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THINKING FAST AND MISSING THE OPPORTUNITY; AN INVESTIGATION INTO  
COGNITIVE PROCESSING STYLE AND OPPORTUNITY RECOGNITION

by

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for the degree of Doctor of Philosophy  
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## **ABSTRACT**

Research on opportunity recognition and entrepreneurial cognition suggests that entrepreneurs are likely to use and potentially benefit from heuristics (Baron, 1998, 2004; Busenitz & Barney, 1997). Some heuristics, particularly well-refined and accurate prototypes, may be valuable to entrepreneurs in recognizing opportunities (Baron, 2004). I seek, however, to consider how other types of heuristics that lead to irrational, biased, and inaccurate judgments (e.g., the betrayal heuristic) relate to opportunity recognition (Baron, 2004; Kahneman & Lovallo, 1993). I specifically consider the underlying causal process through which the use of these types of heuristics diminishes the ability to recognize opportunities. I posit that these heuristics reduce the ability to recognize opportunities by causing entrepreneurs to consider less information regarding potential opportunities. Further, I propose two individual differences that allow certain entrepreneurs to mitigate the negative effect that these bias-causing heuristics have on entrepreneurs' ability to form the belief that they have recognized an opportunity.

I test my theory with two experimental designs that use a product from a technology transfer office that has been licensed by entrepreneurs and applied to a real-world market. This allows me to isolate the underlying variables of interest and to affix my theorizing to a well-documented phenomenon (the licensing and application of tech-transfer technology/products by entrepreneurs) (Gregoire & Shepherd, 2012; Mowery, 2004; Shane, 2001). Results show that some heuristic may cause individuals to consider less information about an opportunity, which reduces their likelihood of forming an opportunity recognition belief. Post hoc analyses suggest

that this indirect effect may be conditional on how reflective an individual is and that entrepreneurs may be more reflective than non-entrepreneurs.

The major contribution of this dissertation is to examine the theoretical underpinnings as to why certain types of heuristics inhibit entrepreneurs from forming the belief that they have recognized an opportunity. Specifically, I suggest and show that bias-causing heuristics reduce the amount of information that entrepreneurs consider about an opportunity and, as such, inhibit opportunity recognition beliefs. Second, I provide some support for the notion that reflective individuals are more likely to form the belief that they have recognized an opportunity because they consider more information about the opportunity when they initially rely on a bias-causing heuristic. Lastly, this dissertation provides initial support for the notion that entrepreneurs may be more reflective than non-entrepreneurs. Overall, I hope to point out that although a heuristic-dependent processing style has been shown to be beneficial with regard to opportunity recognition (Baron, 2004), the failure to consider the downside of certain heuristics and benefits related to overcoming these heuristics may limit our understanding of the opportunity recognition process.

I dedicate this dissertation to my loving wife Jessica, who has fully supported me in this endeavor and in life.

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## CHAPTER ONE

Opportunity recognition has become one of the most important and researched topics in the field of entrepreneurship as one cannot start a venture until they recognize an opportunity and then determine if that opportunity is for them. Recently, scholars have suggested that this recognition process unfolds over two stages. I focus on the first stage of this process, the formation of an opportunity recognition belief, where individuals form the belief that there is an opportunity for someone who is willing and able to take advantage of it (a third person opportunity). Research on the formation of opportunity recognition beliefs has primarily focused on individual differences (Gregoire & Shepherd, 2012). Recently, however, research has begun to focus on the cognitive processes that may set entrepreneurs apart from non-entrepreneurs and help them recognize opportunities (Baron & Ensley, 2006; Shepherd, Haynie, & McMullen, 2012).

Entrepreneurial cognition research has suggested that entrepreneurs are likely to use and potentially benefit from heuristics, which are often thought to be quick mental shortcuts that allow for satisfactory solutions (Baron, 1998, 2004; Busenitz, 1999; Busenitz & Barney, 1997; Shepherd et al., 2012; Simon, 1990). Specifically, research has suggested that the use of heuristics may better allow entrepreneurs to recognize opportunities (Baron, 2004; Baron & Ward, 2004; Busenitz & Barney, 1997; Zahra, Korri & Yu, 2005). Although some heuristics, particularly well-refined and accurate prototypes, may be valuable in the opportunity recognition process, a vast amount of research shows other types of heuristics (i.e., bias-causing heuristics) systematically lead to irrational, biased, and inaccurate judgments (Baron, 2004; Kahneman,

2011). The former has been considered in the entrepreneurship literature; however, the latter has received far less attention. I seek to consider the latter and specifically how these bias-causing heuristics (e.g., the betrayal heuristic) lead to irrational, biased, and inaccurate judgments related to forming the belief that one has recognized an opportunity (Kahneman & Lovallo, 1993). In doing so, I consider the underlying causal process through which the use of these types of heuristics diminishes the ability to form an opportunity recognition belief. Specifically, I posit that these heuristics reduce the ability to form the belief that one has recognized opportunities by causing entrepreneurs to consider less information about the potential opportunity.

I also propose two individual differences that allow certain entrepreneurs to mitigate the negative effect that these bias-causing heuristics have on entrepreneurs' ability to form the belief that they have recognized an opportunity. I suggest that these individual differences enable some entrepreneurs to overcome bias-causing heuristics and consider more information about an opportunity, making them more likely to recognize that opportunity. I rely on a dual-process theory of cognition to suggest that some entrepreneurs are more likely to shift from a heuristic-based, fast style of thinking to a more deliberate slower style of thinking, allowing them to overcome bias-causing heuristics. Specifically, I consider the need for cognition, which is associated with individuals who enjoy effortful cognitive activity and entrepreneurial alertness, which is associated with entrepreneurs who have "a sense of what might be around the corner" and with entrepreneurs being particularly sensitive to changes and unnoticed possibilities (Cacioppo & Petty, 1982; Kizner, 2009, p. 152; Tang, Kacmar, & Busenitz, 2012). In doing so, I suggest that entrepreneurs high in each of these differences are more likely to override their

initial, biased, fast judgments, enabling them to consider additional information and as such be more likely to form the belief that they have recognized an opportunity (McMullen & Shepherd, 2006).

In considering the effect of bias-causing heuristics on the formation of an opportunity recognition belief, I rely on McMullen and Shepherd's (2006) conceptual model of entrepreneurial action. This model suggests that information reduces uncertainty and allows entrepreneurs to form the belief that they have recognized an opportunity. As noted above, I exclusively consider the cognitive process related to forming the belief that one has recognized an opportunity for the willing and able (a third-person opportunity) and not the evaluation process related to recognizing an opportunity for himself or herself (a first-person opportunity) (McMullen & Shepherd, 2006). Recognizing a third-person opportunity is a necessary but not sufficient step in recognizing a first-person opportunity. Although the cognitive process related to recognizing an opportunity for oneself is an interesting question for future consideration, research has shown that the cognitive processes related to third-person and first-person opportunities differ (Gregoire, Barr, & Shepherd, 2010a; Gregoire & Shepherd, 2012; Haynie, Shepherd, & McMullen, 2009). Thus, for the purpose of this project, I solely focus on the cognitive process related to the first step in the opportunity recognition process, the formation of the belief that one has recognized an opportunity for the willing and able.

In examining this causal process, I rely on a dual-process theory of cognition, specifically a default-interventionist model (Evans, 2007). Generally, this model suggests that people rely on both an autonomous processing system (system 1) and an analytical processing system (system

2). The autonomous system is fast and typically thought to use a heuristic-type of processing. Alternatively, the analytical system is slower and is typically thought to use both a reflective level and an algorithmic level of processing (Evans, 2007). The reflective level is related to differences in individual thinking dispositions that regulate behavior (e.g., how much information is considered in making a decision) and is responsible for triggering the use of the algorithmic level. Whereas, the algorithmic level is related to the cognitive ability (the horsepower) that one has available when making decisions and is responsible for actually determining the correct decision (Evans & Stanovich, 2013). Further, this model suggests that individuals first rely on their autonomous processing system (system 1), which requires little cognitive effort to provide default judgments. Once a default judgment has been made, an individual's analytical processing system (system 2) may or may not intervene. If the analytical system does intervene, it may override or endorse the autonomous system's default judgment (Evans, 2007).

A default-interventionist model provides multiple advantages in examining the process I seek to consider. First, it describes the cognitive process through which bias-causing heuristics inhibit the consideration of information and in doing so reduces the likelihood of forming an opportunity recognition belief. Further, this model provides a strong theoretical justification that points to two individual differences that should alleviate the negative effect that bias-causing heuristics have on the consideration of information. Specifically, I consider the need for cognition and entrepreneurial alertness, both of which have been associated with higher levels of reflective cognitive processing (Gaglio & Katz, 2001; Stanovich, 2009a). Thus, when initially

relying on a bias-causing heuristic, individuals high in each of these individual differences are more likely to shift from their fast processing style to a slower, more deliberate processing style, allowing them to overcome the bias-causing heuristic. This shift, in turn, should allow these individuals to consider additional information about an opportunity and therefore be more likely to form the belief that they have recognized an opportunity when initially relying on a bias-causing heuristic.

I test my theory with an experimental design that uses a product from a technology transfer office that has been licensed by entrepreneurs and applied to a real-world market. This allows me to isolate the underlying variables of interest and to affix my theorizing to a well-documented phenomenon (the licensing and application of tech-transfer technology/products by entrepreneurs) (Gregoire & Shepherd, 2012; Mowery, 2004; Shane, 2001). These features of my research provide a strong case for determining the causal sequence of the process and the external validity of my theorizing (Gregoire & Shepherd, 2012).

