석사학위논문

Capturing the Effects of Network Size and Social Distance on Choice Probabilities in Social Network

소셜 네트워크에서 네트워크 사이즈와 사회적 거리가 선택에 미치는 영향에 대한 연구

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Abstract

It is widely known that consumer choice behavior is largely affected by other consumers, especially in products/services with network effects. This study focuses on capturing the effects of network size and social distance of other consumers on choice probabilities in social network. Motivation of choice and knowledge level of consumer are considered as moderating variables. Multinomial logit model was utilized to analyze choice-based conjoint data.

The result shows that as the size of network grows, the probability of choice of agents in the social network increases. Also, the effect of network size decreases as the social distance increases. Utilitarian-oriented consumers are more susceptible to the network size of Korean population and hedonic-oriented consumers are more susceptible to the network size of friends & family.

The contributions of this study are as follows: First, it introduced network variables that try to explain one of the most significant determinants when consumer make choices on products/services with network externalities. This study measures the effects of network structure, both network size and social distance, on choice decision. In addition, some new determinants that may influence on social choice decision were considered. Many sociodemographic factors have been considered in social network analyses but constructs such as usage motivation and knowledge level have rarely been used in choice model.

Keywords **:** social influence; network effect; social distance; product usage motivation; discrete choice model; conjoint analysis;

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1. Introduction

It is widely known that consumer choice behavior is largely affected by other consumers. This so-called choice interdependence is much more prominent in some product and/or service industries since consumer utility increases as the number of consumer in the same network increases. The phenomenon is referred to as ‘network effect’ or ‘network externality’. Mobile instant messenger services such as WeChat, WhatsApp, and Line are good examples. Ever since the advent of smartphones and applications, the number of mobile instant messenger (hereafter ‘MIM’) users have been exploding due to their conveniences to fulfill people’s needs for connections. Even though the physical distances between people may remain unchanged, technological improvements of communications have destructed physical barriers between people and are making active social interactions in the network possible.

In accordance with the technological and social change, many sociologists, economists, and marketers have tried to explain the mechanism behind this social interactions. Especially, from marketing perspective, understanding the social network and social interactions has become one of the most important part of marketing strategy. When a consumer makes purchase decision, other members connected to the consumer in a network play important role directly or indirectly although the extent of influence may vary. In this sense, optimization of marketing resources allocations is essential. Marketers of the firm want to identify potential customers and to predict choice probabilities of these customers.

There have been many researches attempting to identify and measure the effect of social interactions in marketing literatures (e.g. Bell and Song 2007; Manchanda, Xie, and Youn 2008, Nair, Manchanda, and Bhatia 2010; Iyengar, Van den Bulte, and Valente 2011; Narayan, Rao, and Saunders 2011; Wang,

Aribarg, and Atchadé 2013; Ma, Krishnan, and Montgomery 2015, etc). However, the number of papers focusing on systematically finding the relevant variables influencing choice probabilities within social network is relatively small (e.g. Tucker 2008; Katona, Zubcsek, and Sarvary 2011) and these papers often leave out important constructs that may play significant roles on individuals' choice decisions.

MIM is considered one of the most typical and widely known example in which network effect exists. In this case, overall network size matters to consumers because they benefit from larger number of other users who are connected in the same network. However, there is no reason to believe that all the members of the network influence others to the same extent. Rather, according to Park (1924), the effect of social influence differ depending on the level of social distance to the individual. Social distance is a term originated from a sociologist Georg Simmel. The term refers to a concept of distancing processes with the generative factors for the various societal forms. Intuitively put, social distance is the degree of closeness or acceptance that an individual or group feels towards another individual or group in a social network (Boguñá et al. 2004). In the sense, an MIM consumer is most likely to choose the messenger used by the highest percentage of closest friends.

In addition to network structures, characteristics of individual also affect consumer choice decisions. A plethora of consumer research papers asserted the importance of sociodemographic variables such as gender, age, income, occupation, and social status in choice decision in social network context (Wattal, Racherla, and Mandviwalla 2010; DiMaggio and Garip 2011; Lin 1999; Katona, Zubcsek, and Sarvary 2011). Beside sociodemographic variables, however, psychological factors may also influence social choice decisions. Therefore, usage motivation and knowledge level of consumers are added to potential determinants of choice.

The main objective of this study is to measure the effect of network

variables and characteristics of individuals on social choice and ultimately infer the response function of choice probability empirically depending on these variables.

The contributions of this study are as follows: First, this study measures the effects of network structure, both network size and social distance, on choice decision. To my knowledge, empirical study deriving the choice probability response function according to network size and social distance has never been published. In addition, I consider some new determinants that may influence on social choice decision. Many sociodemographic factors have been considered in social network analyses but constructs such as usage motivation and knowledge level have rarely been used in choice model. Based on the findings of this paper, marketers can actually predict the choice probability of a member in social network.

The remainder of this paper is structured as follows: In section 2, I introduce some relevant literatures on consumer choice decisions in social network. Many researches of related disciplines, such as economics, sociology, and social psychology will be covered as well. Section 3 discusses data collection procedure and measurement issue of some constructs. Section 4 and section 5 deal with model and estimation of the conjoint data respectively. Finally, section 6 concludes the paper and discusses expected future researches.

2. Literature Review

To enrich the discussion, I count on multidisciplinary literatures such as economics, sociology, social psychology, and marketing. Those disciplines all throw different questions of their respective interests with their own perspectives regarding social interaction issue nowadays but the mechanism behind the social network is the one that still bothers scholars working on this issue. Hartmann et al. (2008) pointed out that there exist immense economies-of-scope in bridging these disciplines and bringing these differing approaches to bear on solving common problems of interest.

There are uncountable studies dealing with choice decision in social network throughout many disciplines. However, researches focusing on systematically finding relevant variables affecting consumers in interdependent choice situation particularly when there exists network effect are relatively limited to a small amount.

