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In this issue:

An Empirical Study of Instant Messaging Behavior Using Diffusion of Innovation Theory

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Abstract: Instant messaging (IM) as a form of communication offers unique advantages to traditional email communications, centered mostly on its immediacy. However, levels of IM use are significantly less than email especially in business organizations. In an attempt to understand IM behavior and encourage its adoption, this manuscript explores the instant messaging behavior using the Rogers (1995) model of human behavior known as Diffusion of Innovation (DI). Specifically, findings reveal that both behavioral compatibility with instant messaging, relative advantage (RA) provided by IM, and ease of trying (TRY) IM are positively associated with intention to use IM. In addition, critical mass (CM) is positively associated with intention and findings confirm that intention influences use of instant messaging. A review of gender shows little difference between diffusion influences on intention. The only significant change is relative advantage which is significant at $p < .05$ for males but only at $p < .10$ for females. The modified DI model provides a good fit with the overall data and can be used to predict and understand the usage of instant messaging. Specific recommendations to increase IM usage are proposed.

Keywords: Diffusion of Innovation, DI, Instant Messaging, factor analysis, multiple regression analysis, structural equation modeling

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Abstract

Instant messaging (IM) as a form of communication offers unique advantages to traditional email communications, centered mostly on its immediacy. However, levels of IM use are significantly less than email especially in business organizations. In an attempt to understand IM behavior and encourage its adoption, this manuscript explores the instant messaging behavior using the Rogers (1995) model of human behavior known as Diffusion of Innovation (DI). Specifically, findings reveal that both behavioral compatibility with instant messaging, relative advantage (RA) provided by IM, and ease of trying (TRY) IM are positively associated with intention to use IM. In addition, critical mass (CM) is positively associated with intention and findings confirm that intention influences use of instant messaging. A review of gender shows little difference between diffusion influences on intention. The only significant change is relative advantage which is significant at $p < .05$ for males but only at $p < .10$ for females. The modified DI model provides a good fit with the overall data and can be used to predict and understand the usage of instant messaging. Specific recommendations to increase IM usage are proposed.

Keywords: Diffusion of Innovation, DI, Instant Messaging, factor analysis, multiple regression analysis, structural equation modeling.

1. INTRODUCTION

One of the most popular forms of communications among younger people today is instant messaging. Instant messaging as a form of communication offers unique advantages to traditional email communications, centered mostly on its immediacy. However, levels of IM use are significantly less than email especially in business organizations

(Raine & Horrigan, 2005). This article is an attempt to understand IM behavior and encourage its adoption. The manuscript will explore instant messaging behavior using the Rogers (1995) model of human behavior known as Diffusion of Innovation (DI). According to Rogers (1995) important characteristics of an innovation include:

- Relative Advantage (RA)--the degree to which it is perceived to be better than what it supersedes
- Compatibility (COMP)--consistency with existing values, past experiences and needs
- Complexity (CMPX)--difficulty of understanding and use
- Trialability (TRY)--the degree to which it can be experimented with on a limited basis
- Observability (VI)--the visibility of its results

These factors influence intention to use a new technology and its diffusion into societal behavior. Rogers' (1995) diffusion of innovation theory uses these factors as a basis for modeling intention and subsequent behavior. Our study first reviews existing literature on both IM and Diffusion of Innovation and then applies Rogers' model to understand and predict IM intention and behavior.

2. INSTANT MESSAGING

Despite the fact that users of both email and instant messaging (IM) preferred instant messaging for "conveying emotions, building relationships, and ease of use" (Lancaster, Yen, Huang, & Hung, 2007), IM is largely underused in the workplace. While nearly all companies use email, only 35% of organizations use instant messaging (AMA, 2006). A May 2004 study found that only 12% of Web users employed the Internet for instant messaging, as opposed to 45% who used the Internet for email (Rainie & Horrigan, 2005).

Age is one of the reasons for the disparity between email and IM usage. IM has been rapidly accepted and adopted by individuals between the ages of 8 and 28, but it is now growing in popularity as a form of communication in the workplace. In a study done by Pew Internet & American Life Project (2004), 21% of individuals were found to use IM at work for purposes both personal and business-related. Wilkins notes that 77% of at-work IM users "feel that IM has a positive impact on their work lives" due to its speed, rich communications, and organizational advantages (Wilkins, 2007). Goldsborough suggests that "business people use IM for collaboration" but this still only accounts for 10% of IM users (Goldsborough, 2004). Nevertheless, Lancaster, et. al (2007) found that instant messaging seemed to provide a more social experience than email communications, most likely due to the synchronous nature of the technology, which allows instant feedback.

