

# A Study on UI Design Analysis From the Perspective of Cognitive Psychology for Improving Usability of Airline Service Apps

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**Abstract:** The rapid advancement of the Fourth Industrial Revolution and the widespread adoption of contactless environments have transformed the aviation industry, with mobile applications emerging as pivotal tools for enhancing user experience. Despite their increasing prevalence, usability challenges persist due to inadequacies in human-centered interface design. This study addresses these issues by analyzing key interface elements—layout, navigation, color, and buttons—of airline service apps through the lens of cognitive psychology. Drawing on principles such as the Gestalt principle of continuity, Hick's Law, the Aesthetic-Usability Effect, and the Von Restorff Effect, the research identifies existing usability challenges and proposes targeted design improvements to enhance user interaction and satisfaction. Through a detailed case study of the UMETRIP app, the study integrates cognitive psychology concepts to offer actionable recommendations for improving layout clarity, simplifying navigation, ensuring color consistency, and enhancing button recognition. This approach fosters a more intuitive, user-centered interaction between humans and airline service apps, ultimately contributing to the optimization of digital experiences. However, further empirical validation is necessary to refine the proposed solutions. It is anticipated that these findings will inform the future development of user-centered interface designs in the airline industry and beyond.

**Keywords:** Cognitive Psychology, Mobile Application Design, Airline Service Apps, User Interface, Usability Optimizatio

## Introduction

### Research Background and Objectives

The rapid development of the Fourth Industrial Revolution and the rise of online, contactless environments have significantly transformed people's lifestyles. Mobile applications, a key representation of mobile technology, have become essential in the aviation industry, where fast and immediate communication is crucial. The COVID-19 pandemic further accelerated the adoption of mobile apps and platforms, which have become dominant in the tourism industry due to their convenience and safety in contactless environments (Kim et al., 2023). Similarly, the airline industry has embraced mobile apps to enhance customer travel experiences by providing various user-centric services from the start to the end of a journey. Consequently, online services, alongside face-to-face services, have become key differentiators in airline operations, with mobile apps emerging as a vital service domain.

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Early research on airline apps primarily focused on users' behavioral intentions and technological factors. Studies included those applying the Theory of Planned Behavior (Jin & Jang, 2016), research on purchase intentions for airline tickets via apps (Kim et al., 2011), and investigations into the Technology Acceptance Model (Jeong, 2019). While online airline services have steadily gained popularity, challenges related to app usability persist. These difficulties often stem from overlooking the human-centric nature of technological advancements. It is crucial to emphasize that technology, including mobile apps, should be designed for ease of use and accessibility. Therefore, improving the interface design, which facilitates communication between humans and machines, is as essential as addressing technological issues.

This study aims to identify and address the challenges and inconveniences associated with app usage by examining interface design issues. It focuses on fostering seamless human-machine interaction through mobile apps. To develop user-centered interface designs, it is critical to expand knowledge and understanding of psychology (Hong, 2004). This research proposes ideal solutions based on cognitive psychology principles, considering users' cognitive characteristics.

### **Research Content and Methodology**

This study seeks to analyze airline app interface designs and propose design improvements that enhance user communication and usability. The research aims to provide effective design directions for delivering information efficiently and ensuring user-friendly experiences in airline apps. The methodology is outlined as follows:

1. Literature review: Investigate the concept of mobile apps and examine the current state of airline service apps in China.
2. Case study: Select the airline app brand "UMETRIP", which has the highest adoption rate, to understand the user experience by observing app usage processes and capturing app interface screenshots.
3. Cognitive psychology analysis: Review previous studies and literature to explore the concepts and characteristics of cognitive psychology; analyze app interface elements from the perspective of cognitive psychology to identify issues; based on the analysis, propose design improvements by applying cognitive psychology principles.

## **Theoretical Background**

### **Concept of Mobile Applications and the Current State of Airport Service Apps in China**

Although IBM's Simon Personal Communicator, introduced at the 1992 COMDEX in the United States, is recognized as the world's first smartphone, many consider the true beginning of the smartphone era to be the launch of Apple's first-generation iPhone in 2007. The rapid growth of information technology (IT) and technological advancements have led to the widespread adoption of smartphones. According to the GSM Association (GSMA), the global mobile industry estimates that the number of smartphone users worldwide has reached approximately 3.869 billion, representing nearly half of the world's population.