Generally, in classical economic theory, consumer utility has been a function of price and product attributes. However, it is quite assuring that the choice made by other consumers are an important factor that affect consumer's utility. After the seminal paper of Katz and Shapiro (1985), which deals with network effect and its sources, network effect and social influence on choice have become significant areas of study in many disciplines including economics, sociology, social psychology, and marketing. From marketing perspective, there have been some attempts to identify and measure the effect of social interactions on consumers' choice decisions (e.g. Bell and Song 2007; Nair, Manchanda, and Bhatia 2010; Narayan, Rao, and Saunders 2011; Wang, Aribarg, and Atchadé 2013; Ma, Krishnan, and Montgomery 2015, etc).

There have been a few struggles to formulate network variables and characteristics of individuals that influence consumer choice behavior in

social network. Katona, Zubcsek, and Sarvary (2011) describe three factors affecting adopter's adoption decision in social network. They classified the social influence into network effects, influencer effects, and adopter effects. In choice of network variables, they relied on sociology literature. 'Degree effect' is the number of connections an individual has. The density of connections in a group of already adopted users is called 'clustering effect'. Although they suggest influencer effects and adopter effects influencing the adoption probability of potential consumers, the limitation of this research is that the analysis was only focused on demographic variables, not considering other individual characteristics which may have larger effects on consumer choice.

Tucker (2008) attempted to find the user's characteristics affecting the intensity of network externality. She divided the video-messaging communication into two cases - interactions with those who are higher up in a formal social structure and interactions with those who occupy key positions in the informal communications structure. She confirmed that adopters who are high up in the formal hierarchy or adopters in central position of communication network have bigger network externality than others.

Meanwhile, many sociology and social psychology literatures have been dealing with social distance. Social distance is a term originated from a sociologist Georg Simmel. The term refers to a concept of distancing processes with the generative factors for the various societal forms. Bogardus (1925) emphasizes subjective social distance and refers to the social approval or prestige of various social groups, as measured by the perceived level of intimacy (neighborhood, friendship, marriage and so on) that respondents would find acceptable with individuals from different national, ethnic and religious groups.

My assumption is that socially distant people are less likely to affect a member in social network and there have been some researches reinforcing

my reasonable assumption. According to Park (1924), the effect of social influence differs depending on the level of social distance to the individual. Borjas (1992) assumes that persons interact with members of their own ethnic group. Studies on the structure of social groups show a tendency of individuals to interact with other individuals with similar characteristics (Marsden, 1982, 1990). To my knowledge, there is no marketing literature that accounts for social distance as a determinant of consumer choice in social network.

As some literatures have shown, characteristics of individuals or consumers play a role in choice situation in social network. However, most of the researches focused on sociodemographic variables such as age, sex, social status, income, etc (Wattal, Racherla, and Mandviwalla 2010; DiMaggio and Garip 2011; Lin 1999; Katona, Zubcsek, and Sarvary 2011). Other researches pay attention to the specific characteristics of adopters – mere adopters and adopters who also act as influencers – and focus on new product diffusions at aggregate level (Van den Bulte and Joshi 2007; Iyengar, Van den Bulte, and Valente 2011).

Some psychology literatures suggest that knowledge level, highly correlated with the self-esteem, plays a role not only in consumer decision making (Park and Lessig 1981) but also in consumer's influencibility when uncertainty is involved. Rhodes and Wood (1992) found that recipients of moderate self-esteem proved to be more influenceable than those of low or high esteem. Alba and Hutchinson (1987) asserted that there are two dimensions for knowledge, familiarity and expertise. Familiarity is the number of product related experiences that have been accumulated by the consumer and expertise is the ability to perform product-related tasks successfully. Although Manchanda, Xie, and Youn (2008) showed that specialists need to rely less on contagion, I attempt to measure the knowledge level with continuous variables and to confirm the moderator effects.

Other literatures show that usage motivations – hedonic or utilitarian – are of great importance to describe consumer behaviors (Babin, Darden, and Griffin (1994)). A number of literatures in information system deal with consumers' technology adoption and consumer use of IT in general taking the usage motivation as important factors as well (Kim, Chan, and Gupta 2007; Venkatesh, Thong, and Xu 2012). According to Batra and Ahtola (1990), hedonic dimension of consumption measures the experiential affect associated with the object, i.e. how pleasant those associated feelings are, and utilitarian dimension of consumption measures the instrumentality, i.e. how useful or beneficial the object is. It has been confirmed by many psychology literatures that the usage motivation influence on choice situations and I test whether the effect of this variable is significant.

3. Data Collections

3.1. Experimental Design

Considering the rapidly changing MIM service market, it is impossible to obtain the actual market data. Therefore, by combining questionnaires that measure the individual characteristics and conjoint choice experiment, I collect suitable data for analysis. The survey design is divided into two parts. The first part is questionnaires measuring individuals' characteristics and the second part is conjoint choice experiment.

The subject of the experiment is asked to evaluate his/her usage motivation of MIM. Since utilitarian usage and hedonic usage are not necessarily correlated (Batra and Ahtola 1990), I add two questions for calibrating each usage motivation. In addition, knowledge level of consumers are assessed. There have been a great deal of discussions with regard to the dimensions and measurements of knowledge, I skip those discussions because they are beyond the scope of my research. Therefore, I select subjective knowledge and usage experience as the target constructs to measure for the ease of measurement and without loss of generality.

