

# Resistance and Acceptance of Mobile Innovations in Accordance to Age Groups: Centered on a Comparative Study between the New Generation and Older Age Groups

Jin-Ho Choi\*

Department of Management Information Systems, Chungbuk National University, Chungdae-ro 1, Sewon-gu, Cheongju, Chungbuk, 28644, Republic of Korea; sky\_jino@hanmail.net

## Abstract

**Background/Objectives:** Lately, diverse studies are being conducted on smartphones by comparing and analyzing usage frequency of application available in the device and the degree of acceptance in innovative functions between the new and old generation. **Methods/Statistical Analysis:** By means of analyzing the existing technology acceptance model and theoretical study on innovation assurance, variables that were expected to have an impact on acceptance of applications were set and a research model was developed. To verify the research model, a survey was conducted targeting the new generation (aged twenty), the group aged over forty, and the group aged over fifty to sixty. **Finding:** This work sets the research model and hypothesis based on the information systems Technology Acceptance Model in order to analyze the acceptance factors in smartphone services, and the hypothesis was tested through empirical analysis. First, the self-efficacy of smartphone service users had a significant impact on perceived ease of use and usefulness. Secondly, promoting smartphone services proved to have a significant impact on perceived usefulness and ease of use. Thirdly, the security of smartphone services had a significant impact on the users' perceived ease of use. Fourth, perceived ease of use and usefulness had a significant impact on the degree of acceptance among users, and the impact of ease of use was greater in the high-age group while the impact of usefulness was greater in the low-age group. **Improvements/Applications:** The results of this study may help companies in expanding their consumer bases and stimulating industry activation. Since some age groups react more sensitively at maintainability than usefulness, it will also provide a guideline if the right strategy will be adopted.

**Keywords:** Innovativeness, Self-Efficacy, Smartphone, Social Network Service, Usage Intention

## 1. Introduction

Unlike in the past where information technology and communication industry have clear boundaries, all these boundaries are disappearing and becoming convergent in this fast-changing modern generation. By recombining existing things, a completely different innovation is created resulting into a paradigm of the present generation.

Moreover, design is being recognized as an important factor in product development, so much that it can directly affect the company's survival. This illustrates the need for a strategic approach in design.

As our community rapidly transforms into an aging society, the difference in the degree of acceptance of information technology among the younger and older generation shows the difference in the acceptance of innovative technology. In addition, information and communication developed by combining existing ones are to create a distinctly different and innovative development.

The aging society has become a crucial factor in the modern paradigm that it began to have a direct impact on the survival of an organization. This means that there must be a strategic approach on the older generation in terms of accepting a technology.

\*Author for correspondence

Previous researches attempted to find different aspects of smartphone services but in reality, studies which separate age groups into old and young are still lacking. In line with this, this paper set a research model based on the Technology Acceptance Model to analyze the different acceptance factors and tested the hypothesis through an experiment.

## 2. Theoretical Background

Our country has started to become an aging society and industries have been rapidly transforming to target the elderly. There are several problems that need to be solved in order to activate and popularize the service sector which involves smartphones. Innovative products which will elevate the quality of smartphone services need to be developed and there must be support in terms of regulations and policies.

Especially, there must be a strategy which will promote the acceptance of smartphone services by understanding the characteristics and needs of potential users.

As a solution to this, smartphone is emerging as a new model in the convergence of the medical and IT fields. The convergence of information and communication technology in smartphones is an innovative service that enables the users to avail of related services anywhere at any time.

### 2.1 Smartphone Service

Smartphone services have surpassed the introductory stage where communication and sensor technology are leading, and is now entering into maturity stage where data and content are leading. In line with this, a full-pledged competition among platform operators is expected<sup>1</sup>.

IoT (Internet of Things), big data, and SNS will not only be positioned as key factors in smart healthcare technology and services, but will also contribute largely in the growth of the smart healthcare industry<sup>1</sup>.

However, despite the positive outlook on the growth potential of the mobile internet market, it does not show any impressive qualitative growth overall. At this very moment, we must examine the domestic mobile internet service environment, develop a better service and intensify the researches on the perspective of the users.

