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Editors

Text Messaging Today: A Longitudinal Study of Variables Influencing Text Messaging from 2009 to 2016

Alan Peslak
arp14@psu.edu
Penn State University
Scranton, PA

D. Scott Hunsinger
hunsingerds@appstate.edu
Appalachian State University
Boone, NC

S. E. Kruck
kruckse@jmu.edu
James Madison University
Harrisonburg, VA

Abstract

This paper shares the results of our longitudinal study of text messaging. The same survey was given at 2 institutions seven years apart. All variables showed a gain in positive valence from 2009 to 2016. In other words, all variables were more positive in 2009 versus 2016. For nearly all these variables, these differences were significant. The influencing variables from many popular behavioral models including Theory of Reasoned Action, Theory of Planned Behavior, Technology Acceptance Model, End User Computer Satisfaction, and to a lesser extent Diffusion of Innovation all were found to have increased over the seven years.

Keywords: Text Messaging, Theory of Reasoned Action, Theory of Planned Behavior, Technology Acceptance Model, End User Computer Satisfaction, Diffusion of Innovation

1. INTRODUCTION

We hear all the time on the news that text messaging is one of the most used data phone services and how often those without unlimited text messaging incur very large bills. A few recent stats indicate how popular text messaging has become. The number of monthly texts sent increased more than 7,700% over the last decade and over 18.7 billion texts are sent worldwide every day (not including app to app) (Statistic Brain, 2014). Furthermore, 4.2 billion+ people

text worldwide (Burke, 2015). But a question is whether this increase is due to sheer growth by necessity or whether there has been a corresponding increase in influencing variables that affects this increase.

This paper will share our longitudinal study using variables from five models on human behavior to determine whether there has been a corresponding increase in influencing variables that affects the increase in text messaging usage. Those five models are: End User Computer

Satisfaction (EUCS); Theory of Reasoned Action (TRA); Theory of Planned Behavior (TPB); Technology Acceptance Model (TAM) and Diffusion of Innovation (DI). Each of the variables will be explored using each of the five models.

2. LITERATURE REVIEW

Text messaging
Nielsen (2013) reports that text messaging (SMS) is the most used data service in the world. Over the last decade, the number of texts sent has increased by more than 7,700% (Statistic Brain, 2014). More than 560 billion texts are sent monthly worldwide, including over 6 billion texts sent daily in the United States alone (Burke, 2016).

It has been estimated that 97% of American adults text on a weekly basis (Smith, 2015), with the average adult texting 23 hours per week (Wolff, 2014). According to Gallup (Newport, 2014), texting is the most common form of communication for adults under 50 years old in the United States. On average, college students spend over 90 minutes texting per day (Wood, 2014). As shown in Table 1, texting has become popular for a wide range of age groups, as even those individuals over 55 years of age send and receive an average of 16 texts per day.

Age Range	Approximate Number of Texts Sent and Received Daily
18 – 24	128
25 - 34	75
35 - 44	52
45 - 54	33
55+	16

Table 1: Number of Texts Sent and Received Daily by Age Group

Text messages are much more likely to be opened than emails, as SMS messages have a 98-99% open rate while email's open rate is 20% (Burke, 2016; Essany, 2014). The response rate for text messages (45%) is also higher than the response rate for email messages (6%) (Small, 2013). Forbes reported that 95% of texts are read within three minutes of when they were sent, with an average response time of 90 seconds. Text messages also take less time to read - approximately 5 seconds, on average (Burke, 2016).

Review of Relevant Theories
This paper integrates variables from multiple relevant theories in order to examine their influence from our previous work (**blind this – previous study**) and our data collection completed in 2016. We used variables from the following models.

- Diffusion of Innovation Theory (*Compatibility; Complexity; Relative Advantage; Visibility*)
- End User Computing Satisfaction (*Timeliness*)
- Theory of Reasoned Action (*Attitude*)
- Theory of Planned Behavior (*Perceived Behavioral Control*)
- Technology Acceptance Model (*Ease of Use; Usefulness*)

In the following subsections, we provide a brief overview of each of these theories.