This paper has distinguishing characteristics in data collection compared with other papers in that I used penetration rate as one of attributes constructing a product to operationalize the network size, representing the percentage of already-adopted consumers. Even though Katona, Zubcsek, and Sarvary (2011) used penetration rate as a proxy for network size before, the usage in conjoint experiment has not been accomplished in marketing literature to my knowledge. Starting from 'less than 1%', '10%', and ending with '90%', 'over 99%', I used 10% intervals to penetration rate, which in turn makes 11 levels of penetration rate attribute. In addition, to analyze the effect of penetration rate depending on social distance, I divide the penetration rate attribute into three – Friends & family, Korean population

(Subjects are all Koreans), and the world population. Friends & family represents the least socially distant group and world population represents the most socially distant group. Most importantly, friends & family is directly connected group in social network. 5 additional attributes were selected based on in-depth interviews on some of heavy MIM users. They were asked to select 3 most significant attributes when choosing MIM. The selected attributes involve item store, PC version, group-chat, file transmission, and security level. To operationalize the security level, 3 levels are defined. Strong level of security is defined as the status where all the messages of users are encrypted and unidentified by service provider. Moderate level of security is defined as the status where all the messages are encrypted but service provider may identify users' messages. Weak level of security is defined as the status where messages of users are not encrypted. Detail attributes and corresponding levels are shown in Table 1.

Table 1 Conjoint Design

Attribute		**Level**
Penetration Rate	Friends & family (z_1)	0%-100% (10% interval)
	Korea (z_2)	0%-100% (10% interval)
	World (z_3)	0%-100% (10% interval)
Item store (x_1)		Yes/No
PC version (x_2)		Yes/No
Group-chat (x_3)		Yes/No
File transmission (x_4)		Yes/No
Security (x_{51}, x_{52})		Strong/Moderate/Weak

To construct the efficient choice-based conjoint design, a blocked design involving 10 sets of a number of quadruples was created using an optimal

design generated by Design Expert 9. There are various criteria that evaluate the validities of optimal conjoint designs. Since D-optimality is most widely used in marketing literatures, this paper used the criterion. As a result, the design was aimed at maximizing D-optimality, which is:

$$\text{D-optimality} = \frac{1}{|(X'X)^{-1}|}$$

where X is a design matrix.

Participants were expected to be randomly assigned to one of the 10 sets and complete choice tasks. Each choice task have 4 alternatives including 'no-choice' option. Each subject of the experiment accomplished 25 choice tasks. The last 5 choice observations were used for out-of-sample validations so that the number of training data set is 20 for each subject.

3.2. Data Descriptions

The number of subjects of the choice experiment is 200. Exactly half of the subjects are men and women respectively. Since one of the research focus is to find the moderating effect of usage motivation – utilitarian and hedonic – of MIM on choice, the subjects of the experiments are restricted to workers in their twenties who currently uses any kind of MIM. Samples were collected from one of the biggest market research company in Korea. Since each of the subject answers to 25 choice tasks and each choice task consists of 4 choice alternatives, there are 20,000 observations in total. About 35.9% of the responses for choice tasks were 'no-choice' options.

Majority of MIM users take advantage of more than one messenger at once. 199 subjects out of 200 uses KakaoTalk, the most popular MIM in Korea. The number of users of world-renowned MIM such as WeChat and WhatsApp is ignorable. Table 2 shows the details of MIM adoptions in Korea.

Table 2 Number of Popular MIM Users (N=200)

MIM brand	KakaoTalk	Line	NateOn	Facebook Messenger	Telegram	Between
Number of Users	199	81	90	92	20	47

Variables for individual characteristics show relatively low correlation. As Batra and Ahtola (1990) argued, utilitarian usage and hedonic usage are not necessarily correlated. As in Table 3, the correlation coefficient of utilitarian usage and hedonic usage of MIM is merely 0.190134. The correlation coefficient of familiarity and utilitarian usage is 0.457627, and that of familiarity and hedonic usage is 0.348788.

Table 3 Correlation Matrix of Individual Characteristics Variables

	Utilitarian usage	Hedonic usage	Familiarity
Utilitarian usage	1		
Hedonic usage	0.190134	1	
Familiarity	0.457627	0.348788	1

4. Model Specification

4.1. Conjoint Multinomial Logit Model

Multinomial Logit (MNL) has been largely used in marketing literatures to analyze conjoint choice experiment data due to its simplicity and light computational burden.

Let $y_{it} = j$ denotes the event that subject *i* (*i* = 1, ..., *I*) chooses alternative *j* (*j* = 1, ..., *J*) on choice task *t* (*t* = 1, ..., T_i). Let z_{ijt} denotes penetration rates, x_{ijt} denotes subject *i*'s explanatory variables other than penetration rates for alternative *j* on choice task *t*. Table 1 describes the variables in details. In addition, u_i denotes the intensity of utilitarian usage, h_i denotes the intensity of hedonic usage, and f_i denotes the familiarity of subjects towards MIM. Log formation is assumed for the effects of penetration rates and interaction terms are added to capture the moderating effects of individual characteristics. $\Theta = (\beta_1, \beta_2, \beta_3, \gamma_1, \cdots, \gamma_{51}, \gamma_{52}, \delta_1, \cdots, \delta_9)$ is a parameter set to be estimated. Then, the utility of subject *i* for choosing alternative *j* on choice task *t* can be represented as follows:

$$\begin{aligned}\omega_{ijt} = \zeta &+ \beta_1 \ln z_{1ijt} + \beta_2 \ln z_{2ijt} + \beta_3 \ln z_{3ijt} + \gamma_1 x_{1ijt} + \gamma_2 x_{2ijt} \\ &+ \gamma_3 x_{3ijt} + \gamma_4 x_{4ijt} + \gamma_{51} x_{51ijt} + \gamma_{52} x_{52ijt} + \delta_1 u_i \ln z_{1ijt} \\ &+ \delta_2 u_i \ln z_{2ijt} + \delta_3 u_i \ln z_{3ijt} + \delta_4 h_i \ln z_{1ijt} + \delta_5 h_i \ln z_{2ijt} \\ &+ \delta_6 h_i \ln z_{3ijt} + \delta_7 f_i \ln z_{1ijt} + \delta_8 f_i \ln z_{2ijt} + \delta_9 f_i \ln z_{3ijt} \\ &+ \varepsilon_{ijt}\end{aligned}$$