Driven by diverse motivations and purposes, users can download and install various applications from app stores to personalize their smartphones and access a wide range of services. Through app stores, users can quickly access diverse content and useful information, customizing their smartphones to suit their individual needs and preferences. This level of user autonomy and engagement appears to enhance user experience by fostering deeper immersion and emotional connection.

In this context, the concept of immersive experience refers to the phenomenon where individuals feel intrinsic enjoyment and fascination while interacting with digital media, often losing track of time due to their deep engagement. Such experiences highlight the significance of user-centered design in mobile applications, especially in environments where users seek both utility and entertainment.

According to statistics from Aurora Big Data, the number of users of airline service apps in China has shown a significant upward trend from 2018 to June 2023. In 2018, the total accumulated user base for China's airline service apps was 29.87 million. However, by June 2023, the cumulative user base of the UMETRIP app alone had surpassed 119 million. This growth trend reflects the increasing demand for air travel and the widespread adoption of mobile internet technology, which has led more users to choose airline service apps.

Airlines and travel platforms have continuously enhanced the functionality and services of their apps to meet the growing needs of users, thereby driving the healthy development of the Chinese airline service app market. As of March 2018, the top-ranking airline service apps in China by market share included Flight Steward, UMETRIP, VariFlight, China Southern Airlines, and China Eastern Airlines. Among these, this study focuses primarily on the interface design of the UMETRIP app.

### **App Interface Design**

Interface design refers to a user-centered approach aimed at resolving issues that arise between interactive systems and users. It is also known as UI (user interface) design (Hong, 2004). The primary purpose of the user interface is to facilitate communication between users and machines, with various visual elements serving as the mediums for information exchange.

With advancements in technology and the evolution of mobile devices, people increasingly access diverse services through smartphones. An efficient and user-friendly UI design enables users to interact with systems more easily. Unlike traditional computer interfaces (e.g., desktops, laptops), mobile app UI components differ in several aspects due to varying screen sizes, interaction methods, and usage environments. Given the smaller screen sizes of mobile devices, mobile UI design must prioritize optimal space utilization and content compactness to ensure that information is displayed clearly and concisely, with intuitive touch controls.

UI components in mobile apps play a crucial role in design by conveying information to users. These components include layout, color schemes, typography, images, navigation elements, buttons, icons, and other visual elements. They work together to effectively communicate information, enabling users to understand the app's functions and content. Mobile app UI components not only represent the visual appearance and style of the app but also significantly influence functionality and user experience, directly impacting user perception and app usage.

A well-designed UI enhances user experience, strengthens brand identity, promotes user engagement and retention, and improves the app's competitiveness. By prioritizing user needs and preferences, effective UI design fosters seamless interactions, ultimately contributing to the success of the mobile application.

### **Cognitive Psychology and Interface Design**

**Definition of cognitive psychology and cognitive characteristics.** Cognitive psychology is a branch of psychology that empirically investigates the processes by which humans process internal and external information and the nature of knowledge representation from an information-processing perspective. It focuses on cognitive processes such as attention, perception, memory, language, and thinking (Lee, 1999). In essence, it is the study of how humans judge problems and process information that leads to behavior based on the input they receive (Yoon, 2016).

In cognitive psychology, cognition refers to the process by which humans gather, process, and utilize information to make decisions and take actions. The cognitive process encompasses all stages from the input of information through sensory organs to the final output as behavior. When individuals encounter various problems or stimuli in daily life, they undergo a structured information-processing process, as illustrated in Figure 1.

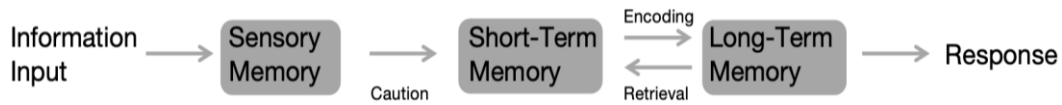


Figure 1. The process of human information processing.

Among the cognitive processes, perception, attention, and memory play a fundamental role in how people acquire and process information. These three cognitive characteristics are crucial in determining how information is interpreted and used during decision-making (Xie, 2018). Given their importance, this study applies these cognitive characteristics to key app interface design elements such as layout, navigation, color schemes, and buttons for analysis. By examining the relationship between cognitive psychology principles and interface design, the study aims to enhance user experience through optimized design solutions.

