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INFLUENCE OF DEPENDENCE OF SMARTPHONE USERS ON DECISION-MAKING FOCUSING ON THE MODERATING EFFECT OF AGE

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Abstract. *The purpose of this study is to explore how the dependence of users using smartphones affects decision making, and to find out how much moderating effect age has on it. The independent variable in this study was use/dependence, decision making as the dependent variable, and age added as a moderating variable. In this study, data for each age group was collected and analyzed through a questionnaire with nonlinear analysis conducted using Warp PLS software. The results showed that the dependence of smartphone users was higher with age, and it was found that it was more likely to be used in decision making. The analysis has resulted in completely different results from the existing linear analysis methods and suggests that the use and dependence of the elderly will increase in future smartphone development and use. Therefore, results of various studies in the future related to smartphone devices and users' accessibility can develop this further.*
Keywords: Smartphones, Use, Dependence, Decision making, Nonlinear analysis

1. **Introduction.** With over six billion people having smartphones globally, phone users are as diverse as the world itself and span in age from the very young to the very old. Smartphones themselves seemingly occupy a large portion of people's lives too with the majority of smartphone users spending up to five hours a day on them. People of all ages may use smartphones, but behavioral and life style decisions vary greatly among different age groups [1,2]. Due to the fact that different stages of life require different decision making, smartphone use and dependence need to be studied more within the context of age [3]. Previous studies have investigated smartphone use in infants as well as kindergarten aged and preschoolers [4,5], but they did not specifically use age as a moderating variable on decision making. Other studies have examined the relationship between smartphone use and age [6-8]. However, the influence on decision making was not the focus. Studies which could apply to decision making tend to focus on the relationship between age and problematic smartphone use and the fear of being separated from smartphones – nomophobia [9-11]. The importance of the studies cannot be overlooked, but they emphasize the negative aspects of smartphone use. There are also studies that emphasize the benefits of smartphone use on decisions related to health and tourism [12,13], but they too have a limited focus. The volume of studies with a generalized interest on the relationship between smartphone use, age, and decision making appears limited. This study helps bridge that gap in the current knowledge on the topic with surprising results. After describing the variables that were used in this study, nonlinear analysis was conducted on questionnaire data using Warp PLS to examine the effect of age as a moderator of smartphone

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use/dependence and decision making. The analysis results are presented and visualized below with conclusions and suggestions for further research following. Smartphones are an undeniable part of humanity, and a more thorough understanding of the influence of their use on decision making, examined through the lens of various age groups, is necessary to maximize potential benefits and mitigate potential problems that arise from them.

2. Literature Review.

2.1. **Smartphones and decision making.** Smartphone use can influence decisions in numerous ways, both positive and negative, and even lead to dependence. Specific smartphone apps can aid in intrinsic motivation development and lead to decisions that better mental and physical health in individuals [14,15]. In the context of tourism, smartphones have made the decision making process more ambiguous and free-flowing. Tourists are able to reevaluate plans and make new decisions via on-hand access to information that their smartphones give them [12]. However, one cannot only focus on the positives. The negative influence of smartphone use on decision making needs to be examined too. A study of soccer athletes shows that as little as thirty minutes of smartphone app usage impaired performance related to decision making [13]. Heavy smartphone use has also been associated with problematic decision making not dissimilar to people who suffer from substance addictions and gambling [16,17]. This problematic decision making favors choices that might benefit the individual in the short-term but could end up being disadvantageous in the future [18]. Short-term decision making also has a relationship with self-control, and adults tend to have better self-control than children [16], thus illustrating the need to further investigate the effect of age as a moderator between smartphone use and decision making.