In vector notation,

$$\omega_{ijt} = \boldsymbol{\psi}'_{\boldsymbol{ijt}}\boldsymbol{\Gamma} + \boldsymbol{\lambda}'_{\boldsymbol{i}}\boldsymbol{\Lambda} + \varepsilon_{ijt} = V_{ijt} + \varepsilon_{ijt}$$

where ω_{ijt} denotes latent utilities, $\boldsymbol{\psi}_{\boldsymbol{ijt}}$ denotes attributes of choices, $\boldsymbol{\lambda}_{\boldsymbol{i}}$ denotes the characteristics of individuals and ε_{ijt} denotes error term that follows

Table 4 Description of Coefficients

Coefficient	Description
ζ	Constant
β_1	The effect of network size of friends & family on choice
β_2	The effect of network size of Korean population on choice
β_3	The effect of network size of world population on choice
γ_1	The effect of item store of MIM on choice
γ_2	The effect of PC version of MIM on choice
γ_3	The effect of group-chat of MIM on choice
γ_4	The effect of file transmission of MIM on choice
γ_{51}	The effect of moderate level of security of MIM on choice
γ_{52}	The effect of strong level of security of MIM on choice
δ_1	The interaction effect of individual intensity of utilitarian usage and the network size of friends & family
δ_2	The interaction effect of individual intensity of utilitarian usage and the network size of Korean population
δ_3	The interaction effect of individual intensity of utilitarian usage and the network size of world population
δ_4	The interaction effect of individual intensity of hedonic usage and the network size of friends & family
δ_5	The interaction effect of individual intensity of hedonic usage and the network size of Korean population
δ_6	The interaction effect of individual intensity of hedonic usage and the network size of world population

δ_7	The interaction effect of individual familiarity towards MIM and the network size of friends & family
δ_8	The interaction effect of individual familiarity towards MIM and the network size of Korean population
δ_9	The interaction effect of individual familiarity towards MIM and the network size of world population

Gumbel distribution. $\boldsymbol{\Gamma}$ and $\boldsymbol{\Lambda}$ are part-worth vectors of aggregate level. Then, the probability of subject *i* chooses alternative *j* in choice task *t* can be represented as following:

$$\begin{aligned} Pr(y_{it} = j|\boldsymbol{\Gamma}, \boldsymbol{\Lambda}) &= Pr\{argmax(\omega_{i1}, \omega_{i2}, \cdots, \omega_{iJ}) = j|\boldsymbol{\Gamma}, \boldsymbol{\Lambda}\} \\ &= Pr(V_{ij} + \varepsilon_{ij} > V_{ik} + \varepsilon_{ik}, \forall j \neq k) \\ = \int I(V_{ij} - V_{ik} > \xi_i, \forall j \neq k) f(\xi_i) d\xi_i &= \frac{exp(V_{ij})}{\sum_{k=1}^{J} exp(V_{ik})} \\ = \frac{exp(\boldsymbol{\psi}'_{ijt}\boldsymbol{\Gamma} + \boldsymbol{\lambda}'_i\boldsymbol{\Lambda})}{\sum_{k=1}^{J} exp(\boldsymbol{\psi}'_{ikt}\boldsymbol{\Gamma} + \boldsymbol{\lambda}'_i\boldsymbol{\Lambda})}, k &= 1,2, \cdots j \cdots, J \end{aligned}$$

4.2. Identification

I hereafter apply the MNL model to conjoint data set collected. To deal with the identification problem, I set the utility of no-choice option *J* to 0. That is, $\omega_{iJt} \equiv 0$. Therefore, the utility function can be rewritten as following:

$$\begin{cases} \omega_{ijt} = \zeta_i + \boldsymbol{x}'_{ijt}\boldsymbol{\Gamma}_i + \varepsilon_{ijt}, \ \ j = 1, \cdots, J-1 \\ \omega_{iJt} \equiv 0 \end{cases}$$

An intercept, ζ_i, captures individual-level intrinsic utility. Adding 3 penetration rates, dummy variables for each level of product attributes, variables representing individual characteristics, and their interaction terms, $\boldsymbol{x}'_{ijt}$ is 21-dimensional vector. There are 3 attributes that have 11 levels, 4 attributes that have 2 levels, one attribute that has 3 levels, 2 variables (utilitarian and hedonic) capturing the usage motivations, and a variable capturing knowledge level of consumers. All the attributes are modelled with effect-type coding.

5. Empirical Analysis

5.1. Estimation Results

It is known that there are many ways to estimate the parameters of Multinomial Logit Model. Among them, the simplest and the mostly widely accepted way is Maximum Likelihood Estimation (MLE). In this paper, individual-level parameters do not have to be estimated. As a result, MLE was conducted to estimate the parameters. The log-likelihood can be represented as follows:

$$\ln L = \sum_i \sum_j \sum_t y_{ijt} \ln \frac{exp(\boldsymbol{\psi}'_{ijt}\boldsymbol{\Gamma} + \boldsymbol{\lambda}'_i\boldsymbol{\Lambda})}{\sum_{k=1}^{J} exp(\boldsymbol{\psi}'_{ikt}\boldsymbol{\Gamma} + \boldsymbol{\lambda}'_i\boldsymbol{\Lambda})}$$

In choice-based conjoint analysis, since there are choice tasks available for every individual, there is a notation for time *t*. y_{ijt}=1 if alternative *j* is chosen by subject *i* in choice task *t* and 0 otherwise.