**Cognitive characteristics and app interface design elements.** The visual interface elements that make up an app screen include layout, color, typography, images, navigation, buttons, and icons. These elements serve as a communication bridge between the user and the app. Previous studies, such as *A Study on the Visual Aspects of UI Design* (Hong & Choe, 2019), focused on layout, color, and buttons, while *Interface Design Research for Mobile Banking Usability Enhancement* (Park, E., 2018) examined navigation, color, buttons, and icons. Additionally, Xie's study on the cognitive psychology perspective in museum mobile app GUI design (2018) analyzed layout, color, buttons, and icons, emphasizing their direct influence on user cognition, psychological activity, usability, and efficiency.

Based on this research, the current study will focus on four key visual interface elements—layout, navigation, color, and buttons—that play a pivotal role in user experience.

**Layout.** Layout refers to the overall composition, structure, arrangement, and organization of content on the screen based on its size. It plays a critical role in guiding users' visual attention and effectively conveying information (Xie, 2018). Layout design is a fundamental cognitive psychology element, influencing how users perceive information based on their prior experiences and learned knowledge rather than simply what is visually presented (Yoon, 2016). This process of organizing and interpreting information through sensory organs, known as perception (Oh, 2021), aligns layout design with the cognitive characteristic of perception.

A well-designed layout should facilitate intuitive understanding of information without requiring extensive learning, thereby reducing visual confusion and cognitive fatigue (SDF, 2022).

**Navigation.** Navigation serves as a mechanism for users to move seamlessly through an app to achieve their goals. It should incorporate elements that prevent user confusion by facilitating clear interaction (Park, 2018). From a cognitive psychology perspective, navigation is closely tied to attention, as it enables users to quickly and accurately locate the information they need (Hong, 2004). Effective navigation design minimizes cognitive overload by avoiding the display of excessive information on a single screen and eliminating unnecessary elements like advertisements or recommendations during key user interactions (SDF, 2022).

**Color.** Color functions as a visual language that captures attention, enhances memory retention, and creates an aesthetically pleasing atmosphere (Chun, 2008). From a cognitive psychology standpoint, color is linked to

memory, as it evokes associated images and emotions based on the user’s past experiences. For example, red is commonly associated with warnings, urgency, or passion. This ability to trigger associations aligns color design with memory processes, helping users focus on important information and recall it easily. Proper color usage also reduces errors by guiding user actions effectively, as highlighted in Xie’s study (2018).

**Buttons.** Buttons are interactive elements that prompt users to perform actions such as navigating to the next page or executing commands immediately (Xie, 2018). Humans are generally better at recognizing previously encountered stimuli rather than recalling abstract information (Lee, 2019). Buttons, whether in elevators, remote controls, or smartphone interfaces, are familiar interactive components that users instinctively recognize and utilize based on their past experiences. This aligns buttons with the cognitive characteristic of memory. Therefore, button design should consider user familiarity and efficiency in information selection (Park, 2018).

### App Design Proposals From a Cognitive Psychology Perspective

#### User Survey

To identify the interface issues in airline service apps, a five-day interview study was conducted with eight participants (both male and female, aged 30 to 40) who used Chinese airline service apps UMETRIP and VariFlight. The interviews focused on the difficulties and inconveniences experienced during app use. Participants were also asked to share their overall impressions. In cases where participants found it difficult to answer, the researcher provided additional questions. The findings are summarized below.

Table 1  
*An Interviewee*

Gender	Age	Visit frequency (per month)	Gender	Age	Visit frequency (per month)
Male (Participant 1)	34	3 times	Female (Participant 5)	32	4 times
Male (Participant 2)	38	4 times	Female (Participant 6)	36	3 times
Male (Participant 3)	42	1 times	Female (Participant 7)	40	3 times
Male (Participant 4)	47	3 times	Female (Participant 8)	45	2 times

To identify the major difficulties and inconveniences encountered during the process of using the app, the following four questions were asked:

Question 1: What difficulties did you experience when searching for and selecting flight information?

Question 2: What difficulties did you face when selecting a flight and proceeding to payment?

Question 3: What difficulties did you encounter when changing options during the flight booking process?

Question 4: Were the size and shape of the buttons, images, and photos displayed during the booking process appropriate?