The major contribution of my study is to examine the theoretical underpinnings as to why certain types of heuristics (bias-causing heuristics) inhibit entrepreneurs from forming the belief that they have recognized an opportunity. Specifically, I suggest that bias-causing heuristics reduce the amount of information that entrepreneurs consider about an opportunity and, as such, inhibit opportunity recognition beliefs. Second, I propose two individual differences that have been associated with higher levels of reflective cognitive processing (entrepreneurial alertness and the need for cognition) as first stage moderators to this process. Specifically, I suggest that these reflective individuals are likely to shift to a deliberate cognitive style that increases their

chances of forming an opportunity recognition belief because they consider more information about the opportunity. Overall, I hope to point out that although a heuristic-dependent processing style has been shown to be beneficial with regard to opportunity recognition (Baron, 2004), the failure to consider the downside of certain heuristics and benefits related to overcoming these heuristics may limit our understanding of the opportunity recognition process.

### Theory and Hypotheses

The goal of this research project is to consider how the use of certain cognitive heuristics affects opportunity recognition beliefs through the consideration of information. Generally, I rely on a dual process theory of cognition, particularly a default-interventionist model, to discuss the influence that these bias-causing cognitive heuristics have on the consideration of information (Evans & Stanovich, 2013). I also rely on a theory of entrepreneurial action to discuss how information influences opportunity recognition belief (McMullen & Shepherd, 2006). In the following sections, I first discuss opportunity recognition and lay out key assumptions related to the construct. Then I more thoroughly detail the specific types of heuristics that I am considering. Next, I discuss how these cognitive heuristics influence the consideration of information. Finally, I explain how the consideration of information affects the formation of an opportunity recognition belief. Once I have discussed the indirect effect that these bias-causing cognitive heuristics have on opportunity recognition belief through the consideration of information, I consider two key individual differences (the need for cognition and entrepreneurial alertness) that moderate the first stage of this indirect effect. Specifically, I suggest that when faced with contexts that trigger these bias-causing heuristics, individuals high

in each of these differences are more likely to consider information and thus form the belief that they have recognized an opportunity. A graphical depiction of my theoretical model is presented in Figure 1.

### Opportunity Recognition Belief

Opportunity recognition belief is the outcome variable that I focus on in this dissertation. The conceptualization of opportunity recognition is an important and central focus to the study of entrepreneurship (Baron & Ensley, 2006; Nicolaou, Shane, Cherkas, & Spector, 2009). However, significant conceptual debate exists regarding whether opportunities are discovered or created (Gregoire et al., 2010b; McMullen & Shepherd, 2006). I adopt Gregoire and colleagues' (2010) conceptualization of opportunity recognition belief, which attempts to integrate both views and transcend this debate, as my dependent variable. This conceptualization is represented by the subjective level of certainty that an entrepreneur has regarding a potential opportunity for the willing and able (someone) (Gregoire et al., 2010b). Further, I propose that the effect that bias-causing heuristics have on forming the belief that one has recognized and opportunity is equally applicable to both conceptualizations (discovery/created) of an opportunity. Below, I discuss the ongoing debate regarding opportunity recognition generally and more fully detail Gregoire and colleagues' (2010) conceptualization of opportunity recognition belief.

Generally, theories of discovery assume that disruptions in efficient markets arise from external shocks (e.g., technology changes) and create real opportunities. These opportunities are thought to objectively exist independent of entrepreneurs that may perceive them (Kirzner, 1973; Shane, 2003; Shane, & Venkataraman, 2000). From, this perspective, because opportunities

objectively exist, information can be gathered about them to determine their possible outcomes and the probability of each outcome. From a discovery perspective, decisions associated with opportunity recognition are risky (i.e., possible outcomes and the probability of each outcome can be determined) but not uncertain from a knightian perspective (i.e., information to determine possible outcomes and their likelihood does not exist) (Alvarez & Barney, 2007; Knight, 1921). Alternatively, creation theorists propose that opportunities do not objectively exist independent of the actions that entrepreneurs take to create them. Instead, entrepreneurs' actions and interactions with the environment are thought to create opportunities (Alvarez & Barney, 2007; Alvarez, Barney, & Anderson, 2013; Baker & Nelson, 2005; Sarasvathy, 2001). Thus, from a creation perspective, because opportunities do not exist until entrepreneurs act, information about all of the possible outcomes and the probabilities associated with each outcome cannot be determined *ex ante*. Therefore, creation theorists propose that decisions associated with opportunity recognition are uncertain from a knightian perspective (Alvarez & Barney, 2007).

Recent research, however, has attempted to transcend these conceptual positions and has suggested a more integrative view of opportunity recognition (Gregoire et al., 2010b; McMullen & Shepherd, 2006). Specifically, Gregoire and colleagues (2009) define an opportunity "as projected courses of action to introduce (and profit from) new and/or improved supply-demand combinations that seek to address market failure problems" (p. 117). This view adopts the notion that entrepreneurial opportunities originate from failures of the market process, which suggests that opportunities exist and are recognized (Arrow & Debreu, 1954; Dean & McMullen, 2007; Eckhardt & Shane, 2003; Gregoire et al., 2010b; Kirzner, 1985, 1997). As noted by Gregoire and

colleagues (2009), however, these market failures (i.e. lack of market efficiencies) are just the origins of the opportunities and require the possibility of action on the part of the entrepreneur, which is more consistent with the creation side of the conceptual debate (Drucker, 1985; Venkataraman & Sarasvathy, 2001).

From this view, opportunities are not specifically about the supply side (i.e., the creation of a technology) or the demand side (i.e., opportunities that exist in the current market). Instead opportunities relate to the possibility of changing the demand side with the supply side (i.e., using a new technology to change the current market) (Gregoire & Shepherd, 2012). Thus, this view does not focus on discovery or creation of opportunities but instead on the “*ex ante* interface between situation and action as individuals try to make sense of information signals that could indicate opportunities” (Gregoire & Shepherd, 2012, p. 756). That is, from a forward-looking perspective, opportunities are about an entrepreneur realizing the actions that might make a more efficient transaction possible when considering the parameters of the environment (Gregoire & Shepherd, 2012).

This view assumes that opportunities are fundamentally uncertain because their actual value can only be determined after the fact. In discussing uncertainty, however, this view adopts Lipshitz and Strauss’ (1997) conceptualization of “uncertainty in the context of action [as] a sense of doubt that blocks or delays action” (p. 150). This conceptualization of uncertainty is inclusive and does not refer to a specific type of doubt but instead is conceptualized with regard to its influence on action (McMullen & Shepherd, 2006). Thus whether conceptualized as Knightian uncertainty (which is not susceptible to measurement and such unknowable) (Knight,

1921) or risk (which is susceptible to measurement) (MacCrimmon & Wehrung, 1986), this conceptualization of uncertainty prevents action (McMullen & Shepherd, 2006). Further, as the actual value of opportunities can only be determined after the fact, the recognition of opportunities relies on subjective views and possible projections (what could be) based on some environmental stimuli. The actual potential for opportunities, however, is rooted in objective information and market failure dynamics (i.e. lack of market efficiencies) . Thus, opportunity recognition “rests on the subjective perception and interpretation of objective realities” (Gregoire et al., 2010b, p. 118).

This view of opportunity recognition also adopts McMullen and Shepherd’s (2006) two-stage model of entrepreneurial action, which suggests that third-person opportunities (forming the belief that there is an opportunity for someone) are conceptually and empirically different than first-person opportunities (an opportunity for me) (Dimov, 2007; Gregoire & Shepherd, 2012; McMullen & Shepherd, 2006). Specifically, identifying a third-person opportunity relates to the recognition that there is an opportunity for someone, whereas identifying a first-person opportunity relates to an individual’s willingness to bear the uncertainty associated with exploiting the third-person opportunity. Evidence has suggested that the cognitive processes associated with third-person opportunities and first-person opportunities are different and that the measures of each are distinct (Gregoire et al., 2010a; Gregoire et al., 2010b; Gregoire & Shepherd, 2012; Haynie et al., 2009).

Based on these distinctions, opportunity recognition is concerned with subjective beliefs that a third-person opportunity exists (an opportunity for someone) (Gregoire et al., 2010b;

Shepherd, McMullen, & Jennings, 2007). McMullen and Shepherd (2006) have noted that uncertainty acts to undermine these beliefs. This leads to the above noted conception of opportunity recognition belief that is represented by the subjective level of certainty that an entrepreneur has regarding a potential opportunity for the willing and able (someone) (Gregoire et al., 2010b).

### Heuristics

Simon (1990) argued that heuristics are “methods for arriving at satisfactory solutions with modest amounts of computation,” suggesting that heuristics are a way in which people reduce their effort and save time when making decisions (p. 11). Heuristics have been noted to reduce effort by allowing people to examine fewer pieces of information and by reducing the difficulty associated with retrieving and storing information (Shah & Oppenheimer, 2008). Heuristics are often thought to be accurate and thus generally appear to be useful in decision-making (Gigerenzer & Gaissmaier, 2011).

The usefulness of some heuristics has been explored in the entrepreneurship literature. Specifically, research has suggested that entrepreneurs are more likely to use heuristics than non-entrepreneurs and that the use of some heuristics is beneficial to entrepreneurs (Baron 1998, 2004; Baron & Ward, 2004; Busentiz, 1999; Busenitz & Barney 1997; Zahra et al., 2005). In fact, heuristic-type thinking and the use of accurate, well-refined prototypes have been noted to be advantageous with regard to opportunity recognition (Baron, 2004; Baron & Ensley, 2006; Baron & Ward, 2004). More specifically, Baron and Ensley (2006) noted that some entrepreneurs possess well-refined business opportunity prototypes and as such are likely to

recognize opportunities when products, services, and other environmental attributes and patterns match these prototypes, whereas, not possessing these prototypes likely leads to overlooking such opportunities.