Diffusion of Innovation Theory
The Diffusion of Innovation theory (Rogers, 1962; Rogers, 2003) seeks to explain how, why, and how quickly new ideas and technology spread. As shown in Figure 1, adopters are grouped into into five categories: Innovators, Early Adopters, Early Majority, Late Majority, and Laggards.
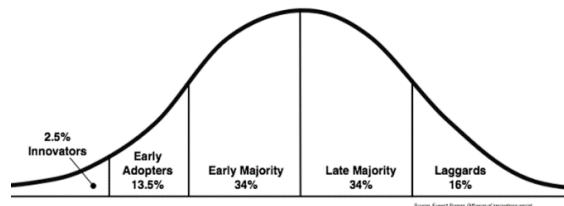
Figure 1: Diffusion of Innovation

Rogers (2003) identified five major factors that impact the rate of adoption. These factors include relative advantage, complexity, compatibility, trialability, and observability or visibility. The adoption of an innovation or technology follows an S curve when it is plotted over a period of time (Fisher, 1971). Critical mass occurs when enough people have adopted the innovation and its rate of adoption becomes self-sustaining (Rogers, 2003).

End User Computing Satisfaction
Doll and Torkzadeh (1988) developed the End User Computing Satisfaction model using the five factors shown in Figure 2: Content, Accuracy, Format, Ease of Use, and Timeliness. They suggested a twelve question instrument to measure these five components. Our study uses

the Timeliness factor, which measures whether the information is up to date and was supplied in time.
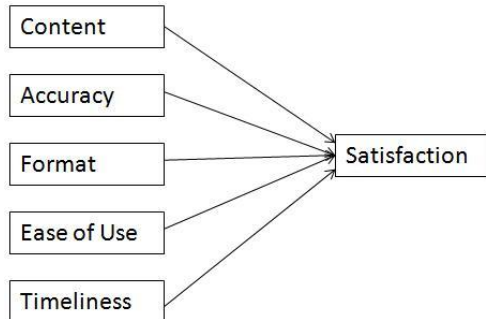
Figure 2: End User Computing Satisfaction

Technology Acceptance Model
The Technology Acceptance Model examines an individual's willingness to adopt technology (Davis, 1989). The Technology Acceptance Model uses two factors to measure an individual's intention of adopting a technology: 1) Perceived Usefulness and 2) Perceived Ease of Use. Perceived Usefulness is defined as "the degree to which a person believes that using a particular system would enhance his or her job performance." Perceived Ease of Use is defined as "the degree to which a person believes that using a particular system would be free of effort" (Davis, 1989). Our study integrates the perceived usefulness and perceived ease of use components from the Technology Acceptance Model as shown in Figure 3.
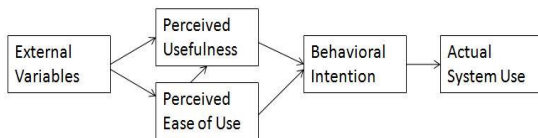
Figure 3: Technology Acceptance Model

Theory of Reasoned Action
According to the Theory of Reasoned Action (Fishbein & Ajzen, 1975), an individual's performance of a specific behavior is determined by his or his/her individual's attitude and his/her subjective norm about the behavior. As shown in Figure 4, a person's intention to perform a specific behavior leads to increased effort and likelihood for the behavior to be actually performed.
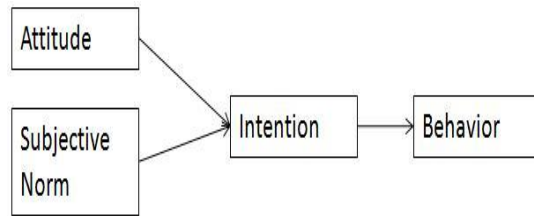

