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USER'S PERSONALITY TRAITS AND USER INTERFACES FOR MOBILE INDOOR MAPS

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Abstract. *UI design that suits users plays an important role in providing a positive user experience. Personality can be used for characterizing users, and providing suitable UI types for the users. The purpose of this study is to explore the relationship between personality traits and perceived usability of mobile indoor map UI design. A total of 8 prototypes of mobile indoor map UI were developed with 3 design features, which has 2 design types each. Design features and design types were selected from popular mobile maps, and previous studies. Big 5 Mini-IPIP questionnaire was used to measure user's personality traits, and perceived usability of mobile indoor map UI design was measured in terms of satisfaction, usefulness, and ease of use, during the experiments. A total of 20 participants participated in the experiments, and were asked to answer the questions in the questionnaire after experiencing each of 8 UI prototypes. In this study, we found there are significant linear relationships between personality traits and perceived usability of mobile indoor map UI design. From the experimental results, we recommend suitable mobile indoor map UI design types for the user according to the user's personality traits.*
Keywords: Big 5 personality traits, Mobile indoor map, User interface design, Usability

1. **Introduction.** Global Positioning System (GPS) is not very helpful for indoor directions, so there are not many effective ways to pinpoint a user's current indoor location [1], which often leads to users getting lost [2]. Indoor maps are usually available now in printed form on the wall, but mobile indoor maps are convenient for mobile phone users, especially in crowed places like large shopping malls. It was reported that the most common way consumers find products in large shopping malls was "keep looking around" for 53% of people and about 10% of people searched for products through maps [3]. Additionally, nearly 71% of consumers answered positively whether they would use a mobile indoor map that guides them to the location of a store or product. However, the difficulty of using mobile indoor maps requires continuous development and improvement of User Interfaces (UIs) for mobile indoor maps [4-6]. On the other hand, since users have different preferences, UI design that fits the user's characteristics can increase user satisfaction. People can usually be classified by gender, age, etc. Among them, personality has been studied in many fields as one of the characteristics that distinguish people [7,8], but studies examining the role of user's personality in UI design, especially in mobile indoor map design, are difficult to find. Personality was identified through personality type tests, such as Myers-Briggs Type Indicator (MBTI), Dominance/Influence/Steadiness/Conscientiousness (DISC), Enneagram, and Big 5 Personality Traits (Big 5). It is necessary to study how to provide effective mobile indoor navigation through UI design that matches user characteristics based on user's personality. Therefore, this study aims to explore the relationship between user's personality and perceived usability of UIs, and how to provide mobile indoor map UIs

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that suit user's personality. This paper is organized as follows. This section gave the motivation of this study and the next section describes an overview of related works, and is followed by a description of research methods in Section 3. Sections 4 and 5 provide the results of the experiments and discussion on the results with conclusions, respectively.

2. Related Works.

2.1. Big 5 personality traits and UI design. The Big 5 personality traits is a typical personality measure, which consists of five main traits: The 'Extraversion' shows an outgoing and social tendency and how active a person is in interaction with others; the 'Agreeableness' reflects how much friendly, receptive, and compliant a person is and is related to feelings of consideration or comfort towards others; the 'Conscientiousness' is a tendency to be sincere and systematic and to comply with rules or principles in organizations; the 'Neuroticism' is a tendency to be unstable, neurological, and negative, and to focus on emotional stability or controllability to the outside world; and the 'Intellect/Open experience' is a tendency to be open and multivariate and to like intellectual stimulation, change, and diversity [9]. According to studies of Big 5 personality traits and UI designs, individuals with high extraversion prefer a UI that emphasizes activity and are interested in challenges or quests [10]. Individuals with high conscientiousness prefer left-aligned text, image buttons with high information density, scroll or slide structure when moving pages, and have high expectations for rewards [11]. Individuals with high neuroticism prefer center-aligned text, low-information-density image buttons, and scrolling when moving pages [11]. Individuals with high intellect/open experience prefer unusual UI design, are interested in rewards, challenges and quests, and prefer online communication such as social media [12]. According to the results of previous studies, UI preferences differ according to personality traits, so it is expected that there will be differences in the preferences of mobile indoor map UIs as well. Due to the lack of research on mobile indoor map UI design according to personality traits, we explore UI designs suitable for indoor maps and identify UI design preferences according to personality traits in this study.

