RECONCEPTUALIZING TRUST: DEFINING, MODELING, AND MEASURING TRUST

by

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Reconceptualizing Trust: Defining, Modeling, and Measuring Trust

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TABLE OF CONTENTS

Page

List of Tables vi
List of Figures vii
List of Equations viii
List of Abbreviations and Symbols ix
Abstract x
Introduction 1
Why Trust? Relevance of a Global Construct 2
Trust is a universal phenomenon 2
No unity in measurement means no scientific body of evidence 4
A framework exists to unify the field 7
Goal 1: Reconceptualizing Trust by a Common Definition and Model 10
Trust as a cognitive state rather than a behavior 12
The Emergent Trust Model 13
Goal 2: Development and Testing of a Common Model of Trust 18
Improving the Model of Trust through Multiple Model Comparisons (Goal 3) 21
Study Rationale and Hypotheses 21
Specific Aims and Hypotheses of the Current Study 23
Part 1: Exploratory Model Testing 24
Part 1 Methods 24
Sample 25
Procedures 26
Trust Manipulation 26
Measures 29
Study 1 - Transformations 31
Analyses 33

Results 34
Study 2 - Random Coefficients 35
Analyses 36
Results 37
Study 3 - Alternative Causal Models 39
Analyses 41
Results 42
Part 1: Discussion 42
Part 2: Confirmatory Model Testing 44
Part 2: Methods 44
Sample 44
Procedures 45
Trust Vignettes 45
Measures 46
Analyses 46
Part 2: Results 47
Overall Discussion 50
Implications 50
Trust Measurement Models and Real Trust 52
Limitations 58
Limitations from the data source 58
Limitations from the method of measurement 59
Future Directions 62
Conclusions 63
Appendix 65
References 70

LIST OF TABLES

Table Page
Table 1: Commonly cited definitions of trust across the literature..... 6
Table 2: Fixed effects estimates of best fitting random coefficient model..... 39
Table 3: Fixed effects estimates of random coefficient model for the independent data set 49
Table 4: ETI Items and Example Vignettes..... 65

LIST OF FIGURES

Figure Page
Figure 1: A simple model of trust 15
Figure 2: Numeric reference for the vignettes representing each high/low combinations of G, U, and R 27
Figure 3: Process of Information and Question Delivery Within Vignettes 28
Figure 4: Bivariate plot of G,U,R and T averaged across scenarios in a prospective vignette study design 32
Figure 5: The interaction of G,U,R predicting trust at different low/high combinations . 37
Figure 6: A Mediation Model of Trust 40
Figure 7: The interaction of G,U,R predicting trust at different low/high combinations . 47

LIST OF EQUATIONS

Equation Page
Equation 1: One parameter box-cox transformation formula 34

LIST OF ABBREVIATIONS AND SYMBOLS

Emergent Trust Model ..... ETM
Goal Importance ..... G
Uncertainty about ability to achieve the outcome alone U1
Reliance ..... R
Uncertainty about the agent on which to rely U2
Self-Reported Trust ..... T
Uncertainty after making a trusting decision U3
Ordinary Least Squares ..... OLS
Emergent Trust Inventory ..... ETI
λ ..... Box-Cox Transformation Exponent
ICC ..... Intraclass Correlation Coefficient

ABSTRACT

RECONCEPTUALIZING TRUST: DEFINING, MODELING, AND MEASURING TRUST

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Several reviews of trust research suggest that trust is suitably measured by a singular, mechanistic model, yet research on trust has yet to yield one. Research on trust is fragmented both between and within different fields of study because the state-dependent, subjective nature of trust is difficult to examine. As a result, trust is often modeled by behaviors or beliefs that fail to generalize. The lack of generalizability perpetuated the fragmented state of trust research. As previously stated, several reviews suggest that a universal model is not only possible but appropriate considering researchers often identify a common set of core ingredients for trust. I - along with my colleagues - responded to this suggestion by developing and testing a more generalizable model that incorporates these common ingredients. Together these common ingredients provide a more parsimonious, universal mechanistic model of trust that we refined over several empirical studies. The current study addresses several lingering concerns from this

previous work and then confirms any changes that may be both theoretically and empirically warranted. From two independent efforts - one exploratory and one confirmatory - I demonstrated that the original model predicted trust best via a fixed effects model specifying trust as the result of a three-way interaction of goal importance, reliance, and uncertainty. Additionally, I discussed the implications of this model with future ideas for refinement and continued testing.

INTRODUCTION

Trust research suffers from fragmented efforts in social and behavioral sciences that unwittingly created results that cannot be summarized in any logical way. Consider two fields - economics and psychology. Economists view trust as a behavior defined through the lending of money or purchasing of a product or service. Those behaviors tend to differ greatly between studies. Several modified versions of the Trust (or Investment) Game (Berg, Dickhaut, & McCabe, 1995) rely on the decision to lend money to another individual as indicative of trust (Glaeser et al., 2000; Ben-Ner & Halldorsson, 2010; Stanley, Sokol-Hessner, Banaji, & Phelps, 2011) whereas others define trust by value judgments on the delivery of a potential payoff (Glaeser et al., 2000), written contractual proposals (Ben-Ner & Halldorsson, 2010), making an online purchase (Gefen, Karahanna, Straub, 2003), and even how someone responds to finding a wallet full of money (Dufwenberg, 2000). Psychologists, on the other hand, view trust even more diffusely as behaviors but rarely tied to any singular context. Some psychologists rely on the economic exchanges (e.g., trust is defined by the behavior of lending money) whereas others rely on self-reports that capture either predispositions to trust (e.g., "I am a trusting person") or trusting attitudes and beliefs about specific agents (e.g., "I trust this person or object"). The examples of the various methods of measuring trust and related behaviors are almost too many to enumerate (cf. self-report measures: Rotter, 1967,

Gassenheimer & Manolis, 2001; the prisoner's dilemma game: Cook & Cooper, 2003; relying on an automated decision aid to achieve a task: McKendrick, Shaw, de Visser, Saqer, Kidwell, & Parasuraman, 2013). Suffice it to say from these examples that trust measurement varies within fields of inquiry and certainly between fields. Areas that focus on the same phenomenon but remain fragmented in their measurement of a concept lead to tremendously difficult situations in science. Research on trust suffers from this very issue - the current body of literature is incommensurate, disallowing for a common understanding of trust. My aim was to help solve this problem by developing a more universal measure of trust that lends itself to describing, predicting, and controlling trust in future research. Moreover, through these efforts, a universal trust measure helps to eliminate these barriers to aggregating research results in both past and future work.

Why Trust? Relevance of a Global Construct

The reasons I chose to study trust are 1) the universality of the phenomenon, 2) the absence of a common measurement model to unite many areas, and 3) to provide an existing framework laying the foundation for a rapid and potentially important contribution to social and behavioral sciences. These reasons are elaborated below.

Trust is a universal phenomenon. Trust is relevant when studying when and how people interact with other agents - both human and non-human - because it plays an important role in human decision making. Researchers consider trust to be one of the most basic variables in any human interaction where cooperation and interdependence are relevant (Gambetta, 1998; Corritore, Kracher, & Wiedenbeck, 2001; De Vries, Midden, & Bouwhuis, 2003). Those interactions are so common that it is no wonder that the trust literature spans many fields. The use of trust in cooperative and interdependent

interactions is not only noted among interpersonal relationships (Geyskens, Steenkamp, Scheer, & Kumar, 1996; Lewicki, Tomlinson, & Gillespie, 2006; Rotenberg & Boulton, 2013), but also marketing transactions (Gefen, Karahana, & Straub, 2003; Ratnasingam, 2005), organizational cohesion (Kramer, 1999; Dirks & Ferrin, 2002; Balliet & Van Lange, 2013), the use of technology (Hancock, Billings, Schaefer, Chen, De Visser, & Parasuraman, 2011; Onnasch, Wicken, Li, & Manzey, 2014), and even a nation's response to political change (Rothstein & Stolle, 2002). That body of evidence supports trust as an important causal variable, particularly in decision making. Individuals make decisions involving others or requiring cooperation based, in part, on trust. A trusted option tends to be favored over an untrusted option. Thus, trust operates as an important cognitive causal agent - affecting decision making. These examples are how trust functions as a main effect in social interactions or human interactions with agents.

Trust may also operate as a mediator in, for example, relationship quality. As trust develops reciprocally between two people, the quality of their relationship improves (Colquitt, Scott, & LePine, 2007; Twenge, Baumeister, DeWall, Ciaroco, & Bartels, 2007; Aurier & N'Goala, 2010). Even more broadly, trust affects organizational behavior in the same way it affects relationship quality - as a mediation process. Individuals who trust one another tend to work more cooperatively (Zaheer, McEvily, & Perrone, 1998; Aryee, Budhwar, & Chen, 2002; Lui, Ngo, & Hon, 2006; Clapp-Smith, Vogelgesang, & Avey, 2009). Finally, trust often serves as the underlying outcome indicated by a certain behavior. Most research in this area focuses on the adoption or reliance upon automation (e.g., GPS, decision aids, etc.). As individuals gain more trust

in automation, they use the devices more. Trust, therefore, serves as a direct cause, a mechanism of action (i.e., a mediator), or an outcome indicated by specific behavior. What makes an option more trustworthy than another option, a mechanism more trustworthy, or a behavior more relevant to the phenomenon of trust requires a clear definition of the concept "trust." Without a clear definition, researchers may erroneously identify disparate phenomena as trust.

No unity in measurement means no scientific body of evidence. Regardless of the explanatory mechanism that appears to warrant different definitions, a simple statement remains; no two research programs use the same definition of trust. The problem with trust as a variable[1] is that this term is commonplace in everyday language and leads many - scientists included - to eschew defining it sufficiently. Scientific progress requires content agreement and homogeneity of definitions to form a consistent and interpretable body of knowledge. Trust research defies this requirement as it is characterized by heterogeneous definitions that provide little guidance on how to assess or alter trust (Rotter, 1967; Mayer, Davis, & Schoorman, 1995; Lewicki & Bunker, 1995). The lack of a singular definition of trust is likely (but not solely) attributable to trust's context-dependency and socially constructed nature (Welter and Alex, 2012). Trust definitions vary widely with many researchers characterizing trust broadly (e.g., by academic discipline) and some more specifically (e.g., as it relates to a particular topic of

[1] I use the term variable instead of hypothetical construct because it remains unclear whether trust functions as a construct or an intervening variable. As a result, I prefer to use the more general term "variable" to not confuse the reader

research interest or even a singular behavior) (see Table 1 for examples of common trust definitions).

Table 1: Commonly cited definitions of trust across the literature

Content Area	Source	Definition
Psychology & Sociology	Rotter (1967, 1980)	A generalized expectancy held by an individual that the word, promise, oral or written statement of another individual or group can be relied upon
	Lewis & Weigert (1985)	Undertaking of a risky course of action on the confident expectation that all persons involved in the action will act competently and dutifully
	Shapiro (1987)	A social relationship in which principals-for whatever reason or state of mind-invest resources, authority, or responsibility in another on their behalf for some uncertain future return
	Golbeck (2006)	Trust in a person is a commitment to an action based on a belief that the future actions of that person will lead to a good outcome. The action and commitment does not have to be significant.
Management & Organizational Behavior	Luhmann (1979)	Trust encompasses not only people's beliefs about others, but also their willingness to use that knowledge as the basis for action; describes certainty judgments about the other's conduct
	Mayer, Davis, & Schoorman (1995)	The willingness of a party to be vulnerable to the actions of another party based on the expectation that the other will perform a particular action important to the trustor, irrespective of the ability to monitor or control that other party.
	Bhattacharya, Devinney, & Pillutla (1998)	Trust is an expectancy of positive (or nonnegative) outcomes that one can receive based on the expected action of another party in an interaction characterized by uncertainty
	Rousseau, Sitkin, Burt, & Camerer (1998)	Trust is a psychological state comprising the intention to accept vulnerability based upon positive expectations of the intentions or behaviors of another
Marketing & Public Relations	Moorman, Deshpande, & Zaltman (1993)	A willingness to rely on an exchange partner in whom one has confidence.
	Hon & Grunig (1999)	One party's level of confidence in and willingness to open oneself to the other party.
	Delgado-Ballester, Munuera-Aleman, & Yague-Guillen (2003)	Feeling of security held by the consumer in his/her interaction with the brand, that it is based on the perceptions that the brand is reliable and responsible for the interests and welfare of the consumer.
Technology & Automation	Lee & See (2004)	The attitude that an agent will help achieve an individual's goals in a situation characterized by uncertainty and vulnerability
	Hoff & Bashir (2015)	[Interpersonal and trust in technology] are similar in that they represent situation-specific attitudes that are only relevant when something is exchanged in a cooperative relationship characterized by uncertainty.

Lack of consensus on how to define and measure trust limits the scope of scientific inference on a topic relevant to so many disciplines. While prior research provides valuable information on potential drivers and correlates of trust, it fails to capture its essence for one reason - lack of a common definition and measurement model. Describing trust from multiple perspectives leads to a plethora of models and measurement strategies that makes comparisons across - and sometimes within - fields difficult. Multiple definitions and measurement strategies limit the generalizability of any set of findings, leading to the current fragmented state of research. Philosophers of science (e.g., Kuhn, 1979 and Lakatos, 1976) argue that the lack of commensurability among researchers within a program indicate a weak area of inquiry, but I beg to differ. The fragmented state of trust research and lack of commensurability is more likely due to difficulty examining the variability inherent in its subjective, state-dependent nature.

Rather than examine trust in its entirety, different areas of research carve out manageable chunks of the phenomenon, studying an aspect of trust or its relevance to a particular context. Different areas of research, therefore, focus on their own aspects of trust at the exclusion of other aspects. Attending to more localized content prevents researchers from creating a concise definition that generalizes across research topics, domains of interest, and individual situations.

A framework exists to unify the field. In light of this localized approach to examining a relatively global phenomenon, several reviews examined the plausibility of researching trust at a broader level. Those reviews indicate that a common understanding of trust is a difficult yet plausible endeavor (Watson, 2004; PytlikZillig & Kimbrough,

2016). An empirically supported and sound definition (and model) of trust allows for exploration of the universal mechanism by which trust forms. Further, a sound model offers us the ability to more accurately determine not only when trust is a relevant predictor but how it affects outcomes - both cognitively and behaviorally - across multiple areas of inquiry (e.g., medicine, psychology, sociology, business, and politics). Lending money (or the failure to do so), for example, may appear as if a person trusts another person by engaging in "trust-like" behaviors but, in fact, may be a manifestation of another underlying cognitive state (e.g., charity, altruism, frugality, or selfishness). Trust becomes relevant only when certain conditions exist and others do not. Some readers may see these conditional statements as a license to choose arbitrarily when trust may be relevant. A consistent model of trust relevance and trust level provides a rule-based alternative to that arbitrary situation. Thus, consensus on how to best define, model, and measure trust offers the potential to better understand the conditions that create a trust relevant situation and, in turn, predict future behaviors.