Participant 1 (VariFlight): The process of selecting various options when booking and purchasing a flight was complex and difficult. Particularly when considering seat selection or additional services for business travel, it was challenging to make decisions. For business travel, selecting comfortable seating and additional services is crucial, but the variety of available options made it hard to decide. Sometimes it was unclear which additional service to choose, leading to confusion. Therefore, making the options for seat selection and additional services clearer and easier to choose would make the booking process smoother.

Participant 2 (UMETRIP): I started using the flight service app recently, but it was awkward at first because I was not familiar with the app, making it uncomfortable to use. The homepage had many functions and options,

which made it difficult for me when I first started. Especially, I had to switch between different screens to complete the booking, which caused confusion. I was constantly worried about delays affecting my schedule. I hope the app can provide a simpler, more intuitive interface that allows for easier booking completion.

Participant 3 (VariFlight): Sometimes, I had trouble using the airline's app to obtain flight information while traveling. The process of checking flight details was complex, and to find flight information for a specific time, I had to refer back to the booking page. When traveling with family, finding the booking page became lengthy and complicated, and the many options made it not intuitive.

Participant 4 (UMETRIP): First of all, I would prefer larger font sizes. The button label size is small, so I rely on the icons, but sometimes I'm unsure of their function. It would be better if the screen were brighter and clearer. Additionally, the clickable areas should be clearly indicated. I often had to spend time deciding whether to press a button or not.

Participant 5 (VariFlight): I primarily want to check information like flight times, arrival times, and flight numbers. However, it takes a long time to find this information because there is no clear search bar on the page, and I have to jump to another page to find it.

Participant 6 (UMETRIP): When it comes to refunds, I need to know the airline's refund policy, but I found it difficult to locate the relevant page while using the app. Even when I found the page, the information was unclear, which was confusing.

Participant 7 (VariFlight): Finding and selecting options was not too difficult. However, before completing the payment, other recommendation messages popped up, which made me momentarily doubt whether I had made the right purchase decision.

Participant 8 (UMETRIP): I needed information about transportation from the airport to the city, but I had difficulty finding the button to access this information, which took a long time. When I eventually navigated to the airport information page, I realized that I could not find the transportation details and had no choice but to ask at the information desk. This made it very difficult for users to adapt to the app.

### **Interface Design Analysis and Improvement Directions**

To propose improvements to the user-centered design of the flight service app interface, the two most widely used apps, VariFlight and UMETRIP, were selected. The four key visual elements of the interface—layout, navigation, color, and buttons—were analyzed from a cognitive psychology perspective. Based on the above interviews, the issues were identified and improvement directions were derived. The analysis of user characteristics in Table 2 and the interface analysis in Table 3 were used to conduct the cognitive psychology-based interface research (Xie, 2018) and web research using principles of visual perception (Chun, 2008).

Table 2

#### *Characteristics of Surveyed Users*

Category	Features
Visual	The users generally have mature vision and color perception, so they place more emphasis on comfort and convenience, preferring interfaces and images that are clear and easy to read.
Cognitive	Users generally have accumulated extensive experience and knowledge to solve complex problems and cope with challenges. However, they place greater importance on time management and efficiency, preferring to quickly acquire information or complete tasks in a simpler and clearer manner.
Psychological	Middle-aged individuals may experience a certain level of stress and anxiety due to various life challenges, including career development, family responsibilities, and financial stress. They also place greater importance on personal and family relationships.

Table 3

*Characteristics of Surveyed Users*

Category	Analysis criteria
Layout	Considering the discomfort in processing visual perceptual information, is there a familiar and simple structure?
Navigation	Considering the psychological pressure caused by life challenges, is the user process appropriate, and are there any elements that hinder the flow of usage?
Color	Considering the visual characteristic of difficulty in distinguishing subtle color differences, has clear and consistent color usage been implemented?
Button	Considering the visual characteristics that reduce comfort and convenience, does the button's shape stand out from other visual elements by providing outlines, shadows, or a sense of depth?

The layout corresponds to the perceptual aspect of cognitive psychology, and it should have a familiar and simple structure that allows users to easily understand the screen's organization and obtain information without the need for a learning process (Hong & Choe, 2019). From a cognitive psychology perspective, this can reduce visual confusion for users and decrease their cognitive load (Xie, 2018). Providing a simple and consistent layout is especially necessary for users who experience discomfort with processing visual information. Therefore, an analysis was conducted to determine whether the layout of the app's main menu screen is familiar and simple enough to reduce visual confusion and cognitive load for all users (Xie, 2018), and whether it takes into account the user's habitual eye movement patterns from left to right or top to bottom (Chun, 2008).