Ilie, Van Slyke, Green, & Lou (2005) used diffusion theory to examine gender difference in perceptions and use of instant messaging. The authors determined that women value perceptions of ease of use and visibility more than men, while men value perceptions of relative advantage, the perceived utility and the perceived popularity or critical mass more than women. Women focused more on the social aspects, while men focused more on task completion.

Primeaux and Flint (2004) agree that the use of IM is desirable in the workplace due to its immediacy. Indeed, IM allows for "[i]mmediate and spontaneous conversation between co-workers, precisely the type of communication that is becoming less and less available as email has become such a huge part of the corporate landscape…IM is the next best thing to standing in the hallway and discussing work." Doyle (2003) sees instant messaging as a new and effective direct marketing tool that will replace email or direct mail, and Castelluccio (1999) calls IM, email in real time, a communications revolution.

The exploration of the factors influencing use of information technology behavior is an important topic for information technology researchers and practitioners (Venkatesh & Morris, 2000; Ilie, Van Slyke, Green, & Lou, 2005); yet, surprisingly, instant messaging has not been extensively studied in the literature. The significantly lesser use of an Internet communications technology that has perceived advantages over a more common technology is puzzling, thus IT practitioners should be very interested in models that explore the usage of a new

communications technology that is advantageous to business. The primary motivation for this study, then, is to uncover factors that influence technology usage and to better explain why IM has not achieved a comparable level of adoption to email. Suggestions about areas where adoption can be improved will be suggested.

If acceptance of instant messaging as a means of communication in business and in the population at large is desirable due to its favorable attributes, then understanding the factors influencing IM behavior is important to aid in deployment and use. Wang, Hsu, and Fang (2005) note that, "the success of any information systems development depends on a combination of user acceptance and advancements in technology."

3. DIFFUSION

Diffusion of Innovation (DI) theory is a theory of communication and adoption of new ideas and technologies. There are numerous studies on IS implementation using diffusion of innovation theory in the IS literature; three are widely cited: Rogers (1995); Kwon & Zmud (1987); and Tornatzky & Fleischer (1990). Rogers' model has been frequently cited and is well established in the diffusion theory literature. Rogers defines innovation as "an idea, practice, or object that is perceived as new by an individual or other unit of adoption." (Rogers, 1995). He defines diffusion as "the process by which an innovation is communicated through certain channels over time and among the members of a social system." In other words, the diffusion of innovation evaluates how, why, and at what rate new ideas and technology are communicated and adopted.

Rogers identified five factors that strongly influence whether or not someone will adopt an innovation. These factors are: relative advantage, complexity, compatibility, trialability and observability. The relative advantage is the degree to which the adopter perceives the innovation to represent an improvement in either efficiency or effectiveness in comparison to existing methods. The majority of studies have found that the relative advantage is significant (Teo & Tan, 2000; Premkumar & Ramamurthy, 1995). Ilie, et. al (2005) found that relative advantage was significant for men, but not for women.

The complexity is the degree to which the innovation is difficult to understand or apply. The compatibility refers to the degree to which an innovation is perceived as being consistent with the existing values, past experiences, and needs of potential adopters. Premkumar and Ramamurthy (1995) in one application found that the greater the complexity the slower the rate of adoption. Ilie, et al (2005) found when referring to instant messaging women placed more importance on the ease of use than did men.

Trialability refers to the capacity to experiment with the new technology before adoption. Observability or visibility refers to the ease and relative advantage with which the technology can be seen, imagined, or described to the potential adopter. Ilie, et al (2005) found another variable, critical mass, to be the most significant predictor for the use of instant messaging.

Rogers identified four main elements that affected the adoption of innovation: (1) the innovation, (2) communication channels, (3) time, and (4) the social system. The innovation is the new product or service. The communication channel is the means by which messages are transmitted from one individual to another. Time refers to the amount of time it takes to adopt the new innovation. The social system is the set of interrelated units that are devoted to joint problem-solving, to accomplish a common goal (Rogers, 1995).