An unarticulated but available framework existed in the literature to guide that consensus. Several reviews identified that most definitions of trust contain common elements. These common elements offered the framework for developing a common model of trust that synthesizes the literature across domains. Specifically, researchers consistently identify six common elements of trust - subjectivity, uncertainty/risk, reliance, willing vulnerability, expectation, benevolent intent - across many research programs (Bhattacharya, Devinney, & Pillutla, 1998; Grabner-Krauter, 2002). Researchers fail to agree, however, on how to synthesize these common elements into a

common definition and measurement model because each element is typically specified and studied in a manner unique to each research program and discipline. My colleagues and I, through careful examination of the literature and the correlations among these elements, arrived at a potential starting point. We identified three common elements - goal importance, reliance, and uncertainty - that subsumed all the other common elements and provided the most parsimonious measurement model. Through additional consultation with experts and cognitive think-aloud sessions, we gained greater confidence that these three elements sufficed for our purposes and would allow us to test a more generalizable model of trust across disciplines. Our model separated these essential elements and allowed us to examine each in turn and the implications for understanding trust development, maintenance, and decay.

The purpose of our efforts to date was to eliminate the disparities among researchers; they failed to agree on any singular conceptualization and yet there existed sufficient overlap to warrant a singular model. The persistent, differential method of defining and measuring each element contributed to the poor conceptualization and measurement of trust (Pearson & Raeke, 2000; Watson, 2005; PytlikZilling & Kimbrough, 2016). Several, well-cited papers (e.g., Rousseau, 1998; Watson 2004; among others) called for a simpler model and common definition of trust in order to overcome this fragmented view of trust and synthesize the literature. Yet, that call remained unanswered. The cross-disciplinary research, however, provided the foundation for a common theoretical conceptualization of trust from these common elements. This foundation for a common theoretical conceptualization of trust served as

the starting point for my research program, wherein the goals were: (1) to review and synthesize trust research across several domains and disciplines to determine whether a simplified, universal model of trust is appropriate, (2) identify and test what type of conceptual model best captures the nature of trust, and (3) develop and refine measurement of the conceptual model to determine the most necessary components required for a conceptualization of trust that offers better predictive validity than previous models. Below, I provided more details of these three goals.

Goal 1: Reconceptualizing Trust by a Common Definition and Model

Using these six common elements, my colleagues and I chose to identify a definition and model of trust to advance our understanding of the phenomenon. Previous efforts to develop a general model of trust guided our qualitative assessment of how these six common elements influenced the development of trust. Specifically, Hoff and Bashir (2015) note that trust generally requires three components - a truster to give trust, a trustee to accept trust, and something at stake. Within these three, uncertainty and risk surrounding both the trustee (e.g., intention, trustworthiness) and the something at stake (e.g., risk of loss) become relevant. Coupling this platform for the general components required for trust with the six common elements identified across the literature identified that trust is a judgment based on many factors guided by the perception (subjectivity) of the individual (trustor) who must choose to trust another agent (trustee) in order to achieve a desired outcome (something at stake).

That perception (subjectivity) influences all assessments relevant to trust. This perception is influenced by dispositional factors (e.g., personality, propensity for risk-

taking, propensity to trust, and other traits) as well as prior - and eventually future - experience. The assessments relevant to trust begin with the assessment of a situation. An individual must determine the likelihood (uncertainty) of obtaining a desired outcome in that situation (risk) without aid. If an individual is entirely uncertain about his ability to obtain that desired outcome without help, the level of risk warrants consideration for help from another. This leads to the second assessment relevant to trust - assessment of the agent. Any agent available to help the individual reduce his uncertainty about obtaining that desired outcome (i.e., increase the likelihood of obtaining the desired outcome) warrants assessment. The individual assesses his willingness and need to share responsibility of achieving the desired outcome with that agent (risk, willing vulnerability), the potential reliability of the agent in sharing responsibility of achieving the desired outcome (uncertainty, reliance), and the assumption that the individual on which reliance is placed is acting in the trustor's best interest to achieve the desired outcome (expectation, benevolent intent). In sum, trust is the result of an individual's perception of the need and willingness to rely on an agent (i.e., assessment of the agent) who can help the trustor achieve a desired outcome when he is uncertain about that outcome's likelihood (i.e., assessment of the situation). These two overarching assessments subsume the six common components into three main considerations - the importance of an outcome (or goal) , the uncertainty about achieving that outcome, and the need to rely on another in order to achieve that outcome - that determine not only when trust becomes relevant but also how much of it is needed.

Attending to three overarching considerations that encompass the six common elements provides a more flexible approach to conceptualizing, measuring, predicting and altering trust. A flexible approach to conceptualizing trust seems warranted given that subtle differences - whether borne from contextual factors or individual differences - have kept the field of trust research fragmented for decades. Further, different contexts may requiring different degrees of each of these elements or, in some cases, only some of them. That is, benevolent intent may matter when a person decides to trust another person but not when trusting a machine. A common understanding of trust must account for these variations, leading my colleagues and I to focus on the three overarching factors that include the six common elements of trust - importance of the outcome (i.e., goal importance), uncertainty, and reliance.

An empirically supported and sound definition (and model) of trust allows for exploration of the universal mechanism by which trust forms. The purpose of this first goal was to offer a clear definition that may be used throughout science to define, observe, and eventually manipulate trust along common grounds. A review of the literature produced a set of common features of trust noted across multiple fields that could be summarized into three overarching factors. This review provided the foundation for developing a clear definition and conceptual model of trust. Our definition and model incorporates not only these common features of trust but also seeks to address several known limitations of modeling and measuring trust.

Trust as a cognitive state rather than a behavior. The development of a unified model of trust from the aforementioned components, we argue, ought to focus on the

cognitive mechanism underlying the internal state of trust. Trust is universally understood as a psychological state. Both behavioral and traditional trust research, however, retained behaviors as the primary outcome of interest (McKnight & Chervany, 1996; Buchan, Croson, & Solnick, 2008; DuBois, Goldbeck, & Srinivasan, 2011). While behaviors are much more readily measured, the underlying cognitive mechanism leading to the state of trust must be understood to advance understanding of trust and interpret the behaviors appropriately. Trust is a subjective experience - one that requires the measurement focus to be within the individual and one that accommodates contextual and individual differences. The cognitive state is what drives the behavior and, in turn, the behavior influences the person in future trust scenarios (Lahno, 1995; Castelfranchi & Falcone, 2000). Cognition and behavior cannot be fully separated but we argue implicitly for the primacy of cognition in trust as a mechanism for producing behaviors. Focusing solely on behavioral outcomes leaves too many opportunities for failure in the scientific investigation of trust, especially because all behaviors that may look like trust (e.g., lending money in an investment game) may not be indicative of actual trust (e.g., the person just decided to share out of kindness).

The Emergent Trust Model. The aim in proposing a new definition and model of trust was not to revolutionize areas where the term appeared relevant but rather to simplify connections among the studies where trust was the focal mechanism. Simply put, a singular model would result in a more cohesive knowledge base surrounding trust and lessen current fragmentation in the field. The model developed from this endeavor proposes trust as an emergent variable because we expect the interaction of three

variables (goal importance, reliance, and uncertainty) causes trust. Treating trust as an emergent variable is a unique concept compared to the current models of trust. Current models treat trust as a hypothetical construct rather than an emergent variable (cf Bollen and Lennox, 1991). Trust as a hypothetical construct assumes trust to be a latent entity that causes the observed variables we measure. Trust as an emergent variable, instead, assumes that the observed variables cause trust. My colleagues and I chose to model trust from this alternative perspective for two reasons. First, trust is typically treated as a hypothetical construct for no particular reason other than convenience. That convenience stems from the abundance of psychometric tools that help us refine hypothetical construct models and from the almost complete absence of psychometric tools for emergent variable models. In short, we often aim our efforts where our tools allow (i.e., we are searching for our lost keys under the street light). It is not to say that the available tools offer no insight into our phenomenon of interest, but merely that they limit our scope of understanding. We ought to press beyond the limitations of the tools available rather than guide the scope of our scientific inquiry by their limits, especially when those limits restrict the ability to solve problems for a wider population (McKnight, Johns, McGovern, & Najab, 2010). Second, despite the limited psychometric tool set to validate emergent models, modeling trust as an emergent variable appears more theoretically defensible - considering that I argue trust is a context-dependent, state-oriented phenomenon. Thus, modeling trust as an emergent variable better fits those characteristics.

The proposed approach to defining and measuring trust as an emergent variable affords the opportunity to address multiple concerns with current trust research - most notably determining whether trust functions as a state or trait, identifying the connection between the cognition underlying trust and resulting behaviors, and assessing how trust changes over time in a dynamic process. My colleagues and I define trust as a psychological state caused by the interaction among perceptions of goal importance, reliance, and uncertainty (see Figure 1).

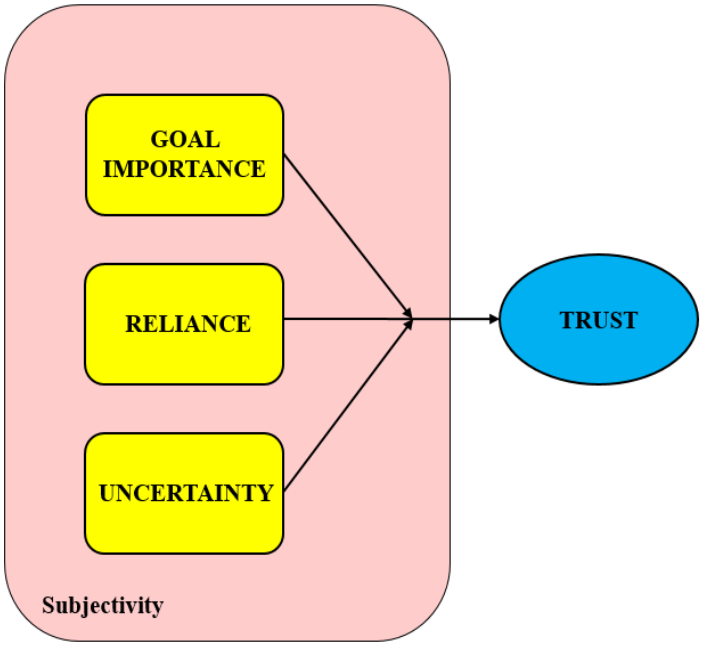

Figure 1: A simple model of trust

All three perceptions in our model arise from an individual's subjective assessment of a situation. Goal importance and uncertainty represent future-oriented

assessments based upon a learning history as in "if I don't get to work on time, I may be fired". The learning history provides knowledge (e.g., company rules, a co-worker being fired for tardiness) that certain behaviors often relate to outcomes (i.e., showing up late to work likely results in losing one's job). Goal importance is a perception that arises from a person's evaluation of the relevance of possible outcomes to his or her situation (e.g., "my family relies on me so I cannot get fired"). Uncertainty about the desired outcome to be unconditionally attainable (i.e. achieve the desired outcome without assistance) creates the perception we labeled uncertainty. Finally, reliance represents a present-oriented or perhaps a past-oriented assessment as in "I need this person's help now because I cannot do it myself and nobody else is around" or "I found this person helpful in the past when I faced this situation." Each of these subjective assessments are individually and contextually dependent because each individual may view the same situation differently. Furthermore, each individual may change their views about that same situation over time. Thus, trust emerges from subjective views of goal importance, reliance, and uncertainty. Individuals experience trust after they appraise a situation and, as a result of that appraisal, act in accord with their resulting level of trust. IF a person views a situation as meaningfully important AND relies upon someone or something to either achieve a good outcome or avoid a bad outcome AND recognizes sufficient uncertainty in the outcome THEN the person enters into a state of trust between herself and the agent to be trusted. Trust therefore becomes relevant given these conditions and the level of trust is determined by the person needing to trust. All three subjective appraisals follow a similar pattern where individuals assess situations (evidence) in light

of their own dispositions (i.e., prior sensitivity to goal importance, reliance upon others, and tolerance for uncertainty) to formulate an action plan (i.e., behaviors consistent with their trust).

The Emergent Trust Model (ETM) above (see Figure 1) summarizes and incorporates the extant literature, offering the opportunity for researchers to better describe, predict, and eventually control trust. These aims are more likely achievable through the examination of the internal process of trust within individuals as opposed to following traditional latent models of trust that focus on behaviors as outcomes. Furthermore, a descriptive model provides opportunities for us (and other researchers) to predict if and when trust is likely to occur. The model may be used both prospectively or retrospectively to understand how trust may operate from prior studies. Those studies that achieved behaviors consistent with trust may actually be grounded in the foundations we hypothesize for trust (Panksepp, 2009): however, many studies that failed to replicate or produce these trusting behaviors might suggest that behavioral measures alone are poor indicators of the internal processes leading to trust (Buchan, Croson, & Solnick, 2008; Hoge et al., 2012). These distinctions between internal processes and behaviors may be more fully realized by understanding the state of the individuals in future studies. Finally, by describing the process and offering a predictive model, we specified a mechanism by which trust may be developed and, more importantly, how trust may be manipulated deliberately. The intent is not to manipulate individuals for mal-intent but rather to offer researchers mechanisms to alter trust prospectively and allow all researchers to understand the limits of current trust manipulations. Through these

prospective studies, researchers may learn more about the limits of our simpler model and its potential weaknesses.

Goal 2: Development and Testing of a Common Model of Trust

Validation of the conceptual model of trust developed from a review of the literature (Goal 1) occurred over a series of four studies (Goal 2). These studies systematically varied the three primary components believed to cause trust - goal importance (G), uncertainty (U1), and reliance (R). The systematic variation intended to obtain data on how individuals trust - or do not trust - depending on the presence or absence of these components. This variation occurred through the application of two methods: (1) polling participants to provide vignettes where they either trusted some agent to varying levels (ranging from "no trust" to "complete trust") or (2) from our own vignettes where we varied G, U1, and R. Both methods resulted in the same approach to assess the predictive validity of a 3-way interaction of G, U1, and R in predicting a single item of trust (T). Our rationale was that if these three components could predict an overall trust measure, we could soon understand the necessary and sufficient parts relevant to the development, maintenance, and decay of trust over time. In short, the model predicts, but also allows us to control and monitor trust in a more detailed manner than simply asking people their trust levels.