Heuristics-based processing, however, is not without flaws. Specifically, there is a substantial literature in psychology that has shown some heuristics lead to cognitive biases and systematic errors (Kahneman, 2011). The entrepreneurship literature has also noted that these bias-causing heuristics have potentially negative effects on the ability to recognize opportunities (Ucbasaran, Westhead, & Wright, 2009). The potentially negative effects related to these heuristics, however, have received far less attention than the benefits associated with heuristics generally. Further, the underlying causal process through which these heuristics negatively affect the ability to recognize opportunities has not been considered. Thus, for the purpose of this dissertation, I focus on these bias-causing heuristics that negatively affect the ability to form an opportunity recognition belief. In the next section, I briefly list some of the most common heuristics and resulting biases and then more thoroughly discuss the way in which three of these heuristics (representativeness, affect, and betrayal) lead to biased decisions.

#### Bias-causing heuristic

Bias-causing heuristics have a long tradition in the psychology literature. Kahneman and Tversky's research program on heuristic and bias has shown these types of heuristics result in systematically inaccurate judgments (Kahneman, 2011). Common biases that systematically result from these heuristics include erase of recall and retrievability caused by the availability heuristic; insensitivity to base rates, insensitivity to sample size, misconception of chance,

regression to the mean, and the conjunction fallacy caused by the representativeness heuristic; and the confirmation trap, anchoring, conjunctive, and disjunctive event bias, overconfidence and hind sight/the curse of knowledge caused by the confirmation heuristic (see Bazerman & Moore, 2012, for a review). Other heuristics that have been shown to systematically bias decisions include the affect heuristic, the outrage heuristic, and the betrayal heuristic (Bazerman & Moore, 2012; Kahneman, 2011, Kahneman, Schkade, & Sunstein, 1998; Kahneman & Frederick, 2002; Sunstein 2003, 2005). A more thorough description of these and other bias-causing heuristics are provided in Appendix O and a review of the literature where heuristics have been applied to entrepreneurship is provided in Appendix P.

So, why would these heuristics systematically lead to biased, non-rational, and inaccurate judgments? The well-documented research program on heuristics and biases has suggested that these errors often occur due to attribute substitution, where automatically computed attributes provide answers to different questions than the one actually being considered (Kahneman & Frederick, 2002). In this case, “judgment is mediated by a heuristic when an individual assesses a specified *target attribute* of a judgment object by substituting another property of that object — the *heuristic attribute*— which comes more readily to mind” (Kahneman & Frederick, 2002, p. 4). This substitution inevitably leads to a systematic bias because “the target attribute and the heuristic attribute are different” (Kahneman & Frederick, 2002, p. 5).

This type of heuristic-based attribute substitution affects all types of decisions and judgments. Consider the following classic example that is based on the representativeness heuristic where participants are told, “Linda is 31 years old, single, outspoken and very bright.

She majored in philosophy. As a student, she was deeply concerned with issues of discrimination and social justice and also participated in antinuclear demonstrations.” (Tversky & Kahneman, 1983, p. 297). Participants are then asked the probability of different scenarios for Linda. Scenarios include descriptions such as “Linda is a teacher at an elementary school.” More importantly, two of the scenarios note, “Linda is a bank teller” and “Linda is a bank teller and is active in the feminist movement.” Interestingly, the great majority of people find that Linda is more likely to be a bank teller and active in the feminist movement than just a bank teller. This, of course, is a mathematical impossibility because if Linda is a bank teller and active in the feminist movement, by definition, she is also a bank teller. Thus, the probability of her being a bank teller could not be less than the probability of her being a bank teller and active in the feminist movement. In this case, people appear to answer the question “[h]ow representative is Linda of a feminist bank teller?” instead of how likely Linda is to be a bank teller or a feminist bank teller (Shah & Oppenheimer, 2008, p. 216).<sup>i</sup>

Another example of a well-documented heuristic that is based on attribute substitution is the affect heuristic (Kahneman & Frederick, 2002). In the case of the affect heuristic, decision makers may focus on how they feel about something, whether they like it or not, instead of answering the underlying question, which may be, “Will she be a good employee?” or “Is this a good investment?” (Kahneman, 2011). Kahneman (2011) provided an example where tens of millions of dollars were invested by a CIO of a large financial firm based on the affect heuristic. In that case, the CIO made the multimillion-dollar investment in Ford stock not because a detailed economic analysis led him to believe that the stock was underpriced but because he

liked the company. While it is true that well-liked companies are often successful in the market, it is doubtful that anyone would hire a financial advisor who bases his or her investment decisions on which companies he or she personally likes, with no formal or rational analysis.

Attribute substitution also appears to be related to the betrayal heuristic, which I will focus on and operationalize in this paper. The betrayal heuristic appears closely tied to the affect heuristic and is a rule of thumb where people, “Punish, and do not reward, betrayals of trust” (Sunstein, 2005, p. 537; Sinnott-Armstrong, Young, & Cushman, 2010). That is, it seems that when people are making judgments about things that include a betrayal, they answer the question, “Does this betray?” as opposed to the underlying question (e.g., What punishment does this person deserve? or Which product is better?). For example, Koehler and Gershoff (2003) showed that people punished identical criminal offenses significantly more when they also involved betrayal (e.g., people punished a security guard more than a janitor in regard to a bank robbery and a day-care worker more than a grocery clerk in regard to child molestation).

The effect of the betrayal heuristic is not limited to punishment or even to people. Koehler and Gershoff (2003) have also shown that this heuristic relates to decisions about products. Specifically, they gave participants the option to purchase car A that was equipped with an airbag (that would not cause death) where the chance of death from a serious crash was 2% or car B that was equipped with an airbag (that would cause death an additional .01% of the time) where the chance of death from a serious crash was 1%. In this case, the rational choice is clearly Car B (i.e., the car that is equipped with the airbag that causes death an additional .01% of the time) as the overall chance of death associated with Car B was 1.01%, whereas Car A (i.e.,

the car that is equipped with the airbag that does not cause death) has an overall chance of death of 2% of the time. Interestingly, more than two-thirds of participants choose car A, suggesting that people are willing to “double their overall chance of dying to avoid incurring a very small chance of dying via betrayal” (Koehler and Gershoff, 2003, p. 255). In this case, the betrayal is that a product that is supposed to protect you ends up killing you. Thus, as noted above, it appears that participants focused on how they felt about the car as opposed to which car was better/safer.

#### Bias-causing heuristics and the decision to consider additional information

It is important to note that I am specifically focusing on the effect that these bias-causing heuristics have on opportunity recognition belief. In particular, I propose that the use of these types of heuristics negatively affects the ability to form an opportunity recognition belief and that this effect is mediated by the consideration of information. More specifically, I suggest that the use of these heuristics reduces the amount of information considered, which in turn, reduces the ability to form the belief that one has recognized an opportunity. Further, I suggest that some individuals are less likely to be affected by these bias-causing heuristics. I acknowledge, however, that in some situations, some bias-causing heuristics could lead to the consideration of more information. These situations, however, are less interesting in regard to the outcome variable because they likely lead to the same prediction regardless of whether the bias occurs. That is, in these situations, entrepreneurs likely form the same opportunity recognition belief regardless of the bias-causing heuristic being activated.

For example, the affect heuristic could lead a potential entrepreneur to consider additional information about a very bad/nonexistent opportunity. Consider the following example. If a potential entrepreneur has the ability to sell snow cone ice to Eskimos (who for the purposes of this dissertation we can assume would obviously have no interest in snow cone ice), a heuristically biased entrepreneur who loves snow cones might consider additional information about the opportunity. A non-heuristically biased entrepreneur, however, would likely decline additional information. In this case, I suggest the biased entrepreneur might be answering the question “How do I feel about this opportunity?” as opposed to “What do I think about it?” The consideration of additional disconfirming information, however, would likely lead the biased entrepreneur to realize there was no opportunity for anyone. That is, when the biased entrepreneur learned that Eskimos have no interest in buying snow cone ice, the heuristically biased entrepreneur would likely realize what the non-heuristically biased entrepreneur had previously realized: there was no opportunity. In the situation where bias-causing heuristics leads to less information being considered, however, I predict that heuristically biased and non-heuristically biased entrepreneurs will differ regarding the belief that they have recognized an opportunity. Thus, the rest of this dissertation will focus on situations where bias-causing heuristics lead to less information being considered. For the ease of illustration, I will specifically focus on heuristics that I posit always lead to less information being considered such as the betrayal heuristic.

I specifically chose to use the betrayal heuristic because it squarely fits into the types of bias-causing heuristics that I seek to consider, because it constitutes a strong manipulation and

because it was easily adapted to the context I seek to explore in this dissertation. More specifically, the betrayal heuristic is the type of heuristic that systematically leads to non-rational and inaccurate decisions. This heuristic is also the type of heuristic that pushes people away from the stimuli. In an opportunity recognition context this should cause participants to consider less information about a business opportunity, which as noted above are the situations I exclusively seek to consider. Further, after pretesting multiple heuristic manipulations, betrayal consistently proved to be the strongest manipulation, which is important for the type of experimental design that I employ in both of my studies. Lastly, the betrayal heuristic was easily adapted in an understandable way to the entrepreneurial setting.