2.2. Indoor map design and landmarks. When designing an indoor map, it should be considered that vertical navigation, orientation and relative positioning, meaningful routes, navigation by visible landmarks, and consistency between UI design and the real world that users navigate while looking at the map [13]. Localization should also be considered as this is the most difficult problem when doing directions [5]. The main features of Kakao Map (ver. 1.14.0), Naver map (ver. 5.8.2), and Google map (ver. 10.41.2), which are popular mobile maps in Korea, can be analyzed in the aspects of functions and contents. For example, the zoom function of the map is activated by dragging, pinching, double clicking, and using buttons. In addition, in the navigation-related contents, recommended contents such as restaurants or cafes around the route or around the current location are provided. One of the best ways to find the user's current location indoors is with unique and recyclable reference landmarks [4]. Hampe and Elias [14] also argued that users prefer to use landmarks in the navigation process. In an experiment comparing the time it took to recognize a destination indoors with one to four landmarks, participants achieved fast self-localization when there was only one landmark [15]. And people tend to describe the routes with at least one, usually two or three landmarks [4].

3. Method.

3.1. **Mobile indoor map UIs for experiments.** When developing an indoor map UI, it is necessary to refer to the functions and contents of representative mobile indoor maps, and the number of landmarks should be considered. Thus, we selected three design features. First, the zoom feature shows a direct interaction between the map and the user and is provided by all major mobile maps. Second, navigation is a traditional and important feature of maps. Third, the landmark feature is necessary because it helps users to identify their location [4].

In each of these three design features, we developed two design alternatives for the experiments (see type 1 and type 2 in Table 1). As for the zoom feature, type 1 was developed with double click, drag and pinch zoom operation, and type 2 was developed with buttons and zoom sliders on the screen. As for the navigation feature, type 1 was developed with sequential route guidance and type 2 was developed with information recommendation around route. Since a user's location awareness depends on the number of landmarks [15], for the navigation feature, we developed type 1 with one landmark and type 2 with three landmarks.

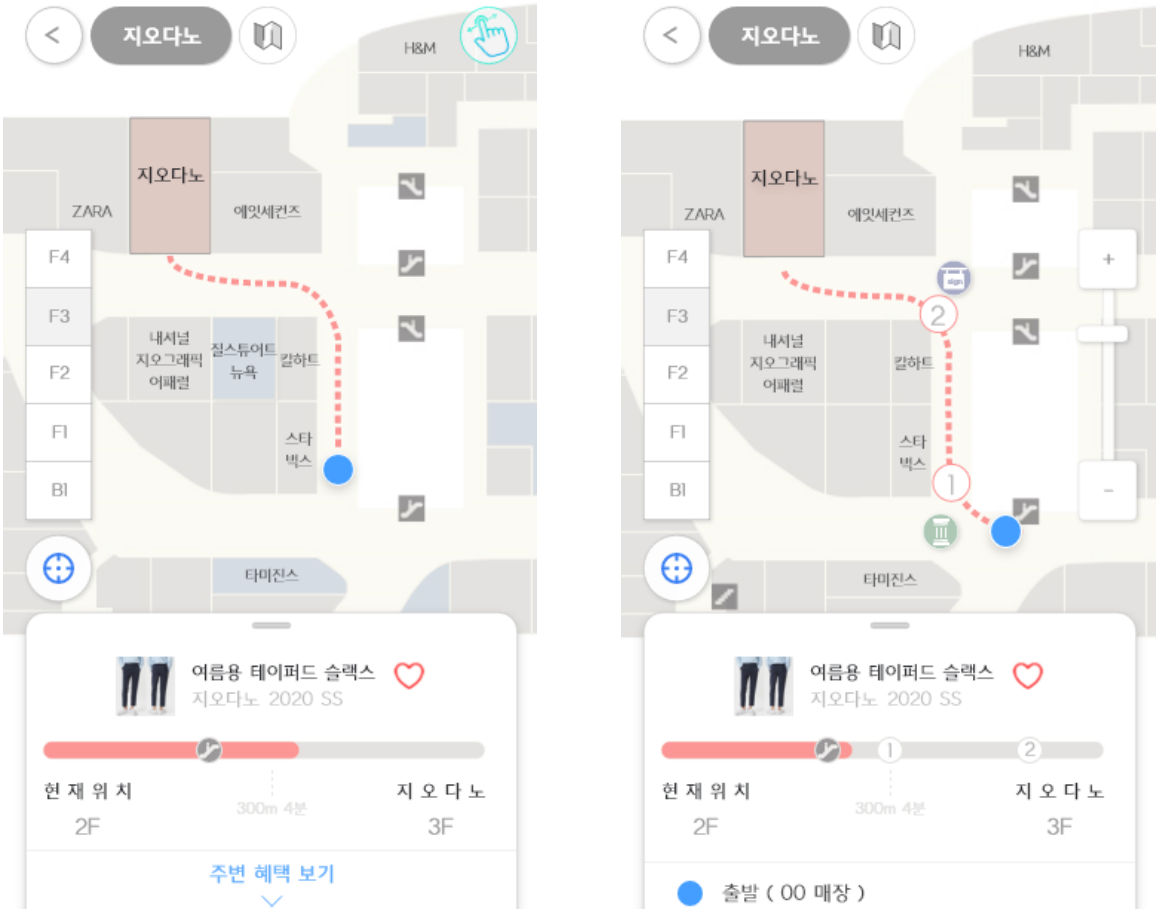
Table 1. Indoor map UI design features and types