In these efforts, we found evidence to support the core idea that the cognitive state of trust comes from an interaction of these three components. A significant 3-way interaction predicted overall trust across all four studies, explaining, on average, 20% of the variance in self-reported trust. This supporting evidence led us to test various

methods to critically examine the performance of the model. These various methods mostly centered on altering the vignettes to increase variability in the three components. Specifically, we had limited success in getting all three components to equivalently predict overall trust - granted that we hypothesized a 3-way interaction. The equivalence may be a fool's errand but we continually noticed that reliance was dominant in predicting trust; we did not believe that dominance to be valid. Instead, we noted the relative variance among the three components and realized that our vignettes successfully manipulated reliance the most with goal importance and uncertainty well below the variance values of reliance. These discoveries and realizations lead us to alter our vignettes, change response options for our single items, and reorder how the vignettes were displayed and when participants would be prompted. Overall, the changes refined our results and made them clearer. What remains, however, are questions about the optimal model - hence the logical progression to model refinement.

All of these efforts support the continued development of a simplified, universal model of trust from an emergent, state perspective. Our results indicate that the current model requires improvements because the relationship between the three essential components and trust appears more complex than originally modeled. Prior to examining sources of complexity in the model (e.g., how uncertainty functions in relation to goal importance and reliance), the fit between the model and our data requires improvement. Our current data and model clearly support the hypothesized relationship of a 3-way interaction. All studies to date produced a significant 3-way interaction whereby G, U1, and R were restricted to only the full interaction and accounted for between 3.5% and

21.6% of the variance in overall trust (T) as previously mentioned. Thus, we have sufficient evidence that the complex moderation effect seems plausible. However, we have yet to account for the remaining variance in T that is not explained solely by that interaction. We also examined a full factorial model where we allowed all main effects and 2-way interactions to be included and the minimum variance accounted for in those models was between 41.7% and 57.3%. The obvious conclusion from those results is that the simple 3-way interaction does not fully explain the entire variance in T.

Traditional interpretations of general linear model results mandate the interpretation of higher-order interactions at the exclusion of lower-order effects as the effect of each variable depends on the values of the others. This method of interpretation justifies overlooking the main effects and 2-way interactions computed in the full factorial model.

Yet, concern remains that the 3-way interaction alone does not wash out most of these lower-order effects. We demand more from our model than the traditional interpretations allow. Complicating matters, bivariate plots between each of the three components (G, U1, and R) and T revealed that only R produced a consistent monotonically positive (i.e., linear, consistently increasing) relationship. G and U1 were far more complicated and often looked curvilinear or non-monotonic in some instances. These more complicated relationships also provide us with sufficient evidence to seek either transformations of the existing data or different models that do not assume rectilinear relationships. Thus, the need for an improved model fit comes from inconsistency between expectations demanded by our current modeling method and the empirical results in Goal 2.

Goal 3: Improving the Model of Trust through Multiple Model Comparisons

Study Rationale and Hypotheses. The first two goals in the research program - the development (Goal 1) and validation (Goal 2) of a common definition and, thus, universal conceptual model of trust - provided some evidence for our simple, more state-dependent, emergent measurement model of trust (i.e., the ETM). What remains, however, is a third goal that calls for a more refined model (Goal 3). This third goal sought to address several of the limitations of the model and explore unexpected effects identified in Goal 2. Specifically, the three-way interaction of our three predictors - G, U1, and R - and the outcome of trust (T) assumes a rectilinear relationship between the variables, but our data indicate a curvilinear relationship between some of our predictors and outcome. A non-rectilinear relationship appears more likely considering that trust results from a series of subjective, state-dependent assessments of each component in the model. Therefore, while the relationship between our predictors and trust does monotonically increase, trust is less likely to increase in a uniform fashion across varying levels of each component, producing an inconsistent yet monotonic relationship. Given that trust is unlikely to function as a rectilinear relationship with G, U1, and R, the focus of my next study was a reassessment of the current model and exploration of alternative models that may provide a better explanation of trust (T).

This dissertation aims to reassess and refine the ETM through the alterations of the individual components via scaling, testing alternative models, and using alternative methods to classical test theory or OLS parameter estimation. Scaling the components and running nested comparison of several models determined what type of model best

explains the relationship between our three components and trust (PART 1). The refinements resulting from PART 1 enabled me to understand the limitations of the simple emergent model hypothesized in our previous work - the ETM - and identify if a better model fit seems relevant. Concurrent with those comparisons, I collected data from various samples to confirm the model (PART 2) that fit best from those comparisons with several confirmatory analyses. Confirming the refinements is a critical step as it supports that the refinements do not simply fit a single dataset but rather generalize to new data that include new participants and new vignettes. This dissertation fulfills the two parts of this third goal of our model development; I refer to these parts as the 1) exploratory and 2) confirmatory steps in this third goal of model refinement.

I have two primary expectations from the proposed model comparisons with the originally proposed 3-way interaction model: (1) I expect that the transformed models may lead to slightly better fitting models; and (2) I expect the SEM mediation model will likely fit well, accounting for any temporal continuity in making a trusting decision. However, I expect difficulty modeling the proposed "risky" 3-way interaction with the SEM mediation model despite a good fit. Thus, while the mediation may make sense logically from a temporal standpoint, it may make our explanation of the results more difficult.

Specific Aims and Hypotheses of the Current Study

PART 1 - Exploratory Model Testing

1. Study 1: Transformations - Do transformed variables (goal importance, uncertainty, reliance, or self-reported trust) provide a better fitting model compared to the raw, untransformed variables?
2. Study 2: Random Coefficients - Are random coefficient models warranted over the fixed-effects regression models for predicting self-reported trust using goal importance, uncertainty, and reliance as predictors?
3. Study 3: Alternative Causal Models - Do alternative causal models (e.g., mediation, latent, or other temporal models) fit the data better than the originally predicted moderation model?

PART 2 - Confirmatory Model Testing

4. Can the best fitting model from PART 1 be replicated with a new sample and new vignettes?

PART 1: EXPLORATORY MODEL TESTING

Part 1 Methods

I used the same general approach for both parts of this dissertation. That approach was an evolving data collection effort sampling from multiple sources. The evolution involved changing the method of asking participants to rate subjective levels of the ETM's components along with modifications to the measure (e.g., gradual changes in the rating scales and anchors). I evolved my approach to asking these questions to ensure that the phenomenon captured in the process was indeed trust and not alternative parallel, but irrelevant, phenomena. I documented each change and the entire evolutionary process below in order of their occurrence. Also, common to this approach was the use of multiple participant sources. These sources included local undergraduates, university community members at large, online Reddit forum readers, and Amazon Mechanical Turk workers. All sources and all participant responses were assessed for validity and reliability. In some cases, I chose to omit participants due to clear problems in the data collection process or inattentive responding (e.g., a failure to correctly answer simple validity items, failing logical performance metrics embedded in the online questionnaire administration software). The entire process spanned 5 studies - two pilot studies that provided the foundation for this work, two large data collection efforts with refined measures, and one final data collection effort to serve as my confirmatory data.

Regarding analytic methods used for these data sources, I followed the following

procedures. First, I evaluated the ETM fit using various transformations of the components - goal importance, reliance, and uncertainty (Study 1). Second, I used the best performing data transformations to test random coefficient models (Study 2) in ascending order of complexity. I began with the null model and incrementally added complexity, assessing model fit via nested model comparisons on each iteration (-2 log likelihood tests that are chi-square distributed). Finally, I tested alternative causal models to determine if the proposed moderation model explained the data better than others (Study 3). Examining alternative models provided an opportunity to explore whether another causal model potentially raised concerns about my a priori hypothesis that trust is an emergent and state-dependent, subjective cognitive experience. Given these general methods, I provide further detail about the actual methods for each study.

Sample. As mentioned above, I used the third and fourth data sources for Part 1 of my dissertation. The third round of data collection provided a varied sample of respondents (N=212) recruited from multiple sources including but not limited to Amazon's Mechanical Turk (N=46), undergraduate psychology students (N=103), and the general community (e.g., community flyers, online forum postings, social media platforms postings) (N=63). Mechanical Turk and psychology undergraduates received compensation for their responses (monetary compensation and course credit, respectively) whereas the general public respondents voluntarily completed the measures. Of all respondents, 73.7% (N=149) completed all vignette scenarios, providing a full data set on which to test model fit. Full demographics were obtained on 82 of the 212 respondents who completed the vignettes and ETI. Demographics indicated most

respondents were lower- (57.06%) to middle-class (30.4%) female (85%) young adults (mean age = 29) of Caucasian descent (61%) living in the United States (83.6%). The fourth round of data collection provided an equivalent-sized sample (N=149) of undergraduate psychology students. Participants for the fourth round of data collection only completed the series of 8 vignette to test confirmation of the results found in the third round (i.e., the first test of the new vignette version); thus no demographic data is available for the fourth round participants. In sum, model fit tests were performed on a sample size of 298 full vignette responses.

Procedures. All respondents completed a set of questions related to eight vignettes (see Appendix for the format and wording of vignettes) presented to them via an online (Qualtrics) survey software. The questions pertained to the trust model we (my colleagues and I) developed over the past 5 years. That model required the measurement of an individual's ratings of goal importance, uncertainty, and reliance along with an overall rating of trust and the likelihood of a trusting behavior. Respondents completed all measures online.

Trust Manipulation. As indicated above, I employed an evolutionary process of refining data collection methods. Early in the research program, my colleagues and I had participants provide situations where they trusted or failed to trust other persons, devices, or systems. Those situations provided excellent evidence about our model but the variance observed for the three components we hypothesized to be most relevant for trust had large variance differences. Respondents only remembered important situations (i.e., low variance in goal importance) where they either fully trusted or distrusted (i.e.,

extreme situations for trust). As a result, we opted to manipulate trust by creating scenarios that would lead people to gauge the extent they felt the outcome important (G), relied on some agent (R) for an uncertain outcome (U). We developed a series of vignettes to assess how participants would characterize trust across situations comprised of differing levels of each of these three components. After several pilot attempts, we arrived at eight vignettes that best represented the extreme combinations (i.e., low and high) of the ETM's three components - Goal Importance, Reliance, and Uncertainty (see Figure 2).

Figure 2: Numeric reference for the vignettes representing each high/low combinations of G, U, and R

The vignettes served as the stimuli for all studies documented in this dissertation. The software delivered small portions of each vignette at a time followed by questions pertaining to the material presented. Our objective was to decompose what may be a fairly fast and non-deliberative cognitive process into a more deliberative one. Thus,

material pertaining to goal important and uncertainty was presented first (e.g., "you need to drive across town during rush hour for your dream job interview"). Once presented with the vignette snippet, the software presented a series of questions pertaining to the subjective evaluation of that aspect. As the vignette continued, we anticipated that the participant would synthesize the parts into a whole and respond to the questions following with all aspects of the vignette in mind (see Figure 3). Cognitive think aloud studies during the original development of the vignettes confirmed this anticipated situation and, as a result, we assumed that it held true for all our online participants.

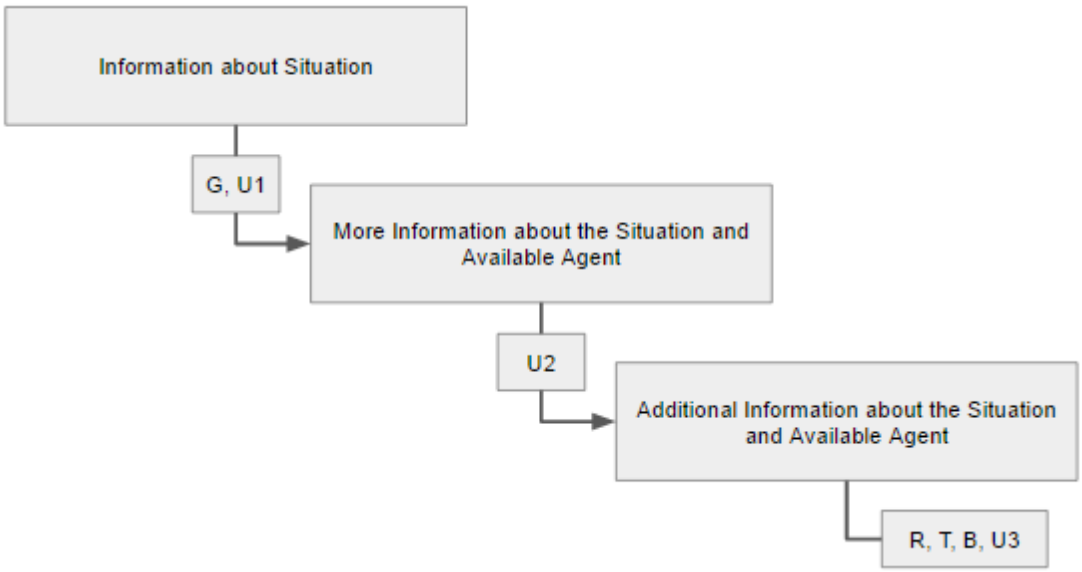

Figure 3: Process of Information and Question Delivery Within Vignettes

Presenting information in this fragmented vignette manner allowed for an artificially deconstructed "walk through" of the cognitive process individuals face when making a decision steeped in uncertainty. This method further allowed for differential assessments

of uncertainty. That is, we could assess uncertainty about the situation (U1), uncertainty about the agent (U2), and uncertainty about the decision to trust or not (U3) as the participant received more information about the scenario.

Measures.

Emergent Trust Inventory. As discussed previously, the current set of studies fits into a broader aim of developing a measurement model, designing a measure that suits that model, refining the model via empirical assessments (this dissertation) and then assessing the model in broader contexts. That second aim (referred to as Goal 2 previously) of this research program developed the Emergent Trust Inventory (ETI) to assess the Emergent Trust Model (ETM). Development and refinement of the ETI occurred over three iterations of pilot studies and actual data collection using a rapid-prototyping, iterative approach (for detailed development of the ETI, refer to the Goal 2 Overview). The final version of the ETI used in Experiments 3 and 4 was a seven-item measure intended to assess an individual's perspectives on relevant predictors of trust as defined in the ETM (i.e., goal importance, uncertainty, and reliance), self-reported trust, and behavioral intent (see Appendix for the detailed ETM item format). Each of the ETI's seven items assessed the following: the participant's perspective of the importance of the goal in a given vignette (G), the uncertainty the participant had about her ability to achieve an outcome given the provided information (U1), the uncertainty about an agent that could offer potential aid (U2), willingness to rely on the agent offering aid (R), how much the participant trusts in that particular scenario (T), whether the participant chooses to rely on the agent for aid (B), and how uncertain the participant is following making the

trusting decision (U3). While our model specifically focuses on G, U1, and R as predictors of T, additional uncertainty assessments (U2 and U3) were included in order to examine different sources of uncertainty in the judgment task. These additional sources of uncertainty (i.e., uncertainty about the agent, U2; uncertainty after determining a trust judgment, U3) serve as discriminant validity indicators for the uncertainty we proposed influenced trust. Further, they offer future avenues of exploration in regard to other aspects of trust (e.g., trustworthiness, dynamic trust, etc.) that I discuss in the future directions of this paper.

