Fuzzy-Trace Theory & Financial Risk Tolerance

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This article furthers the financial planning and consumer behavior literature by using a new psycho-linguistic processing model, Fuzzy-Trace Theory (FTT), to organize and parse constructs influencing risky decision-making. FTT, which has been used extensively in the public health literature, has improved behavioral interventions related to helping patients to understand health risks (Reyna, 2008; Reyna, 2012a, 2012b). The theory characterizes decisions, "in terms of background knowledge, dual mental representations (verbatim and gist), retrieval of values, and application of values to representations in context" (Reyna, 2012, p. 3790). Although FTT has been used to review framing effects and time preference reversals (Reyna, 2012), this framework has not been used to address financial risk tolerance (FRT) inconsistency. The purpose of this study is to introduce FTT and to use it investigate measurement of self-reported willingness to take risk.

Literature Review and Theoretical Framework

An immense literature uses FRT as a predictor of financial behavior but understanding the determinants of FRT and how to appropriately measure FRT remain debated. Although literature shows that risk tolerance is fairly stable (Van De Venter & Michayluk, 2009; Sahm, 2007), education, experience, and emotion may impact the way individuals respond to particular FRT measures (Mazzoli, Marinelli, & Palmucci, 2017; Finke & Guillemette, 2016; Grable, McGill, & Britt, 2009; Roszkowski & Grable, 2005; Lowenstein, Hsee, Weber, & Welch, 2001). This review focuses on these measurement issues and the other factors that may influence willingness to take risk.

Measurement

Numerous FRT measures have been developed. Some of these measures rely on categorical statements like those in the Survey of Consumer Finance (SCF) and the National Longitudinal Survey of Youth (NLSY). In the (SCF) specifically, surveyors categorize themselves by answering, "Which of the following statements…comes closest to the amount of financial risk that you are willing to take when you save or make investments?" The responses vary from "take substantial risk expecting substantial return" to "not willing to take any financial risk." The NLSY's and the SCF's risk questions have been rigorously reviewed; leading to validity and reliability concerns (Grable & Rabbani, 2014; Gilliam, Chatterjee, & Grable, 2010).

Another type of FRT measure can be described as a decision-tree. Riskalyze and FinaMetrica, popular financial planning tools, and the income gamble questions, available in the NLSY and Health and Retirement Survey (HRS), ask individuals to think through linked probabilistic trade-offs allocating respondents to a risk tolerance level. Measures of this kind, at least in the HRS, appear to measure risk tolerance consistently and demonstrate stability (Sahm, 2007). Conversely, medical decision-making research has clearly demonstrated that people struggle with probabilities and linked probabilistic tradeoff decisions (Trevena et. al., 2013). There have also been direct criticism of the income gamble questions themselves; they are difficult to understand (Halko, Kaustia, & Alanko, 2012; Hanna & Lindamood, 2004).

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Inputs

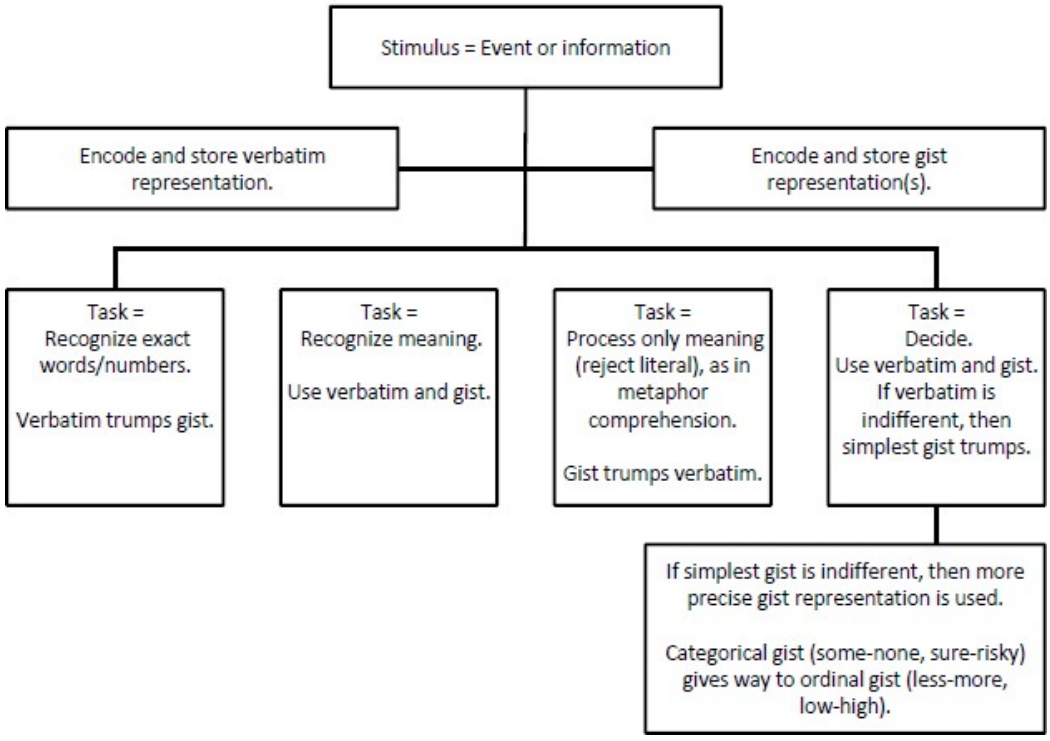
Even if the measurement issues could be remedied, how can other outside influences impacting the expression of FRT be handled? A recent literature review of risk tolerance published by Finke and Guillemette (2016) surmised that even if risk tolerance is constant, many other things are still acting upon its expression and may cause it to look unstable. Theory is generally the way to consider or organize these "other" influences. As just one example, a theory known as Risk As Emotion posits that risk tolerance is stable but that its expression can be mediated by the presence of both present and future ephemeral emotions (Lowenstein, Hsee, Weber, & Welch, 2001).

