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TAM or VFM? Which Model Matches How People Ascribe Actually Value?

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ABSTRACT

The IT community has a long history of developing theory to explain when people will change their behaviors to adopt new technology systems. Two current technology adoption theories, the Technology Adoption Model and the Value Frequency Model, draw from different groups of referent theory: Reasons Theories (RTs) and Expectancy Value Theories (EVTs). RTs and EVTs make different assumptions about how people form attitudes toward behavioral changes (i.e., to adopt or not). Having a better understanding of how people make judgments that affect their behavioral choices could help guide the choice of referent theory when developing new IT theory. This study examined how people responded to attitude-shaping scenarios as a way to gain insight into the assumptions that could be guiding their choices. Their responses indicated a tendency to assign values in ways consistent with the assumptions and processes articulated in EVTs.

Keywords

Theory building, referent theory, Technology Acceptance Model, TAM, Value Frequency Model, VFM.

INTRODUCTION

Two major theoretical perspective have been used to help explain how people choose behaviors: Reason Theories (RTs) and Expectancy Value Theories (EVTs) (Westaby, 2002). Models based on these perspectives have been developed to explain behavioral choices for job choice (Lawler III, Kuleck Jr., Rhode and Sorensen, 1975), performance of leadership tasks (House, 1971), and managerial motivation techniques (Campbell, Dunnette, Lawler III and Weick, 1970). Within the IT domain, research has focused on trying to explain and predict when people will choose to use new technologies. The most prominent IT theory, the Technology Acceptance Model (TAM), was explicitly modeled on RTs (Davis, Bagozzi and Warshaw, 1989). The Value Frequency Model (VFM), an emerging theory that seeks to explain and predict when people would be willing to change to a new technology-based work practice, takes an EVT-based approach.

While both the RT and EVT perspectives have been useful in multiple domains, there are notable differences in the assumptions they are based on and the ways in which they model motivation toward contemplated actions (e.g. change). It could, therefore, be useful to gain more insight into the degree to which people's behavior is consistent with these perspectives' assumptions. Developing a better understanding of their choice process could help guide the selection of appropriate referent theory when developing new theory within our IT domain.

Toward that end we have designed a study with an instrument that we believe provides insight into the core mechanisms that could be guiding the choice process. In the next section, we discuss the foundations of the two choice models and show how they have been used in the IT domain. Then we describe the design of a study that we believe illuminates the mechanisms of individual choice. We follow that by explaining the results of our survey and close with a discussion of possible implications of those results.

THEORETICAL BACKGROUND

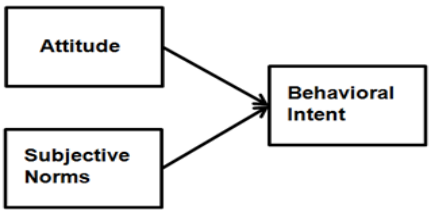
Scholars in both the RT and EVT perspectives have long studied the relationship between attitude and behavior to identify specific factors that motivate behavioral choices and have developed numerous theories that explain and predict those choices (Ajzen and Fishbein, 1973; Brett and Reilly, 1988; Rosenberg, 1956; Vroom, 1964; Westaby and Fishbein, 1996). The EVTs and the RTs both assume that 1) attitude shapes individual behavior, and 2) attitude thus determines how people will respond to changes (Westaby, 2002). However, EVTs assume a holistic, generalized assessment of the values that one could derive from a potential change in behavior, whereas RTs assume a more systematic mechanism.

EVTs define e*xpectancies* as how strongly individuals believe specific outcomes will result from a given behavior, and *value* as an assessment of how beneficial or detrimental they expect those outcomes could be (Rosenberg, 1956). EVTs describe *attitude* as an affective response that reflects a preference for a particular behavior (Vroom, 1964). EVTs assume

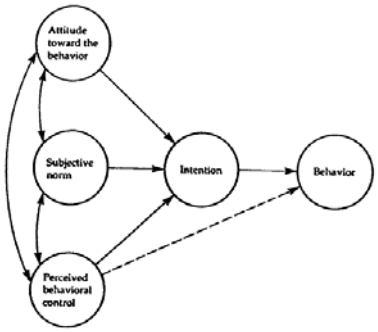
expectancies and values interact to shape attitudes and thereby drive behavioral intent (e.g. willingness to change) (Westaby, 2002).