### 2.2 Technology Acceptance Model

In (Technology Acceptance Model; TAM)<sup>2</sup> is a theory that explains the process of adopting a new technology through two concepts: ease of use and usefulness<sup>3</sup>. The Technology Acceptance Model argues that a consumer must feel that the technology is useful and easy to use in order to accept it.

In<sup>4</sup> argued that two particular principles exist namely, perceived usefulness and perceived ease of use. He believed that these two principles affect the formation of behavior towards a technology or an innovative product and this behavior influences the usage intention. Perceived usefulness refers to the extent of belief that using a new technology will boost the user's productiveness and perceived ease of use refers to the degree of expectation that using a new technology would not require a lot of effort.

### 2.3. Diffusion of Innovation Theory

The Diffusion of Innovation Theory proposes relative advantage, compatibility, complexity, trialability, and observability as the characteristics of innovation and discusses that these are the factors that best explain the adoption of innovation<sup>3</sup>. Perceived usefulness and perceived ease of use, which are the core concepts of Technology Acceptance Model, are some of the characteristics of innovation that the Diffusion of Innovation Theory proposes. Existing studies identify the two information system theories as merely similar concepts<sup>5</sup>.

### 2.4. Advanced Researches on Technology Acceptance Model

In has observed the actual process of user acceptance on new media or technology based on the Technology Acceptance Model which proposes resistance to innovation as the control variable<sup>6</sup>. The results showed that perceived usefulness and perceived ease of use may or may not affect the final purchase decision of the users depending on the degree of their resistance to innovation. The results also showed that the perceived usefulness variable only affects the happiness variable in a highly resistant group.

Factors that significantly influence perceived ease of use are perceived happiness and complexity while brand image was the only thing that gave a significant impact on the purchase intent of the resistant group. Brand image,

complexity, and perceived happiness were proven to significantly affect perceived usefulness in the low-resistance group. Perceived ease of use was found to be affected only by complexity and perceived happiness just like in the highly resistant group. The factors that affect the purchase intent of the low-resistance group are perceived usefulness, perceived ease of use, and brand image.

In verified the factors that affect usage intention through the expanded Technology Acceptance Model in the process of users in accepting smartphones<sup>7</sup>. Exogenous variables were categorized into smartphone characteristics (portability, diversity, security) and smartphone users' personal characteristics (innovativeness and self-efficacy of the user), and the parameters of perceived usefulness, perceived ease of use, and perceived cost were designed. Observing the users of 3G phones, the factors that can have a significant impact on usefulness are portability, diversity, and innovativeness while diversity is the only factor that affects ease of use.

Factors that directly affect usage intention are diversity, innovativeness, usefulness, and ease of use. Observing the users of 2G phones, the factors that affect usefulness are shown to be portability and diversity, while self-efficacy is the only factor that affects ease of use. Factors that have a direct impact on the degree of acceptance (usage intention) are security and innovativeness.

In<sup>8,4</sup> appropriately applied the TAM theory on the characteristics of smartphones and identified and verified the factors that can affect the decision-making process of smartphone acceptance through a research on the user environment as well as usefulness, ease of use, and acceptance factor of smartphones. The results showed that versatile application, accessibility, and work compatibility are factors that affect usefulness while perceived cost network externality affects ease of use.

The research of proved the factors that affect the acceptance of mobile banking on the basis of Technology Acceptance Model<sup>9</sup>. According to the results, while instant connectivity, security, and information overload among the factors under the intent to use affect perceived usefulness, information overload does not affect perceived ease of use. Perceived usefulness and perceived ease of use were shown to have a significant influence on mobile banking usage intention.

The research by studied user acceptance based on the Technology Acceptance Model<sup>10</sup>. Based on the result, the factors that affect usefulness are relative advantage, expectation of better products, socially influential mass

communication, and attitude towards new technology. Perceived ease of use was verified as a leading variable and perceived usefulness has been shown to form a positive behavior towards digital convergence products.

The results of the behavioral theory and TAM research, which state that the behavior affects the intention to act, have been applied to the relationship between behavior towards digital convergence products and acceptance, and verified that a benevolent attitude leads to positive acceptance.

## 3. Research Model and Hypothesis

### 3.1 Research Model

This study designed the research model with individual innovativeness, self-efficacy, social impact, security, cause of hindrance towards something new, and economic burden as independent variables and degree of acceptance as a dependent variable based on existing studies.