Design features	Design type 1	Design type 2
Zoom	Double click, drag, pinch zoom	Button, zoom slider
Navigation	Sequential route guidance	Information recommendation around route
Number of landmarks	1	3

For the experiments, a total of 8 indoor map UI prototypes were made in the context of a large shopping mall by combining 2 design types for each of 3 design features. For example, Figure 1(a) shows the indoor map UI prototype with a combination of 'double click, drag, pinch zoom' (type 1 in the zoom feature), 'information recommendation around route' (type 2 in the navigation feature) and 'one landmark' (type 1 in the number of landmarks), whereas Figure 1(b) shows another indoor map UI prototype consisting of 'button, zoom slider' (type 2 in the zoom feature), 'sequential route guidance' (type 1 in the navigation feature) and 'three landmarks' (type 2 in the number of landmarks).

3.2. **Measurement of personality traits and perceived usability.** We used Big 5 Mini-IPIP's test [16] that was translated into Korean to measure participant's personality traits, since Big 5 personality traits have been widely used in academic research related to UI designs, as mentioned in '2. Related Works'. To evaluate the perceived usability of indoor map UI prototypes, we measured satisfaction, usefulness and ease of use for each UI prototype by using questionnaires that were developed in the previous studies [17,18]. To measure satisfaction, we used four satisfaction questions: navigation, additional information, screen design and overall satisfaction. Three questions were used to measure usefulness: whether users achieve what they want, usefulness of navigation and usefulness of additional information. Four questions were used to measure ease of use: overall ease of use, ease of navigation, ease of using additional information, and ease of perceiving situations. All questions were answered on a 7-point interval scale.

3.3. **Participants and experimental procedure.** A total of 20 participants (10 males and 10 females) participated in the experiment, and the mean age of the participants was 29.9 years (standard deviation: 13.66 years). Each of participants followed the experimental procedures as follows. First, details of indoor map UIs and experimental tasks were explained to the participants. Second, each of participants experienced all of 8 indoor map UIs conducting experimental tasks in a random order. Third, each of participants



(a) UI screen shot with 'click/drag, information rec., 1 landmark'

(b) UI screen shot with 'button/slider, seq. route, 3 landmarks'

Notes. "현재위치": your current location, "지오다노": clothing brand you are looking for, "출발": start

FIGURE 1. Indoor map UI

was asked to answer the questions in the questionnaire immediately after experiencing each of the 8 indoor map UIs.

The experimental tasks include 'zoom in and out once', 'click the navigation panel at the bottom of the display to see sequential route guidance or information recommendation around route', and 'click the landmark icon'. The experiment took about an hour on average.

4. **Results.** To find the linear relationship between each of 5 personality traits and dependent variables, such as satisfaction, usefulness and ease of use, simple linear regression analysis was conducted for each of indoor map UI design types. Table 3 summarizes the results of regression analysis.

4.1. **Basic statistics of personality traits.** Big 5 Mini-IPIP's test was conducted on a 7-point interval scale with a total of 20 questions, and Table 2 shows basic statistics of Big 5 personality traits, such as mean and standard deviation. Agreeableness has high mean (5.44) and low standard deviation (0.80), and Neuroticism has low mean (4.10) and relatively high standard deviation (1.15).