4. HYPOTHESIS

As a result of our literature review, we propose two research hypotheses that will be tested. The hypotheses focus on determining whether the diffusion of innovation model will fit IM behavior and use. In addition, Ilie, et al (2005) have proposed gender differences in IM DI factors. We have reviewed our factors for gender differences to best understand IM intentions and behavior.

H1: A model will be developed based on Rogers' Diffusion of Innovation theory and will have significant fit with Instant Messaging intention to use and actual behavioral usage.

H2: Instant Messaging based on Diffusion of Innovation will have significant gender differences.

5. METHODOLOGY

A survey was prepared and pretested with a small group of students at a northeastern US university. The survey was modified based on preliminary testing and administered to 128 students at a small southeast US university. The survey was a comprehensive survey of instant messaging behavior. A subset of this study included specific questions that developed into Diffusion of Innovation factors.

For each of the relevant factors, survey questions modeled prior research. Visibility, compatibility, relative advantage, complexity and intention factor questions were modeled after Ilie, et al. (2005), and behavior questions were based on common usage terminology and software piracy behavior factors in Woolley and Eining (2006). Trialability questions were inspired by He, Dun, Le, Fu (2005). In addition, critical mass was included as suggested by Ilie, et.al (2005) and the questions were based on that study. The questions used to develop the factors are presented in Appendix 1. Software used in the study were SPSS 16.0 and AMOS 16.

6. RESULTS

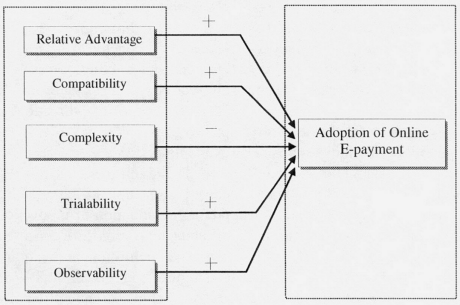
The first step was to analyze the survey results and perform factor analysis and scale reliability on the factors found. The factors tested were relative advantage, complexity, compatibility, trialability, visibility, critical mass, use intention, and behavior. Factor analysis and scale reliability were used to determine diffusion factors from our survey.

For relative advantage (RA) the questions 57 to 62 were analyzed to determine whether IM was seen as providing an advantage to the user. The results show one factor found through confirmatory factor analysis with an eigenvalue over 1, the minimum threshold for relevant factors (Moore, 2000). The eigenvalue of the one factor was 4.008. All components were significantly over the .5 minimum and scale reliability analysis showed a Chronbach's alpha of .90. This is well above the minimum acceptable of .7 (Nunnally, 1978).

All the other factors were analyzed in a similar fashion and the results are shown in Appendix 2. All of the factors found resulted in acceptable statistics. All had one factor found, an eigenvalue over 1, all components over .5, and a Chronbach's alpha over .7. Two factors required one item dropped from the factors. Complexity (CMPX) needed to drop the statement "Instant Messaging is frustrating" to obtain an alpha over .7. The inclusion of this statement would have resulted in an alpha of .6, below the cutoff. Visibility (VI) needed to drop the question "I have not seen many others using Instant Messaging" in order to have all factors over .5.

In order to test hypothesis one, the basic Rogers' diffusion model as well as modifications by Ilie, et. al (2005) were reviewed. The first attempt at developing a model for diffusion of instant messaging was to use the model unadjusted as proposed by Rogers. The basic model as proposed by Rogers is illustrated in figure 1 (He, Duan, Fu, & Li, 2006).

Figure 1. Theoretical model



The results of model are illustrated in figure 2 and the corresponding regression weights are in Appendix 3 and Table 1. All factors shown are significant at $p<.01$ except complexity (CMPX) which is not significant at even $p < .10$. The model and analysis was prepared with AMOS 16.0. This model does not meet the criteria for proper fit. Chi square divided by degrees of freedom is 15.4 which is well over the minimum acceptable 3.0 and RMSEA is .234 which is also well above the minimum acceptable of .08 (Moore, 2000).