Figure 4: Theory of Reasoned Action

Theory of Planned Behavior
The theory of planned behavior, shown in Figure 5, expands the theory of reasoned action by adding the construct of Perceived Behavioral Control (PBC) in order to deal with behaviors under incomplete volitional control. Performance of behaviors that are not under total volitional control may depend on the availability of opportunities and resources such as time, money, skills, and the cooperation of others (Ajzen, 1991).
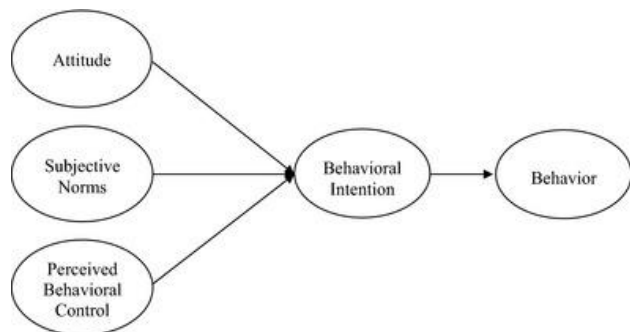
Figure 5: Theory of Planned Behavior

Role of Emotions
Previous research has shown that emotions can impact performance and behavior (Glinow, Shapiro, and Brett, 2004; Peslak and Stanton, 2007; Sy, Cote, and Saavedra, 2005). Our study integrates a group of four positive emotions used in our previous work.

3. RESEARCH APPROACH

A comprehensive survey was developed to explore all aspects of text messaging usage in 2009. The survey included key questions used in the development of past studies of Theory of Reasoned Action, Technology Acceptance Model, Theory of Planned Behavior, End User Computer Satisfaction, and Diffusion of Innovation. The same survey was used for 2016. Table 2 shows the variables and questions that were used in this

study. Appendix 1 shows the variable, question, model, and source for question.

Our primary research goal was to determine how various variables associated with technology adoption changed with regard to text messaging from 2009 to 2016.

One key question was selected for each variable. This survey was administered in 2009 to students and other University personnel at two Northeastern Universities. Many results were published as a result of this survey **(blinded).** The exact same survey was repeated in 2016 to see if attitudes towards text messaging had changed over time. The study this time was administered at three Northeastern Universities and though the same subjects were not available for the 2016 study, they were drawn from the same demographic pool as the 2009 study.

Variable	Actual survey question
Attitude	Text messaging is good.
Compatibility	Text messaging is completely compatible with how I communicate.
Complexity	Text messaging requires a lot of mental effort.
Critical Mass	Many people I know will continue to use text messaging.
Ease of Use	Text messaging is easy to do.
Emotions	Pleased Satisfied Contented Delighted
Perceived Behavioral Control	Text messaging is entirely within my control.
Relative advantage	Text messaging improves my productivity.
Timeliness	Text messaging provides needed information quickly.
Usefulness	I find Text messaging useful.
Visibility	I have seen many people Text messaging.

Table 2: Variable Models and References

All questions were scaled from 1 to 7 with 1 being Strongly Disagree and 7 being Strongly Agree. Four was a Neutral view. All the questions except the one used to measure Complexity were positive questions (good, pleased, compatible) so the higher the score the higher the favorability toward text messaging. By having all scaled similarly, relative comparisons could be made across all variables. The one exception to positive questions was Complexity in Diffusion of Innovation Theory, Text messaging requires a lot of mental effort which is a negative question. The

same survey instrument was used in 2009 and in 2016.

The statistical analyses were based on a sample of 153 valid surveys in 2009 and 162 valid surveys in 2016.   Since the surveys were collected in classes, response rate was near 100%. The 2009 survey however included a strong mix of faculty and other professionals. In order to properly compare 2009 with 2016, only self-identified students were included in the survey analysis. This resulted in 72 respondents from 2009 and 141 from 2016. The gender mix was higher in females in 2009 versus 2016 as shown in table 2. A prior study **(blinded)** however found no significant difference between females and males in all these variables except emotions. The age distribution is shown in Table 3 and the gender distribution is shown in Table 4. Most students in both 2009 and 2016 were in the 18-24 age bracket. We propose the sample has a comparable mix of gender and age.