The measure used single items to assess each component of the model - goal importance, reliance, and uncertainty. Although we deconstructed uncertainty into three separate assessments, the uncertainty about the outcome (U1) remains the predictor in the ETM's proposed three-way interaction and is assessed by the single question. The decision to trust is a complex process in which multiple sources of uncertainty likely play a role. Identifying these sources of uncertainty (i.e., in the outcome, in the agent, and following the decision to trust or not) offers us the ability to determine the relative influence of each on trust outcomes. As previously noted, we used single items in order to assess the temporary psychological state of trust - requiring a measure whose execution is rapid and flexible to multiple contexts. Single items can be a valid and reliable measurement method in a variety of domains when compared to traditional multi-item measures (cf. self-esteem, Robins, Hendin, & Trzesniewski, 2001; life satisfaction, Schimmack & Oishi, 2005; global quality of life, Gebauer, Broemer, Haddock, & von Hecker, 2008; and job satisfaction, Bergkvist & Rossiter, 2007). Our selection of single

items was purely pragmatic. We expect a flexible, brief measure to have more utility across all disciplines than an unwieldy instrument that cannot be practically deployed in more rapid and momentary data collection instances when trust might be more relevant to everyday life.

Study 1 - Transformations

The analysis of most psychological data frequently centers on mean values and tests linear relationships. We psychological scientists employ t-tests, ANOVAs, or other linear models that rely heavily on normal distributions where means, mean differences, and relationships among variables must abide by a rectilinear or straight line assumption (i.e., a monotonic relationship) to be interpretable. Moreover, our linear models often allow for more flexibility because variables are said to be "optional" in that a linear model does not mandate predictors exist together. Specifically and more technically, the "+" or additive nature of our linear models suggests a logical OR such that our variables may be relevant or not. Normally distributed, monotonically related, and conditionally optional models place restrictions on our level of inquiry that may not hold true in reality. We do know, however, many natural phenomena are not well suited for these assumptions. Our data in social and behavioral science are often non-normal and we occasionally see a progression representing more of a curve (i.e., an ogive or logistic function) with variable rates of change rather than a linear progression required of a monotonic relationship. These relationships often indicate that the relationship cannot be adequately summarized nor explained by a linear, monotonic function that mandates some normal distribution. Without enough adequate evidence to know the true nature of

the relationship, I aimed to test whether the relationships might better fit alternative models (i.e., data transformed to fit the linear model). This determination resulted from examination of the bivariate plots (data from initial pilot studies, see Figure 4).

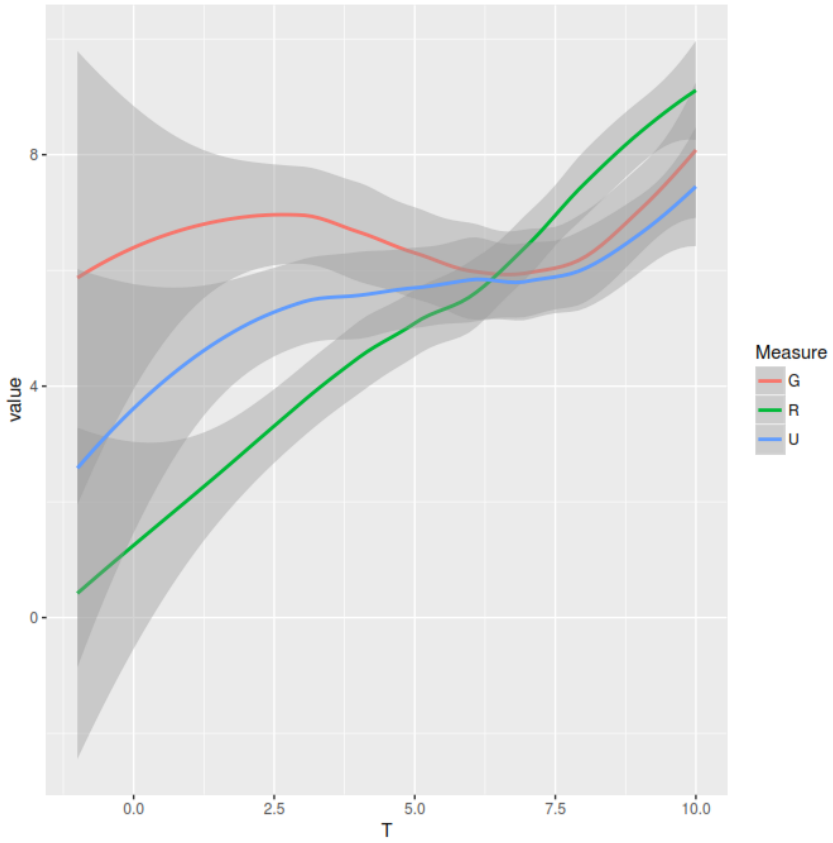

Figure 4: Bivariate plot of G,U,R and T averaged across scenarios in a prospective vignette study design

These plots indicated that a slight curvilinear relationship may exist between some of our components and trust. In order to ensure the components are correctly modeled (i.e., the appropriate relationship between the components and trust is described), I examined transformations to normality in order to ensure the model was not

misspecified in future studies. I employed transformations to create monotonic, linear models based upon Box-Cox and Mosteller-Tukey's bulging rule transformations to identify whether an exponential or log-scale provides a more suitable scale for analysis of trust.

Analyses

The predictors in the ETM - goal importance (G), uncertainty about the outcome (U1), and reliance (R) - were transformed using two methods. The first method is a rather crude one but sufficient for a rough cut at the transformations - the Mosteller-Tukey bulging rule (Mosteller & Tukey, 1977). That rule stipulates that transformations are appropriate when the bivariate relationships bulge away from the expected straight line. These rules are effects "rules of thumb" whereby data analysts may use them as a general approach but they result in very coarse results. Specifically, a bivariate curve that bulges upward - meaning that the curve begins at the origin with a steep slope but then slowly flattens - ought to be transformed with some minimizing function for x (e.g., log, square root) or expanding function for y (e.g., squared or cubed). These rules of thumb are rough but very useful for a quick guide to better performing linear models. The second method I employed is a more refined method called the Box-Cox transformation whereby the actual transformation exponent (λ, see Equation 1 below) can be empirically estimated by modifying the variable to form a more Gaussian normal variable.

$$y_i^{(\lambda)} = \begin{cases} \dfrac{y_i^{\lambda} - 1}{\lambda} & \text{if } \lambda \neq 0, \\ \ln(y_i) & \text{if } \lambda = 0, \end{cases}$$

Equation 1: One parameter box-cox transformation formula

The equation for such transformations were originally formulated by Box & Cox (1964) to solve the common problem of non-normal variables leading to violations of the Markov-Gaussian assumptions of linear models. By transforming variables to be more normally distributed, the linear model results tend to comply with the rectilinear assumption. Thus, while the bulging rule provides a rough guide, the Box-Cox transformation provides a more precise value (e.g., $x^{1.7}$ instead of just x^2). I computed all transforms using the standard methods included in the MASS package in R (Venables & Ripley, 2002; R Core Team, 2016). After transforming the variables, I tested them sequentially using the linear model of self-reported trust as the dependent variable predicted by G, U1, and R - along with all interactions. I then evaluated the model performance based upon changes in the adjusted R^2.

Results

Based upon many model comparisons, there were no significant improvements by transforming the variables. Transforming the composite of the model components (G*U1*R) - based upon the Box-Cox function - for best fit transformation required a minimizing function ($\lambda = 0.9$) and despite the added complexity, that transformed predictor explained the same amount of variance in self-reported trust ($R^2 = 0.21$) as the rectilinear model. Since only some of the model components appear to have a curvilinear

relationship with trust (see Figure 3), I also computed transformations for each individual component. None of the resulting transformations ($\lambda_G = 3.0$, $\lambda_{U1} = 0.4$, $\lambda_R = 1$) affected performance of the model in comparison with the original rectilinear model. These results indicate that retaining a rectilinear model for testing does not mis-represent the model nor the relationship among the predictors (G, U1, and R) and the outcome (T). All models had identical fit characteristics ($R^2 = 0.21$) and had no effect on the interpretation of self-reported trust outcomes.

Study 2 - Random Coefficients

All studies to date (i.e., Goal 2 studies and Part 1: Study 1) suggest that the best fitting models are fixed effects or rather fixed coefficient models. Every subject, therefore, is expected to "fit" the same coefficient for the 3-way interaction. Scientific progress depends upon this more generalizable, parsimonious model but in some instances when the model fit is imperfect, more complex models such as random coefficient models may allow each subject slight deviations from an overall model (see Gelman & Hill, 2006 for more details). Considering trust is defined as a state-dependent, subjective experience, a comparison of the relative influence of individual and scenario (i.e., state) on self-reported trust outcomes seemed necessary. Specifically, this more complex model helps to determine if the original fixed effect and untransformed predictor model from Study 1 would be better suited or better fit using a random coefficient model. Following a similar logic to model comparisons from above, I ran a series of random coefficient models using the lmer function in R (lme4 package), compared those models among one another, and compared them to the fixed effects models from Study 1. The

purpose of this step again was to overfit the data to ensure that I found the best fitting model.

Analyses

I first tested the linear fixed-effects model (using the lm function in R) to produce fixed effects. All models following were compared to the performance of this model. I conducted random coefficient models using the lme4 package in R (Bates, Maechler, Bolker, & Walker, 2015) and compared them sequentially using a standard nested model comparison approach. In all models presented here, I used the original untransformed predictors since the results from Study 1 above indicated the transformed predictors offered no benefit to model fit. The first comparison examined performance of several unconditioned random coefficient models within each variable group (i.e., individual and scenario). These "null" models provided the baseline evidence necessary to compute the importance or relevance of random coefficient models for these data sources. Second, I examined the relative performance of each subsequent model by including greater complexity. That complexity came in the form of including new conditioning variables (e.g., after modeling the intercept, I added, G, then U1, and then R followed by making each random coefficients and so on). Finally, the best performing random coefficient models were compared with the fixed effects models identified in Study 1 to ensure that there was an adequate reduction in residual error for the added complexity - that is, a tradeoff between model complexity and model fit.

Results

The original fixed effects model once again produced a significant interaction between G, U1, and R ($F(1,2308) = 602.7$, $p < 0.05$; see Figure 5).

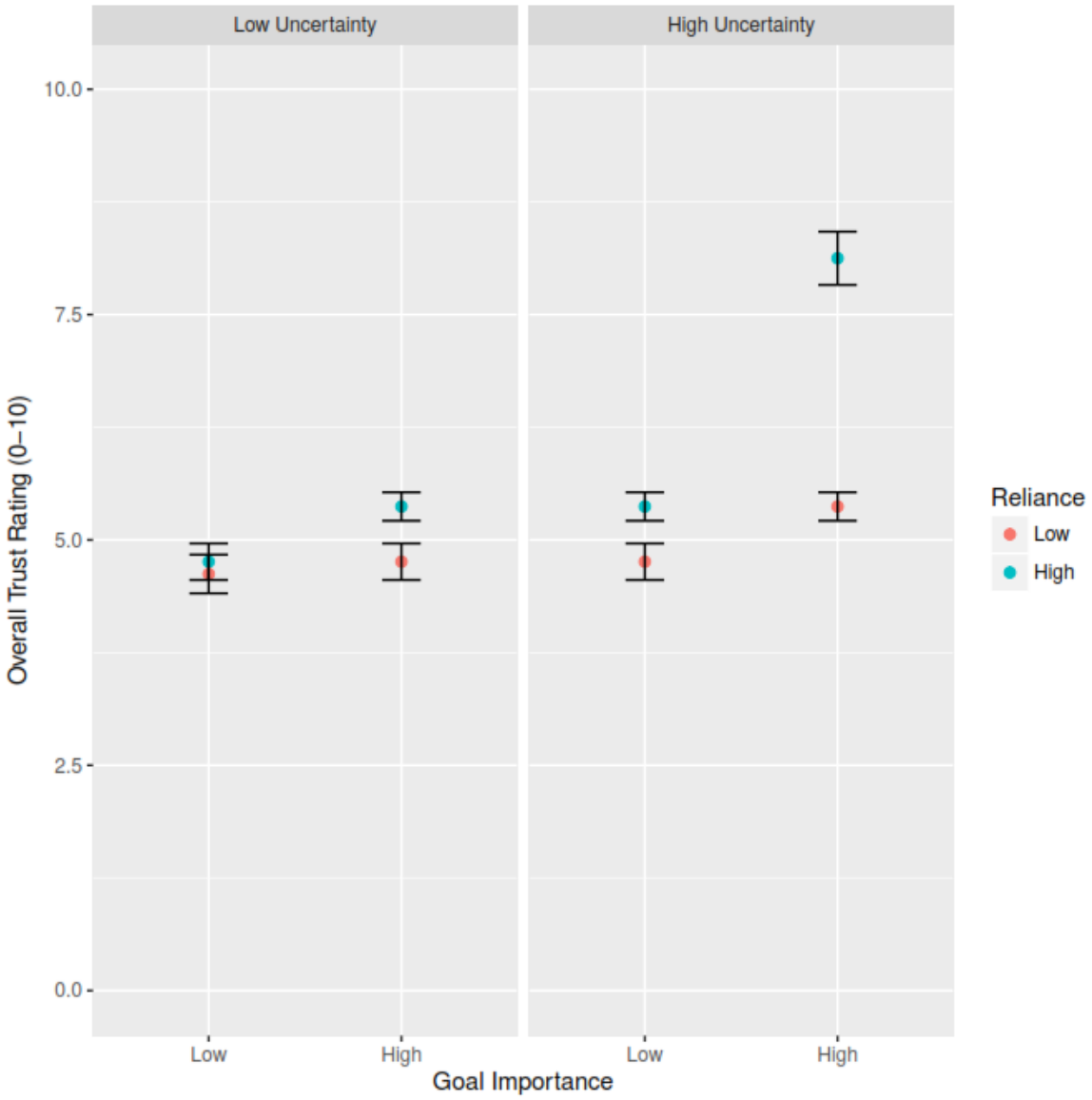

Figure 5: The interaction of G,U,R predicting trust at different low/high combinations

Multiple model tests indicated that the best fitting model for the data is a random effects model instead of the originally proposed fixed effects model. Allowing each predictor - G, U1, and R - to vary randomly by scenario provided a significantly better fit over the fixed effects model ($\chi 2$ (9)=360.91, $p < 0.05$). Both models explained approximately the same amount of variance in self-reported trust outcomes with the random effects model (Adj. $R^2 = 0.591$) explaining slightly more variance than the fixed effects model (Adj. $R^2 = 0.573$). The similarity in variance explained is likely influenced by the relatively similar weights for each component. Inspection of the coefficients between the random and fixed effects models identified that many, although not all, differences between each predictor's coefficients would be accounted for by the standard error (see Table 2). Overall, however, scenarios affected ratings of G (b = 0.139, SE = 0.073), U1 (b = 0.393, SE = 0.078), and R (b = 1.041, SE = 0.097), indicating the intended manipulations in the vignettes were not only successful but must be accounted for when using the model to predict self-reported trust (T). Critical to all of these results are the intraclass correlations of the facets of randomization. For the two data sets analyzed, the amount of variance in trust attributable to scenario was 36 percent (ICC = 0.36) and 33 percent (ICC = 0.33), respectively. In contrast, the amount of variance in trust attributable to the participants was much lower (8% and 12%, respectively). Thus, while the random effects models fit best for the models where scenario was the facet of randomization, the relative improvement over fixed effects model might not be defensible - a point I shall return to in the discussion.