Personal financial planning has no formal theory (Buie & Yeske, 2011), and many theories used in financial planning have been more focused on organization and framework (Overton, 2008) as opposed to processing and implications. The medical industry has had these same issues but recent theoretical advancements, like Fuzzy-Trace Theory, have highlighted that theory, when focused on causal mechanisms, can do more than frame an issue. Theory can provide insight into action-oriented implications and guide intervention development (Reyna, 2008 p. 850).

Fuzzy-Trace Theory

FTT has organized measurement and input issues in a pro-active way. FTT employs observable demographics, but also makes room for what may be more difficult to observe, latent variables like personal values, which have been found to influence how individuals process risk information (Reyna, 2008). FTT deals with measurement issues through its incorporation of contextual knowledge and numeracy. FTT was recently hypothesized as a potential avenue for how to improve adolescents', unconscious decision-making related to financial skills (Drever et al., 2015). FTT, different from framework-focused theory, garners its prevailing power from it its direct and promising tie to specific types of interventions over simply providing additional financial education (Drever et al., 2015). As such, using FTT there was the expectation that individuals with greater numeracy would be less likely to exhibit risk inconsistency. FTT would also expect to find, similar to decision-making theories like Ajzen's (1991) Theory of Planned Behavior, that context and values, shape the way individuals would report FRT.

Figure 1: Tenets of fuzzy-trace theory tested in research on memory, judgment, and decision making



Methods

This study utilized respondent data from a survey collected by Qualtrics (*N*=490) to investigate what factors may influence inconsistent reports of FRT across two of its common measures: the income gamble questions and willingness to take risks scale. These questions represent a verbatim (i.e., income gamble questions) and a gist (i.e., willingness to take risk scale) version of FRT measures. In order to evaluate inconsistent reporting a "risk inconsistency" variable was created by rank-ordering responses from the categorical-style FRT question from "no risk" to "high risk" and assigning numerical scores (1 = no risk, etc.) as well as utilizing the rank ordering provided by the income gamble questions and assigning scores. The difference between these scores provided the "consistency score" – how consistently respondents provided matching reports of FRT using the two measures. Smaller differences represented greater consistency; the respondent fell into the high-risk group using the income gamble questions and self-categorized as high-risk.

Some interesting sample characteristics included risk inconsistency, reference group risk for both family and peers, as well as the results of the Berlin Numeracy test. Risk inconsistency in particular was interesting with only 35% of respondents being completely consistent in reporting of FRT. Approximately 33% of respondents were somewhat inconsistent (score of 2), but 17% were inconsistent (score of 3), and 15% were highly inconsistent (score of 4). Sixty-five percent of the sample lacked FRT consistency.

Empirical strategy

The primary goal of this investigation was to understand the impacts of financial knowledge, numeracy, personal risk, financial values, as well as application of those values on reported FRT consistency between a verbatim and gist measure of FRT. Each risk question was developed into four-part categorical variable; and then combined to create the "risk inconsistency" variable. Multinomial logit analyses are the most useful statistical technique when the dependent variable has more than two categorical outcomes (Allison, 2012).