2.2. **Use and dependence.** Research has also uncovered a trend between age and smartphone dependence [19]. Although not focused on decision making, these studies have shown a negative correlation between age and smartphone dependence. Teenagers were found to be the most vulnerable age group for problematic smartphone use [20]. This could possibly be due to them being born in the age of mobile technology and social networking services. Earlier studies on mobile phone use, before the advent of smartphones, show younger people are more at risk for dependence than older ages [21,22]. Mobile dependence puts people at increased risk for anxiety when without their phones, too [23]. Despite the youth being more at risk for dependence, parents with smart phone addiction may have a negative effect on their children's well-being. One study found that smartphone dependence in parents positively correlated with the smartphone dependence of their children [24].

Examples such as those above illustrate the importance for the further study of age as a moderator between smartphone use and decision making.

2.3. **Smartphone users by age.** The younger generation has grown up in a world dominated by mobile technology while older age groups inevitably had to adopt and adapt to it throughout their life. It makes sense, based on daily life alone, that the effect of smartphone use on decision making would vary between age groups. Younger people tend to spend longer periods of during single-session smartphone use [19]. This relates to environmental psychology studies that suggest behaviors are influenced by an individual's interdependence on various aspects of their environment [25]. Smartphones are an integral part of the environment in that sense. Social networks for young people depend on smartphone technology with countless apps that provide and integrate spaces for entertainment and social interactions. Younger smartphone users make more decisions related to that in their daily lives. While older people indeed take advantage of the connectivity of mobile social networks, their decision to use smartphones correlates more

with information gathering and traditional phone use [6]. This is due to people of different ages having different needs and life styles. Therefore, this study aims to find out how much age adjustment affects smartphone users when making decisions and to explore whether there is an information gap between the younger generation and the elderly when using smartphones as mentioned in previous studies.

3. **Data Analysis.** Based on the theoretical background, this study aims to analyze the relationship between the dependence of smartphone users on decision-making. The research model is shown in Figure 1.

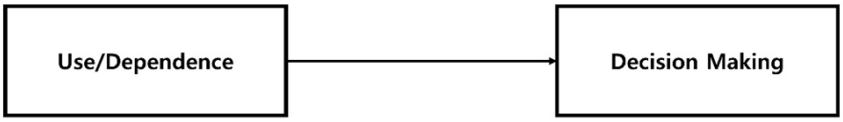

FIGURE 1. Research model

The hypotheses created based on the theoretical background to verify the hypothesis for the research model in Figure 1 are as follows.
H1. The use and dependence of smartphone users will affect decision making.
H2. Age will control the relationship between smartphone users' dependence and decision making.

In this study, a total of 500 questionnaires were collected for smartphone users, and the demographic characteristics thereof are shown in Table 1. Both male and female respondents were collected at the same rate, and data was collected by setting the same distribution for each age.

TABLE 1. Demographic analysis

Var	Division	Frequency	Ratio (%)
Gender	Male	250	50%
	Female	250	50%
Age	20∼29 years old	100	20%
	30∼39 years old	100	20%
	40∼49 years old	100	20%
	50∼59 years old	100	20%
	Over 60 years of age	100	20%
Period of use	Not more than a year	11	2.2%
	1 to 3 years	53	10.6%
	3 to 5 years	32	6.4%
	5 to 7 years	47	9.5%
	more than 7 years	357	71.3%
Education	Middle school	3	0.6%
	High school	91	18.2%
	College school	315	63.0%
	Graduation	38	7.6%
	Above graduate school	53	10.6%

In this study, Warp PLS7.0 was used for nonlinear analysis, and in Figure 2, in Warp PLS, the structural model analysis determines that the suitability of the research model is high if the coefficient of determination (R^2) value is 0.25 or more. In this study, it was found that the dependent variable, decision making, was $R^2 = 0.34$, so the suitability was high. In addition, it is considered significant only when the value of P-value based on the