Various EVT-based theories use and combine these factors in slightly different ways to describe precisely how expectancies and values interact to shape attitude. For example, Instrumentality Theory (Rosenberg, 1956) portrays a process where the individual estimates the value of a behavior's potential outcomes and then weights that value with an estimate of the expectancy of that outcome. Valence Theory (Vroom, 1964) uses the same value-expectancy calculation, but then weights it again with an estimate of how frequently one expects to experience that value. While the EVT-based formulas vary from theory to theory, the core assumptions are that people assign general values to form one overall attitude assessment that determines their intention to behave in a particular way.

Like EVTs, RTs posit that attitude determines behavior, but they take a different approach to assessing attitude. Instead of a single value-based attitude construct that explains intention, RTs propose multiple context-specific constructs to explain intention (Westaby, 2002). These theories assume that each factor contributes independently and is carefully considered in a more rational process than was assumed in EVT-based theories. Figure 1 depicts two prominent RT-based models. TRA posited that behavioral intentions arise from an individual's attitude and the subjective norms surrounding the behavior (Ajzen et al., 1973). TPB extended TRA by adding another new factor and proposing relationships between intention's antecedents.



Theory of Reasoned Action (Ajzen et al., 1973)



Theory of Planned Behavior (Ajzen, 1991)

Figure 1: Examples of Reason Theories

IT scholars have drawn from both the EVT and RT lines of theory to develop theory to explain and predict when people could be willing change to new IT systems. TAM was explicitly modeled on TRA to explain computer acceptance (Davis et al., 1989). It used TRA's core Attitude–Behavioral Intention mechanism plus two external factors, Perceived Usefulness and Perceived Ease of Use, to explain a user's attitude toward using a technology (Figure 2). Subsequent iterations of TAM have led to the inclusion of 15 separate factors in TAM3 (Venkatesh and Bala, 2008).

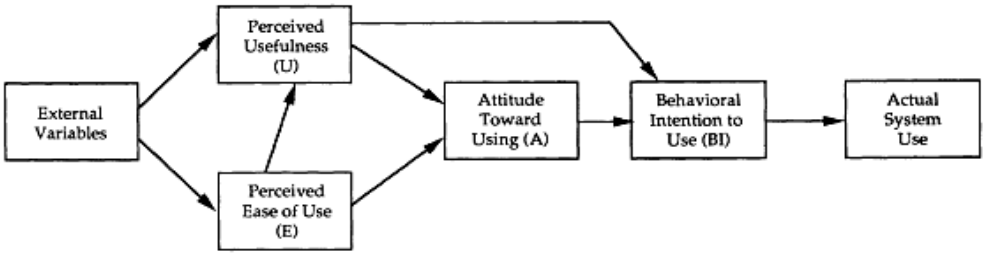


Figure 2: The Technology Acceptance Model (Davis, 1989)

VFM, a newer model that situates change of behavior in the IT context, seeks to explain and predict willingness to change work practices (Briggs, 2006). As shown in Figure 3, VFM posits that Value and Frequency interact and are then moderated by Certainty and the value one ascribes to the change process to determine Change of Practice. This model mirrors the core components of Valence Theory, a prominent EVT, with the addition of the Transition Value construct.

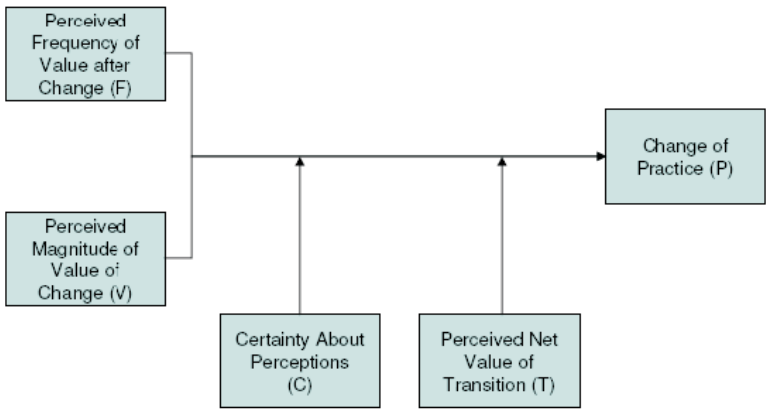


Figure 3: The Value Frequency Model (Briggs, 2006)

In sum, both EVTs and RTs assume that people ascribe value to potential changes in behaviors, and that sense of value determines their intention to act in particular ways. EVTs assume a holistic, generalized approach to assigning values, while RT models assume that people follow a rational, analytical approach to calculating values. Since both the RTs and the EVTs have been used as foundations to build models to explain changes in people's behaviors relative to technology artifacts, the question then becomes, "*Do people's choices tend to be more consistent with the mechanisms proscribed by one of these theoretical perspectives more than the other?*"