		09or16		
		1	2	Total
18-24	Count	84	144	228
	% within 09or16	97.7%	92.9%	94.6%
25-30	Count	0	10	10
	% within 09or16	0.0%	6.5%	4.1%
31-40	Count	0	1	1
	% within 09or16	0.0%	0.6%	0.4%
41-50	Count	2	0	2
	% within 09or16	2.3%	0.0%	0.8%
Total	Count	86	155	241
	% within 09or16	100.0%	100.0%	100.0%

Table 3 Age

		09 or16		
		Female	Male	Total
2009	Count	47	64	111
	% within 09or16	54.7%	41.0%	45.9%
2016	Count	39	92	131
	% within 09or16	45.3%	59.0%	54.1%
	Count	86	156	242
	% within 09or16	100.0%	100.0%	100.0%

Table 4 Gender

4. RESULTS

The variables were analyzed using SPSS 22.0 using Independent Samples t-tests. The results of this analysis are presented in Tables 5 and 6. Table 5 shows the mean for each of the influencing variables. Table 6 shows the results of the t-test to determine whether the differences between 2009 and 2016 were statistically significant. Overall, it can be said that nearly all variables showed an increase in positive effect between 2009 and 2016. In the two situations where a decrease was shown this decrease was found not to be statistically significant. Our overall assessment is that for all variables across all popular behavioral models studied, text messaging is seen more favorably in 2016 than in 2009. Supporting this conclusion was a separate studied variable, Time Spent text messaging. This significantly increased from a mean of 4.18 to 4.62 from 2009 to 2016. This takes us from a "4", which is 3 hours per month, to nearly a "5" which is 10 hours per month. Not only is it viewed more favorably but also significantly more time is spent using it. It has become an integral form of communication in our society. An analysis of each of the variables follows.

	09or16	Mean
Is good	2009	4.96
	2016	5.59
Is compatible	2009	4.68
	2016	4.66
Requires mental effort	2009	2.76
	2016	2.85
Many people	2009	5.08
	2016	6.50
Easy to do	2009	5.04
	2016	6.05
Pleased	2009	2.68
	2016	4.82
Satisfied	2009	2.59
	2016	4.89
Contented	2009	2.68
	2016	4.86
Delighted	2009	2.63
	2016	4.69
Within my control	2009	5.08
	2016	5.55
Improves my productivity	2009	4.67
	2016	4.61
Information quickly	2009	5.18
	2016	5.73
Useful	2009	5.13
	2016	6.00
Seen many people	2009	5.41
	2016	6.28
,	2009	6.44
	2016	6.62
Time	2009	4.18
	2016	4.62

Table 5 Variable Means

t-test for Equality of Means		Sig. (2-tailed)
Is good	Equal var	0.006
Is compatible	Equal var	0.943
Requires mental effort	Equal var	0.716
Many people	Equal var	0.000
Easy to do	Equal var	0.000
Pleased	Equal var	0.000
Satisfied	Equal var	0.000
Contented	Equal var	0.000
Delighted	Equal var	0.000
Within my control	Equal var	0.037
Improves my productivity	Equal var	0.810
Information quickly	Equal var	0.012
Useful	Equal var	0.000
Seen many people	Equal var	0.000
Often	Equal var	0.205
Time	Equal var	0.023

Table 6 Independent samples t test

"Text messaging is good" measures overall attitude toward the activity. It is a key influencing variable in both Theory of Reasoned Action and Theory of Planned Behavior. In these models it influences behavioral intention which then influences actual behavior. The rating here rose from 4.96 in 2009 to 5.59 in 2016. This moves the favorable rating from a 5 or somewhat agree to nearly a 6, Agree. This increase was statistically significant at p <.006. Text messaging is viewed better in 2016 versus 2009.