Table 2: Fixed effects estimates of best fitting random coefficient model

	Random Effects Model				
Predictor	**Coef. β**	**SE (β)**	***df***	**t-value**	***p***
Intercept	0.776	0.926	12.400	0.838	0.417
G	0.131	0.072	22.500	1.800	0.082
U1	0.364	0.071	186.100	5.121	0.000
R	0.874	0.109	23.400	7.973	0.000
G:U1	-0.037	0.008	264.600	-4.469	0.000
G:R	-0.028	0.010	108.200	-2.816	0.004
U1:R	-0.037	0.010	1892.000	-3.468	0.000
G:U1:R	0.005	0.001	1360.000	3.390	0.000

Study 3 - Alternative Causal Models

As indicated above, our initial results from our previous studies provide evidence for a statistically significant and relatively efficient (i.e., parsimonious) prediction model of trust. I noted, however, that a more nuanced model may better explain the results. Since trust is a dynamic process with a temporal component (Chang, Thomson, Dillon, & Hussain, 2005), accounting for the temporal order of the trust components warranted examination. I ran two models testing the indirect effect using standard mediation model procedures in both linear models and structural equation models. The model I tested consisted of this mediation path:

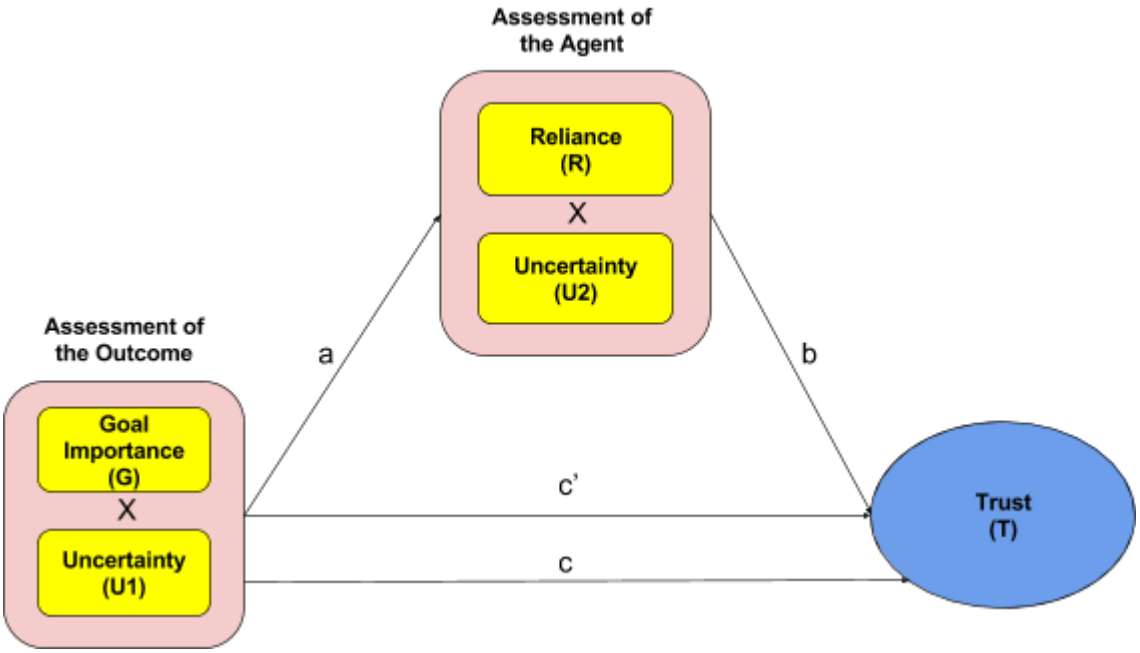

Figure 6: A Mediation Model of Trust

The rationale for this model comes from two considerations: (1) trust stems from both situational and agent-based assessments, and (2) the understanding that reliance may only become relevant once the conditions for sufficient uncertainty about an important enough outcome are met. The interaction model originally proposed assumes that all three criteria, regardless of temporal order, are necessary conditions for trust. However, if reliance (R) (i.e., assessment of the agent) only becomes relevant once the initial conditions for goal importance (G) and uncertainty about the outcome (U1) (i.e., assessment of the situation) are met, then temporal effects must be taken into consideration. Thus, the mediation model proposed suggests that once an individual deems a goal important (G) and is sufficiently uncertain (U1) about her ability to achieve an outcome without assistance, then she will consider the need to rely (R) on another

individual or agent in the face of uncertainty (U2) about that agent's ability to help achieve the desired outcome before deciding to trust (T). More broadly, this model suggests that the assessment of the agent (R and U2) mediates the relationship between assessment of the situation (G and U1) and trust (T).

Analyses

The effect of temporal order on the emergent trust model's components were tested using standard mediation model procedures. This model was estimated by using a two step procedure. Step 1 combining the temporal variables together (i.e., G with U1 and R with U2) to produce two composite scores. In Step 2 I tested these composite scores with a simplex design using standard mediation procedures with bootstrapped estimates of standard errors. Using bootstrapped estimates ensured relatively unbiased hypothesis test outcomes from the Sobel test. The indirect effect was tested using a bootstrap estimation approach with 1000 samples (Shrout & Bolger, 2002). These two mediation models were run using structural equation models (the lavaan package in R; Rosseel, 2012).

The mediation model investigated whether the assessment of agent (i.e., ability to rely on the agent) mediated the relationship between trust and the assessment of the situation (i.e., assessment of goal importance and uncertainty about the outcome) using multiplicative components. The multiplicative components better reflect the proposed interaction in the emergent trust model and assume the influence of each component is yoked to the others throughout the development process of trust.

Results

The multiplicative mediation model of trust was not supported. Results indicate that the assessment of the outcome (G*U1) was significantly related to trust ($b = -0.006$, $SE = 0.002$, $p < .05$), but had no significant relationship with the mediator - assessment of the agent (R*U2) ($b = 0.002$, $SE = 0.002$, $p > .05$). Assessment of the agent (R*U2) did, however, have a significant relationship with trust ($b = 0.030$, $SE = 0.003$, $p < .05$), supporting the notion that all three of the components - G, U1, and R - proposed in the emergent trust model are relevant to predicting trust (T) but not necessarily when considering temporal order. The non-significant results rule out mediation as a plausible alternative model.

Part 1: Discussion

Overall, trust appears to be best modeled by the interaction of goal importance (G), reliance (R), and uncertainty about a situation's outcome (U1). Results indicated that transformations to the individual predictors - G, U1, and R - do not improve model fit. This finding suggests that while the bivariate plots of each component's relation to trust may exhibit some curvilinear qualities, modeling the interaction of the three components by a traditional rectilinear model does not detract from its interpretability and predictive power. Another potential alternative to our fixed effect linear model was a random coefficient model. Varying coefficients by scenario increased model fit but at the expense of parsimony. Additionally, the amount of variance accounted for by scenario was only about 30% and, as a result, cannot be defended as a true improvement over the fixed effect model - especially since the fully factorial fixed effect model accounted for almost 60% of the total variance in self-reported trust. These results indicate that

individuals were relatively consistent in their approach to assessing trust among the three predictors but differed significantly by scenario. Additionally, by finding the scenario to be the best fitting unit of randomization (rather than participant), I gained more confidence in the vignette manipulation of trust - perhaps not uniformly across all the predictors. Vignettes merely serve a role as different contexts or situations where trust may emerge. Based upon these results, I intended to confirm the linear mixed-effects models alone because they were the only results that could be both theoretically and empirically justified. Note, however, that even the random effects may be questionable given the relatively low ICC's observed for scenario - leaving only the original fixed-effects linear models as the lone justifiable model to replicate. I focused on confirming both in Part 2 below.

PART 2: CONFIRMATORY MODEL TESTING

The second aim of this dissertation was to investigate whether the optimal model identified in Part 1 would be validated with an independent sample. Validating this model with an independent sample provides support that the identified optimal model is generalizable beyond the specific data set on which it was fit. Since the transformations and mediation model were found to provide a worse fit than the original linear fixed-effects model proposed, those analyses will not be tested for confirmation. The random effects model allowing for each predictor - G, U1, and R - to vary randomly by scenario had a better model fit and, thus, became the focus of Part 2's confirmatory model testing. I expected results of confirmatory testing to show that the best fit model will better predict - or explain more variance in - self-reported trust than other models. Further, I expected this model to predict trust better as an interaction of the three predictors (G, U1, and R).

Part 2: Methods

Sample. Recruitment from multiple sources including Amazon's Mechanical Turk (N=78), undergraduate students (N=174), the local community (e.g., via flyers and word of mouth) (N=58), and online social media platforms (e.g., Reddit, Facebook, etc.) (N=10) provided a sample of 320 participants. Approximately 76% (N=243) of respondents provided complete data that passed all validity checks. Demographics

indicated most respondents were lower- (62.9%) to middle-class (19.4%), female (76%), young adult to middle-aged individuals (M=27.88, SD = 13.74) of Caucasian descent (52%) living in the United States (81.1%).

Procedures. I employed the same procedures as those used in Part 1 above with one minor exception - the number of vignettes increased from 8 to 16 to assess whether the effects for the first 8 replicated vignettes held not only between studies but also the effects would be observed from 8 new vignettes.

Trust Vignettes. Participants responded to questions nested throughout 16 vignettes. In addition to the original 8, my colleagues and I developed 8 new vignettes to increase variability of the components across scenarios and to assess the generalizability of effects for new vignettes. These additional 8 vignettes followed the same process as the first 8, with a primary focus on manipulating high and low levels of goal importance (G). I aimed to maximize the variance of goal importance to ameliorate the potential restriction of range issue observed in the previous data collection efforts. Thus, if the interaction model replicated with a more varied set of stimuli, we could be confident that the model might be easily replicated between labs, samples, and even manipulations. As before, each vignette presented a unique scenario in which information about the goal, ability to attain the outcome, and agents on which an individual could choose to rely were varied. We structured the vignettes to sequentially deliver the relevant information. The first portion of information contained general information about the situation and desired outcome at the start. The second portion contained information about the agent and reliability of the agent. The third and final portion contained additional information

about the situation and agent that might influence an individual's overall assessment of trust.

All participants began the study by completing the series of 16 vignettes describing a myriad of situations that may or may not have demanded trust. The Emergent Trust Inventory (ETI), a set of seven questions assessing each component of the new emergent trust model as well as self-reported trust and behavior, was administered with each of the 16 vignettes. Specifically, the ETI questions were administered in the same fashion as in Part 1 above, distributed throughout the vignettes after the information relevant to the question content is provided in the vignette. Goal importance (G) and uncertainty about the likelihood of the outcome (U1) were administered first, followed by uncertainty about the agent (U2), the need to rely on the agent (R), and finally the uncertainty about the likelihood of the outcome working out given the reliance assessment (U3), self-reported trust (T), and the likelihood of engaging in a particular behavior (B). The best fit model from PART 1 was validated against the original interaction model using data from the 16 vignettes.

Measures.

Emergent Trust Inventory. I used the same structure and implementation of the ETI nested throughout the vignettes - thus, I refer readers back to Part 1 for the details.

Analyses. Using the same lmer model syntax used to arrive at the best fitting model from Part 1, I simply applied that to the new data. I also tested the linear fixed-effects model (using the lm function in R) to produce fixed effects. As before, the random effects model specified the model predictors - G, U1, and R - to vary by scenario.

Part 2: Results

First, the original fixed effects model was tested for confirmation with the new data set. The interaction between G, U1, and R was found to be significant ($F(1,3543) = 1070$, $p < 0.05$; see Figure 7).