Table 4

*Characteristics of Surveyed Users*

APP	UMETRIP	Vari Flight
Layout		

The main screen of the UMETRIP app can be broadly divided into three sections: the tab bar, the navigation bar, and the content area. A Grid and List layout are predominantly used. In the recommended flight list section on the main screen, two flight routes are displayed per row. From the perspective of cognitive factors such as perception, attention, and memory, the layout of the main screen is clearly divided, and the functional areas of each section are highly recognizable. There is a degree of overall coherence and significance. However, the main screen displays many information elements, including eight category icons and two flight routes per row in the recommended flight list. Although much functional information is provided, it can distract the user's attention, influencing quick decision-making, and the abundance of information increases cognitive load, affecting the user's memory.

The main screen of the VariFlight app is divided into three main parts: the top toolbar, navigation, and the content area at the bottom. The app predominantly uses Grid, List, and Card layouts. Among these, the toolbar layout on the main screen includes options such as maps, one-way, round-trip, and a middle card-style list. In the content area, two recommended flight routes are displayed per row. From the perspective of cognitive elements such as detection, attention, and memory, the structure of the main screen is clearly divided, and the identification of functional areas is high. The layout's functional division is clear, and usability is relatively good, although the visual effects and aesthetics of the UI design are not particularly high.

Navigation corresponds to the cognitive psychology factor of attention and should provide necessary information in a simple and clear flow. As life challenges increase and the stress from a fast-paced lifestyle rises, users, as mentioned in the interviews, find it very inconvenient to recheck orders or find flight information. Therefore, it was analyzed whether the app's selection options are numerous and not overly complicated, and whether there are any elements that disrupt the flow, such as advertisements, rewards, suggestions, or recommendations.

In the case of the UMETRIP app, after touching the "Flight" option on the first screen, users must go through 14 steps, including selecting the flight, choosing seats, selecting luggage options, meal preferences, entering passport information, adding emergency contacts, selecting additional services, selecting priority boarding, choosing lounge access, selecting payment methods, confirming payment, issuing the ticket, and issuing the boarding pass. There is also a process of recommending additional services or upgrades before payment. In the case of the VariFlight app, after selecting the "Flight" option on the first screen, users go through 12 steps, including selecting the flight, choosing seats, selecting luggage options, meal preferences, entering emergency contact information, selecting additional services, proposing temporary membership registration, selecting payment methods, entering payment information, entering passport details, issuing the ticket, and final confirmation. Both apps involve more than 10 steps to complete an order, and the inclusion of recommendations, rewards, and membership registration proposals disrupts the flow from a cognitive psychology perspective, extending the time to order completion and increasing users' psychological burden. As stated by the interview participants, long and complex ordering processes with unnecessary proposals can cause confusion, making the app feel inconvenient to use. Therefore, simplifying the reservation process with an easy reservation option on the first screen will reduce psychological burden and ensure that the flow of the app remains smooth by excluding additional advertisements, rewards, suggestions, and recommendations.

Color, as a cognitive psychology feature related to memory, plays a crucial role. Using appropriate colors that are consistent with each other in the app interface can reduce the user's memory load, decrease visual confusion and fatigue, and emphasize important information (Xie, 2018). Especially for users who find it difficult to recognize subtle color differences or experience spatial and temporal limitations, it is important to avoid using colors that lack correlation. Therefore, it was analyzed whether the app interface elements use clear and consistent colors to maintain visual coherence and emphasize important information (Xie, 2018).

Thus, appropriate use of correlated colors within the screen reduces visual confusion and fatigue, maintains visual consistency, and highlights key information (Xie, 2018).

UMETRIP uses yellow, orange, and dark brown as its primary colors, with green and white as secondary colors, while VariFlight uses blue as its primary color, with yellow and white as secondary colors applied to advertisements and buttons. Both brands consistently apply their brand colors to app screens, incorporating them into interface elements such as buttons, text, and navigation bars.



However, UMETRIP uses a single dark gray color for buttons with different functions. This lack of differentiation impairs users' ability to intuitively distinguish between buttons, which can negatively impact their ability to quickly identify and recognize the desired button, as noted in cognitive psychology (Xie, 2018). Interview participants indicated difficulty in distinguishing between buttons, resulting in challenges when making selections.