"Text messaging is completely compatible with my current situation" measures overall compatibility toward the activity. It is a key influencing variable in Diffusion of Innovation theory. In this model it influences behavioral intention which then influences actual behavior. The rating here fell slightly from 4.68 in 2009 to 4.66 in 2016. This increase was not statistically significant at p <.05. Text messaging is viewed with the same compatibility in 2016 versus 2009.

"Text messaging requires a lot of mental effort" measures overall complexity of the activity. It is a key influencing variable in both Diffusion of Innovation theory. In this model it influences behavioral intention which then influences actual behavior. The rating here rose from 2.76 in 2009 to 2.85 in 2016. This is a small increase in the unfavorable variable but this increase was not statistically significant at p <.005. Text messaging is viewed as requiring the same mental effort in 2016 versus 2009.

"Many people use Text messaging" measures critical mass of the activity. It is a key influencing variable in Diffusion of Innovation theory. In this model it influences behavioral intention which then influences actual behavior. The rating here rose from 5.08 in 2009 to 6.50 in 2016. This moves the favorable rating from a 5 or somewhat agree to nearly a 7, Strongly Agree. This increase was statistically significant at p <.001. Text messaging is seen as being used more in 2016 versus 2009.

"Text messaging is easy to do" is ease of use of the activity. It is a key influencing variable in both Technology Acceptance Model and End User Computer Satisfaction. In these models it influences behavioral intention which then influences actual behavior. The rating here rose from 5.04 in 2009 to 6.05 in 2016. This moves the favorable rating from a 5 or somewhat agree to over a 6, Agree. This increase was statistically significant at p <.001. Text messaging is seen as easier to use in 2016 versus 2009.

"Pleased, satisfied, contented and delighted" are emotions associated with overall attitude toward the activity. It is a key influencing variable in models of Emotions. In these models it influences behavioral intention which then influences actual behavior. The rating here rose from about 2.6 in 2009 to about 4.8 in 2016. This moves the favorable rating from a 3 or somewhat disagree to nearly a 5, Somewhat Agree. This increase was statistically significant at p <.001. The emotions associated with text messaging have changed a great deal for the better in 2016 versus 2009.

"Text messaging is entirely within my control" is perceived behavioral control toward the activity. It is a key influencing variable in Theory of Planned Behavior. In this model it influences behavioral intention which then influences actual behavior. The rating here rose from 5.08 in 2009 to 5.55 in 2016. This moves the favorable rating from a 5 or somewhat agree to nearly a 6, Agree.

This increase was statistically significant at p <.037. Respondents feel more in control with text messaging in 2016 versus 2009.

"Text messaging improves my productivity" measures relative advantage of the activity. It is a key influencing variable in Diffusion of Innovation. In this model it influences behavioral intention which then influences actual behavior. The rating here rose from 4.67 in 2009 to 4.61 in 2016. This decrease in the favorable rating was not statistically significant at p <.05. Text messaging is viewed the same in productivity improvement in 2016 versus 2009.

"Text messaging provides needed information quickly" measures timeliness of the activity. It is a key influencing variable in End User Computer Satisfaction. In this model it influences behavioral intention which then influences actual behavior. The rating here rose from 5.18 in 2009 to 5.73 in 2016. This moves the favorable rating from a 5 or somewhat agree to nearly a 6, Agree. This increase was statistically significant at p <.012. Text messaging is viewed as providing information more quickly in 2016 versus 2009.

"I find Text messaging useful" is usefulness toward the activity. It is a key influencing variable in Technology Acceptance Model. In this model it influences behavioral intention which then influences actual behavior. The rating here rose from 5.13 in 2009 to 6.00 in 2016. This moves the favorable rating from a 5 or somewhat agree to nearly a 6, Agree. This increase was statistically significant at p <.001. Text messaging is viewed as more useful in 2016 versus 2009.

"I have seen many people Text messaging" measures usefulness of the activity. It is a key influencing variable in both Theory of Diffusion of Innovation Theory. In this model it influences behavioral intention which then influences actual behavior. The rating here rose from 5.41 in 2009 to 6.28 in 2016. This moves the favorable rating from a 5 or somewhat agree to nearly a 6, Agree. This increase was statistically significant at p <.001. Text messaging is viewed as more ubiquitous in 2016 versus 2009.