RESEARCH DESIGN

To discern which approach people tended to use, we asked our study's participants to score to a series of time-based scenarios. By presenting value-neutral activities (i.e., effectively holding value constant), the variation in their reported scores should be explained solely by how often the activity occurred. The presumption was that someone who used a RT approach would tend to report values more consistent with a mathematically-derived approach whereas someone who reflected an EVT approach would report more general values. For example, when asked to score a value-neutral annual event, a RT-driven person may think in terms of 1/365 (i.e., it occurred on 1 of the 365 days of the year), whereas someone who reflected an EVT approach could think in terms of "that's not very often" and assign such less precise value. In this way, the frequency of the activities effectively becomes a proxy for examining the fundamental judgment mechanism.

Scale Development

The scales used in this study asked subjects to assign a score based on how often the activity occurred. The responses were represented as real numbers between zero and one: zero for an activity that never occurs (e.g. governments forgo taxation) to one for an activity that occurs continuously (e.g. respiration). We then defined a series of activities with different periodicities (i.e., yearly, quarterly, monthly, weekly, and daily) and asked subjects to assign a value between zero and one for each. To compensate for potential measurement errors due to scale construction and presentation, we developed three different scales that presented the same periodicities. Each scale was presented on a separate page to minimize any "carry-over" effect between the scales.

The first scale provided a text description of an activity's periodicity and a single horizontal scale. Subjects marked the scale to indicate the numeric value they associated with each of the study's periodicities. Figure 3 depicts the yearly item.

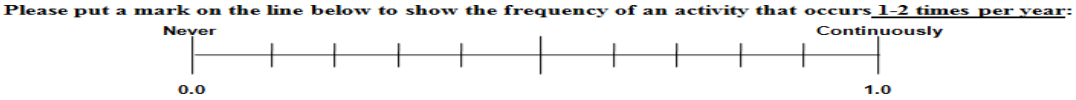


Figure 3: First Perceived Frequency Scale

The second scale presented the entire set of periodicities in a table, and subjects wrote a numeric value they associated with each periodicity (see Figure 4).

Please indicate how you perceive the frequencies listed in the table below by assigning each a numeric value between 0.0 and 1.0.

Activity occurs	Value
Never	0.0
1-2 times per year	
1-2 times per quarter	
1-2 times per month	
1-2 times per week	
1-2 times per day	
Continuously	1.0

Figure 4: Second Perceived Frequency Scale

The third scale returned to a graphical format, but this time the subjects were provided with a list of periodicities and asked to mark the numeric value that they associated with each periodicity on one vertical line (see Figure 5).

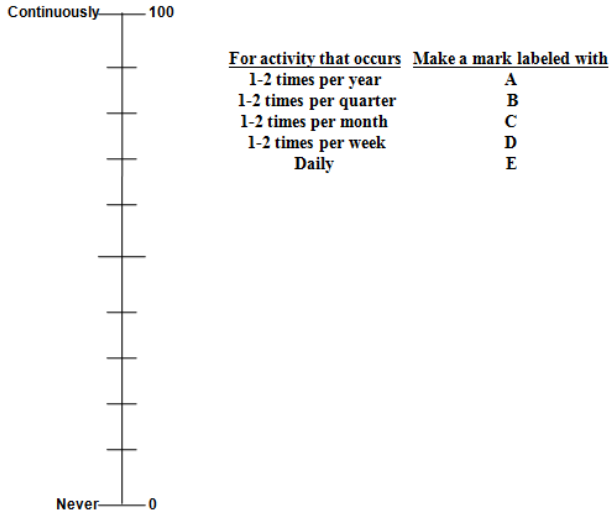


Figure 5: Third Form of Perceived Frequency Scale

Data Collection

All of the participants in this study were volunteers. The scales were distributed to students in two classes at a mid-sized metropolitan university in the Midwestern United States. One class was an Introduction to Management Information Systems (MIS) course that is mandatory for all computer science and MIS students. This class had 23 students. The surveys were anonymous, so the subjects cannot be identified by major. This class had roughly equal numbers of freshmen and sophomores, with only one junior taking the class. The other class was a Principles of Collaboration course. It had 15 juniors and seniors and 10 graduate students. Additionally, surveys were distributed to another 17 PhD students and faculty/staff.