In contrast, VariFlight uses yellow—unrelated to its brand colors—in the top menu category, disrupting visual consistency. This reduces its ability to highlight important information effectively (Xie, 2018). Therefore, it is essential to use colors with clear associations within the interface to reduce visual confusion and fatigue, maintain visual consistency, and emphasize critical information (Xie, 2018).

Buttons are related to the cognitive psychological feature of memory and serve as visual elements that guide users to obtain the information they need by touch. Therefore, buttons should be intuitively displayed and clearly distinguished from other icons, images, and backgrounds. Important buttons should have size and prominent effects to prevent mistakes (SDF, 2022). Particularly for people with decreased focus ability and lower readability or distinguishability due to the reduction of lens elasticity or enlargement, buttons should have clear lines or shadows so that their shape does not resemble images (SDF, 2022). Thus, the analysis was conducted to determine whether the button's shape is clearly distinguished from other visual elements, and whether it has a clear form with lines or shadows (SDF, 2022).

Both UMETRIP and VariFlight use thin lines to separate menus, sidebars, and selection screens, making it difficult to distinguish buttons from images. From a cognitive psychology perspective, this impairs users' ability to identify buttons easily (SDF, 2022), impacting task efficiency and increasing cognitive load during app usage (Xie, 2018).

Participant 4 noted in the interview that the screen lacked clarity and brightness, making images hard to discern and causing confusion about whether a button required interaction. Similarly, Participant 8 struggled to find the button to proceed to the next step, ultimately failing to place an order and resorting to staff assistance.

To address these issues, the app should enhance screen brightness and apply clear outlines or shadows to buttons, ensuring they are visually distinct and easily recognizable as interactive elements (SDF, 2022). This will effectively guide users through calls to action (CTAs) and improve the overall user experience.

### **Proposal and Improvement Suggestions for Airline Service App Interface Design**

Based on the analysis in Section 3.2 and insights from prior studies on interface design for airline service apps, this research identifies key issues and suggests improvement directions. The study integrates findings from previous research, cognitive psychology principles, and reports on cognitive characteristics to evaluate existing interface designs from a cognitive psychology perspective, highlighting problems and proposing solutions.

Unlike prior research, the focus here is on a human-centered approach to app interface design. To support this, the study references “Laws of UX” by designer Jon Yablonski, which outlines 10 psychology-based principles for UX (User Experience) /UI (User Interface) design. These principles are also summarized on the website lawsofux.com and validated by relevant scholarly articles. From these, four cognitive psychology-based principles applicable to four key interface elements were selected.

The table below (Table 5) summarizes the identified problems, suggested improvements, and descriptions of the cognitive psychology principles applicable to each interface element. Based on these insights, the study provides specific recommendations and explanations for improving the interface design.

Table 5

*Problems and Improvement of Kiosk Interface Elements*

Category	Problem identification	Improvement direction	Cognitive psychology-based design direction
Layout	Providing all information on a single screen or using buttons that are difficult to perceive—especially with a swipe-to-navigate interface—makes it challenging for users to grasp the overall screen structure, disrupting the natural flow of their visual attention.	The top menu categories use horizontal scrolling, while the selection menu uses vertical scrolling. If additional categories or selection options are available, part of the screen should be visible, indicating that more options are present, ensuring there are no limitations in menu selection.	Gestalt Psychology's Law of Continuity The law suggests that elements aligned in a continuous direction lead the viewer's eye to follow a smooth, uninterrupted flow, resulting in the perception of these elements as a unified group.
Navigation	Complex ordering processes involving a minimum of 10 steps, combined with recommendations, rewards, or temporary membership suggestions mid-process, disrupt the flow and increase the user's psychological burden.	Provide a simplified order screen on the home page, where non-essential processes like recommendations and rewards are omitted or minimized, in order to reduce psychological burden and avoid a complicated order process.	Hick's Law This law states that the time required for a user to make a decision increases with the number of choices available. The more options presented, the longer it takes for the user to choose.
Color	Using a single color for buttons with different functions makes it difficult for users to recognize them as distinct buttons. The use of colors unrelated to the brand's color scheme makes it challenging to maintain visual consistency and highlight important information.	Apply different colors to buttons with distinct functions to clearly differentiate them, and use consistent colors that are visually related to reduce visual confusion and cognitive load.	Aesthetic-Usability Effect This law suggests that the more aesthetically pleasing and well-designed an interface is, the higher its perceived usability. Users tend to believe that visually appealing designs are easier to use and more efficient, which can enhance their overall experience.
Button	The buttons are only differentiated by thin lines, which can lead users to mistake them for images. This delays the action of touching the button and increases the time required to recognize them as buttons, thereby increasing visual and psychological burden.	Make the buttons visually distinct by adding clear outlines or making them appear three-dimensional, ensuring they are easily recognizable as buttons, which will reduce both visual and psychological strain.	Von Restorff Effect This effect suggests that when similar items are presented together, the one that differs in color or shape is more likely to be remembered. This phenomenon highlights how distinct visual elements stand out and grab attention, making them easier to recall.