A final measure which confirms that the majority of variables potentially affecting text messaging usage has indeed increased usage is the measure of time spent using text messaging. The measure here rose from 4.18 in 2009 to 4.62 in 2016. The scale used here indicated "4" as 3 hours per month and "5" as 10 hours per month. Our respondents significantly increased their time text messaging at p < .001. Interpolating these measures suggests an approximate increase from 4.26 hours per month to 7.34 hours per month.

5. LIMITATIONS

As with any study, there are limitations. We used a convenience sample of undergraduate students at two university locations. Although students are significant users of text messaging, they are a select population in the 18-24 age bracket. The figure 6 below shows that although 18-24 send the most text messages, it is used by all ages (Burke, 2016). It was not a surprise that text messaging is seen as more favorable for 18-24 year olds because of the increase in usage. And the increase in usage means there is an increase in time spent text messaging, almost 8 hours per month. Test messaging in personal use has increased but so has text messaging for business purposes. It is the highest rated contact method for customer satisfaction compared to all other communication channels (Text – 90; Phone – 77; Facebook – 66) (Eddy, 2014). Not only is it a preferred method, it costs a company's customer service center a lot less; pennies per conversation instead of several dollars (Varley, 2014).
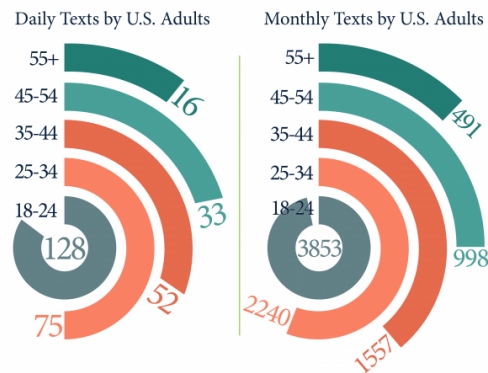

Figure 6 Text Trends
This study should be replicated with other populations, other age groups, and again in another 7 years.

6. CONCLUSION

Overall, this longitudinal study of text messaging has provided significant variables that influence and affect text messaging frequency of use and time spent using the technology has increased in the last 7 years. We see this as the continuation of an exploration of ways to increase and improve penetration of this valuable communications technology. With a high rate of acceptance, more and more businesses are likely to text message with their customers. We conclude that text messaging has not just grown due to popularity

but has grown due to specific influencing variables from each of the five studied theories of technology adoption.

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Appendix

Table 1: Variable Models and References

Variable	Actual survey question	Model	Questions adapted from
Attitude	Text messaging is good.	Theory of Reasoned Action/TPB	Fitzmaurice
Compatibility	Text messaging is completely compatible with how I communicate	Diffusion of Innovation	Ilie, Van Slyke, Green, & Lou
Complexity	Text messaging requires a lot of mental effort	Diffusion of Innovation	Ilie, Van Slyke, Green, & Lou
Critical Mass	Many people I know will continue to use text messaging	Diffusion of Innovation	Ilie, Van Slyke, Green, & Lou
Ease of Use	Text messaging is easy to do.	Technology Acceptance Model /EUCS	Davis [8]
Emotions	Pleased Satisfied Contented Delighted	Emotions	Peslak and Stanton
Perceived Behavioral Control	Text messaging is entirely within my control.	Theory of Planned Behavior	Venkatesh & Morris
Relative advantage	Text messaging improves my productivity.	Diffusion of Innovation	George
Timeliness	Text messaging provides needed information quickly	End User Computer Satisfaction	Fitzmaurice
Usefulness	I find Text messaging useful	Technology Acceptance Model/ECT	Abdinnour-Helm, Chaparro, & Farmer
Visibility	I have seen many people Text messaging.	Diffusion of Innovation	Davis