#### Bias-causing heuristics and the decision to consider less information

Heuristics research has also examined specific heuristics that relate to the way in which people search for and consider information (Shah & Oppenheimer, 2008). These heuristics are rules of thumb that people typically use in determining how they search for information (e.g., one may always stop collecting information after he or she has seen two confirming pieces of information (Karelaia, 2006)). These specific heuristics, however, are outside the purview of this paper, as they are rules of thumb regarding the process that an individual uses when considering information after deciding to consider information and not rules of thumb that affect the decision to consider information. These types of heuristics, however, show that individuals may only use a small amount of the information available when making judgments (Shah & Oppenheimer, 2008). In fact, some suggest that individuals may only consider a single piece of information when making a judgment (Shah & Oppenheimer, 2008).

Considering less information is in line with heuristics being an effort-reduction tool (Shah & Oppenheimer, 2008). Relying on, “how I feel about a company?” as compared to, “is this a good investment?” reduces time and effort in making a judgment in much the same way relying on a single piece of information is faster and easier than considering all of the information available in a compensatory manner (Shah & Oppenheimer, 2008). Thus, it seems likely that judgments based on bias-causing heuristics (i.e., determining that an investment is bad because one does not personally like it) may also lead individuals to reduce their effort and consider less information. Thus, I suggest that when entrepreneurs rely on bias-causing heuristics, they are more likely to make systematically inaccurate judgments that reduce the likelihood of considering additional information about an opportunity. Formally hypothesized as:

*Hypothesis 1. Relying on bias-causing heuristics reduces the amount of information considered related to an opportunity.*

#### The Consideration of Information and Opportunity Recognition Belief

Information has also been related to the conceptualization of opportunity recognition belief that I adhere to in this paper, the subjective level of certainty that an entrepreneur has regarding a potential opportunity for someone (i.e. the willing and able ) (Gregoire et al., 2010a). In fact, the entrepreneurship literature has suggested that the discriminating feature between an entrepreneur who recognizes a third-person opportunity and one who does not is knowledge and relevant information (McMullen & Shepherd, 2006; Shepherd et al., 2007). Specifically, the literature has suggested that information about the environment and relevant knowledge reduce

uncertainty, allowing entrepreneurs to overcome ignorance, enabling them to form the belief that they have recognized an opportunity (McMullen & Shepherd, 2006; Shepherd et al., 2007).

Generally, the literature appears consistent in noting the importance of information and suggests that individuals who have better access to, or a superior ability to utilize, information are better able to recognize opportunity (Baron & Ensley, 2006; Shane, 2003). Thus, I suggest by considering more information, potential entrepreneurs are more likely to form the belief that they have recognized an opportunity. Formally hypothesized as follows:

*Hypothesis 2. The amount of information considered related to an opportunity is positively related to opportunity recognition belief.*

Taken together, Hypotheses 1 and 2 suggest that relying on bias-causing heuristics has a negative, indirect effect on forming the belief that one has recognized an opportunity. Specifically, I propose that relying on bias-causing heuristics reduces the amount of information that an entrepreneur considers about an opportunity, which in turn reduces the likelihood of forming the belief that the entrepreneur has recognized an opportunity. Formally hypothesized as follows:

*Hypothesis 3. The amount of information considered mediates the negative relationship between the reliance on bias-causing heuristics and the likelihood of forming an opportunity recognition belief.*

#### Individual Differences That May Help Individuals Overcome Heuristic-Based Biases

Recently, many psychologists have adopted a dual process approach that helps explain the existence and use of heuristics. This dual process approach argues that humans rely on two

distinct types of information processing systems (Dane & Pratt, 2007; Gollwitzer & Bayer, 1999; Sloman, 1996). Each system has been referred to in many different ways, but for the purpose of this dissertation, I will use the most widely used descriptors, system 1 and system 2.

System 1 is often thought to be the older of the two systems from an evolutionary perspective (Dane & Pratt, 2007; Epstein, 1994; Reber, 1992). It involves the seamlessly effortless and automatic learning and processing of information (Dane & Pratt, 2007; Stanovich & West, 2000). Evans and Stanovich (2013) have suggested its defining features are that it does not require working memory, and that it operates autonomously. It is typically associated with being fast, non-conscious, contextualized, automatic, independent of cognitive ability, and biased (Evans & Stanovich, 2013).

System 2 is thought to be more deliberate and allows for intentional learning, development, and analysis of ideas (Dane & Pratt, 2007). Evans and Stanovich (2013) have suggested its defining features are that it requires working memory and that it involves cognitive decoupling, hypothetical thinking, and mental stimulation. It is typically associated with being slower, controllable, providing normative responses, being conscious, and using consequential decision-making (Evans & Stanovich, 2013).

Generically, dual process approaches suggest the use of distinct cognitive and neurological systems; however, there are different interpretations as to how these distinctive systems work together (Evans, 2008; Evans & Stanovich, 2013). I rely on a default-interventionist theory that suggests a fast autonomous process (system 1) provides initial responses and that the slower analytic process (system 2) acts as a check and may or may not

intervene (Evans, 2007, 2008; Kahneman, 2011; Kahneman & Frederick, 2002). Put another way:

Heuristic process often cue default mental models that imply—with only shallow analytic processing of the task requirements—default responses, inference or decisions. Analytic processes may or may not intervene in order to revise or replace such default models and to inhibit default heuristic responding. (Evans, 2007, p. 329)

From a default-interventionist perspective, heuristic biases would occur when system 2 (the analytical process) does not intervene and override system 1 (the heuristic process) errors (Evans, 2008). Thus, individuals who are more able and/or likely to shift to and use their analytical processes would be less likely to make heuristic-based errors.<sup>ii</sup>

As briefly discussed above, the cognitive process that leads to overriding system 1 default judgments is best understood when viewing system 2 as containing, “two levels of processing—the algorithmic level and the reflective level” (Stanovich, 2009a, p. 57). The difference between these levels of processing can be understood by considering differences between measures of thinking dispositions and cognitive ability. Measures of cognitive ability are related to the algorithmic processes’ ability, “to sustain decoupled representations” and is largely related to measures of general intelligence (Evans & Stanovich, 2013). Alternatively, the reflective process operates “to set the goal agenda or .... in the service of epistemic regulation (i.e., to direct the sequence of information pickup)” (Stanovich, 2009a, p. 66-67). Measures of thinking dispositions, which are related to the reflective process, are less related to general intelligences

and are, “higher level regulatory states of the reflective mind” (Evans & Stanovich, 2013, p. 230). These higher-level regulatory states include:

the tendency to collect information before making up one’s mind, the tendency to seek various points of view before coming to a conclusion, the disposition to think extensively about a problem before responding, the tendency to calibrate the degree of strength of one’s opinion to the degree of evidence available, the tendency to think about future consequences before taking action, and the tendency to explicitly weigh pluses and minuses of situations before making a decision. (Evans & Stanovich, 2013, p. 230)

Evans and Stanovich (2013) have suggested that system 1 is overridden by the algorithmic processing of system 2 but that the reflective processing of system 2 causes the override itself. That is, the reflective level of processing is responsible for the shift itself, and the algorithmic level is related to the mental ability needed to analyze information and determine if the heuristic-based judgment is correct. Thus, the likelihood that system 2 will override system 1 is based on both individuals’ cognitive ability and thinking disposition, but the initial override is likely initiated by thinking dispositions (Evans & Stanovich, 2013). For a more thorough discussion on this topic, please see Evans and Stanovich (2013) and Stanovich (2009a, 2009b, 2011).

In this context, where I suggest that a bias-causing heuristic leads to the decision to not consider additional information, individual cognitive ability would likely allow (provide the mental horsepower) entrepreneurs to determine if the decision to not consider additional

information (system 1's decision) was an error. I am more interested, however, in individual differences that allow a potential entrepreneur to override his or her initial intuitive system 1 decision to not consider more information, which is what is responsible for the use of the individual cognitive ability in the first place. Thus, for the purposes of this paper, I focus on individual differences that relate to the reflective level of processing. Specifically, I focus on two individual differences. First, I consider the need for cognition, a rational thinking disposition that relates to an increased reflective level of processing. Second, I consider entrepreneurial alertness. This construct is typically associated with the increased use of heuristic-based processing but is also related to an increased sensitivity to information that does not conform to heuristic responses and the adjustment of such responses (Gaglio & Katz, 2001). Thus, it should also relate to an increased reflective level of processing.

### The need for cognition

Within the dual process literature, the need for cognition has been noted to be an individual difference at the intentional level and associated with the increased use of reflective processing (Cacioppo, Petty, Feinstein, Blair, & Jarvis, 1996; Stanovich, 2009a). Thus, it likely leads to the reassessment of initial decisions based on bias-causing heuristics and the potential overriding of an initial inaccurate heuristic-based judgment.