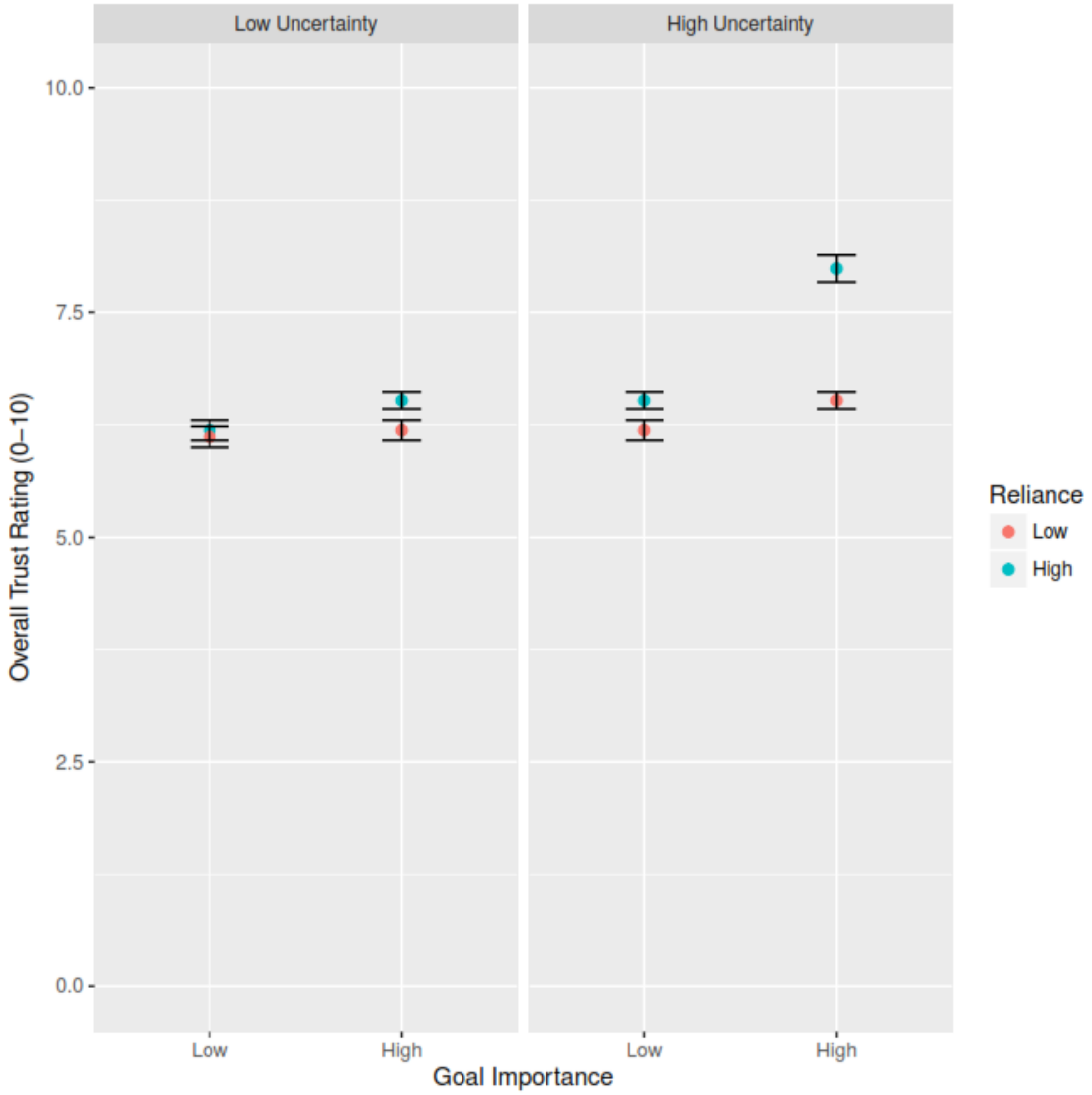

Figure 7: The interaction of G,U,R predicting trust at different low/high combinations

The random effects that included all 16 vignettes where the three predictors - G, U1, and R - were allowed to vary by scenario failed to converge. Despite the lack of convergence, the model did produce results. The warning was that the eigenvalues were large - perhaps due to high collinearity among the model parameters. Centering the predictors did not eliminate the warning.

Validation of the random effects model with the independent sample indicated that it still performed better than the original fixed effects model. Allowing each predictor - G, U1, and R - to vary randomly by scenario provided a significantly better fit over the fixed effects model ($\chi 2$ (9)=1067.8, $p < 0.05$). The random effects model indicated that scenarios affected ratings of G (b = 0.632, SE = 0.450), U1 (b = 0.401, SE = 0.059), and R (b = 0.797, SE = 0.069), indicating the intended manipulations in the vignettes were not only successful but must be accounted for when using the model to predict self-reported trust (T). However, both models explained the same amount of variance in self-reported trust outcomes (Adj. $R^2 = 0.528$), with the three-way interaction between G, U1, and R achieving significance in both models ($p < .05$). The lack of improvement in variance explained is likely influenced by the relatively similar weights for each component. Inspection of the coefficients between the random and fixed effects models identified that any difference between each predictor's coefficients would be accounted for by the standard error (see Table 3).

Table 3: Fixed effects estimates of random coefficient model for the independent data set

	Random Effects Model				
Predictor	**Coef. β**	**SE (β)**	***df***	**t-value**	***p***
Intercept	2.609	0.666	27.300	3.917	0.000
G	-0.034	0.067	170.300	-0.520	0.603
U1	0.214	0.061	136.800	3.493	0.000
R	0.575	0.086	82.300	6.660	0.000
G:U1	-0.020	0.007	1234.000	-2.916	0.003
G:R	-0.003	0.009	2651.000	-0.357	0.721
U1:R	-0.012	0.008	2662.000	-1.404	0.160
G:U1:R	0.002	0.001	2913.000	2.809	0.005

OVERALL DISCUSSION

A simple, moderation model of trust appears to be both reliable and generalizable within the limits of the present set of studies. Given that statement, there are rather large implications should those results hold with even greater stress tests. I enumerate those implications, provide some insights into the potential limitations these methods hold, and discuss how I intend to mitigate them in future studies.

Implications

More than 20 different areas of inquiry may benefit by a simple measurement model as examined in the studies described herein. Those benefits include a clearer understanding of the development of trust, the maintenance of trust, and the decay of trust over time. Consider two areas where each of these points would prove hugely beneficial - interpersonal trust and trust in automation. Interpersonal trust requires an assessment of another party to determine his or her trustworthiness; this trustworthiness assessment helps determine how much to rely on that individual. A trustworthy individual is a reliable individual, creating a foundation for trust and, thus, behavioral engagement with that individual. Trust in automation researchers have the same aim - increase a user's behavioral engagement with different devices. The difference merely lies in the agent requiring trust and the expectations a user holds about that agent (Hoff & Bashir, 2015). A user who trusts an automated system is more likely to show consistent high levels of

behavioral engagement, typically measured as the act of relying on the system to help perform a task. That behavioral engagement results from an assessment of trustworthiness and, thus, the willingness to rely on a system, leading to the necessary conditions for trust. Trusting in the automation allows a user to reap the benefits of greater efficiency and increased performance that the system provides. However, too much reliance can sometimes result from too much trust in a system over time (i.e., improper calibration of trust). Trust without reservation in a system can lead to catastrophic results - both short and long-term - when it fails, however. Consider Sebok & Wickens' (2016) analogy of lumberjacks to automation failures. For lumberjacks, the higher the tree, the greater the impact of failure (trees falling). Highly automated vehicles represent a high tree as their prevalence on roads steadily increase (e.g., Google's self-driving car, Uber's autonomous taxis, Tesla's autopilot). Failures of these automated vehicles rapidly gain attention and, as such, may reduce user interest.

Applying my current measurement model of trust, we may find that the failures result in a reduction of uncertainty about the automated system. That is, they will better understand the limitations of the automated system. Understanding of why an automated system fails allows a user to calibrate his understanding of when a system is trustworthy due to its limited reliability. On the other hand, the failures may lead people to question their need for automated aids entirely. A user who trusts without reservation and has little understanding of a system does not know when to expect a system's performance to remain optimal or decrease. Knowledge about the system is just as important as knowledge about another person when trusting interpersonally. Blindly trusting another

agent - human or automated - places an individual in a state of vulnerability that, when violated, can produce highly negative outcomes. Calibrating trust appropriately, regardless of the agent of trust, requires an understanding of the necessary conditions for trust to form as well as how trust differs at differing levels of those conditions. Knowledge about these two points allows an individual to predict the likelihood any one combination of conditions will lead to a desired outcome or a worst case scenario and act accordingly. More globally, researchers can use this information to better guide design of automated systems to help guide user assessments and expectations of an automated system. This knowledge provides implications for the role of trust and optimal conditions under which one-on-one interactions, team dynamics, organizational structure, and the design of automated devices will perform.

Trust Measurement Models and Real Trust. The work presented here and conducted to date with my colleagues serves as an initial effort into testing the efficacy of our theoretical model of trust. We hold that by first understanding the relevant components of self-reported trust, we can then work both retrospectively and prospectively in understanding the development, maintenance, breakdown, and repair of trust. Thus, this work is merely a start. I used the term efficacy because the model currently proposed aims to examine whether the expected results could be obtained under ideal, controlled conditions. A focus on efficacy allows for the determination of whether the model predicts outcomes as expected and, is thus, specified correctly. This work aims to follow the process akin to of a bench scientist examining her phenomenon of interest. First, she observes the material of interest in isolation. After sufficient

observation, she perturbs the material to see how it reacts - all in an artificial environment. Later, once she fully appreciates how the material behaves with multiple perturbations, she transfers the material into a more realistic environment - a point where the efficacy work turns into effectiveness work. Our work to date remains at the efficacy level. We have more to do to fully appreciate the necessary and sufficient predictors of self-reported trust but for now, the evidence appears clear that goal importance, uncertainty, and reliance are dependable predictors. Future work needs to include other potentially relevant predictors but ones that we do not hypothesize as essential (i.e., discriminant predictors). Additionally, our work seeks to complement the existing literature by offering a mechanism to directly measure the influence of dispositional, situational, and learned factors that are known to influence levels of trust (Hoff & Bashir, 2015). Individual differences (e.g., disposition) will affect the perception of our three components (e.g.,whether a goal is perceived as important enough, how comfortable with uncertainty levels a trustor is, and how willing a trustor is to become vulnerable); that is, they may well alter an individual's threshold for any one of our model's components to be judged high enough that trust becomes relevant. Contextual factors (e.g., situational) will influence uncertainty about both the situation and agent (i.e., U1, U2, and U3 assessments), and learned factors are likely to be the result of experience over time (e.g., U3 assessments and the actual outcome of a trust-based decision). These learned factors will likely impact future dispositional and contextual factor assessments, serving as evidence on which to make a judgment of the importance of a particular goal given uncertainty about obtaining that goal in the face of relying on a particular agent in a new

situation. With these points in mind, we need to carry our measurement model out of these hypothetical vignettes into more realistic environments where the true dynamic nature of trust may be fully studied.

Alternative predictors and related constructs. The proposition of an emergent model demands proper specification of the model's components. Examining the influence of additional variables likely to influence the development of trust must be tested in order to not only ensure proper model specification but also to ensure that we have not oversimplified our perspective of the components relevant to predicting trust. We took six core components and subsumed them into three overarching variables based on how they overlapped in their conceptualization, definition, and measurement across the literature. However, we need to test whether our variables accurately reflect these relevant components. For example, trust requires vulnerability as it represents the risk associated with relying on another individual to help obtain a desired outcome. We do not directly model vulnerability in our model, but we assume that U1 creates a condition where vulnerability might be warranted and the components of R and U2 capture the level of comfort an individual has with risking vulnerability. We cannot know if this is sufficient, however, until we directly test assessments of vulnerability and identify whether it adds to the prediction of trust above and beyond what our model currently explains.

Further, our model is not the first to take common elements of trust and define them by other means. For example, the assessment of reliance on an agent is typically subsumed into an assessment of trustworthiness of the agent. We do not explicitly

measure trustworthiness, however, we believe that the combination of assessing one's need to rely on an agent (R) and the uncertainty about relying on that agent (U2) may well comprise the foundational elements of trustworthiness. Establishing parallels between our model and existing models ensures that we are considering the facets of trust previously identified as important (e.g., ensuring we specified the model correctly) and also demonstrating the ability to explain related but distinct concepts of trust. These tests also will help identify the limitations of our model and where we may have failed to incorporate relevant considerations of trust.

Another implication of this model is whether it provides information on how to distinguish trust and distrust from each other. Trust and distrust are characterized as two distinct but related constructs in which both are active choices (Lewicki, McAllister, & Bies, 1998; McKnight & Chervany, 2001; Marsh & Dibben, 2005). One choice is positively valenced, however, and the other is negatively valenced leading to parallel but distinct assessments of an agent. However, a distinction that often seems to be overlooked is the differentiation between distrust and lack of trust. Distrust appears to result from active assessments of a situation and agent's untrustworthiness (e.g., "I believe you will work against me", Marsh & Dibben, 2005) whereas a lack of trust is not an active assessment. A lack of trust is akin to the phenomenon identified as untrust. Untrust is a passive conclusion stemming from an individual's inability to determine whether he should trust or not trust in a given situation; it is neither one or the other but merely a deficiency in information from which one can choose to trust or distrust an agent (cf. untrust, March & Dibben, 2005). Better distinguishing between trust, lack of

trust, and distrust therefore seems warranted to maintain consistency across the literature. One of the limitations in our findings identifies that our model might offer some insight into this distinction. That limitation was the restriction of range across all trust ratings regardless of scenario (see Figures 4 & 6). While the three-way interaction identified that trust was significantly higher when all three components were sufficiently high, none of the trust ratings for other scenarios fell below a 4.5 on our trust scale. This rating floor of 4.5 might be indicative of a general baseline to trust (e.g., I am neither trusting nor distrusting) and anything below that value begins to represent a scenario in which someone distrusts. While this supposition cannot be confirmed with the current data, additional exploration is warranted on this point.

Examining trust in alternative paradigms. Examinations of trust in a behavioral task can provide insight toward this proposition. We have only measured perceptions of trust and behavioral intent (B). While we can further examine the relationship between T and U3 with B, we are likely to gain limited inference about how perceptions of trust and uncertainty of the outcome relate to behavior as well as how they may influence future trust assessments. This is for two reasons. First, behavioral intent is commonly known as a relatively poor indicator of actual behavior. Second, none of the vignettes provided an outcome for the individuals to assess following the T, U3, and B decisions. Behavioral tasks offer the chance for individuals to react to support for and violations of trust in real-time, updating their trust and, subsequently, behavior through the task. The limitations of current behavioral tasks, however, are that trust is not measured in real-time and, thus, the reasoning as to whether and how an individual's trust

changes throughout the task and how that relates to a shift - or lack thereof - in behavior is unknown. Overall trust is typically measured after the scenario is complete, offering a limited scope of insight toward an individual's state experience. Further, assessments after the outcome is known may bias reports of trust as we noted in our retrospective study design. A lack of insight into how trust is changing in real-time offers limited interpretation of behavioral shifts. Applying this model within a behavioral paradigm offers the ability to assess the relative influence of each predictor on changes in trust, uncertainty, and their relation to behavior as the conditions of a task change.

The dynamic and cyclic nature of trust. Trust is known to change over time as a result of experience. Although considered in our theoretical conceptualization of trust, we have yet to test how it explains the dynamic and cyclic nature of trust (e.g., maintenance of trust, decay of trust). Our state model offers insight into individual experiences of trust. Thus, we posited that this model likely functions well by Bayesian principles. That is, each state of trust predicted from the model (i.e., the posterior) becomes new evidence (i.e., an updated prior) that may influence future trust assessments of trust for an individual. Two elements of the model that serve to affect future assessments are the perception of trust (T) and how uncertain an individual is about that assessment (U3) prior to knowing the outcome (i.e., did the agent follow through and help the trustor obtain the desired outcome). Both T and U3 appear relevant to future trust assessments because uncertainty about whether a decision to trust or not may influence an individual's response to a violation of trust. For example, I may decide to trust my GPS to guide me to a job interview although I'm unsure about its ability to do so

without error. If I am highly uncertain and the GPS fails to guide me properly, I have two methods of responding - (1) never trust the GPS again or (2) assume that my uncertainty was a proper calibration of trust in that device because it proved unreliable when I thought it might be unreliable. Trust is a mechanism intended to diminish uncertainty in a given situation, so if the decision to trust is still accompanied by sufficient uncertainty, it seems relevant to explore how that might impact future assessments of trust long-term.

