The page transition reduces the disturbed factors.	B21	The start direction of the page transition follows the visual movement.	-0.279	0.296
	B22	The start direction of the page transition is as same as the gesture.	0.015	
	B23	No blur effect on the previous page.	-0.977	
	B24	The page transition applies parallel shifting instead of view scaling.	0.992	
The page transition reduces users' anxious waiting.	B31	During the page transition, users can find the focus point on the screen (e.g. interface frames / category labels).	-0.518	0.220
	B32	This transition hints users that the system is still working during a running process.	0.446	
R = 0.450, R ² = 0.203				



B13 The new page stays longer than the current page during the page transition.

B32 This transition hints users that the system is still working during a running process.



B24 The page transition applies parallel shifting instead of view scaling.

Figure 7: Influential concrete features of “Fluency”

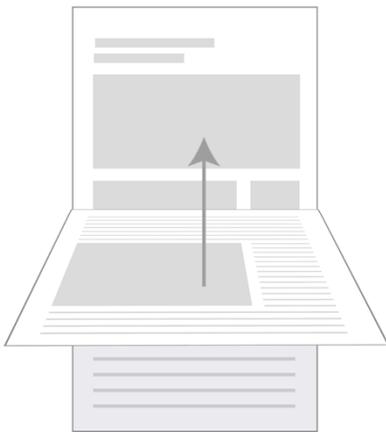
(3) Spatial Extension

There are two items and five categories on the dimension of “Spatial Extension”. The partial correlation coefficient of “Extension of the visual movement” was 0.401, which means it had the highest impact on this dimension. Among the features, “Page-flipping with a central axis” and “The previous page is like to be sucked to another space” were relatively influential concrete features of attractive page transitions.

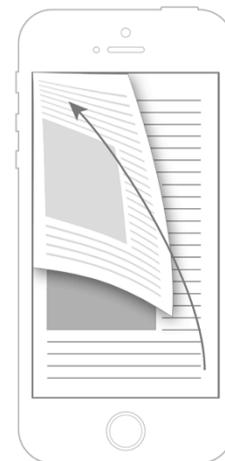
Table 6: On the part of dimension “Spatial Extension”

Spatial Extension				
Item	Code	Category	Score	Partial Correlation

				Coefficient
Extension of the visual movement.	C11	Horizontal movement of sequential pages.	0.145	0.401
	C12	Page-flipping with a central axis.	0.509	
	C13	Turning the page is like a polyhedron rotation.	-0.924	
Pages are seems to be tidy up to another space.	C21	The previous page is like to be sucked to another space.	0.437	0.274
	C22	The previous page is like to be fold up.	-0.262	
R = 0.464, R ² = 0.215				



C12 Page-flipping with a central axis.



C21 The previous page is like to be sucked to another space.

Figure 8: Influential concrete features of “Spatial Extension”

(4) Reading Satisfaction

There are one item and four categories on the dimension of “Reading Satisfaction”. The partial correlation coefficient of “The page transition provides the physical and mental feedback after reading” was 0.296 on this dimension. Among the features, “The previous page follows the swipe gestures to leave the screen” was relatively influential concrete feature of attractive page transitions.

Table 7: On the part of dimension “Reading Satisfaction”

Reading Satisfaction

Item	Code	Category	Score	Partial Correlation Coefficient
The page transition provides the physical and mental feedback after reading.	D11	The previous page follows the swipe gestures to leave the screen.	0.928	0.565
	D12	The previous page is like to be sucked to another space.	0.045	
	D13	Imitating the way of page turning of paper books.	-0.643	
	D14	The previous page smoothly fades out off the screen.	-0.263	
R = 0.565, R ² = 0.319				



D11 The previous page follows the swipe gestures to leave the screen.

Figure 9: Influential concrete features of “Reading Satisfaction”

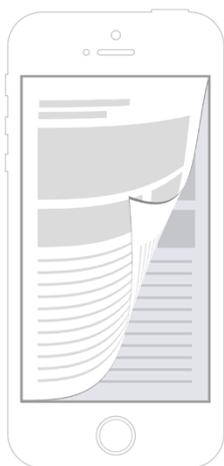
(5) Natural and Intuitive

There are three items and five categories on the dimension of “Natural and Intuitive”. The partial correlation coefficient of “The page transition follows physical principles” was 0.347, which means it had the highest impact on this dimension. Among the features, “Imitating the texture of paper to turn pages”, “There is a bounce effect while user slides a page to the end”, and “The page smoothly fades in and fades out” were relatively influential concrete features of attractive page transitions.

Table 8: On the part of dimension “Natural and Intuitive”

Natural and Intuitive

Item	Code	Category	Score	Partial Correlation Coefficient
To Simulate the reading experience of paper books.	E11	Imitating the texture of paper to turn pages.	0.559	0.206
	E12	Turning pages with a fixed axis.	-0.299	
	E13	The backside page subtly reveals the content of the front page.	-0.168	
The page transition follows physical principles.	E21	While swiping the page, the previous page follows the direction of gestures to leave the screen.	0.054	0.347
	E22	The new page turns into the current view with a bounce effect.	-0.625	
	E23	There is a bounce effect while user slides a page to the end.	1.077	
Gradually variation of transitions.	E31	The page smoothly fades in and fades out.	0.125	0.075
	E32	The page smoothly zooms in and zooms out.	-0.145	
R = 0.413, R ² = 0.170				



E11 Imitating the texture of paper to turn pages.



E23 There is a bounce effect while user slides a page to the end.



E31 The page smoothly fades in and fades out.

Figure 10: Influential concrete features of “Natural and Intuitive”

5. CONCLUSION

Throughout the experiment and analysis, it is concluded as follows. Firstly, one essential function of animated page transitions is that guiding users to explore interface smoothly and friendly. For this purpose, to design precise animation depends on how to interact with users. A well-designed animation should follow the movement of user's gesture closely, make user feel the animation realistic, and help user to realize the current location in the information architecture.

Furthermore, visual movement and layout of contents also should be consideration. The appealing animations smooth view transitions while user is reading, not affect user's flow. Consequently, initial direction and duration of animations should match contents to make users feel more fluency and nature.

Finally, wisely following physical principles and imitating physical books prepare users for an action, and make the action appear more realistic. From applying realistic reading experience also make user interface more instinctive and friendly.

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