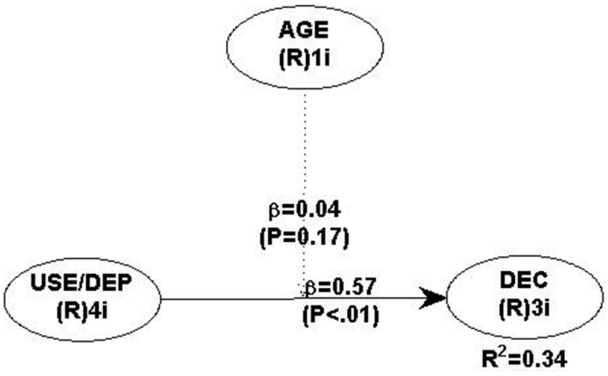

FIGURE 2. Analysis result

suitability of the research model is less than 0.1, and as shown in Figure 2, it can be seen that all paths in this study meet the criteria [26].

In Table 2, as a result of the verification of the research hypothesis, it can be seen that the path has a significant effect by satisfying the P-value of 0.01. This means that the higher the dependence of smartphone users, the more likely they are to use it in decision-making.

TABLE 2. Summarization of path hypotheses test

Hypotheses	**Coefficients**	**Effect size**	***P*-values**	**Results**
Use/dependence → decision making	0.571	0.333	0.001***	Accept

***$P < 0.01$

Therefore, as shown in Table 3, it was confirmed that all paths were in a non-linear form.

TABLE 3. Linear or non-linear (Warp) relationship of paths

Latent variables	**Use/dependence**
Decision making	Warped

In addition, in Table 4, a moderating effect analysis was conducted to examine the statistical significance of whether the dependence of smartphone users was affected by age. As a result of the moderating effect analysis, the significance level $p > 0.001$ was significant for decision making, and the use/dependence variable showed statistical significance at a significance level of about 10%.

TABLE 4. Moderating effects by gender variable

Latent variables	**AGE*use/dependence**
Decision making	0.165 (0.001)***

***$P > 0.01$

As shown in Figures 3 and 4, it was confirmed that smartphone users in the older group were more dependent on decision making in the smartphone use/dependence and decision making path. It can be said that the relatively elderly use the information, knowledge, and functions on their smartphones to make decisions, showing a more dependent tendency. This means that young smartphone users use smartphones when making decisions but do not show high dependence. If environmental conditions such as social experience and education level are higher, the more they use phones for decision making. On the other hand, older people will become more familiar with smartphone functions.