Research on the need for cognition most notably comes from Cacioppo and Petty (1982), who suggest that people differ in how much they enjoy and engage in effortful cognitive activity. They suggest that both high- and low-need for cognition individuals seek to make sense of the world around them; however, these individuals tend to go about this in different ways (Cacioppo,

Kao, Petty, & Rodriguez, 1986; Cacioppo & Petty, 1982; Cacioppo et al., 1996; Cacioppo, Petty, & Morris, 1983). Individuals with a high need for cognition seek out, think about, thoroughly process, and reflect back on information to make sense of stimuli and the world around them. Alternatively, individuals with a low need for cognition are more likely to rely on simple cues and others' opinions and use cognitive heuristics (Cacioppo et al., 1996; Kearney, Gebert, & Voelpel, 2009; Petty, Briñol, Loersch, & McCaslin, 2009). This would suggest that compared to low need for cognition individuals, high need for cognition individuals may be more reflective because they are less resistant to mental work and as such are more willing to shift to and use their analytical system. Thus, in the case where a bias-causing heuristic is triggered, high need for cognition individuals who are less resistant to using their analytical system should be more able to avoid making an inaccurate judgment. This assertion appears to be supported in the literature, as it has been shown that high need for cognition individuals are more likely to “correct or adjust their judgments for biasing factors than . . . . individuals low in need for cognition” (Cacioppo et al., 1996; Martin, 1986; Strack, 1992).

In regard to the indirect effect that bias-causing heuristics have on opportunity recognition beliefs through the consideration of information, I suggest that high need for cognition entrepreneurs are more likely to override heuristic-based judgments, consider additional information, and form an opportunity recognition belief when they encounter a bias-causing heuristic. Alternatively, this indirect relationship should be weaker or non-existent when no bias-causing heuristic is present. This is because when no bias-causing heuristic is present,

low need for cognition individuals do not have a simple cue that suggests they should not consider additional information to rely on. Formally hypothesized as follows:

*Hypothesis 4. Entrepreneurs' need for cognition moderates the first stage of the indirect effect that relying on bias-causing heuristics has on opportunity recognition belief via the amount of information considered, such that the indirect effect is weaker for entrepreneurs with high levels of need for cognition.*

### Entrepreneurial alertness

Entrepreneurial alertness is often discussed as the ability to notice opportunities without search and has been related to having accurate mental models and schemas that appear to be in line with using heuristic-based processing (Baron, 2004; Gaglio & Katz, 2001). Thus, it seems that alert entrepreneurs tend to rely on accurate heuristics. Alert entrepreneurs are also more likely to adjust their mental models to incorporate new information (Gaglio & Katz, 2001). In doing so, they are able to shift from a heuristic-based processing style to an analytical processing style and override their initial inaccurate heuristic-based judgments. Thus, alert individuals also appear to be more reflective in their processing style. This view is in line with Kirzner's (1974) original definitions of the construct. Specifically, Kirzner (1979) defined the construct in two different ways: first, as "the ability to notice without search opportunities that have hitherto been overlooked" (p. 49) and second as "a motivated propensity of man to formulate an image of the future" (Kirzner, 1985, p. 56). While the first definition does appear to be related to heuristic-based thinking (system 1), the second involves the motivation to think hypothetically, which is clearly related to the analytical system (system 2). Specifically, the motivation to think

hypothetically relates to the reflective process of the analytical system, and thinking hypothetically is associated with the algorithmic process of the analytic system (Evans & Stanovich, 2013).

Based on Kizner's work, Gaglio (2001) has noted that the crucial difference between opportunity finders and non-finders is their ability to accurately perceive reality as well as potential implications and consequences of actions. That is, the more accurately a potential entrepreneur can perceive the environment, the more likely he or she will be able to determine if existing products and services are working and the potential for an opportunity (Gaglio & Katz, 2001). Thus, alert entrepreneurs may possess complex and accurate models of what a successful opportunity looks like and as such they are able to easily notice such opportunities (Baron, 2004; Baron & Ensley, 2006). These mental models/heuristics, however, are not innate but instead refined over time and through the use of the analytical system (Baron & Ensley, 2006; Evans & Stanovich, 2013; Gaglio & Katz, 2001). Thus, I would suggest that alert entrepreneurs have more accurate mental models/heuristics because they are better able to refine them.

Gaglio and colleagues (2001) also suggest that alert individuals are particularly good at reassessing their current heuristics. They suggest that alert individuals emphasize objective accuracy (Gaglio & Katz, 2001). The goal of objective accuracy certainly falls within the purview of the reflective process of the analytical system. Because of this focus on objective accuracy, alert entrepreneurs are more likely to notice when things are "unusual, unexpected, or anomalous" and then realize that the most appropriate behavior may require the reassessment of their schema (Gaglio & Katz, 2001 p. 103). From a default-interventionist perspective, this

means that alert individuals are more likely to use the reflective process of their analytical system to initiate a system 1 override and allow the algorithmic process of the analytic system to reevaluate the heuristic-based judgment. This reevaluation by system 2 could lead to the endorsement or overriding of the heuristic system's original judgment (Evans, 2008). If the heuristic-based judgment is endorsed, this confirms the accuracy of the heuristic and likely leads to its continued use (unchanged). Alternatively, if the heuristic-based judgment is not endorsed, the heuristic will likely be adjusted and perform better in the future. Either way, an increased use of the reflective process may explain why alert individuals have particularly accurate mental models.

From a dual process perspective, it seems that alert entrepreneurs, more so than non-alert entrepreneurs, often rely on an accurate heuristics processing style (system 1) but also appear more likely to recognize situations where their heuristics are not appropriate and in these situations shift to a more analytical processing style (system 2). Thus, for the purposes of this paper, I suggest that alert entrepreneurs are less likely to make the initial inaccurate heuristics-based judgment that they are not interested in considering additional information. This is because their heuristics are typically more accurate. When alert entrepreneurs do make an inaccurate heuristic-based judgment, however, I suggest they are more likely to override the initial heuristic-based judgments, consider additional information, and form an opportunity recognition belief. Formally hypothesized as follows:

*Hypothesis 5. Entrepreneurs' alertness moderates the first stage of the indirect effect that relying on bias-causing heuristics has on opportunity recognition belief via the amount of*

*information considered, such that the indirect effect is weaker for entrepreneurs with high levels of alertness.*

### Method

In testing my hypotheses, I conducted two studies. The first study used two collections and considered the underlying causal process through which bias-causing heuristics reduce the ability to form the belief that one has recognized an opportunity through the consideration of information (hypotheses 1-3). In study 1 I used both a measurement of mediation approach (collection 1) and an experimental causal chain approach (collection 2) to explore this causal process. The second study further considered the mediated relationship and examined entrepreneurial alertness and the need for cognition as first stage moderators to this indirect effect (hypotheses 3-5). I used a between participant experimental design and actual entrepreneurs to examine these effects and further bolster the generalizability of Study 1.

### Study 1

Study 1 used a between participant experimental-causal-chain design paired with a measurement of mediation approach (Spencer, Zanna, & Fong, 2005). Specifically, I used two experiments to establish the effect of independent variable ( $X$ ) on a dependent variable ( $Y$ ) through a mediator ( $M$ ). The first experiment considered the relationship between the independent variable (the reliance on a bias-causing heuristic) and the mediator (the consideration of information). The first experiment also tested the indirect relationship between the independent variable (the reliance on a bias-causing heuristic) and the dependent variable (opportunity recognition belief) through the mediator (the consideration of information). The

second experiment then considered the relationship between the mediator (the consideration of information) and the dependent variable (the formation of an opportunity recognition belief).

#### Procedure for collection 1 of Study 1

In collection 1, I considered both the relationship between the reliance on a bias-causing heuristic and the consideration of information ( $X \rightarrow M$ ) as well as the indirect effect that the reliance on a bias-causing heuristic has on forming an opportunity recognition belief through the consideration of information ( $X \rightarrow M \rightarrow Y$ ). Although collection 1 tested mediation because both the mediating variable and the dependent variable were measured variables, directionality was difficult to establish. Thus, the second collection extended the findings of collection 1 by using an experimental manipulation to consider the effect that the consideration of information has on the formation of an opportunity recognition belief ( $M \rightarrow Y$ ).

Both collection 1 and collection 2 relied on the application of a real technology, from a tech-transfer office, to a market that it was actually applied to. Specifically, participants were given information about the application of a low-temperature oxidation catalyst filter technology (hereafter referred to as “the technology”) to the personal safety market. This technology was originally developed at NASA’s Langley Research Center for carbon dioxide laser research. Smoke Mask, Inc. then applied this technology to personal safety through their personal escape hood that allowed for respiratory protection when escaping hazardous conditions. Applying a tech-transfer technology to a new market closely adheres to Gregoire and colleagues’ (2009) definition of an opportunity, “as projected courses of action to introduce (and profit from) new and/or improved supply-demand combinations that seek to address market failure problems.” (p.

117). Specifically, the application of the technology to the personal safety market provided a new and possibly better way to solve homeowners' demands for a home-based fire safety product, a need that the market had failed to fully meet. Using the application of a real technology from a tech-transfer office is also in line with prior research that has asked entrepreneurs to look at the applicability of a tech transfer technology to a potential market (Gregoire & Shepherd, 2012; Shane, 2001).

#### Sample for Collection 1 of Study 1

I tested the first link of the indirect relationship by having student participants at a large southeastern university identify a non-student participant. Student participants were awarded extra credit for identifying a non-student participant. Non-student participants then completed an online survey that was provided to them via email. Sixty-four non-student participants completed the survey. I removed nine cases (14%) where respondents did not understand the manipulation (specifically cases were removed where participants did not correctly indicate whether the product that they read about caused death, see below manipulation). My final sample was comprised of 55 non-student adult participants. Of the 55 participants, 31% were male; on average, they were 40 years old; and they were 58% Caucasian/White. Further, 26% had previously founded a business, and 42% of the entire sample including those who had previously founded a business noted they intended to found a business.