Figure 2 Rogers Model

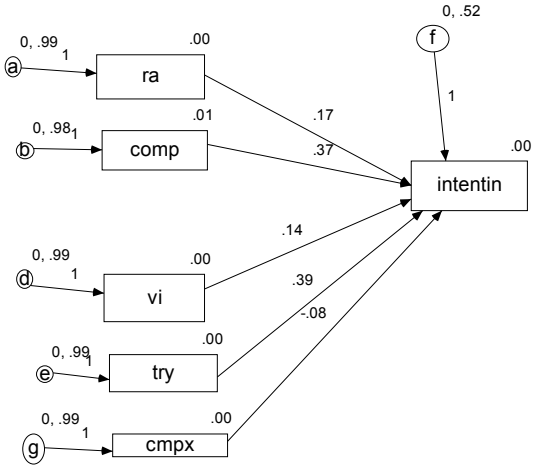


Table 1 Standardized Regression Weights: (Group number 1 - Default model)

			Estimate
intentin	<---	ra	.187
intentin	<---	comp	.395
intentin	<---	try	.421
intentin	<---	vi	.149
intentin	<---	cmpx	-.084

The second model then started with taking out complexity. One study (Lou, Luo, & Strong, 2000) found that critical mass or having a sufficient number of people using the technology had a significant impact on groupware use. Critical mass also suggests wider applicability (McGrath & Zell, 2001). As an example, who would want the first telephone? You need to have others to call to make the telephone worthwhile. Ilie, et al (2005) suggested critical mass as an important variable for all communication innovations. Based on the findings of these researchers, critical mass (CM) was added to our IM diffusion of variables model. The resulting model is shown in figure 3. Note that all factors have a significant influence on intention except visibility VI. The results are shown in Appendix 4 and Table 2. The Chi square divided by degrees of freedom is 20.6 which is well over the minimum acceptable 3.0 and RMSEA is .268 which is also well above the minimum acceptable of .08 (Moore, 2000).

Figure 3 Diffusion of Innovation model for IM without complexity but including critical mass

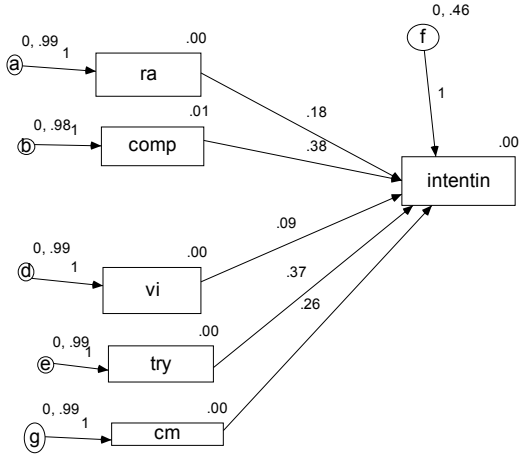


Table 2 Standardized Regression Weights: (Model 2, Group number 1 - Default model)

			Estimate
intentin	<---	ra	.190
intentin	<---	comp	.415
intentin	<---	try	.395
intentin	<---	vi	.098
intentin	<---	cm	.281

As noted, visibility was not a significant variable in the previous model. Therefore a final version was run with it excluded. Without Visibility, or Complexity but with critical mass; all are factors were significant (Appendix 5 and Table 3). This model (illustrated in figure 4) is a good fit for the data and represents a usable model of IM intention to use. The chi square statistic divided by the degrees of freedom is 1.8 which is less than the required maximum 3.0 and the RMSEA is .079 which is less than the required maximum.08. These are prime indicators that the model fits (Moore, 2000). Total R squared which represents the percentage of variance explained by the model is .483. This means that approximately one half of the adoption of IM into an intention to use IM is explained by the model.

Figure 4. Final Diffusion of Innovation model for IM without complexity and without visibility but including critical mass

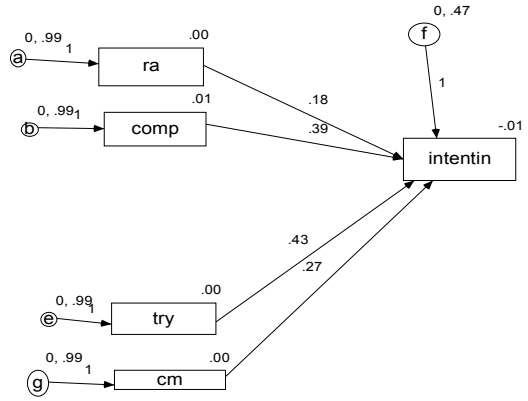


Table 3 Standardized Regression Weights: Final Model

			Estimate
intentin	<---	ra	.194
intentin	<---	comp	.407
intentin	<---	try	.447
intentin	<---	cm	.281