In particular, the research aims to examine whether the degree of influence between the two age groups will differ after setting the type of users as the control variable and classifying the new generation from the older group. In other words, the research strives to find out whether the control variable (type of users) will have a regulatory effect on the impact of research variables.

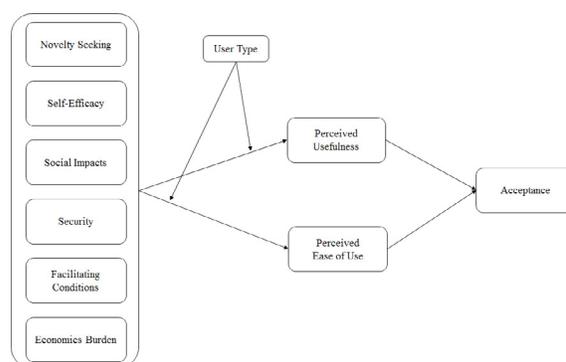


Figure 1. Research model.

### 3.2 Research Hypothesis

Diffusion of Innovation Theory is the representative theory which various researches on the adoption of innovation used as a basis of their theory. Moreover, it is being used as an analysis framework in the adoption of innovation on personal and social dimension in a wide range of academic domain is shown in Figure 1.

The Diffusion of Innovation Theory pointed out innovation propensity (the psychological characteristic of the users) as a factor that can explain the adoption of innovation. Innovation propensity refers to how early an individual adopt new ideas in relation to the other members of the same social system.

- H1: The individual innovativeness of smartphone users would have a positive (+) effect on perceived ease of use.
- H2: The individual innovativeness of smartphone users would have a positive (+) effect on perceived usefulness.
- H3: The self-efficacy of smartphone users would have a positive (+) effect on perceived ease of use.
- H4: The self-efficacy of smartphone users would have a positive (+) effect on perceived usefulness.
- H5: The promotion of smartphones would have a positive (+) effect on perceived ease of use.
- H6: The promotion of smartphones would have a positive (+) effect on perceived usefulness.
- H7: The security of smartphone users would have a positive (+) effect on perceived ease of use.
- H8: The security of smartphones would have a positive (+) effect on perceived usefulness.
- H9: The security of smartphones would have a positive (+) effect on the perceived ease of use.
- H10: The perceived ease of use of smartphones would have a positive (+) effect on usage intention.
- H11: The usefulness of smartphones would have a positive (+) effect on perceived ease of use.
- H12: The level of impact of innovativeness of smartphone service users on perceived ease of use would depend on the type of users (low age group vs high age group).
- H13: The level of impact of innovativeness of smartphone service users on usefulness would depend on the type of users (low age group vs high age group).
- H14: The impact of self-efficacy of smartphone service users on perceived ease of use would depend on the type of users (low age group vs high age group).
- H15: The impact of self-efficacy of smartphone service users on perceived usefulness would depend on the type of users (low age group vs high age group).
- H16: The impact of promotion of smartphone services on perceived ease of use would depend on the type of users (low age group vs high age group).
- H17: The impact of promotion of smartphone services on perceived usefulness would depend on the type of users (low age group vs high age group).

Security is privacy on personal information and can be defined as autonomy over the control in the collection and use of personal information. This refers to the right to prohibit or limit others from using one's personal information without permission. According to a research by, concerns on information privacy decreases the possibility to provide personal information to companies and furthermore, in case of using services that require users to provide information, users resort to abandoning the service which negatively affects the operation of the firms<sup>[1]</sup>.

- H18: The impact of security of smartphone service users on perceived ease of use would depend on the type of users (low age group vs high age group).
- H19: The impact of security of smartphone service users on perceived usefulness would depend on the type of users (low age group vs high age group).
- H20: The impact of perceived ease of use of smartphone users on usefulness would depend on the type of users (low age group vs high age group).
- H21: The impact of perceived ease of use of smartphone users on the intent of acceptance would depend on the type of user (low age group vs high age group).
- H22: The impact of perceived usefulness of smartphone users on the intent of acceptance would depend on the type of user (low age group vs high age group).

### 3.3 Operational Definition of Research Variables

The concepts and operational definition of research variables mentioned in the research model and hypothesis were modified to reflect the characteristics of smartphone services and set as shown in Table 1.