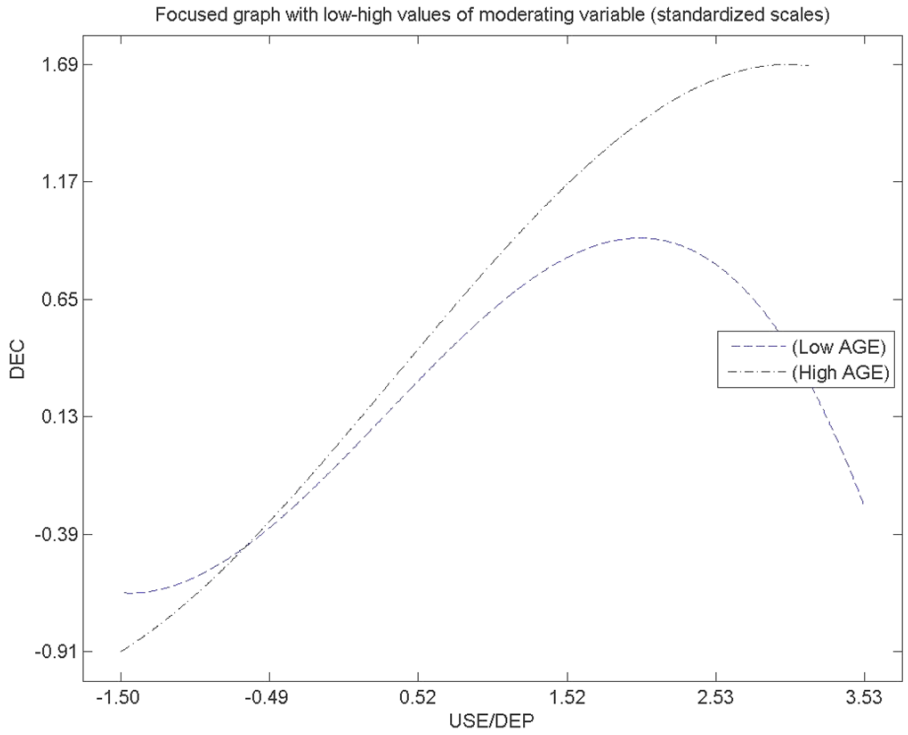

FIGURE 3. Non-linear relationship between smartphone use and dependence and decision-making path according to age-adjusting

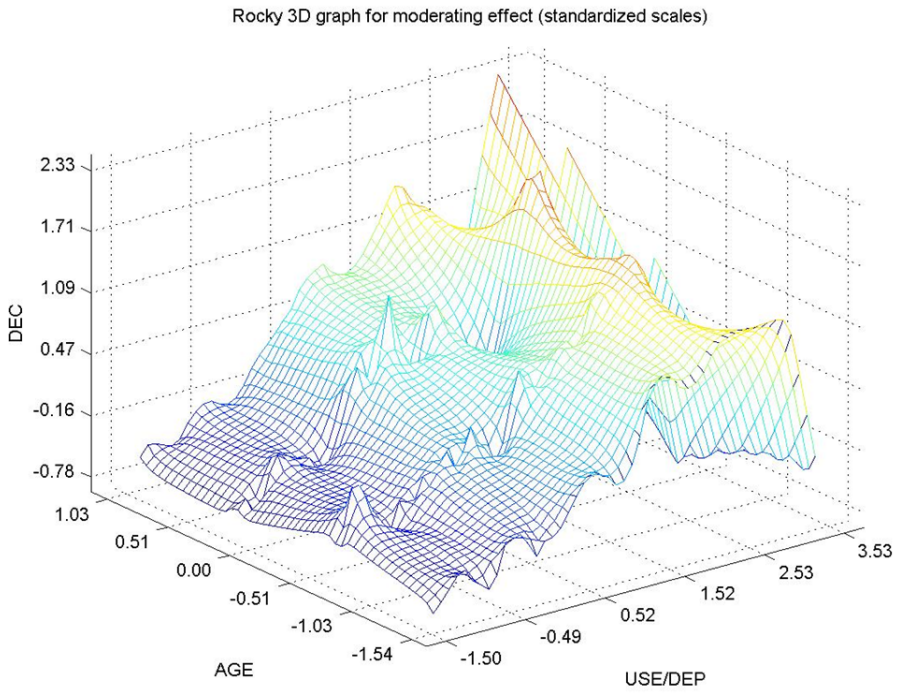

FIGURE 4. (color online) Moderating effect 3D graph

4. **Conclusions.** In the preceding studies mentioned in the text, there were various opinions on the dependence and decision-making of smartphone users. Contrary to the recognition that the dependence of the younger generation on smartphones is high, nonlinear analysis showed that the older people in this study felt more dependent on smartphones. This statistical significance showed that the elderly are highly dependent on smartphones when analyzed nonlinearly in a different way from the existing analysis method – which

had only used linear analysis. It also suggests that older people are increasingly dependent on smartphones, as diverse information and smartphones have become more common.

Therefore, this study is differentiated in that it provides a new perspective from an academic and management perspective related to smartphone addiction and the digital gap related to general smartphone dependence.

Based on the research results of this study, when developing smartphone devices in the future, it is necessary to continuously develop them with age-specific differences so that older generations and the elderly can use functions more conveniently with various interfaces and information being provided appropriately.

In addition, this study discovered new statistical significance through nonlinear analysis of dependence and decision-making via smartphone use. However, since it focused on use/dependence for each age group, it is necessary to further expand research topics for future generalization.

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