RESULTS AND ANALYSIS

Fifty three people responded to the surveys for an overall response rate of 81.5%.The first statistical analysis examined the reliability of the scales, and Cronbach's alpha exceeded the recommended 0.7 level for each periodicity (see Table 1). ANOVA was then used to compare the scales to each other to detect differences between the three measurement scales (see right side of Table 1). This ANOVA found no differences between scales on any of the frequencies at the .05 level of significance. The reliability analysis and ANOVA indicate that the scales used in this study gathered reliable data.

			Scale Comparisons		
Frequency	**Cronbach's α**		**1 vs. 2**	**1 v2. 3**	**2 vs. 3**
Yearly	0.942		p = 1.00	p = 1.00	p = 1.00
Quarterly	0.942		p = 1.00	p = 1.00	p = 1.00
Monthly	0.853		p = .07	p = .22	p = 1.00
Weekly	0.907		p = .82	p = .92	p = 1.00
Daily	0.888		p = .24	p = .80	p = 1.00
Reliability			**ANOVA Test Between Scales**		

Table 1: Survey Quality

Table 2 presents the descriptive statistics for the data sorted into ascending order by the mean for each item's value. Each frequency (i.e., yearly, quarterly.) was examined in three ways and was named accordingly. Inspection of the results shows that subjects reported ever-increasing values as the frequency of the activities rose.

Item	Mean	Minimum reported value	Maximum reported value
Yearly 2	0.166	0.0	0.5
Yearly 3	0.169	0.0	0.5
Yearly 1	0.183	0.0	0.6
Quarterly 2	0.230	0.05	0.55
Quarterly 3	0.232	0.05	0.55
Quarterly 1	0.247	0.05	0.63
Monthly 3	0.522	0.11	0.8
Monthly 2	0.545	0.1	0.85
Monthly 1	0.575	0.12	0.9
Weekly 2	0.713	0.2	0.95
Weekly 3	0.715	0.25	0.95
Weekly 1	0.745	0.25	0.97
Daily 2	0.881	0.5	1.0
Daily 3	0.893	0.7	1.0
Daily 1	0.913	0.6	1.0

Table 2: Descriptive Statistics

A second ANOVA tested for differences between the frequencies within each scale to confirm that the scales discriminated between periodicities. Results showed that the subjects did not discriminate between annual and quarterly activities on any of the three scales (see Appendix 1). We therefore merged those frequencies into one category by averaging the responses across all three scales into a new category labeled "low" (see Table 3).

Item	Mean	Minimum	Maximum
Low	0.205	0.0	0.6
Monthly	0.547	0.1	0.9
Weekly	0.724	0.2	0.97
Daily	0.896	0.5	1.0

Table 3: Reported Frequency Values

These values can now be plotted against mathematically derived values associated with each periodicity (Figure 5). The solid line with diamonds representing the data points plots the values reported by our subjects from Table 3. The dashed line with squares for the data points represents the calculated values for each periodicity; i.e., a monthly activity occurs 12 times per year, or a value of 12 / 365. The shapes of the two curves are noticeably different, indicating that people are not following strict rational logic as they ascribe values to activities. Said another way, the subjects seem to be reporting values in ways more consistent with general assessments of frequency rather than rational calculations.