4.2. **Satisfaction.** First, the stronger the Extraversion tendency, the higher the satisfaction with 'double click, drag, pinch zoom' (type 1 in the zoom feature) and 'information recommendation around route' (type 2 in the navigation feature). Second, the stronger

Table 2. Basic statistics of Big 5 personality traits

Personality traits	**Extraversion**	**Agreeableness**	**Conscientiousness**	**Neuroticism**	**Intellect/Open experience**
Mean	4.89	5.44	5.41	4.10	4.34
Standard deviation	1.01	0.80	1.10	1.15	1.29

Table 3. Regression results for satisfaction, usefulness, ease of use

Personality traits	**UI design type**		**Satisfaction**			**Usefulness**			**Ease of use**		
			β	t-value	p-value	β	t-value	p-value	β	t-value	p-value
Extraversion	Zoom	1	**0.334**	**2.425**	**0.018**	**0.345**	**2.426**	**0.018**	0.139	1.029	0.307
		2	0.197	1.330	0.187	0.221	1.465	0.147	0.135	0.919	0.361
	Navigation	1	0.190	1.386	0.170	0.233	1.744	0.085	0.099	0.803	0.424
		2	**0.341**	**2.311**	**0.023**	**0.333**	**2.114**	**0.038**	0.175	1.118	0.267
	Number of landmarks	1	0.248	1.764	0.082	0.280	1.959	0.054	0.102	0.758	0.451
		2	0.283	1.964	0.053	0.285	1.908	0.060	0.171	1.174	0.244
Agreeableness	Zoom	1	0.088	0.489	0.626	0.197	1.071	0.287	−0.090	−0.527	0.600
		2	−0.145	−0.773	0.442	−0.083	−0.430	0.668	−0.197	−1.068	0.289
	Navigation	1	−0.062	−0.356	0.723	0.018	0.105	0.917	−0.170	−1.096	0.277
		2	0.005	0.027	0.979	0.096	0.474	0.637	−0.117	−0.594	0.554
	Number of landmarks	1	−0.027	−0.147	0.884	0.060	0.326	0.745	−0.123	−0.726	0.470
		2	−0.030	−0.164	0.871	0.054	0.281	0.779	−0.163	−0.888	0.377
Conscientiousness	Zoom	1	−0.255	−1.981	0.051	−0.393	−1.244	0.217	−0.138	−1.120	0.266
		2	−0.240	−1.778	0.079	**−0.393**	**−2.226**	**0.029**	−0.218	−1.631	0.107
	Navigation	1	−0.081	−0.638	0.525	−0.062	−0.495	0.622	−0.044	−0.39	0.698
		2	**−0.413**	**−3.127**	**0.002**	**−0.413**	**−2.887**	**0.005**	**−0.312**	**−2.225**	**0.029**
	Number of landmarks	1	−0.181	−1.391	0.168	−0.209	−1.580	0.118	−0.161	−1.310	0.194
		2	**−0.313**	**−2.395**	**0.019**	−0.260	−1.896	0.062	−0.195	−1.460	0.148
Neuroticism	Zoom	1	0.244	1.981	0.051	**0.317**	**2.547**	**0.013**	**0.313**	**2.741**	**0.008**
		2	**0.570**	**4.963**	**0.000**	**0.548**	**4.584**	**0.000**	**0.566**	**4.996**	**0.000**
	Navigation	1	0.125	1.032	0.305	0.150	1.266	0.209	0.105	0.965	0.337
		2	**0.690**	**6.303**	**0.000**	**0.715**	**6.094**	**0.000**	**0.774**	**7.209**	**0.000**
	Number of landmarks	1	**0.357**	**2.979**	**0.004**	**0.402**	**3.335**	**0.001**	**0.396**	**3.582**	**0.001**
		2	**0.458**	**3.844**	**0.000**	**0.463**	**3.728**	**0.000**	**0.482**	**4.101**	**0.000**
Intellect/Open experience	Zoom	1	0.209	1.902	0.061	0.171	1.501	0.137	0.194	1.864	0.066
		2	**0.251**	**2.207**	**0.030**	0.215	1.834	0.070	**0.258**	**2.307**	**0.024**
	Navigation	1	0.065	0.599	0.551	0.040	0.372	0.711	0.037	0.378	0.706
		2	**0.395**	**3.564**	**0.001**	**0.346**	**2.871**	**0.005**	**0.415**	**3.648**	**0.000**
	Number of landmarks	1	0.176	1.594	0.115	0.114	0.998	0.321	0.145	1.387	0.169
		2	**0.284**	**2.555**	**0.013**	**0.272**	**2.349**	**0.021**	**0.307**	**2.788**	**0.007**

Notes. Bold numbers indicate statistically significant slopes (β) of the regression line when p-value < 0.05.

the Conscientiousness tendency, the lower the satisfaction with 'information recommendation around route' (type 2 in the navigation feature) and 'three landmarks' (type 2 in the number of landmarks). Third, the stronger the Neuroticism tendency, the higher the satisfaction with 'button, zoom slider' (type 2 in the zoom feature) and 'information recommendation around route' (type 2 in the navigation feature). There is no difference in the number of landmarks in that the stronger the Neuroticism tendency, the higher the satisfaction with both types. Fourth, the stronger the Intellect/Open experience tendency, the higher the satisfaction with 'button, zoom slider' (type 2 in the zoom feature), 'information recommendation around route' (type 2 in the navigation feature) and 'three landmarks' (type 2 in the number of landmarks).