Results

The income gamble questions do not appear to be correlated with the simpler, categorical investment risk question. Regression results are mixed in direction of effect when assessing whether numeracy predicts "risk inconsistency." Selected results are detailed in Table 1. Numeracy is significant in all comparisons. Of particular note, those with higher numeracy were 23% less likely to be in the highly incongruent group.

Financial knowledge was not significant in any comparison and reference group was significant in only a few estimates. This finding points at how values and emotion may have more of an influence on financial decision making than financial knowledge alone. For instance, those who identified as slightly lower risk tolerance than their peer group were 2.59 times more likely to be highly incongruent. While the other categories were not significant, it is interesting to note direction changes on the coefficients, suggesting that respondents also have a difficult time assessing their risk tolerance when compared to peer groups.

Conclusions

Many theories organize, but few theories provide testable hypotheses that lend themselves to useful implications, a major problem in personal financial planning. FTT has explained how, "people can get all the facts right, and still not derive the proper meaning, which is key to informed decision making" (Reyna, 2008 p. 850). In personal financial planning, this may come into play when helping clients to select an appropriate level of risk for their retirement portfolio. There are numerous risk tolerance questionnaires available and some of these questionnaires may be more or less user friendly depending on a consumer's numeracy skill over financial knowledge. Further, consumers may also be employing personal stories, which are values and the values in context. FTT has helped to organize and address values on top of the risk elements, and most importantly, provide

implications and ideas for intervention. Financial advisors may need to start measuring numeracy alongside risk tolerance. Financial advisors may also need to start asking more contextual questions about what is driving the clients' expression of FRT. The same suggestions may be relevant for public policy too, as nearly all major life decisions involve finances and risk.

Table 1

Multinomial Logistic Regression – Risk Inconsistency (*n*=490)

	High inconsistency vs. no inconsistency		Inconsistency vs. no inconsistency		Some inconsistency vs. no inconsistency	
	Point estimate	Odds ratio	Point estimate	Odds ratio	Point Estimate	Odds Ratio
Intercept	-0.27		-1.07*		-1.2	
Numeracy	-0.27**	0.77**	.25***	1.29***	0.25***	1.28***
Financial Knowledge	0.005	1.005	0.06	1.05	-0.03	0.97
Risk reference group - peer	-	-	-	-	-	-
Much lower	1.01	2.75	1.39**	4.03**	0.44	1.55
Moderately lower	-0.04	0.96	0.28	1.32	-0.11	0.89
Slightly lower	0.95	2.59**	0.61	1.85	0.55	1.74
Slightly higher	-0.45	0.63	0.08	1.08	-0.41	0.66
Moderately higher	0.32	1.38	-0.10	0.91	0.06	1.06
Much higher	-1.18	0.31	-0.05	0.95	-0.08	0.92
Risk reference group - family	-	-	-	-	-	-
Much lower	0.21	1.23	-1.14*	0.32*	-0.34	0.71
Moderately lower	0.17	1.19	-1.15	0.32	-0.05	0.95
Slightly lower	0.82	2.27	-0.12	0.89	-0.32	0.72
Slightly higher	0.13	1.14	-0.18	0.83	-0.24	0.78
Moderately higher	0.33	1.40	0.12	1.13	-0.83	0.43
Much higher	1.64	5.17	-0.06	0.94	-0.66	0.52
Market Outlook	-	-	-	-	-	-
Extremely dissatisfied	0.04*	1.04*	-0.58	0.56	0.72	2.06
Somewhat dissatisfied	0.32	1.38	-0.77	0.47	-0.09	0.92
Somewhat satisfied	0.52	1.68	-0.32	0.73	0.81**	2.27**
Extremely satisfied	-0.16	0.86	-0.15	0.86	0.41	1.51

*Source - Qualtrics Survey - Fuzzy Trace, VIF Conducted; c=0.73; *=p<.1, **=p<.05, ***=p<.01*

In terms of consumer policy, we are left contemplating two questions. One, the results show that the two risk questions are uncorrelated. The follow-up question then becomes, are they measuring the same thing? The income-gamble questions may be measuring numeracy or mathematical skill along with risk, while the categorical questions may just be measuring subjective risk or something else. If this is the case, what does that mean for the risk tools available in the marketplace or the implications derived from research papers using these different measures? The second question is what do these results mean or how can they still help? Numeracy matters; we can measure numeracy in simple ways and it is clear that understanding a consumer's baseline numeracy can and could impact the way we provide information to them. Graphs, for example, have been helpful in health literature. Perhaps more use of specific types of graphical information would be worthwhile as pointed out by Trevena et. al. (2013).

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