**Layout**

The layout displays the form and structure within the screen, and is related to perception in cognitive psychology, aligning with Gestalt psychology, which studies visual perception characteristics and principles (Chun, 2008). In particular, the principle of continuity in Gestalt psychology refers to the tendency for elements that are aligned to be perceived as a group, as the viewer's gaze naturally follows the alignment (Oh, 2021). This principle can be applied to menu arrangement (Chun, 2008).

From a cognitive psychology perspective, the layout should guide the user's gaze, as it typically moves horizontally or vertically, allowing the eyes to flow naturally (Chun, 2008). Additionally, the layout should apply scrolling to help users recognize that there are more categories and menu items, indicating further options. This enables users to make selections without limitations (SDF, 2022) and provides a certain number of choices on the screen, allowing for easy understanding of the flight options and reducing visual confusion and cognitive load (Xie, 2018).

The improved layout applying the Gestalt principle of continuity can be seen in the suggested improvements below.

Improvement plan: Both UMETRIP and VariFlight have been redesigned to incorporate horizontal scrolling for the top categories and vertical scrolling for the selection menu. By applying the principle of continuity in the layout, additional categories and menu items are displayed, indicating the availability of more options. This improvement ensures that users can make selections without limitations and easily comprehend the information, thereby reducing cognitive load and visual confusion.

### **Navigation**

Navigation plays a key role in ensuring a smooth user flow. However, both UMETRIP and VariFlight require users to go through more than 10 steps to complete an order, which increases cognitive load and psychological burden, as it demands a significant amount of time from users (SDF, 2022). While having multiple steps is intended to offer additional services, it is important to reduce the psychological burden by offering a simplified ordering process for users who are not familiar with the app, allowing them to gradually transition to the more complex ordering process (SDF, 2022).

According to the results of an app usage survey, a significant percentage of users, regardless of age, experience discomfort, or anxiety when using the app in public (Ahn, 2022). Providing an option for simplified ordering can reduce psychological pressure not only for users who are unfamiliar with the app but also for general users. The psychological principle known as Hick's Law (Yablonski, 2020), which states that the time taken to make a decision increases with the number of choices, can be applied to simplify complex processes in this situation.

The improvement in the order selection screen, incorporating Hick's Law, can be seen in the improvement plan below.

Improvement plan: The app should provide an option for simplified ordering on the first screen, excluding unnecessary ads, recommendations, or suggestions during the order process. This will help reduce the time needed to complete an order, thus alleviating the psychological burden on users. To address this, the improved design for the simplified ordering screen has been created in both vertical and horizontal formats.

### **Color**

Color plays a crucial role in focusing users' attention on the interface and enhancing memory, which in turn guides users to take appropriate actions. Using aesthetically pleasing and correlated colors can maintain visual consistency, reduce visual confusion, and highlight important information from a cognitive psychology perspective (Xie, 2018). According to the Aesthetic-Usability Effect (Laws of UX, n.d.), designs that are visually appealing and beautiful are perceived as more usable, leading to a more positive user experience and improved usability (Yablonski, 2020). Therefore, applying the Aesthetic-Usability Effect to interface elements can enhance user responses and overall effectiveness, as shown in the improved design in the following recommendations.

Improvement plan: In the UMETRIP selection menu confirmation page, the buttons that can be modified have been unified with a green color, allowing users to recognize that they serve the same function. The important "Add to Cart" button has been highlighted with yellow to emphasize its significance, ensuring users can proceed smoothly to the next screen. For the VariFlight menu selection screen, the top category menu has been designed using VariFlight's blue color, providing consistency across different pages. By unifying the colors of buttons with the same function and using correlated colors, confusion among users is reduced, leading to a more positive effect on usability.