#### Procedure for Collection 1

For collection 1, I created vignettes to test hypotheses 1 and 3, which propose that the reliance on a bias-causing heuristic negatively impacts the consideration of information and that the amount of information considered mediates the negative relationship between the reliance on

bias-causing heuristics and the likelihood of forming an opportunity recognition belief, respectively. I used different descriptions about the technology market combination that either primed a strong bias-causing heuristic or did not. As discussed above, I relied on the betrayal heuristic, which is a rule of thumb where people, “Punish, and do not reward, betrayals of trust” (Sunstein, 2005, p. 537). As noted above I chose to use the betrayal heuristic because it squarely fits into the types of bias-causing heuristics that I seek to consider, because it constitutes a strong manipulation and because it was easily adapted to the context I seek to explore in this dissertation. In creating my manipulation, I closely followed the wording that Koehler and colleagues (2003) used. Specifically, in my manipulation, participants were told:

Researchers at a large university created low-temperature oxidation catalyst filters to convert carbon monoxide to nontoxic carbon dioxide. The inventors of this technology did not want to personally pursue business opportunities because they are purely scientists. This technology is now part of a university’s technology transfer program that makes the technology available for a licensing deal with a new or existing firm. One possible market that researchers suggested this technology could be applied to is the fire safety and protection market through a personal rescue hood. The university technology transfer office has done some research related to the application of the technology to this market. We are asking **you as a potential entrepreneur** to evaluate this potential opportunity. On the next page we provide you with the executive summary about the opportunity, one

piece of information at a time. **Please explore as little or as much information as you see fit.**

On the following page, participants were provided with an executive summary regarding the technology market combination one piece of information at a time. The first piece of information following the above description contained the heuristic manipulation to which participants were randomly assigned. Specifically, those in the high bias-causing heuristic (betrayal) condition were told:

There is a 5% chance that homeowners in a serious fire will be killed due to smoke inhalation. Scientific tests indicate, however, that there is only a 1% chance of death due to smoke inhalation when a personal rescue hood is used. The rescue hood, however, may also kill some homeowners. Specifically, some rescue hood users may die due to hood suffocation caused by the hood itself. Tests indicate that there is an additional one chance in 200 (0.5%) that someone who is in a serious fire, who uses the rescue hood, will be killed due to hood suffocation.

Whereas participants in the low bias-causing heuristic (no betrayal) condition were told:

There is a 5% chance that homeowners in a serious fire will be killed due to smoke inhalation. Scientific tests indicate, however, that there is only a 1.5% chance of death due to smoke inhalation when a personal rescue hood is used. The rescue hood, however, could also cause minor side effects such as a temporary rash.

It is notable that in both conditions, the chance of death when using the hood is reduced from 5% to 1.5%. After viewing the manipulation participants were then asked to select one of the following choices, “I would like more information” or “I do not want more information.” If they selected “I would like more information,” an additional piece of non-heuristically charged information about the opportunity appeared below the first piece of information, and participants were asked if they wanted more information about the opportunity. This was repeated, such that the maximum amount of information that could be collected was the manipulation (heuristically charged/non-heuristically charged information) and four additional pieces of non-heuristically charged information. If at any point a participant selected, “I do not want more information” or after he or she had viewed all of the information available, they were no longer given any information about the opportunity. Once participants finished collecting information, they were asked to complete an opportunity recognition belief scale regarding the technology being applied to the personal safety market.

#### Sample for Collection 2 of Study 1

I tested the second link of the indirect relationship by again having student participants at a large southeastern university identify a non-student participant. Student participants were awarded extra credit for identifying a non-student participant. Non-student participants then completed an online survey that was provided to them via email. Two hundred and two non-student participants completed the survey. Of the 202 participants, 48% were male; on average, they were 40 years old, and they were 66% Caucasian/White. Further, 25% had previously founded a business, and 38% of the entire samples including those who had previously founded a business noted they intended to found a business.

## Procedure for Collection 2

Collection 2, tested hypothesis 2 , which proposes that the amount of information considered impacts the formation of an opportunity recognition belief. Instructions for this collection were the same as the instructions for collection 1, except in this collection all participants were told, “On the next page we provide you with the executive summary about the opportunity. **Please carefully consider all of the information provided.**” Whereas in collection 1, all participants were told, “On the next page we provide you with the executive summary about the opportunity, **one piece of information at a time. Please explore as little or as much information as you see fit.** Participants were then provided, on a single page, information about the opportunity. Participants were randomly assigned to the low or high information condition. The low information condition provided two pieces of information about the opportunity and the high information condition provided the same information as the low information condition plus two additional pieces of information. After reviewing the information manipulation, participants completed an opportunity recognition belief scale regarding the technology being applied to the personal safety market. See Appendix M for a breakdown of the manipulation.

## Measures for Collection 1 and Collection 2 of Study 1

### Amount of information considered

I assessed the amount of information that participants considered with a count of the number of pieces of information that they viewed. That is, if a participant selected, “I would not like any more information” after viewing the manipulation (the first piece of information), he or she received a score of one. If the participant selected, “I would like more information” after the manipulation and then selected, “I would not like any more information” after viewing the

second piece of information, he or she received a two and so on. If the participant viewed all information available, he or she received a five.

### Opportunity Recognition Belief

I assessed participants' opportunity recognition belief with an adapted version of the measure developed and validated by Gregoire et al. (2010b). Participants were asked to rate how certain (0 = uncertain, 4 = completely certain) they were regarding the fit and the feasibility of the technology market combination. Sample items included "The proposed business solution can be used to solve the problems of the targeted market" and "The proposed business solution is sufficiently developed to be applied with individuals/firms in the targeted markets." The reliability for this measure was .93 for Collection 1 and .84 for Collection 2.

### Results for Pretests

Before testing my hypotheses of interest I followed Koehler and Gershoff's (2003) example and confirmed the effectiveness of my betrayal manipulation. Specifically, I presented a pilot version of the manipulation to student and non-student participants and asked them on a 1 (*definitely no*) to 5 (*definitely yes*) scale if the personal rescue hood betrays the people it is supposed to protect. Appendix O provides the earlier, slightly different, piloted version of the manipulation and the one used in both Study 1 and Study 2. I then conducted an analysis of variance on these ratings. The results indicated a significant main effect for my manipulation,  $F(1, 269) 85.22, p < .001$ . The betrayal description received a significantly higher rating ( $M = 3.26$ ) than the non-betrayal condition ( $M = 1.92$ ) on the manipulation check question. Further, I conducted the same manipulation check using the same question suggested by Koehler and

Gershoff (2003) on the data collected for Collection 1 of Study 1. The analysis of variance on these ratings also indicated a significant main effect for my manipulation,  $F(1, 54) 13.23, p < .001$ . Specifically, the betrayal manipulation received a significantly higher rating ( $M = 2.64$ ) than the non-betrayal condition ( $M = 1.56$ ) on the manipulation check question. Thus, my betrayal manipulation appeared successful.

I also pretested the rationality of decision makers' choices based on the existence of my betrayal manipulation. Specifically, my studies employed a between participant design and did not give participants the choice between a betrayal and a non-betrayal venture. Thus, in following Koehler and Gershoff's (2003) example, I used a within participant design to test the likelihood of participants making a non-rational choice when given an option between two ventures, one that reduced the chance of death by 3.5% but incorporated the betrayal heuristic (the rational choice) and one that only reduced the chance of death by 3% but did not incorporate the betrayal heuristic (the non-rational choice). Specifically, I gave participants the choice between licensing Hood A (no betrayal) or licensing Hood B (betrayal). Hood A did not incorporate the betrayal heuristic and reduced the chance of death in a serious fire from 5% to 2%. Alternatively, Hood B incorporated the betrayal heuristic and reduced the chance of death in a serious fire from 5% to 1% but also caused death .5% of the time. Thus, licensing Hood B (betrayal) was the more rational choice because it reduced the chance of death to 1.5% as opposed to licensing Hood A (no betrayal) that only reduced the chance of death to 2%. A full depiction of this manipulation is presented in Appendix P. Interestingly, when given the choice between licensing these hoods, 70% of participants chose Hood A (no betrayal), the seemingly

less rational venture. Notably, these findings are nearly identical to the results found by Koehler and Gershoff (2003) when manipulating betrayal regarding safety products (airbag/fire alarm/vaccine). Specifically, Koehler and Gershoff (2003) found that 67.4% of people chose a non-betraying safety product over a betraying safety product even though the non-betraying safety product was associated with a greater overall chance of death. Thus, it appears my manipulation triggers the same heuristic type reaction as Koehler and Gershoff's (2003) manipulation that leads to a less rational choice.

### Results for Study 1

Study 1 tested hypotheses 1-3 using a between participant experimental causal chain design that used two experimental collections to test each link of the causal chain. Collection 1 tested the relationship between relying on bias-causing heuristics and considering information related to an opportunity (Hypothesis 1) as well as the indirect relationship between relying on bias-causing heuristics and forming an opportunity recognition belief through the consideration of information (Hypothesis 3). Collection 2 then experimentally tested the relationship between considering information related to an opportunity and the formation of an opportunity recognition belief (Hypothesis 2). Taken together, these studies allow me to infer directionality of the indirect effect that the reliance on a bias-causing heuristic has on forming an opportunity recognition belief through the amount of information considered (Hypothesis 3).