Main Effects

Estimation results (Table 5) show that there are a number of significant main effects. Firstly, network variables are all significant. Parameter of network size of friends & family is 1.298036 ($p<0.01$). Since the sign of parameter is positive, choice probability of MIM increases as the penetration rate of friends & family increases. Effects of penetration rates of Korean population and world population are also significant but the effects diminishes as expected as the social distance increases. As Figure 1 shows, part-worths for network size of friends & family is overwhelming compared to network sizes of Korean population and world population. The effect of directly connected network is substantially noticeable and social distance does not show much of a difference in terms of network effects. In further research, social distance of these three groups of network can be measured numerically using Bogardus social distance scale (Bogardus 1947) as well.

Secondly, MIM characteristics such as item store, PC version, group-chat, file transmission, and strong level of security show significant effects on choices. On the other hand, moderate level of security do not influence choice

probability significantly. As Figure 2 represents, strong level of security is the most important MIM attribute (γ_{52} =0.37491, *p<0.01*) when choosing MIM. The functions of group-chat (γ_3 = 0.27157, *p<0.01*), PC version (γ_2 =0.20068, *p<0.01*), and file transmission (γ_4 =0.18467, *p<0.01*) are also influential.

Table 5 Estimation Results of Parameters

	Estimate	*SE(coef)*	*z*	*Pr(>|z|)*	*Significance*
ζ	-3.50640	0.15577	-22.511	< 2e-16	***
β_1	1.298036	0.330679	3.925	8.66e-05	***
β_2	0.644372	0.298005	2.162	0.03060	**
β_3	0.500340	0.274046	1.826	0.06789	*
γ_1	0.05986	0.02373	2.523	0.01164	**
γ_2	0.20068	0.02410	8.328	< 2e-16	***
γ_3	0.27157	0.02447	11.100	< 2e-16	***
γ_4	0.18467	0.02444	7.555	4.20e-14	***
γ_{51}	0.01580	0.03251	0.486	0.62699	
γ_{52}	0.37491	0.03299	11.365	< 2e-16	***
δ_1	-0.069751	0.035795	-1.949	0.05134	*
δ_2	0.082180	0.032310	2.543	0.01098	**
δ_3	0.054647	0.028910	1.890	0.05872	*
δ_4	0.098782	0.052401	1.885	0.05941	*
δ_5	-0.098936	0.048330	-2.047	0.04065	**
δ_6	-0.140512	0.043256	-3.248	0.00116	***
δ_7	-0.045992	0.053414	-0.861	0.38921	
δ_8	-0.016381	0.049465	-0.331	0.74051	
δ_9	0.034578	0.043219	0.800	0.42367	
Signif. codes: 0 '***' 0.01 '**' 0.05 '*' 0.1					

Figure 1 Part-worths for Network Sizes

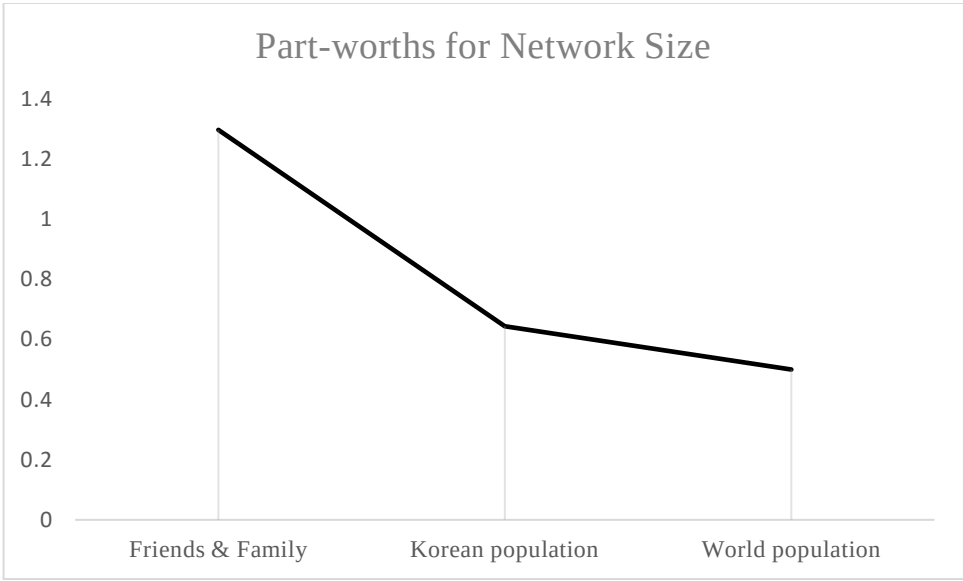
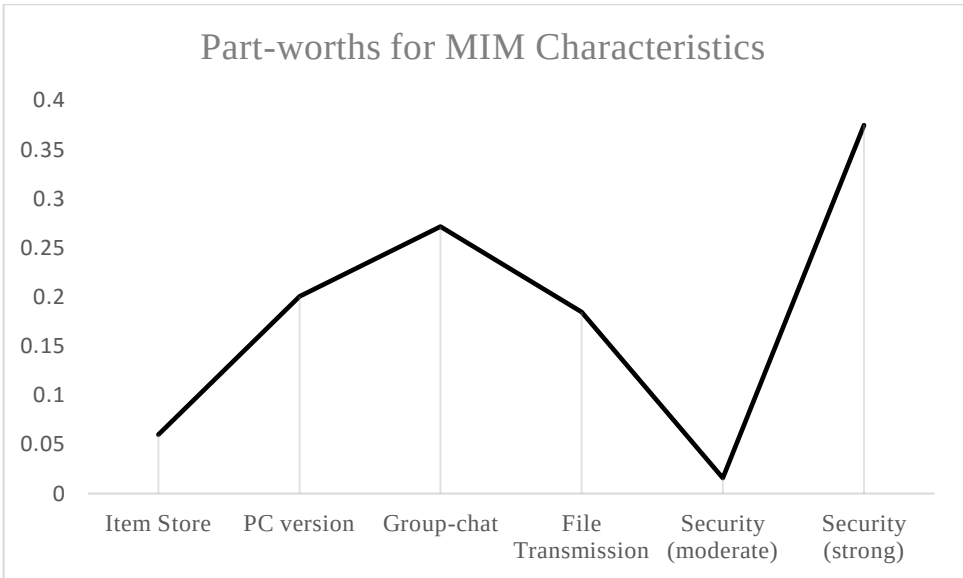