## Buttons

In app interfaces, buttons are essential visual elements that guide the user's clicks, and they should have an intuitive design. Ensuring that users can clearly perceive and accurately use the buttons as intended helps reduce the cognitive load, which positively impacts memory retention from a psychological perspective (Xie, 2018). To make the buttons stand out and appear more effectively, the Von Restorff Effect, also known as the isolation effect, was applied. The Von Restorff Effect is the tendency to better remember an element that differs in color or shape when similar elements are grouped together (Laws of UX, n.d.). This effect is based on the principle of memory, particularly memory influenced by experience (Lee, 2019), and was applied to buttons with similar shapes to enhance task efficiency (Xie, 2018). The design improvements incorporating the Von Restorff Effect can be seen in the following improvement suggestions.

Improvement plan: In the menu selection screens of UMETRIP and VariFlight, outline and shadow effects were applied to the category and menu selection buttons that users need to touch, making the buttons appear three-dimensional and ensuring that their shapes are intuitively visible. Specifically, important buttons like "Pay Now" were distinguished from other buttons by using yellow to draw the user's attention, while other buttons were either colored gray or given different colored lines for improvement. In both UMETRIP and VariFlight, background colors were applied to the selection buttons, enhancing visual contrast and providing a sense of depth to the buttons, making their shapes more intuitive. By clearly distinguishing the shapes of the buttons in this way, the time required for users to recognize the buttons is reduced, leading to increased usability.

## Conclusion

Apps have become an integral part of our daily lives, deeply embedded in our surroundings. The pandemic, triggered by COVID-19, accelerated the growth of remote and online environments, and at the center of this transformation, interface design, which facilitates interaction between humans and machines, has become increasingly important. However, users continue to report difficulties with using airline service apps, which stems from interface designs that do not consider human-centered principles, rather than purely technological issues. This needs to be addressed. Several previous studies have suggested design directions for airline service apps to improve accessibility and usability. However, these studies did not analyze the designs from a cognitive psychology perspective, nor did they apply cognitive principles to propose improvements.

Therefore, this study aims to propose a new, user-centered app interface design by analyzing interface elements—layout, navigation, color, and buttons—from a cognitive psychology perspective. The study identifies issues and improvement directions, applying cognitive psychology-based principles to suggest human-centered solutions for each interface element.

Firstly, the layout can be improved by applying the Gestalt principle of continuity, which states that elements aligned in one direction are perceived as a group. Based on the natural flow of human vision—either horizontally or vertically—scrollable menus are introduced to display part of the available options, ensuring that there are no limits to menu selection. This can reduce visual confusion, particularly for users who may struggle to find specific menus, offering them a simpler and easier layout to complete their orders without difficulty.

Secondly, navigation can be improved by applying Hick's Law, which states that the time required to make a decision increases with the number of choices. Providing a simplified order screen on the first page, minimizing complex processes, reduces the user's psychological burden. This is especially beneficial for users who are not familiar with the app, providing them with a smoother, more seamless flow toward completing their orders.

Thirdly, color can be improved by applying the Aesthetic-Usability Effect, which states that aesthetically pleasing designs enhance usability. Using clear, consistent colors reduces visual confusion and fatigue for users. It also helps highlight important information, making it easier for users, especially those with difficulty distinguishing subtle color differences, to identify key elements.

Lastly, buttons can be improved by applying the Von Restorff Effect, which suggests that elements that differ from similar ones are more easily remembered. By making buttons distinct and three-dimensional, separated from other elements, users can more easily recognize them and make accurate selections. This is particularly helpful for users with diminished recognition abilities, improving the overall usability of the app.

In summary, this study provides a human-centered approach to improving airline service app interface designs, applying cognitive psychology principles to enhance usability and reduce the psychological burden on users.

This study aimed to propose new improvements by designing and comparing the proposed changes with existing app interfaces, to illustrate how these elements should be structured and arranged to create the most ideal, user-centered solution between the app and the user. However, the study has limitations, as it did not conduct empirical research on a wide range of subjects to identify detailed issues or validate the proposed improvements. These aspects will need to be addressed in future studies. Finally, it is hoped that the proposed improvement directions and solutions derived from this study will contribute to the development of user-centered app designs.

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