### 3.4 Data Gathering and Research Method

Based on the operational definition of the measured variables on the survey,

10 familiar smartphone functions, 10 smartphone functions which users use frequently, 4 items for individual innovativeness, 3 items for self-efficacy, 4 items for hindrances, 4 items for security, 4 items for unwanted relationship or interaction through SNS functions aside from the call, 3 items for financial burden, 4 items for perceived ease of use, 4 items for perceived usefulness and 10 items for usage intention were expressed in a five-point Likert Scale.

**Table 1.** The concepts and operational definition of research variables

Research variable	Conceptual definition	Metrics (Name of variables)
Individual innovativeness	Tendency of an individual to like new stimuli	1. Curiosity towards new information technology 2. Impulse for taking advantage of new products 3. Curiosity towards new information technology of new products
Self-efficacy	Having the ability or technology to effectively use an innovative product or service	1. Confidence towards the use of a device 2. Confidence towards the mastery of using a device 3. The level of ease in using the device.
Promotion Condition	The degree of belief that an organizational and technological foundation is equipped to support the use of smart healthcare services.	Can receive professional training regarding the use of services Can receive help from experts regarding the use of services Can receive guidance regarding the use of services
Security	Can receive guidance regarding the use of services	1. Confidentiality on health information 2. Security management of personal information 3. Misuse detection method for personal information
Perceived usefulness	The degree of belief that using smartphone services will improve the outcome of the purpose of the use	1. Can take care of health better 2. Can take care of health more effectively 3. Can take care of health more systematically
Perceived ease of use	The degree of belief that using smartphone services will not require much effort	1. It is easy to use the device 2. The clarity of the operating method of the device 3. The simplicity of the operating method of the device
Usage intention	The intention to continuously use smartphone services or a future intent to use	1. Active intention to use 2. Continuous intention to use 3. Recommend intention to use to other people around

Additional items consist of questions related to the types of users (new generation vs. old generation) and those that ask other demographic characteristics.

The survey was conducted online for 7 days, from May 20, 2016 up to May 26, 2016. A total of 200 surveys were distributed and among these, 140 were returned, and this shows a 70% recovery rate.

SmartPLS 2 was used for encoding the collected data and SPSS was used as the package for statistical analysis<sup>12-14</sup>. Frequency analysis and confirmatory factor analysis were done as the analysis methods.

## 4. Empirical Analysis

### 4.1 Characteristics of the Sample

The general characteristics of the survey respondents are shown in Table 2.

**Table 2.** Characteristics of the sample

Category		Frequency	Ratio (%)	Total
Gender	Male	95	66	100% (143)
	Female	48	34	
Age	Twenties	47	33	100% (143)
	Thirties	18	13	
	Forties	23	16	
	Fifties	54	38	
	Sixty years old and above	1	1	

The gender of the respondents is 95 (66%) male, 48 (34%) female, and the age is dispersed into 47 (33%) in their twenties, 18 (13%) in their thirties, 23 (16%) in their forties, 54 (38%) in their fifties, and 1 (1%) over sixty years old.

## 4.2 Analysis of Reliability and Validity

Analysis was performed on the primary factors to verify the reliability and validity of the measuring tools for the research variables.

3 things are recommended to verify the reliability test of the measured variables in the analysis of primary factors<sup>15</sup>.

First, the  $\lambda^2$  (square of the standard level) which is the impact of concept variable on the measured variables, should be higher than 0.5. Second, the reliability concept must be above 0.7, and third, the AVE (Average Variance Extracted) must be at least 0.5.

Since all  $\lambda^2$  of measured variables are above 0.5 and the reliability concept of the variable as well as the AVE value are above 0.7, the reliability of the measured variable is proven in Table 3.

**Table 3.** Result of reliability analysis

	AVE	Composite Reliability	R Square	Cronbach's Alpha
Economic burden	0.624	0.74914		0.672
Exchange	0.617	0.888249	0.151	0.847
Knowledge on functions	0.434	0.881374		0.854
Function usage	0.533	0.848		0.776
Inhibition	0.567	0.838		0.751
Interaction burden	0.547	0.827		0.730
Novelty seeking	0.637	0.893		0.843
Perceived ease of use	0.885	0.968	0.810	0.956
Perceived usefulness	0.658	0.885	0.404	0.829
Security	1	1		1
Self-efficacy	0.754	0.924		0.891

Next, the validity of each variable can be verified by using the average variation value (AVE) which shows the degree of dispersion of the properties which are contrasted to the attributed error of measurement. Here, the value of AVE should be higher than 0.5, and this means

that at least 50% of each measured item is described by the variables where the item belongs under<sup>16</sup>.