Figure 2 Part-worths for MIM Characteristics



Moderating Effects

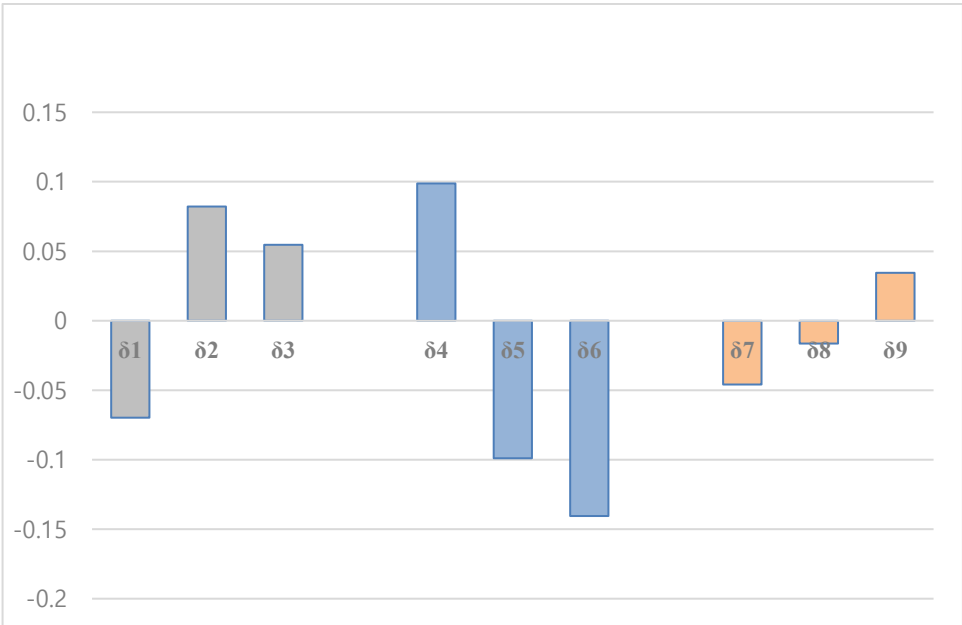
The moderating effects were captured as well. There are two things we have to pay attention to. First, the sign of δ_1 representing the interactions of utilitarian usage and network size of friends & family is negative. Thus, the effect of network size of friends & family decreases as consumer's intensity of utilitarian usage increases (δ_1 =-0.069751, *p<0.1*). On the other hand, the signs of δ_2 and δ_3 are positive, which means the effects of network sizes of indirectly connected agents increase as consumer's intensity of utilitarian usage increases ($\delta_2 = 0.082180$, *p<0.05;* $\delta_3 = 0.054647$, *p<0.1*). The interpretation of the moderating effect is intuitive. Consumers who use MIM for utilitarian usages are more likely to communicate with socially distant agents in social network. Agents who use MIM at work should easily access to the other unknown agents. The number shows exactly this phenomenon. Considering the barriers that can be derived from language differences, Korean population who are in the same network would be the most effective factor when choosing an MIM for utilitarian usage. Therefore, utilitarian-oriented users are susceptible to the network size of indirectly connected agents, especially the network size of Korean population.

The other is the interaction term of network size of friends & family and the intensity of hedonic motivation. The positive sign of δ_4 shows that consumers with high hedonic motivation towards MIM are more likely to be influenced by network size of friends & family (δ_4 =0.098782, *p<0.1*). The result is quite straightforward. Utilities that individuals who use social network for hedonic use obtain generally come from communications and interactions with their friends and family. The more friends and family there are in social network, the merrier the agent in social network will be. On the other hand, the effects of indirect network size decreases as the intensity of hedonic motivation increases (δ_5 =-0.098936, *p<0.05;* δ_6 =-0.140512, *p<0.01*). Furthermore, negative moderating effect is larger when the network is more socially distant. For further inspection of estimation results, refer to the subsequent graphs (Figure 3).

Interaction terms of network size and the level of familiarity were not as significant as other interaction terms. The expected signs were all negative

but the interaction term of the network size of world population and familiarity level towards MIM was positive although it was not significant. The backup explanation as to why the level of familiarity did not affect the susceptibility remains and is planned for the future research.

Figure 3 Interaction Effects



5.2. Validations

Hit Rate

The performance of models can be examined through various methods. Since the model proposed includes individual-specific variables – intensity of utilitarian usage, intensity of hedonic usage, familiarity towards the product – calculation of hit rate would be the most appropriate method. Thus, in this paper, correctly predicted choice referred to as hit rate was calculated. For

each individual, 5 choice observations out of 25 choice tasks were used to validate the model. 20 choice observations were used as training data sets. Since each choice task involves 4 choice alternatives including 'no-choice' option, random hit rate is 1/4=25%. There are a total of 1000 (= 5 choice tasks * 200 subjects) choice observations used for out-of-sample validation. Based on the estimation results and corresponding prediction data, 356 cases out of 1000 matched with the real choice results. That is, correctly predicted hit rate is 35.6%. All in all, the hit rate based on the proposed model drastically improved the prediction from 25% to 35.6%.