### Results for Study 1 Collection 1

Collection 1 of Study 1 provides data to test hypotheses 1 and 3; thus, I will present the results of hypothesis 3 before the results of hypothesis 2, which is tested using data from

Collection 2 of Study 1. Table 1 presents the correlations between the variables in Collection 1 of Study 1 and Figure 2 graphically provides the distribution of the mediating variable (amount of information considered) and the dependent variable (opportunity recognition belief) that were used in this collection. Following procedures recommended by Cohen et al. (2003), I tested Hypothesis 1 using a Poisson regression (Hornsby, Kuratko, Shepherd, & Bott, 2009).<sup>iii</sup>

Hypothesis 1 predicted that relying on cognitive heuristics reduces the amount of information considered related to an opportunity. Table 2 presents the results for this analysis. These results revealed a negative relationship between the reliance on a cognitive heuristic (the betrayal condition) and the amount of information considered ( $B = -.321, p < .05$ ). The incident rate ratio for the heuristic condition was .73, suggesting that participants who were exposed to the betrayal heuristic considered about 73% of the information that participants who did not rely on the betrayal heuristic considered. In regard to the data from Collection 1 of Study 1, this incident rate ratio was associated with participants in the betrayal condition considering on average 2.82 pieces of information, whereas participants in the no betrayal condition considered on average 3.89 pieces of information. Further, I conducted a Tobit analysis as a robustness check to ensure that the results of the Poisson regression were not biased due to the censorship of my dependent variable. Table 2 presents the results for this analysis and shows there is no difference in the pattern of the results. Specifically, both the Poisson and Tobit models show participants in the betrayal condition to consider significantly less information than participants in the non-betrayal condition. Thus, Hypothesis 1 is supported.

I also tested Hypothesis 3 using the data from Collection 1 of Study 1. Specifically I tested this hypothesis using the PROCESS macro for SPSS (Hayes, 2013). Given that my mediator is a count variable, the ordinary least squares regression assumption that the estimation errors are homoscedastic is violated. A bootstrapping procedure, however, is appropriate for this analysis because it does not require standard errors and such this assumption does not apply to inferences about the indirect effect when using bootstrap confidence intervals (Hayes, 2012). Hypothesis 3 predicted that the amount of information considered mediates the relationship between the reliance on bias-causing heuristics and forming an opportunity recognition belief. Table 3 presents the results for this analysis. These results revealed a negative indirect relationship between the reliance on a cognitive heuristic (the betrayal condition) and forming an opportunity recognition belief through the consideration of information ( $B = -.33$ ). Specifically, my analyses demonstrated that the amount of information considered mediates the relationship between the reliance on a cognitive heuristic and the formation of an opportunity recognition belief, as the 95% bootstrapped confidence interval  $([-.49, -.0005])$  does not include zero.<sup>iv</sup> Thus, Hypothesis 3 is also supported, although the directionality of the results is difficult to determine because the mediator and the dependent variable were both measured variables.

### Results for Study 1 Collection 2

Using regression techniques I tested Hypothesis 2 with the data from Collection 2 of Study 1. Table 1 presents the correlations between the variables for this collection and Figure 3 graphically provides the distribution of the dependent variable (opportunity recognition belief) that was used in this collection. Hypothesis 2 predicted that considering information related to an

opportunity is positively related to forming an opportunity recognition belief. Table 4 presents the results for this analysis. These results revealed a positive relationship between the amount of information considered and the formation of an opportunity recognition belief ( $B = .21, p < .01$ ). It is also notable that participants in the low information condition had an average opportunity recognition belief of 3.49, whereas participants in the high information condition had an average opportunity recognition belief of 3.92. Thus, Hypothesis 2 is supported.

### Discussion of Study 1

Taken together, collection 1 and collection 2 provide evidence that: (a) relying on a bias-causing heuristic leads to considering less information about an opportunity (Hypothesis 1); (b) considering less information about an opportunity reduces the likelihood of forming the belief that one has recognized an opportunity (Hypotheses 2); and (c) that the amount of information considered about an opportunity mediates the negative relationship between relying on a bias-causing heuristic and forming the belief that one has recognized an opportunity (Hypotheses 3). Thus, although heuristic-based thinking is generally thought to be beneficial for entrepreneurs, it appears that the reliance on some heuristics can lead individuals to miss an opportunity because they do not consider information about the opportunity. In Study 2, I seek to determine if differences in cognitive processing styles allow some individuals to overcome the negative effect that the reliance bias-causing heuristics have on opportunity recognized through the considerations of less information. Specifically, I consider two individual differences (Entrepreneurial Alertness and the Need for Cognition) that are related to being more reflective in one's cognitive processing style as first stage moderators to this process. I suggest that

individuals high in either of these differences are more likely to shift from their heuristic-based processing style to a slower, more analytical processing style and in doing so consider more information about the opportunity and thus be more likely to form the belief that they have recognized the opportunity. In Study 2, I also extend the generalizability of my findings from Study 1 by using a sample of entrepreneurs.

## Study 2

Study 2 used a between-participant experimental design. I built on Study 1 by using a more generalizable sample (actual entrepreneurs) to reanalyze the indirect relationship between the reliance on a cognitive heuristic and the formation of an opportunity recognition belief through the consideration of information (Hypothesis 3). Further, I considered two individual differences as potential moderators of this indirect effect. As theorized above, I propose two first stage moderators, the need for cognition (Hypothesis 4) and entrepreneurial alertness (Hypothesis 5).

### Sample for Study 2

Entrepreneurs who had founded a business completed an online survey that was provided to them via email in return for a five-dollar Amazon gift card code that was provided to them via email. All respondents and contacts through which data was obtained were assured anonymity and confidentiality, thus their names do not appear in this document. Entrepreneurs' email addresses were obtained through the following outlets. The primary researcher visited businesses located in the central business districts of Wyomissing, PA, Philadelphia, PA, Orlando, FL and Tampa, FL during business hours and asked to speak to the founding owner/s of each business. If

owners were available, the primary researcher asked if they would be willing to take a survey that would be emailed to them that evening in return for a five-dollar Amazon gift card code. If they were willing to partake in the survey, the survey was emailed to them within 24 hours. This group of potential participants was also asked to share the link with any other founding owners from their business or whom they knew.

Email addresses were also obtained through multiple Chambers of Commerce. Specifically, the primary researcher personally visited, called and /or emailed Chambers of Commerce in and around the Philadelphia, PA and Orlando, FL areas. Locations, phone numbers and email addresses for each chamber were found through Internet searches. The primary researcher then asked a representative from each chamber if they would be willing to share the Chambers' email list or send the survey request to members who owned and founded a business. Chambers could not provide their email list but some were willing to send their members the survey link and information.

The primary researcher also contacted and visited incubators and entrepreneurship groups in Reading, PA, Orlando, FL and Tampa, FL. Locations and contact information for each incubator and entrepreneurship group were obtained through Internet searches. The primary researcher then asked representatives from each incubator for an email list of their clients (i.e. businesses) and representatives from entrepreneurship groups for the email addresses of their members. No incubator or entrepreneurship group was willing to provide their email lists but some were willing to send the survey link to their members. Because all entrepreneurs who were personally visited or contacted through an incubator, chamber or entrepreneurship group

responded to the same survey link, specific details of each group cannot be determined. However, over 100 individual businesses, two incubators, four Chambers of commerce and four entrepreneurship groups were contacted which resulted in 64 responses from entrepreneurs. These entrepreneurs founded businesses in a wide range of industries including but not limited to finance, technology, retail, and manufacturing. Lastly, entrepreneurs' email addresses were also obtained by inviting undergraduate entrepreneurship students at a large public university to recruit founding entrepreneurs to partake in the survey. Students received extra credit in return for recruiting entrepreneurs.

All of these efforts resulted in a final sample of 129 participants who completed the survey. I removed 13 (10%) cases where respondents did not understand the manipulation (specifically cases were removed where participants did not correctly indicate whether the product that they read about caused death) and 10 (9%) additional cases where the respondents did not qualify as entrepreneurs because they had never founded a business, leaving a sample of 106 entrepreneurs. Of the 106 entrepreneurs, 64% were male; on average, they were 43 years old, 91% had at least some college courses, and they were 83% Caucasian/White. The entrepreneurs had founded businesses in a wide range of industries including but not limited to finance, technology, retail, and manufacturing.

### Procedure for Study 2

This study used an experimental design similar to the first collection of Study 1 but also considered the moderating variables. This study also used the application of a real technology, from a tech-transfer office, to a market that it was actually applied to. Specifically, participants

were given the same stimulus and manipulation noted in collection 1 of Study 1 and then given the opportunity to collect as little or as much information as they wanted about the opportunity. They were then asked to complete an opportunity recognition belief scale regarding the technology being applied to the personal safety market. Additionally, however, participants were also asked to complete measures of my moderating variables, entrepreneurial alertness, and the need for cognition.

### Measures for Study 2

The amount of information considered and opportunity recognition belief were collected in the same manner as described above. For Study 2 the reliability for the opportunity recognition belief scale was .85

#### Entrepreneurial alertness

I gauged entrepreneurial alertness with a 13-item measure developed by Tang, Kacmar, and Busenitz (2012). Participants were asked to rate the extent to which they agreed with certain statements about themselves on a 5-point scale (1 = *strongly disagree*; 5 = *strongly agree*). Sample items include “I am always actively looking for new information” and “I have a gut feeling for potential opportunities.” The reliability for this measure was .88.

#### Need for cognition

I assessed participants’ need for cognition with the 18-item measure developed by Cacioppo et al. (1984). Participants were asked to rate the extent to which certain statements were characteristic of them on a 5-point scale (1 = *extremely uncharacteristic*; 5 = *extremely characteristic*). Sample items include “I would rather do something that requires little thought

than something that is sure to challenge my thinking abilities” reversed scored and “I really enjoy a task that involves coming up with new solutions to problems.” The reliability for this measure was .85.