Based on the results of the analysis, all the values of AVE in every variable exceeded the standard which is 0.5, and this proved that all the measured variables used in the research were appropriate for the purpose of the research and that they were reliable.

The validity of the structural model in the analysis that uses PLS can be shown through proving that the dispersion of the measured items is more relevant to the variance of related variables compared to the variance of unrelated variables. The validity can be determined by using a correlation coefficient matrix which simultaneously shows the correlation coefficient and the AVE of the variables<sup>17</sup>.

The results of the correlation coefficient matrix in this research are as follows: The validity of the structural model parameters exists when the square of AVE of each variable indicated diagonally in the table is greater than the correlation coefficient among the variables indicated at the left and bottom portion of the values<sup>17</sup>. Since the square of AVE of all variables were found to be greater than the correlation coefficient in this research<sup>18</sup>, validity among the variables is proven to exist as shown in Table 4.

## 4.3 Verification of the regulation effect on the type of users

In this research, the age groups were divided into a low-age group which includes those in their twenties and thirties and a high-age group which includes those in their forties and above. The result was  $p = 0.024$  and the age was proven to have a regulation effect. In other words, there was a difference in the analysis result between the low-age group (twenties-thirties) and the high-age group (forty years old and above).

More specifically, in the high-age group of forty years old and above, the factors that proved to have an impact on the degree of acceptance were performance expectations and promotion condition. The low-age group (twenties to thirties) also exhibited the same results. The two factors: performance expectations and promotion condition had a bigger impact on the degree of acceptance in the low-age group than in the high-age group. Likewise, there was a difference in the results of analysis in the low-age group and the high-age group.

The users of smartphone services can be largely classified into a low-age group and a high-age group. The

Table 4. Latent variable correlations

	Economic burden	Exchange	Knowledge on functions	Function usage	Inhibition	interaction burden	Novelty seeking	Perceived ease of use	Perceived usefulness	Security	Self-efficacy
Economic burden	<b>0.790</b>										
Exchange	-0.145	<b>0.786</b>									
Knowledge on functions	-0.205	0.233	<b>0.659</b>								
Function usage	-0.243	0.288421	0.766	<b>0.730447</b>							
Inhibition	0.171	0.027996	-0.247	-0.226	<b>0.753</b>						
Interaction burden	0.238	0.023033	-0.050	-0.073	0.119	<b>0.740</b>					
Novelty seeking	-0.216	0.4723	0.418	0.399	-0.149	-0.103	<b>0.798</b>				
Perceived ease of use	-0.225	0.328	0.719	0.709	-0.362	-0.102	0.518	<b>0.940</b>			
Perceived usefulness	-0.224	0.335	0.529	0.570	-0.199	-0.267	0.278	0.459	<b>0.811</b>		
Security	-0.197	0.186	0.542	0.513	-0.227	-0.069	0.360	0.639	0.396	<b>1.000</b>	
Self-efficacy	-0.318	0.329	0.693	0.630	-0.413	-0.063	0.521	0.867	0.444	0.691	<b>0.868</b>

low-age group has relatively specialized knowledge on smartphone services while the high-age group has relatively low expertise on the matter.

This research classified the smartphone users into a low-age group and a high-age group and tested whether the degree of influence differ in the research variables depending on the age group. In short, the research model was designed by setting the user type as the control variable.

The standard course coefficient was measured higher in the high-age group than in the low-age group. In other words, this can be interpreted that the high-age group compared to the low-age group feels more ease of use in smartphone services as various promotional policies designed to promote the easier use of the service are provided to them.

## 5. Conclusion

The study was able to obtain results and implications which can be helpful in developing strategies to expand smartphone services.

First, the self-efficacy of smartphone service users had a significant impact on perceived ease of use and usefulness. It means that users with greater confidence in operating IT devices feel greater usefulness with regards to smartphone services. Therefore, there is a need to pursue a variety of information technology education to the general public as a long-term strategy for expanding smartphone services.