Limitations

Two primary sources of limitations were faced with this project - (1) limitations from the data source, (2) limitations from the method of measurement. I address the limitations from each of these sources in turn.

Limitations from the data source. The data sources used for model fit testing and validation posed three potential limitations. The first two considerations were whether (1) availability and (2) quality of the data varied by source. Different data sources supplied differing numbers of respondents with most respondents sourced from compensation-based platforms (i.e., Mechanical Turk and university students). While Mechanical Turk and university students received compensation for participation, all other respondents were volunteers. It is possible that individuals completing the survey for the sake of compensation did not care as much about providing valid data as opposed to receiving compensation for time spent on the task. This limitation was accounted for via two methods. The volunteer participants were incentivized with the opportunity to win an online gift card for their participation; this was intended to increase effort through

incentivization. The second method accounted for valid data by limiting the analysis to data from respondents who took a minimal amount of time required to thoughtfully complete the task. The benchmark for time cut-off was established during pilot procedures; the average lower limit across pilot participants for time to completion served as the criterion for acceptance. The third, and last, limitation of the data source is whether the composition of the samples provided generalizable findings. Trust, being a subjective phenomenon, requires study across multiple samples to confirm whether a universal model is generalizable. However, the majority of our samples were limited to relatively well-educated women from the United States. Support that our findings are sound were found in the random coefficient model insofar that variability of responses stemmed more from the manipulation (i.e., scenario) than the individual, suggesting the model may account well for individual differences. Exploring how the model performs with different samples and across different cultures would address this point.

Limitations from the method of measurement. The second limitation results from the method of manipulating and measuring trust. Three potential limitations were noted. The first two limitations stem from the method used to manipulate trust - the vignettes. The vignettes, while successful at manipulating the outcome of self-reported trust, provide limited inference on the generalizability of our findings. We want to create a measurement model that is universal, not merely relevant to one paradigm. That is, we aim to specify a model wherein G, U1, and R predict trust regardless of paradigm or research topic. Economists and Trust in Automation researchers alike should find that trust in their respective domains is predicated on the interaction of these three variables.

If it is not, we have misspecified the model potentially as a result of the limited scope of our manipulation. As previously mentioned, a test of the measure is warranted in a behavioral paradigm in which the measure can still be administered but the outcomes should reflect similar findings. Based on the results of the random coefficient model, there is evidence that a particular scenario or manipulation will not heavily influence the outcome of the model findings. This provides some support for the generalizability of the model regardless of method of manipulation, but it still remains that the model must be tested with alternative paradigms.

A second limitation of the vignettes is due to the fact that they create an artificially deconstructed paradigm of trust. Assessments of each situation posed in the vignettes were actively controlled and guided by the order of information delivery to the participant. Whether trust is a slow, deliberative process or a split-second decision remains unclear; our vignettes only model the former though. We have purposefully created a slow, deliberative process in order to "tune the dials" of our model components and ensure we could measure how different combinations of each both individually and combined relate to trust. This method helped establish efficacy of the model and ensure proper model specification. However, it is possible that trust more likely results from a quick, split-second process especially when emotions are high or time pressures exist. Measuring trust using our measure in different paradigms (e.g., behavioral task) can provide insight as to whether a better paradigm exists to manipulate and measure trust as well as whether the results of our model from a deliberative trust process generalize to one in which a trust assessment must be made quickly.

The third issue stems from the measurement of our model components relying on single-item measures. Specifically, single-item measures often produce odd results between samples. Overall, this is not a problem that I can address within this study, but I do anticipate it is likely as it is with almost all single item measures. While we cannot explain all the variability in our outcomes, our results provide some support that the single-item measurement did not have a deleterious effect on outcomes across samples. The aforementioned intraclass correlations (ICC) indicated that the majority of the variance in trust was accounted for by scenario (i.e., the manipulation). Variability among individuals contributed very little to overall variance in trust. However, we cannot conclude that the lack of variance was necessarily due to a common interpretation of the single-items presented across participants or some other reason.

The next steps to address concerns arising from the use of single-item measures is two-fold - (1) alter the sample and (2) alter the measure. First, while we collected a more varied sample than typical, the model requires examination with sample population likely to be vastly different than those tested in the current study. A test on a vastly different sample can determine whether and to what degree the single-items perform similarly and, thus, produce similar results. Second, presenting individuals alternative sets of items can identify within-person differences when presented with the same content but different questions. Both the item content and the anchor can be varied to determine the source of response variation. This is an important consideration especially when it comes to how individuals interpret uncertainty. Defining and measuring perceptions of uncertainty face similar challenges to research on the definition and measurement of trust (Zalega, 2016).

Intending to use single-item measures therefore warrants additional examination to ensure that the component of interest - goal importance, reliance, or uncertainty - is adequately captured through additional testing.

Future Directions

Future research on trust would benefit from the continued development of this (or another) universal, simplified model of trust. Several considerations - both theoretical and measurement-related - require further attention. As discussed above, more research is needed to move beyond establishing efficacy of the model. Some of those areas of inquiry include testing alternative predictors and distinct yet similar constructs to trust; examining the model in different testing paradigms, especially in consideration of the relationship between self-reported trust and behavior; and exploring how the model explains the dynamic nature of trust.The ability of the emergent trust model to distinguish trust from other relevant constructs and explain actual sets of behavior over time requires attention to speak to its effectiveness. Science seeks to ultimately explain, predict, and control a set of behaviors that result from a phenomenon. Understanding the cognitive mechanism of trust should lead to a better understanding of the types of behaviors that truly reflect trust and those that may look like but are not the result of trust.

CONCLUSIONS

Trust becomes relevant in risky situations that offer the opportunity to engage with another agent - human or otherwise. As a result, trust may be one of the most widely relevant concepts in decision-making and risk management; omitting it may lead to incomplete or misleading theories. Researchers, however, cannot agree on what specifically leads to trust let alone how to measure or manipulate their desired outcome (McKnight & Chervany, 1996; p. 4; PytlikZilling & Kimbrough, 2016) - a problem that Cronbach (1957) clearly outlined in his "two disciplines" address. The lack of a common definition, model, and measure of trust leaves researchers across multiple fields with an inability to consistently predict and explain the variability in trust research outcomes. My research program aims to take a step toward identifying that common definition, model, and measure. First, my efforts began with a review of the extant literature, identifying the sources of agreement and disagreement on trust. Second, I helped create a new, simplified, universal definition of trust with an accompanying conceptual model derived from this review. Third, my colleagues and I developed a model to be tested against the currently used trust measures across several different scenarios. Lastly, the new measure and model was revised through a series of studies, including the final proposed study elaborated above. The efforts of this program ultimately seek to add to the scientific knowledge on the mechanism through which trust develops as a cognitive state. Results

indicate that the common model of trust proposed in several literature reviews is not only a plausible but feasible endeavor as well. Further development of this simplified, universal model of trust offers the opportunity to integrate trust findings across fields of research, minimizing the fragmented understanding of this phenomenon. Increasing the understanding of how people make trusting decisions may help researchers more accurately and consistently predict future behaviors.

APPENDIX

Table 4: ETI Items and Example Vignettes

ETI Variable Descriptions and Question Anchors

1. G: How important is the outcome
    a. Question anchor: *How important is it that*...
2. U1: Unconditional view of the probability of the outcome - probably influenced by (self-efficacy)
    a. Question anchor: *How likely is it that*...
3. U2: Probability that the agent has utility for helping you achieve the outcome (perceived utility)
    a. Question anchor: *How likely is it that*...
4. R: The degree to which you plan to use the agent
    a. Question anchor: *How much do you rely on*...
5. T: Overall assessment of trust with the agent for the situation
    a. Question anchor: *Do you trust*...
6. B: The binary decision to use the agent or not
    a. Question anchor: *Do you*...
7. U3: Overall rating of uncertainty given the choices above (overall uncertainty)
    a. Question anchor: *How likely is it that*...

Vignette 1

A crucial group project is due tomorrow. The project grade determines your team's final grade and your future in your profession. With only 4 hours to focus on the project and a large portion of your part incomplete, you try your best to finish.

1. *G: How important is it for you to complete the project?*
2. *U1: How likely is it that your project receives a high final grade?*

You are dependent on two of your classmates to complete their parts for the final grade. Up to now, you have not been able to contact them about their contributions. On previous projects, your classmates produced great work half the time and sloppy work the other half.

3. *U2: How likely is it that your classmates will produce high quality work for the project?*

Your classmates have skills you do not have and those skills are essential for your project's success. You try to contact them but get no response.

4. *R: How much do you rely on your classmates to complete their tasks?*
5. *T: Do you trust your classmates to complete their parts of the project with high quality work?*
6. *B: Do you wait for your classmates to fulfill their tasks?*
7. *U3: How likely is it that your team will complete the project?*

Vignette 2

Your allergy to peanuts requires you to be extremely cautious about what you eat lest you find yourself in the emergency room again. You plan to attend a party at your friend's house this weekend. She always serves a variety of food, but she knows about your allergy and offers to put some peanut-free dishes out on the buffet table.

1. *G: How important is it for your meal to be peanut-free?*
2. *U1: How likely is it that you will expose yourself to peanuts at the party?*

Your friend has good intentions, but multiple times in the past the foods were mixed on the buffet table over the course of the party and you found yourself in the emergency room as a result of accidental peanut contamination.

3. *U2: How likely is it that your friend to keep your peanut-free foods separate from other foods?*

You typically bring your own food when visiting friends to ensure you won't get sick, so you decide to pack a small meal for yourself in case the food even looks suspicious or party guests mix both peanut-free and regular food.

4. *R: How much do you rely on your friend to keep your peanut-free food separate from all other foods?*
5. *T: Do you trust your friend to keep the peanut-free food separate from the other food?*
6. *B: Do you eat the meal your friend prepared?*
7. *U3: How likely is it that you eat food contaminated with peanuts?*

Vignette 3

Your company recently announced a voluntary, internal competition to develop the best ad design for their new product. The employee with the winning design receives a certificate of acknowledgment from the company. You are settled in to your career and do not need the recognition, but you've been dabbling in graphic design as a hobby and think it would be fun to participate.

1. *G: How important would you consider it to win the competition?*
2. *U1: How likely is it that you will win the competition?*

The entries go through a "blind" review process (i.e., no individual identification allowed on the submission) so the judges can not show any favoritism to popular employees. However, employees can view all of the submissions and talk about who they think made each submission.

3. *U2: How likely do you think it is that the judging will remain fair?*

You hear gossip about who submitted certain designs circulating through the office at lunchtime. Although you submitted an excellent design, there are several other submissions of similar quality to your own.

4. *R: How much do you rely on the "blind" judging process to choose the best design?*
5. *T: Do you trust the judging process to make an unbiased decision?*
6. *B: Do you submit your design?*
7. *U3: likely is it that you will win the competition?*

Vignette 4

A dollar bill rests on the ledge 5 feet from your open window and 5 feet from your neighbor's window. The bill seems stuck on the ledge and does not move with the wind.

1. *G: How important is it that you get the dollar bill?*
2. *U1: How likely is it that you can retrieve the dollar without assistance?*

You are not sure you can get the bill because it is clearly out of reach of your fingertips. Just as you stick your head out the window again to see the bill, your neighbor - a petite woman who never struck you as very useful - asks if she can help.

3. *U2: How likely is it that your neighbor will be helpful in retrieving the dollar?*

Your neighbor offers to try from her side with a short broom handle.

4. *R: How much would you rely on your neighbor for assistance?*
5. *T: Do you trust your neighbor to help get the dollar?*
6. *B: Do you accept her offer to help?*
7. *U3: likely is it that you get the dollar?*

Vignette 5

You are learning to fly an airplane and completed several hours in a flight simulator. You feel ready as you prepare for your first flight in a real plane.

1. *G: How important is it for you to have a safe flight?*
2. *U1: How likely are you to fly the plane without any issue?*

Your flight instructor accompanies you on your first flight. He informs you he will only provide feedback and guidance during the flight, but you know he has the ability to take over the plane and land if necessary.

3. *U2: How likely is your flight instructor to help you fly the plane if anything goes wrong?*

. On your first trip out, a dense fog settles over the airport, almost completely obscuring your vision. Your flight instructor tells you to "fly by instruments" and use the plane's instrument panel to land the plane. Although you practiced using the instrument panel to land in the simulator, you never relied on it in real-life.

4. *R: How much would you rely on your flight instructor to help fly the plane?*
5. *T: Do you trust your flight instructor to help you land safely?*
6. *B: Do you use the instruments to fly and land the plane?*
7. *U3: likely is it that you will safely land the plane?*

Vignette 6

Tomorrow, you have the biggest presentation of your professional career. Your job is to present your team's accomplishments to all of your company's chief executives.

1. *G: How important would you consider this presentation?*
2. *U1: How likely is it that you will deliver a good presentation?*

You practice the talk in front of your team, altered the talk according to their feedback, and practiced the revised talk in front of others to enthusiastically positive reviews. A friend asks if you'd like one more practice session to refine the talk.

3. *U2: How likely is it that your friend will provide useful feedback that improves the presentation?*

Your friend knows little about your presentation content and is not a very good presenter or even a good listener.

4. *R: How much would you rely on your friend to provide significant help with the talk?*
5. *T: Do you trust your friend to provide extra help?*
6. *B: Do you accept your friend's offer to help?*
7. *U3: likely is it that your presentation will be successful?*

Vignette 7

A close friend asks to borrow your old video camera over the weekend to film her child's graduation. You haven't used your camera in years and often use your phone instead to shoot videos.

1. *G: How important is it for you to get your video camera back after the weekend?*
2. *U1: How likely are you to retrieve the camera from your friend after the weekend?*

Your friend promises to bring the camera back the following Monday. She has borrowed and returned items promptly several times in the past.

3. *U2: How likely is your friend to return the video camera immediately (i.e., on time)?*

When picking up the camera, your friend informs you that after her child graduates they are taking a spontaneous trip around the country. Thus, if she forgets to return your camera when promised, it may be a long time before she once again has the opportunity to give the camera back to you.

4. *R: How much would you rely on your friend to return the video camera on time?*
5. *T: Do you trust your friend to return the video camera on time?*
6. *B: Do you lend your friend the video camera?*
7. *U3: likely is it that you will get your video camera back immediately following the weekend?*

Vignette 8

You cut yourself while chopping some vegetables. The cut seems deep but treatable with a bandaid and antibiotic ointment.