Hypothesis two

Ilie, et. al (2005) suggested that there were differences between diffusion of innovation factors on user intention based on gender. Our study found little difference between males and females. Separate regression analyses were performed for both males and females. In both scenarios the R2 or amount of explained variance was between .53 and .54. For both genders, the same variables were significant, relative advantage, trialability, critical mass, and compatibility (Appendix 6 and 7). The only significance change is relative advantage which is significant at $p < .05$ for males but only at $p < .10$ for females. A t test was also performed between males and females for each factor and the only significant difference was found in relative advantage at $p < .05$. As a result, the second research hypothesis was rejected. There was no significant difference between genders in our factors influencing IM. Both genders can use the model for prediction of intention.

Finally, a test was made to determine the correlation between intention and actual behavior. A high degree of correlation was found and the relationship was significant at $p < .001$. It can safely be assumed that intention to use IM leads to actual IM use.

7. IMPLICATIONS, LIMITATIONS, AND DISCUSSION

Overall the results indicate general support for DI theory for the adoption of a communication technology, specifically instant messaging. It has been proposed that instant messaging provides unique advantages over other electronic communications methods such as email. But despite these advantages, instant messaging is used much less frequently in both individual and business usage. Understanding the factors associated with intention and behavior associated with instant messaging suggests areas that can be focused on to increase instant messaging usage. A limitation of the study is the use of students. The study could be replicated with older individuals, but the students of today will become the employees of tomorrow so the limitation may not be as significant as first proposed.

It was found that compatibility, critical mass, trialability, and intention were all significant factors influencing the use of instant messaging. In addition, critical mass is also an important factor in the use of instant messaging; in fact, it is the most important factor affecting the use of instant messaging. The growth in instant messaging use by students has been fueled by a social circle incentive. Those in the group have more social interaction and pressure exists to belong to this communication circle. This can expand through wider usage by the sampled population.

This has important implications for practitioners. For businesses and organizations, there are fewer users and fewer pressures to use IM. Clearly though, concerted efforts on the part of management to both use and encourage the use of IM can increase intention to use IM and should be undertaken. Education in schools and in the workplace on the benefits, advantages, and details of instant messaging is suggested to allow further penetration of this useful technology and improve overall communications. This could have significant positive cost and productivity improvements for businesses and organizations. In our study, intention to

use was found to be a significant factor influencing actual behavior. This is also supported in the literature. As proposed in the original Ajzen and Fishbein model (1980), intention to use instant messaging is positively associated with use of instant messaging. Many researchers (Gupta & Kim, 2007; Shimp & Kavas, 1984; Tarkiainen & Sundqvist, 2005) have supported this relationship. Since our overall objective is to study and improve overall behavior, it was important that this relationship was established. It was found that complexity and visibility were not significant factors in the intention to use instant messaging. Complexity as a non-factor could be related to the inherent ease of instant messaging or the lack of complexity being important when there are significant communication benefits. Visibility was surprisingly not an important factor. This is probably related to the concept of instant messaging as a solitary activity. Others do generally not see people instant messaging, so visibility is not important. Finally, the study also found little difference between male and female usage. The only significant factor was the relative advantage in the use of IM. Ilie et al. (2005) found that gender moderates the relative advantage, ease of use, visibility, and perceived critical mass on the intention to use IM. Our study did support only one of Ilie's findings, that there are gender differences in how the relative advantage influences their intentions to use instant messaging.

8. CONCLUSION

Overall this study has provided significant factors that influence and model instant messaging intention and behavior. We see this as the start of an exploration of ways to increase and improve penetration of this valuable communications technology. Studies can be undertaken to confirm these findings with larger and more diverse sample groups, but preliminary findings suggest that instant messaging does adhere to the modified diffusion of innovation model and is thus subject to efforts to improve behavior through attention to the significant influencing factors of compatibility, critical mass, trialability, and relative advantage. The authors welcome efforts to assist in this research.