Secondly, promoting smartphone services proved to have a significant impact on perceived usefulness and ease of use. Particularly, the impact of promotion on perceived ease of use is more sensitive in the high-age group compared to the low-age group. In line with this result, there should be various support policies which could help regular users to easily utilize smartphone services.

Thirdly, the security of smartphone services had a significant impact on the users' perceived ease of use. In particular, the impact was shown to be greater in the low-age group compared to the high-age group.

This can be interpreted that as security is strengthened, users believe that service usage would be easier since they would not have to do additional operation to increase the security of personal information. There seems to be a need for strengthening security as a strategy to expand smartphone services.

Fourth, perceived ease of use and usefulness had a significant impact on the degree of acceptance among users, and the impact of ease of use was greater in the high-age group while the impact of usefulness was greater in the low-age group.

Lastly, there is a practical implication for services to work towards the direction of increasing convenience so that users can use smartphone services more easily in order to expand consumer base and promote industrial activation. However, it must be understood that the high-age group which falls under the mass majority, are more sensitive to ease of use rather than usefulness and specific strategies should be developed accordingly.

Nevertheless, this research has the following limitations: First, there is a limitation that the low and high-age group was classified as below and above the age 40. This calls for further researches which adopt complementary measures to the limitations in terms of age group classification. Second, there is a limitation that the degree of acceptance was measured on the perspective of potential consumers for application services that are not popularized yet. Therefore, there is a need for additional research which targets segmentalized groups.

## 6. References

1. Hur Y, Do JH, Kim HJ. Technological trends and industry outlook of smart healthcare. KEIT Report; 2015.
2. Davis FD. A technology acceptance model for empirically testing new end-user information systems: Theory and results [Doctoral dissertation]. Cambridge, MA: MIT Sloan School of Management; 1986.
3. Rogers EM. Diffusion of Innovations. 5th ed. New York: Free Press; 2003.
4. Davis FD. Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*. 1989; 13(3):319–39.
5. Venkatesh V, Morris MG, Davis GB, Davis FD. User Acceptance of information technology: toward a unified view. *MIS Quarterly*. 2003; 27(3):425–78.
6. Kang JH. Research on user's resistance to innovation and brand image regarding the new media [Master's thesis]. Joongang University; 2010.
7. Kim SG. Research on the impact of user environment and smartphone characteristics on perceived usefulness, ease of use and degree of acceptance. [Master's thesis]. Hongik University; 2009.
8. Kim JH. Research on the degree of demand in smartphones centered on expanded TAM model [Master's thesis]. Konkook University; 2010.
9. Baek SD. Research on the factors that influence the intent of reuse of mobile banking service [Master's thesis]. Hankuk University of Foreign Studies; 2009.
10. Park SH. Research on the characteristics of innovation acceptance regarding digital convergence products [Master's thesis]. Joongang University; 2011.
11. Shin MH. The impact of concerns on information privacy in smartphone-based shopping malls and personal innovativeness on the usefulness, ease of use, and satisfaction of the users. *Digital Journal of Korea*. 2014; 12(1):197–209.
12. Park EM, Park ST. The effectiveness of absorptive capacity formation mechanism on innovation performance by industry. *Indian Journal of Science and Technology*. 2015; 8(21):1–9.
13. Yun BN, Lim DH, Li G, Park ST. A study on the factors that affect the entrepreneurial intention of pre-entrepreneurs: focusing on the moderating effect of self-efficacy. *Indian Journal of Science and Technology*. 2016; 9(26):1–7.
14. Im H, Park ST, Ko MH, A Study of Factors that Affect the Right to be Forgotten and Self-Disclosure Intent in SNS, *Indian Journal of Science and Technology*. 2016, 9(26), pp. 1-8.
15. Kim DU. AMOS A to Z. Hakhyunsa, Seoul; 2008.
16. Werts CE, Linn RL, Joreskog KG. Intra class reliability estimates: Testing structural assumptions. *Educational and Psychological Measurement*. 1974; 34(1):25–33.
17. Fornell C, Larcker DF. Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research*. 1981; 18(1):39–50.
18. Chin WW. The partial least squares approach for structural equation modeling Marcoulides GA, editors. London: Modern Methods for Business Research, Lawrence Erlbaum Associates; 1998. p. 295–336.