1. *G: How important do you think it is to get your finger examined?*
2. *U1: How likely is it that you can treat the wound successfully?*

Once you applied pressure to the wound, the bleeding stopped, the bandaid stuck without much difficulty and your finger started to feel normal. Just then, your friend comes by, notices your bandaged finger, and offers to examine it further.

3. *U2: How likely do you think your finger is to cause you problems without help from your friend?*

Your friend has no special training in medicine but you often find her helpful in many situations.

4. *R: How much would you rely on your friend's help with your finger?*
5. *T: Do you trust your friend to help?*
6. *B: Do you accept her offer to re-examine your finger?*
7. *U3: likely is it that your wound will heal without further issue?*

REFERENCES

Aryee, S., Budhwar, P. S., & Chen, Z. X. (2002). Trust as a mediator of the relationship between organizational justice and work outcomes: Test of a social exchange model. Journal of organizational Behavior, 23(3), 267-285.

Aurier, P., & N'Goala, G. (2010). The differing and mediating roles of trust and relationship commitment in service relationship maintenance and development. Journal of the Academy of Marketing Science, 38(3), 303-325.

Balliet, D., & Van Lange, P. A. (2013). Trust, conflict, and cooperation: A meta-analysis.

Bates, D., Maechler, M., Bolker, B., & Walker, S. (2015). Fitting Linear Mixed-Effects Models Using lme4. *Journal of Statistical Software, 67*(1), 1-48. doi:10.18637/jss.v067.i01.

Ben-Ner, A., & Halldorsson, F. (2010). Trusting and trustworthiness: What are they, how to measure them, and what affects them. Journal of Economic Psychology, 31(1), 64-79.

Berg, J., Dickhaut, J., & McCabe, K. (1995). Trust, reciprocity, and social history. *Games and economic behavior*, *10*(1), 122-142.

Bergkvist, L., & Rossiter, J. R. (2009). Tailor-made single-item measures of doubly concrete constructs. *International Journal of Advertising*, *28*(4), 607-621.

Bhattacharya, R., Devinney, T. M., & Pillutla, M. M. (1998). A formal model of trust based on outcomes. *Academy of Management Review, 23*(3), 459-472.

Bollen, K., & Lennox, R. (1991). Conventional wisdom on measurement: A structural equation perspective. *Psychological Bulletin, 110*(2), 305.

Box, G. E., & Cox, D. R. (1964). An analysis of transformations. *Journal of the Royal Statistical Society. Series B (Methodological)*, 211-252.

Buchan, N. R., Croson, R. T., & Solnick, S. (2008). Trust and gender: An examination of behavior and beliefs in the Investment Game. Journal of Economic Behavior & Organization, 68(3), 466-476.

Castelfranchi, C., & Falcone, R. (2000). Trust is much more than subjective probability: Mental components and sources of trust. *Proceedings of the 33rd Annual Hawaii International Conference on System Sciences.* Maui, HI: IEEE Computer Society.

Chang, E., Thomson, P., Dillon, T., & Hussain, F. (2005, August). The fuzzy and dynamic nature of trust. In International Conference on Trust, Privacy and Security in Digital Business (pp. 161-174). Springer Berlin Heidelberg.

Clapp-Smith, R., Vogelgesang, G. R., & Avey, J. B. (2009). Authentic leadership and positive psychological capital: The mediating role of trust at the group level of analysis. Journal of Leadership & Organizational Studies, 15(3), 227-240.

Colquitt, J. A., Scott, B. A., & LePine, J. A. (2007). Trust, trustworthiness, and trust propensity: a meta-analytic test of their unique relationships with risk taking and job performance. Journal of applied psychology, 92(4), 909.

Corritore, C., Kracher, B., & Wiedenbeck, S. (2001, August). Trust in the online environment. In *HCI International* (Vol. 1, pp. 1548-1552).

Cronbach, L. J. (1957). The two disciplines of scientific psychology. American psychologist, 12(11), 671.

Damian, S. A., Sokol-Hessner, P., Banaji, M., & Phelps, E.A. (2011). Implicit race attitudes predict trustworthiness judgments and economic trust decisions. Proceedings of the National Academy of Sciences 108, no. 19: 7710–7715. doi:10.1073/pnas.1014345108.

Delgado-Ballester, E., Munuera-Aleman, J. L., & Yague-Guillen, M. J. (2003). Development and validation of a brand trust scale. *International Journal of Market Research, 45*(1), 35-54.

Dirks, K. T., & Ferrin, D. L. (2002). Trust in leadership: meta-analytic findings and implications for research and practice.

DuBois, T., Golbeck, J., & Srinivasan, A. (2011, October). Predicting trust and distrust in social networks. *Proceedings of the third IEEE International Conference on Social Computing (SocialCom)*, (pp. 418-424). Amsterdam, Netherlands: IEEE Computer Society.

Dufwenberg, M., & Gneezy, U. (2000). Measuring beliefs in an experimental lost wallet game. Games and economic Behavior, 30(2), 163-182.

Gambetta, D. (1988). "Can we trust trust?" In D. Gambetta (Ed.), *Trust: Making and Breaking Cooperative Relations* (pp. 213-237). New York: Basil Blackwell.

Gebauer, J. E., Broemer, P., Haddock, G., & Von Hecker, U. (2008). Inclusion-exclusion of positive and negative past selves: Mood congruence as information. *Journal of Personality and Social Psychology*, *95*(2), 470.

Gefen, D., Karahanna, E., & Straub, D. W. (2003). Trust and TAM in online shopping: an integrated model. MIS quarterly, 27(1), 51-90.

Gelman, A., & Hill, J. (2006). *Data analysis using regression and multilevel/hierarchical models*. Cambridge university press.

Geyskens, I., Steenkamp, J. B. E., Scheer, L. K., & Kumar, N. (1996). The effects of trust and interdependence on relationship commitment: A trans-Atlantic study. International Journal of research in marketing, 13(4), 303-317.

Golbeck, J. (2006). *Generating predictive movie recommendations from trust in social networks* (pp. 93-104). Berlin Heidelberg: Springer.

Grabner-Kräuter, S. (2002). The role of consumers' trust in online-shopping. *Journal of Business Ethics, 39*(1), 43-50.

Hancock, P. A., Billings, D. R., Schaefer, K. E., Chen, J. Y., De Visser, E. J., & Parasuraman, R. (2011). A meta-analysis of factors affecting trust in human-robot interaction. Human Factors, 53(5), 517-527.

Hoff, K. A., & Bashir, M. (2015). Trust in automation integrating empirical evidence on factors that influence trust. *Human Factors: The Journal of the Human Factors and Ergonomics Society*, *57*(3), 407-434.

Hoge, E. A., Lawson, E. A., Metcalf, C. A., Keshaviah, A., Zak, P. J., Pollack, M. H., &

Simon, N. M. (2012). Plasma oxytocin immunoreactive products and response to trust in patients with social anxiety disorder. Depression and Anxiety, 29(11), 924-930.

Hon, L. C., & Grunig, J. E. (1999). Guidelines for measuring relationships in public relations. The Institute for PR. Available at: http://www.instituteforpr.org/ research_single/guidelines_measuring_ relationships.

Kramer, R. M. (1999). Trust and distrust in organizations: Emerging perspectives, enduring questions. Annual review of psychology, 50(1), 569-598.

Kuhn, T. S. (1970). *The structure of scientific revolutions* (2nd ed.). Chicago, IL: University of Chicago Press.

Lahno, B. (1995). Trust, reputation, and exit in exchange relationships. *Journal of Conflict Resolution, 39*(3), 495-510.

Lakatos, I. (1976). Falsification and the methodology of scientific research programmes. In *Can Theories be Refuted?* (pp. 205-259). Netherlands: Springer.

Lee, J. D., & See, K. A. (2004). Trust in automation: Designing for appropriate reliance. Human Factors: *The Journal of the Human Factors and Ergonomics Society,* 46(1), 50-80.

Lewicki, R. J., & Bunker, B. B. (1995). Trust in relationships: A model of development and decline. In B. B. Bunker & J. Z. Rubin (Eds.), *Conflict, cooperation, and justice: Essays inspired by the work of Morton Deutsch. The Jossey-Bass management series and The Jossey-Bass conflict resolution series*, (pp. 133-173). San Francisco, CA: Jossey-Bass.

Lewicki, R. J., McAllister, D. J., & Bies, R. J. (1998). Trust and distrust: New relationships and realities. Academy of management Review, 23(3), 438-458.

Lewicki, R. J., Tomlinson, E. C., & Gillespie, N. (2006). Models of interpersonal trust development: Theoretical approaches, empirical evidence, and future directions. Journal of management, 32(6), 991-1022.

Lewis, J. D., & Weigert, A. (1985). Trust as a social reality. *Social Forces*,*63*(4), 967-985.

Luhmann, N. (1979). *Trust; and, Power: two works by Niklas Luhmann.* Chichester: Wiley.

Lui, S. S., Ngo, H. Y., & Hon, A. H. (2006). Coercive strategy in interfirm cooperation: Mediating roles of interpersonal and interorganizational trust. Journal of Business Research, 59(4), 466-474.

Marsh, S., & Dibben, M. R. (2005, May). Trust, untrust, distrust and mistrust–an exploration of the dark (er) side. In International Conference on Trust Management (pp. 17-33). Springer Berlin Heidelberg.

Mayer, R. C., Davis, J. H., & Schoorman, F. D. (1995). An integrative model of organizational trust. *Academy of Management Review*, *20*(3), 709-734.

McKendrick, R., Shaw, T., de Visser, E. J., Saqer, H., Kidwell, B., & Parasuraman, R. (2013). Team performance in networked supervisory control of unmanned air vehicles effects of automation, working memory, and communication content. Human Factors: The Journal of the Human Factors and Ergonomics Society, 0018720813496269.

McKnight, D. H., & Chervany, N. L. (1996). The meanings of trust. (Technical Report MISRC Working Paper Series 96-04). University of Minnesota, Management Information Systems Research Center.

McKnight, D. H., & Chervany, N. (2001). While trust is cool and collected, distrust is fiery and frenzied: A model of distrust concepts. Amcis 2001 Proceedings, 171.

McKnight, P. E., Johns, M., McGovern, P., & Najab, J. (2010). The Pitfalls of a Tool-based Science and the Promise of a Problem-focused Science. *Journal of Methods and Measurement in the Social Sciences, 1*(2), 1-14.

Moorman, C., Deshpande, R., & Zaltman, G. (1993). Factors affecting trust in market research relationships. *the Journal of Marketing*, 81-101.

Mosteller, F., & Tukey, J. W. (1977). Data analysis and regression: a second course in statistics. *Addison-Wesley Series in Behavioral Science: Quantitative Methods*.

Onnasch, L., Wickens, C. D., Li, H., & Manzey, D. (2014). Human performance consequences of stages and levels of automation: An integrated meta-analysis. Human Factors, 56(3), 476-488.

Panskepp, J. (2009). Primary process affects and brain oxytocin. *Biological Psychiatry, 65*(9), 725-727.

Pearson, S. D., & Raeke, L. H. (2000). Patients' trust in physicians: many theories, few measures, and little data. *Journal of general internal medicine, 15*(7), 509-513.

PytlikZillig, L. M., & Kimbrough, C. D. (2016). Consensus on Conceptualizations and Definitions of Trust: Are We There Yet?. In Interdisciplinary Perspectives on Trust (pp. 17-47). Springer International Publishing.

R Core Team (2016). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL https://www.R-project.org/.

Ratnasingam, P. (2005). E-commerce relationships: The impact of trust on relationship continuity. International Journal of Commerce and Management, 15(1), 1-16.

Robins, R. W., Hendin, H. M., & Trzesniewski, K. H. (2001). Measuring global self-esteem: Construct validation of a single-item measure and the Rosenberg Self-Esteem Scale. *Personality and social psychology bulletin*, *27*(2), 151-161.

Rothstein, B., & Stolle, D. (2002, August). How political institutions create and destroy social capital: An institutional theory of generalized trust. In delivery at the Annual Meeting of the American Political Science Association, Boston, August-September.

Rotter, J. (1967). A new scale for the measurement of interpersonal trust. *Journal of Personality*, *35*(4), 651-665.

Rotter, J. B. (1980). Interpersonal trust, trustworthiness, and gullibility. *American Psychologist*, *35*(1), 1.

Rousseau, D. M., Sitkin, S. B., Burt, R. S., & Camerer, C. (1998). Not so different after all: A cross-discipline view of trust. *Academy of Management Review*, *23*(3), 393-404.

Rosseel, Y. (2012). lavaan: An R Package for Structural Equation Modeling. Journal of Statistical Software, 48(2), 1-36. URL http://www.jstatsoft.org/v48/i02/.

Schimmack, U., & Oishi, S. (2005). The influence of chronically and temporarily accessible information on life satisfaction judgments. *Journal of personality and social psychology*, *89*(3), 395.

Sebok, A., & Wickens, C. D. (2016). Implementing Lumberjacks and Black Swans Into Model-Based Tools to Support Human–Automation Interaction. *Human Factors: The Journal of the Human Factors and Ergonomics Society*, 0018720816665201.

Shapiro, S. P. (1987). The social control of impersonal trust. *American Journal of Sociology,* 623-658.

Shrout, P. E., & Bolger, N. (2002). Mediation in experimental and nonexperimental studies: New procedures and recommendations. *Psychological methods*, *7*(4), 422-445.

Twenge, J. M., Baumeister, R. F., DeWall, C. N., Ciarocco, N. J., & Bartels, J. M. (2007). Social exclusion decreases prosocial behavior. Journal of personality and social psychology, 92(1), 56.

Venables, W. N. & Ripley, B. D. (2002) Modern Applied Statistics with S. Fourth Edition. Springer, New York. ISBN 0-387-95457-0

Watson, M. L. (2005). Can there be just one trust? A cross-disciplinary identification of trust definitions and measurement. The Institute for Public Relations. Retrieved from http://www.instituteforpr.org/wp-content/uploads/Cross-Disciplinary-Identification-of-Trust.pdf.

Welter, F., & Alex, N. (2012). Researching trust in different cultures. In F. Lyon, G. Mollering, & M. Saunders (Eds.), *Handbook of Research Methods on Trust* (pp. 50-59). Cheltenham: Edward Elger.

Zaheer, A., McEvily, B., & Perrone, V. (1998). Does trust matter? Exploring the effects of interorganizational and interpersonal trust on performance. Organization science, 9(2), 141-159.

Zalega, T. (2016). Uncertainty and Risk in Mainstream Economics: an Outline. *Studia i Materiały/Wydział Zarządzania. Uniwersytet Warszawski*, (2), 80-95.

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