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APPENDIX 1 SURVEY QUESTIONS AND FACTOR COMPONENTS

CMPX	Instant messaging is frustrating.
CMPX	Instant messaging requires a lot of mental effort.
CMPX	Instant messaging is cumbersome.
COMP	Instant messaging is compatible with how I communicate.
COMP	Instant messaging fits well with how I like to communicate.
COMP	Instant messaging is completely compatible with my current situation.
COMP	Instant messaging fits my style.
RA	Instant messaging allows me to exercise greater control over my life.
RA	Instant messaging improves my performance.
RA	Instant messaging improves my effectiveness.
RA	Instant messaging allows me to accomplish my goals more quickly.
RA	Instant messaging provides an overall advantage to me.
RA	Instant messaging improves my productivity.
VI	I have seen many people instant messaging.
VI	It is easy to observe others instant messaging.
VI	There is plenty of opportunity to see others instant messaging.
VI	I have not seen many others instant messaging.
VI	I have seen others instant messaging.
TRY	It is easy to try Instant messaging.
TRY	It is easy to first do Instant messaging.
TRY	I had little difficulty using Instant messaging on a trial basis.
TRY	There is low financial risk in trying Instant messaging.
BEH	I plan to use instant messaging in the future.
BEH	I currently use instant messaging.
BEH	I will continue to use instant messaging.
UI	I think it is a good idea to buy things over the Internet.
UI	I see myself buying things over the Internet.
UI	I like the idea of buying things over the Internet.
UI	I would buy things over the Internet.
CM	Many people I know use Instant Messaging.
CM	Many people use Instant Messaging.
CM	Many people I know will continue to use Instant Messaging.

APPENDIX 2 FACTOR STATISTICS

Factor	# factors found through CFA	Eigenval. of one Factor	All Components over .5	Cronbach's alpha
CMPX	1	1.584	Yes	.734
COMP	1	3.410	Yes	.941
RA	1	4.008	Yes	.900
VI	1	3.017	Yes	.890
TRY	1	2.726	Yes	.814
BEH	1	2.701	Yes	.940
UI	1	3.359	Yes	.936
CM	1	2.621	Yes	.927

APPENDIX 3 ORIGINAL ROGERS MODEL REGRESSION WEIGHTS

REGRESSION WEIGHTS: (GROUP NUMBER 1 - DEFAULT MODEL)

			Estimate	S.E.	C.R.	P	Label
intentin	<---	ra	.174	.066	2.631	.009	par_1
intentin	<---	comp	.370	.066	5.604	***	par_2
intentin	<---	try	.393	.065	6.050	***	par_3
intentin	<---	vi	.139	.065	2.128	.033	par_4
intentin	<---	cmpx	-.078	.066	-1.181	.238	par_5

APPENDIX 4. REGRESSION WEIGHTS: MODEL 2

			Estimate	S.E.	C.R.	P	Label
intentin	<---	ra	.176	.063	2.813	.005	par_1
intentin	<---	comp	.384	.062	6.167	***	par_2
intentin	<---	try	.365	.061	5.948	***	par_3
intentin	<---	vi	.091	.062	1.472	.141	par_4
intentin	<---	cm	.260	.062	4.159	***	par_5

APPENDIX 5. REGRESSION WEIGHTS: FINAL MODEL

			Estimate	S.E.	C.R.	P	Label
intentin	<---	ra	.185	.063	2.947	.003	par_1
intentin	<---	comp	.389	.062	6.233	***	par_2
intentin	<---	try	.426	.062	6.922	***	par_3
intentin	<---	cm	.268	.063	4.279	***	par_4

APPENDIX 6. MALES REGRESSION COEFFICIENTS WITH FINAL MODEL

Coefficients[a,b]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.047	.112		-.424	.674
	try	.398	.121	.372	3.291	.002
	cm	.348	.119	.336	2.920	.006
	ra	.200	.098	.233	2.037	.049
	comp	.444	.118	.420	3.752	.001

a. Dependent Variable: intentin

APPENDIX 7. 10 FEMALES REGRESSION COEFFICIENTS WITH FINAL MODEL

Coefficients[a,b]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.010	.084		-.117	.907
	try	.461	.089	.462	5.207	.000
	cm	.224	.087	.223	2.579	.012
	ra	.170	.095	.146	1.796	.077
	comp	.370	.082	.371	4.495	.000

a. Dependent Variable: intentin

b. Selecting only cases for which var00003 = f