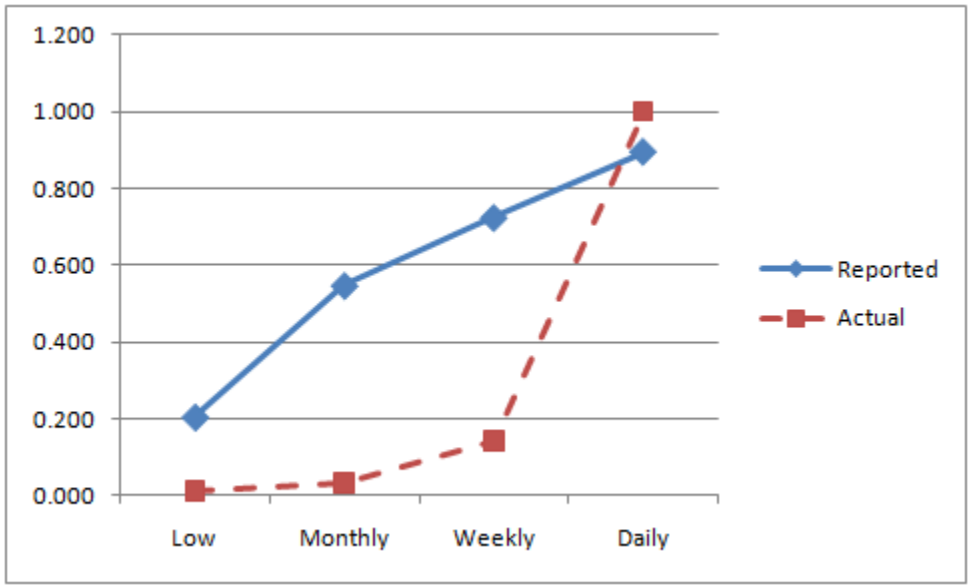


Figure 5: Plot of Reported vs. Actual Frequencies

CONCLUSION

This study was designed to use measurements of the perceived frequency of activities with various periodicities as a means of gaining insight into the underlying mechanisms people use when choosing between alternative courses of behavior. Data gathered in this study showed that subjects assigned ever-increasing values as activities occurred more often, which confirmed the assumption that people do perceive differences of frequency. It also provides a clearer understanding of the relative weights people may attach to their perceptions. The reported values indicate that this study's participants seemed to assign those values in ways more consistent with the assumptions and processes articulated in EVTs rather than in RTs. This could be seen as evidence that the constructs and relationships presented in EVTs may be useful in building theory within the IT domain.

Future Research

The study's scales seemed to provide reliable, valid data, but much larger sample sizes are needed before stronger conclusions could be formed. It could also be useful to examine this value assignment process qualitatively to explore why people might prefer one way of thinking about the value of a potential change in behavior over another.

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Appendix 1: Results of ANOVA: Comparing frequency measures within each scale

Dependent Variable	(I) Frequency	(J) Frequency	Mean Difference (I-J)	Std. Error	Sig.
Scale 1	Yearly	Qtrly	-.066509	.027570	.165
		Mnthly	-.412170*	.027570	.000
		Wkly	-.561604*	.027570	.000
		Daily	-.730094*	.027570	.000
	Qtrly	Yearly	.066509	.027570	.165
		Mnthly	-.345660*	.027570	.000
		Wkly	-.495094*	.027570	.000
		Daily	-.663585*	.027570	.000
	Mnthly	Yearly	.412170*	.027570	.000
		Qtrly	.345660*	.027570	.000
		Wkly	-.149434*	.027570	.000
		Daily	-.317925*	.027570	.000
	Wkly	Yearly	.561604*	.027570	.000
		Qtrly	.495094*	.027570	.000
		Mnthly	.149434*	.027570	.000
		Daily	-.168491*	.027570	.000
	Daily	Yearly	.730094*	.027570	.000
		Qtrly	.663585*	.027570	.000
		Mnthly	.317925*	.027570	.000
		Wkly	.168491*	.027570	.000
Scale 2	Yearly	Qtrly	-.067057	.025330	.086
		Mnthly	-.362528*	.025330	.000
		Wkly	-.550075*	.025330	.000
		Daily	-.718189*	.025330	.000
	Qtrly	Yearly	.067057	.025330	.086
		Mnthly	-.295472*	.025330	.000
		Wkly	-.483019*	.025330	.000
		Daily	-.651132*	.025330	.000
	Mnthly	Yearly	.362528*	.025330	.000
		Qtrly	.295472*	.025330	.000
		Wkly	-.187547*	.025330	.000
		Daily	-.355660*	.025330	.000
	Wkly	Yearly	.550075*	.025330	.000
		Qtrly	.483019*	.025330	.000
		Mnthly	.187547*	.025330	.000
		Daily	-.168113*	.025330	.000
	Daily	Yearly	.718189*	.025330	.000
		Qtrly	.651132*	.025330	.000
		Mnthly	.355660*	.025330	.000
		Wkly	.168113*	.025330	.000
Scale 3	Yearly	Qtrly	-.065358	.023551	.059
		Mnthly	-.373849*	.023551	.000
		Wkly	-.548566*	.023551	.000
		Daily	-.726113*	.023551	.000
	Qtrly	Yearly	.065358	.023551	.059
		Mnthly	-.308491*	.023551	.000
		Wkly	-.483208*	.023551	.000
		Daily	-.660755*	.023551	.000
	Mnthly	Yearly	.373849*	.023551	.000
		Qtrly	.308491*	.023551	.000
		Wkly	-.174717*	.023551	.000
		Daily	-.352264*	.023551	.000
	Wkly	Yearly	.548566*	.023551	.000
		Qtrly	.483208*	.023551	.000
		Mnthly	.174717*	.023551	.000
		Daily	-.177547*	.023551	.000
	Daily	Yearly	.726113*	.023551	.000
		Qtrly	.660755*	.023551	.000
		Mnthly	.352264*	.023551	.000
		Wkly	.177547*	.023551	.000