Model Comparison

In addition, three alternative models were compared in terms of diverse criteria - R^2, adjusted R^2, AIC, BIC, and log-likelihood. The first model (M_1) consists of product attributes-related variables only, the second model (M_2) consists of network size variables only, and the full model (M_F) is a model encompassing all the variables including interaction terms of individual characteristics and network sizes. As shown in Table 7, the full model (M_F) shows by far the most effective model in terms of model performances. The full model proposed, therefore, is superior in terms of validity.

Table 6 Model Comparisons

	Product attributes only (M_1)	Network variables only (M_2)	Full Model (M_F)
ζ	-0.66283 ***	-3.49163 ***	-3.50640 ***
β_1		1.28662 ***	1.298036 ***
β_2		0.62871 **	0.644372 **
β_3		0.60164 **	0.500340 *.
γ_1	0.04859 **		0.05986 **
γ_2	0.19834 ***		0.20068 ***
γ_3	0.28685 ***		0.27157 ***
γ_4	0.15217 ***		0.18467 ***
γ_{51}	0.02810		0.01580
γ_{52}	0.33731 ***		0.37491 ***
δ_1		-0.06379 *	-0.069751 *
δ_2		0.07670 **	0.082180 **
δ_3		0.05385 *	0.054647 *
δ_4		0.09583 *	0.098782 *
δ_5		-0.09041 *	-0.098936 **
δ_6		-0.14235 ***	-0.140512 ***
δ_7		-0.04838	-0.045992
δ_8		-0.01126	-0.016381
δ_9		0.03036	0.034578
Signif. codes: 0 '***' 0.01 '**' 0.05 '*' 0.1			
R^2	0.0593375	0.08494214	0.1230859
Adjusted R^2	0.05807492	0.08259735	0.1196589
AIC	10444.44	10172.52	9761.568
BIC	10488.49	10254.34	9881.155
Log-likelihood	-5215.218	-5073.261	-4861.784

6. Conclusion

According to the empirical results, a number of comments and managerial implications can be made.

In social network, where a huge number of people communicate and interact with each other, social influence plays a significant role when an agent in the network makes decisions. In particular, a product or a service in which positive network effect exists, social network and its attendant network variables are of absolute importance when a consumer make purchase-related decisions. As the size of network grows, the probability of choice of agents in the social network increases. Although the effects of network size decrease as the social distance of network increase, the effects of network never disappears in social network. Even the network size of world population affects the choices of consumers when the network effect exists.

The contributions of this study are as follows: First, it introduced network variables that try to explain one of the most significant determinants when consumer make choices on products/services with network externalities. This study measures the effects of network structure, both network size and social distance, on choice decision. To my knowledge, empirical study deriving the choice probability response function according to network size and social distance has never been published.

In addition, I consider some new determinants that may influence on social choice decision. Many sociodemographic factors have been considered in social network analyses but constructs such as usage motivation and knowledge level have rarely been used in choice model. Based on the findings of this paper, marketers can actually predict the choice probability of a member in social network.

The results from this paper suggest that marketing resources can be allocated for targeting of consumers. Based on the purpose of product usage,

consumers are classified into utilitarian-oriented and/or hedonic-oriented. They show different characteristics in terms of choice decision of products/services that have network externalities. In this paper, utilitarian-oriented consumers are more susceptible to the network size of Korean population and hedonic-oriented consumers are more susceptible to the network size of friends & family. Optimal configurations of product characteristics and network-related variables can be constructed as to different consumers' choice decisions.

This paper is not without limitations. Future research related to this topic can be conducted. Since almost all of the MIMs in the market are distributed free of charge, price-related attributes were not included in this paper. It will be more interesting to see how network variables can be evaluated in monetary values.

Appendix: Survey

본 설문은 20대 직장인들의 모바일 메신저(예: 카카오톡, 라인 등)의 사용에 대한 것입니다. 각 문항들을 잘 읽고 답변해 주세요. 소요 시간은 약 15분입니다.

1. 귀하께서는 현재 모바일 메신저를 사용하고 계십니까?

① 예

② 아니오

2. 귀하께서는 20대 직장인이십니까?

① 예

② 아니오

● 다음 문항들을 읽고 귀하께서 해당하는 곳에 체크해주십시오.

3. 내가 맡은 직무의 효율성을 높이기 위해 모바일 메신저를 많이 활용하고 있다

매우 그렇지 않다	그렇지 않다	약간 그렇지 않다	보통이다	약간 그렇다	그렇다	매우 그렇다
①	②	③	④	⑤	⑥	⑦

4. 나는 가족, 친구 및 주변지인과의 사교를 위해 모바일 메신저를 많이 사용하고 있다

매우 그렇지 않다	그렇지 않다	약간 그렇지 않다	보통이다	약간 그렇다	그렇다	매우 그렇다
①	②	③	④	⑤	⑥	⑦

5. 모바일 메신저의 기능과 사용법에 대해서 나는 다른 사람들보다 더 잘 알고 있다

매우 그렇지 않다	그렇지 않다	약간 그렇지 않다	보통이다	약간 그렇다	그렇다	매우 그렇다
①	②	③	④	⑤	⑥	⑦

6. 나는 다른 사람들에 비해 모바일 메신저를 더 많이 활용하고 있다

매우 그렇지 않다	그렇지 않다	약간 그렇지 않다	보통이다	약간 그렇다	그렇다	매우 그렇다
①	②	③	④	⑤	⑥	⑦

7. 현재 귀하께서 사용하고 계시는 모바일 메신저를 **모두** 선택해 주십시오 (복수응답)

카카오톡	라인	틱톡	왓츠앱	텔레그램
위챗	페이스북 메신저	비트윈	커플릿	기타
				( )

8. 귀하께서 모바일 메신저에서 사용하는 기능들을 **모두** 선택해 주십시오 (복수응답)