4.3. **Usefulness.** First, the stronger the Extraversion tendency, the higher the usefulness with 'double click, drag, pinch zoom' (type 1 in the zoom feature) and 'information recommendation around route' (type 2 in the navigation feature). Second, the stronger the Conscientiousness tendency, the lower the usefulness with 'button, zoom slider' (type 2 in the zoom feature) and 'information recommendation around route' (type 2 in the

navigation feature). Third, the stronger the Neuroticism tendency, the higher the usefulness with 'information recommendation around route' (type 2 in the navigation feature). There is no difference in the zoom feature and the number of landmarks, in that the stronger the Neuroticism tendency, the higher the usefulness with both types. Fourth, the stronger the Intellect/Open experience tendency, the higher the usefulness with 'information recommendation around route' (type 2 in the navigation feature) and 'three landmarks' (type 2 in the number of landmarks).

4.4. **Ease of use.** First, the stronger the Conscientiousness tendency, the lower the ease of use with 'information recommendation around route' (type 2 in the navigation feature). Second, the stronger the Neuroticism tendency, the higher the ease of use with 'information recommendation around route' (type 2 in the navigation feature). There is no difference in the zoom feature and the number of landmarks, in that the stronger the Neuroticism tendency, the higher the ease of use with both types. Third, the stronger the Intellect/Open experience tendency, the higher the ease of use with 'button, zoom slider' (type 2 in the zoom feature), 'information recommendation around route' (type 2 in the navigation feature) and 'three landmarks' (type 2 in the number of landmarks).

5. **Discussions and Conclusion.** Based on the experimental results, it was found that there are significant linear relationships between user's personality traits and the perceived usability of indoor map UIs in terms of satisfaction, usefulness and ease of use according to the design types of indoor map UI. It may be implied from the experimental results that we can recommend a design type of indoor map UI that has a significant linear relationship between perceived usability, such as satisfaction, usefulness and ease of use, and personality traits for users who exhibit strong tendencies of certain personality traits.

First, for users with a strong Extraversion tendency, it can be recommended to provide 'double click, drag, pinch zoom' and 'information recommendation around route' design types in terms of satisfaction and usefulness. It can be interpreted that outgoing users prefer to use design types with features related to active actions such as double click, drag, pinch zoom and retrieval of additional information. Second, for users with a weak Conscientiousness tendency, it can be recommended to provide 'button, zoom slider' design type in terms of usefulness, 'information recommendation around route' design type in terms of satisfaction, usefulness and ease of use, and 'three landmarks' design type in terms of satisfaction. It can be interpreted that non-systematic users prefer to use design types with features related to various tasks, such as using buttons or zoom slider, and search for additional information around route or multiple landmarks. Third, for users with a strong Neuroticism tendency, it can be recommended to provide 'button, zoom slider' design type in terms of satisfaction, and 'information recommendation around route' design type in terms of satisfaction, usefulness and ease of use. It can be interpreted that control-oriented users prefer to use design types with features related to typical actions following buttons or zoom slider, and retrieval of additional information. Finally, for users with a strong Intellect/Open experience tendency, it can be recommended to provide 'button, zoom slider' design type in terms of satisfaction and ease of use, and 'information recommendation around route' and 'three landmarks' design types in terms of satisfaction, usefulness and ease of use. It can be interpreted that intellectually curious and open-minded users prefer to use design types with features related to various tasks, such as using buttons or zoom slider, and search for additional information around route or multiple landmarks. By the way, there were no significant results for Agreeableness, which can be interpreted that the tendency to easily accept new designs is not related to the type of design. In sum, from this exploratory study, we can show that it is possible to recommend suitable mobile indoor map UI for the user according to the user's personality traits, but there are practical issues with how easy it is to identify a user's

personality traits and how to easily provide a suitable UI type for the user based on the user's personality traits. Therefore, further studies are needed to solve the above practical problems.

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