아이템스토어	게임	그룹채팅	영상통화	파일전송
비밀채팅	선물하기	위치공유	모바일 결제	PC 연동

9. 귀하께서 생각하는 모바일 메신저 속성들의 중요도를 체크해 주십시오

	← 전혀 중요하지 않다						매우 중요하다 →
아이템스토어	1	2	3	4	5	6	7
PC 연동	1	2	3	4	5	6	7
그룹채팅	1	2	3	4	5	6	7
파일전송	1	2	3	4	5	6	7
보안수준	1	2	3	4	5	6	7
게임	1	2	3	4	5	6	7
영상통화	1	2	3	4	5	6	7
비밀채팅	1	2	3	4	5	6	7
선물하기	1	2	3	4	5	6	7
위치공유	1	2	3	4	5	6	7
모바일 결제	1	2	3	4	5	6	7

10. 나는 현재 사용하고 있는 모바일 메신저가 마음에 든다

매우 그렇지 않다	그렇지 않다	약간 그렇지 않다	보통이다	약간 그렇다	그렇다	매우 그렇다
①	②	③	④	⑤	⑥	⑦

11. 현재 사용하고 있는 모바일 메신저 외에 새로운 메신저가 출시된다면 그 메신저로 전환할 의향이 있습니까?

① 예 ② 아니오

● 이제 귀하께서는 여러 화면에 걸쳐 아래 제시된 8가지 속성들이 다양하게 조합된 가상의 모바일 메신저들을 보게 됩니다 예를 들어, 아래과 같은 속성을 지닌 모바일 메신저의 경우,

가족, 친구 등 주변지인 중 사용자 비율	60%
국내 사용자 비율	30%
세계 사용자 비율	70%
아이템스토어 이용가능 여부	아니오
PC 연동 여부	예
그룹채팅 가능 여부	아니오
파일전송 가능 여부	예
보안 강도	강

현재 귀하의 가족, 친구 등 주변지인들 중 해당 모바일 메신저를 사용하는 사람들의 비율이 60%, 국내 인구 중 해당 모바일 메신저를 사용하는 인구의 비율이 30%, 세계 인구 중 해당 모바일 메신저를 사용하는 인구의 비율이 70%이며, PC 연동과 파일전송 기능이 있는 보안강도가 강한 상품입니다. 귀하께서 사용할 모바일 메신저를 선택한다고 가정하시고, 각 화면에서 가장 선호하는 상품을 하나씩 선택해 주십시오. 각 화면마다 3개의 대안들이 주어지며, 모두 마음에 들지 않으면 '마음에 드는 것 없음'을 클릭해 주십시오. 귀하께는 총 25번의 태스크가 주어집니다. 아래 정의된 속성들을 잘 염두에 두시고 설문에 임해주세요.

- 속성 정의

① **가족, 친구 등 주변지인 중 사용자 비율**: 귀하의 가족, 친구 등 친한 주변지인들 중 해당 모바일 메신저를 사용하는 사람들의 비율

② **국내 사용자 비율**: 국내 인구 중 해당 모바일 메신저를 사용하는 사람들의 비율

③ **세계 사용자 비율**: 세계 인구 중 해당 모바일 메신저를 사용하는 사람들의 비율

④ **아이템스토어 이용가능 여부**: 새로운 테마와 이모티콘을 아이템스토어에서 구매할 수 있는지 여부

⑤ **PC 연동 여부**: 메신저앱과 PC의 연동 여부

⑥ **그룹채팅 가능 여부**: 다대다(多對多) 그룹채팅 가능 여부

⑦ **파일전송 가능 여부**: 모바일 메신저를 통한 사용자간 파일의 전송 가능 여부

⑧ **보안 강도**: 암호화를 통한 메신저 대화내용의 보안처리 강도

-강: 전송하는 모든 메시지가 암호화되고 서비스 제공자가 메시지 내용을 확인할 수 없음

-**중**: 전송하는 모든 메시지가 암호화되지만 서비스 제공자가 메시지 내용을 확인할 수 있음

-**약**: 전송하는 메시지가 암호화되지 않음

Block 1

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12. 귀하의 성별에 체크해 주십시오

① 남성

② 여성

설문에 응해주셔서 대단히 감사합니다

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국문초록

소셜 네트워크에서 네트워크 사이즈와 사회적 거리가 선택에 미치는 영향에 대한 연구

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소비자들의 구매행동이 다른 사람들에게 영향을 받는다는 사실은 잘 알려져 있다. 본 연구는 소셜 네트워크 상에서 네트워크 사이즈와 사회적 거리가 소비자의 선택에 미치는 영향을 포착하는데 초점이 맞추어져 있다. 소비자들의 제품 구매 동기와 지식수준을 매개변수로 고려하였고 다항로짓모형을 통해 컨조인트 데이터를 분석하였다.

본 연구의 결과에 따르면 네트워크 사이즈가 클수록 소비자들의 구매확률에 긍정적인 영향을 주었고, 사회적 거리가 증가할수록 그 네트워크 사이즈의 효과는 줄었다. 또한 효용지향적인 소비자의 경우 국가 수준의 네트워크 사이즈에 가장 큰 영향을 받았고, 쾌락지향적인 소비자의 경우 친구와 가족 수준의 네트워크 사이즈에 가장 큰 영향을 받았다.

본 연구는 첫째, 네트워크 외부성이 존재하는 제품/서비스를 선택할 때에 큰 영향을 미치는 네트워크 관련 변수들을 도입하여 설명을 시도하였다는 점, 둘째, 이에 더해 소비자들의 제품 구매동기와 지식수준 등 개인의 심리적 변수들을 선택 모형에 도입하여 설명을 좀더 풍부하게 하였다는 점에서 의미가 있다.

주요어 : 사회적 영향; 네트워크 효과; 사회적 거리; 제품 구매동기; 이산선택모형; 컨조인트 분석;

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