### Results for Study 2

Study 2 tested hypotheses 3-5 using a between participants experimental design and a more generalizable group of participants (actual entrepreneurs). Before testing my hypotheses of interest I followed Koehler and Gershoff’s (2003) example and confirmed the effectiveness of my betrayal manipulation for the data from Study 2. Specifically, I asked participants on a 1 (*definitely no*) to 5 (*definitely yes*) scale if the personal rescue hood betrays the people it is supposed to protect. I then conducted an analysis of variance on these ratings. The results indicated a significant main effect for my manipulation,  $F(1, 105) 5.29, p < .05$ . Specifically, the betrayal description received a significantly higher rating ( $M = 2.21$ ) than the non-betrayal condition ( $M = 1.71$ ). Thus, my betrayal manipulation also appeared successful for Study 2.

Table 1 presents the correlations between the variables in Study 2 and Figure 4 graphically provides the distribution of the mediating (amount of information considered) and the dependent variable (opportunity recognition belief) that were used in this collection. I tested hypotheses 3-5 using the PROCESS macro for SPSS (Hayes, 2013). Hypothesis 3 predicted the amount of information considered mediates the relationship between the reliance on bias-causing heuristics and forming an opportunity recognition belief. Table 6 presents the results for this analysis. These results do not indicate a significant indirect effect, as the 95% bootstrapped confidence interval ([-.0841, .1042]) includes zero. Thus, the results for Study 2 do not support

Hypothesis 3. Hypotheses 4 and 5 predicted that the need for cognition and entrepreneurial alertness respectively moderate the indirect effect that the reliance on bias-causing heuristics has on opportunity recognition belief via the amount of information considered. Specifically, I proposed that this indirect effect is weaker for entrepreneurs with high levels of each of these individual differences. Table 6 presents the results for these analyses. These results show that the indirect effect, through the amount of information considered, is not significant at any level of the need for cognition or entrepreneurial alertness. Thus neither, Hypothesis 4 nor Hypothesis 5 was supported.

### Discussion of Study 2

Surprisingly, the results from Study 2 were inconsistent with the results from Study 1 in regard to hypothesis 3. Specifically, for entrepreneurs, I did not find that the amount of information considered about an opportunity mediates the negative relationship between relying on a bias-causing heuristic and the formation of an opportunity recognition belief. A closer inspection of the individual path relationships shows that Path A, the relationship between relying on a bias-causing heuristic to considering less information about an opportunity, was not supported ( $B = .05, p = ns$ ) but that Path B, the relationship between considering information about an opportunity and an increased likelihood of forming the belief that one has recognized an opportunity, was supported ( $B = .12, p < .05$ ). Further, the results for Study 2 did not find this non-significant indirect effect to be conditional on either the need for cognition or entrepreneurial alertness. Thus, the results suggest that entrepreneurs are not affected by the reliance on a bias-causing heuristics in regard to how much information they consider about an

opportunity and that, for entrepreneurs, the amount of information considered about an opportunity does not mediate the relationship between the reliance on a bias-causing heuristic and the formation of an opportunity recognition belief.

#### Post Hoc Analysis

Given the inconsistent results between Study 1 and Study 2 regarding Hypothesis 3 (the indirect effect through the amount of information considered), it seemed possible that the inconsistent findings were related to the types of participants in each sample. Specifically, I found a negative indirect effect from the reliance on a bias-causing heuristic to the formation of an opportunity recognition belief through the amount of information considered using a sample of working adults (26% of whom were entrepreneurs in Study 1) and a marginally significant indirect effect using a sample of students and adults (using an piloted version of the manipulation provided in Appendix N). This indirect effect, however, was not found in Study 2 when considered with a sample exclusively made up of entrepreneurs. As I theorize above, I generally suggest that reflective people (e.g. alert and high in the need for cognition) will be less likely to reduce the amount of information that they consider when faced with a bias-causing heuristic and thus be less affected by bias-causing heuristics during the opportunity recognition process. It seems plausible that entrepreneurs people that have previously gone through the opportunity recognition process and recognized an opportunity may be representative of these reflective people. Thus, the sample from Study 2, that was exclusively made up of entrepreneurs may have limited my ability to tease out conditional indirect effects based on being reflective.

To address that line of argument, I combined the data from collection 1 of Study 1 with the data from Study 2 and conducted an analysis of variance to determine whether entrepreneurs were significantly different in regard to variables that are associated with being reflective. Further, I analyzed the conditional indirect effect that the reliance on a bias-causing heuristic has on opportunity recognition belief through the consideration of information based on whether the participant was an entrepreneur (had founded a business). The sample for the post hoc analyses consisted of the 106 entrepreneurs from Study 2, the ten respondents from Study 2 who did not qualify as entrepreneurs because they had not founded a business (see page 42) and the 55 respondents used in Study 1. This led to a sample of 171 participants, 120 of who had founded of business. Fifty-three percent of the participants were male; on average, participants were 41.1 years old; 86% had at least some college courses; and 75% were Caucasian/White. The entrepreneurs in the sample had founded business in a wide range of industries including but not limited to finance, technology, retail, and manufacturing.

In terms of my analysis of variance, I tested to see if entrepreneurs were significantly higher in entrepreneurial alertness, their need for cognition, and their score on the cognitive reflections test. The cognitive reflections test is a three-question test designed by Frederick (2005) that measures how reflective someone is when making a decision. Specifically, it tests how likely someone is to override their initial inaccurate heuristic based response for further consideration that leads to the correct answer. In following Toplak, West, and Stanovich's (2011) example, I created a composite of performance on the three items, which are provided in

Appendix Q. The mean performance for the test was 0.4 items correct ( $SD = .39$ ). The reliability for this measure was .79.

Table 7 presents the correlations between the variables for my post hoc analyses. Table 8 presents the results for the analysis of variance. It is notable that sample sizes of the groups for this analysis are significantly different. To that, I conducted homogeneity of variance tests and did not find any of the variance to be significantly different. Results indicate that entrepreneurs score significantly higher in all three of these variables associated with being reflective. Specifically, my analysis indicated a significant main effect for being an entrepreneur on entrepreneurial alertness  $F(1, 170) 7.68, p < .01$ , the need for cognition  $F(1, 170) 5.62, p < .05$ , and scores on the cognitive reflections test  $F(1, 163) 10.13, p < .01$ . Regarding alertness, entrepreneurs rated themselves as higher on the alertness scale ( $M = 4.03$ ) than non-entrepreneurs ( $M = 3.77$ ). Regarding the need for cognition, entrepreneurs rated themselves as higher on the need for cognition scale ( $M = 3.66$ ) than non-entrepreneurs ( $M = 3.41$ ). Lastly, regarding scores on the cognitive reflections test, entrepreneurs scored higher on the cognitive reflections test ( $M = 0.44$ ) than non-entrepreneurs ( $M = 0.24$ ). Thus, it appears that from a cognitive perspective, entrepreneurs may be more reflective than non-entrepreneurs.

I analyzed the conditional indirect effect that the reliance on a bias-causing heuristic has on opportunity recognition belief through the consideration of information based on whether or not the participant was an entrepreneur (had founded a business) using the PROCESS macro for SPSS (Hayes, 2013). Consistent with my mixed findings in Study 1 and Study 2, based on a 90% confidence interval, bootstrapping results revealed that the indirect effect from the reliance on a

bias-causing heuristic to opportunity recognition belief through the consideration of information was negative and significant for non-entrepreneurs ( $B = -.14, [-.2901, -.0070]$ ) but not significant for entrepreneurs ( $B = -.01 [-.0971, .0842]$ ).

Taken together, the results of Study 1, Study 2 and the above post hoc analysis suggest that entrepreneurs may react differently to bias-causing heuristics during the opportunity recognition process than non-entrepreneurs because they are more reflective. To examine that, I further tested my general proposition that being reflective weakens the negative indirect effect that the reliance on a bias-causing heuristic has on opportunity recognition belief through the consideration of information using the combined samples. Specifically, I analyzed this conditional indirect effect based on variables associated with being reflective (entrepreneurial alertness, the need for cognition and scores on the cognitive reflections test) using the PROCESS macro for SPSS (Hayes, 2013).

Table 9 presents the results for these analyses. These results showed that this indirect effect is not conditional based on either of my hypothesized individual difference moderators (entrepreneurial alertness or the need for cognition). This indirect effect, however, was found to be conditional based on a 90% confidence interval regarding how reflective an individual is (assessed by the cognitive reflections test). Specifically, based on a 90% confidence interval, the indirect effect is negative and significant ( $B = .01, [-.2339, -.0038]$ ) for individuals who scored low on the cognitive reflections test and not significant ( $B = .03, [-.0789, .1438]$ ) for individuals who scored high on the cognitive reflections test.

## Discussion

I found mixed support for the notion that bias-causing heuristics, in this case the betrayal heuristic, causes individuals to consider less information (Hypothesis 1). Specifically, this appears to be true for less-reflective individuals and non-entrepreneurs. I found consistent support for the notion that the consideration of information leads to forming the belief that one has recognized an opportunity (Hypothesis 2). Further, I found inconsistent results regarding the indirect relationship between the reliance on a bias-causing heuristics and forming the belief that one has recognized an opportunity through the consideration of information (Hypothesis 3: supported in Study 1, marginally supported in the pretest, but not in Study 2). These inconsistent findings appear to be a result of the samples chosen for each study (Study 1 = Adults, Study 2 = Entrepreneurs) and because this indirect effect is conditional on how reflective individuals are (based on the cognitive reflection test). I also proposed that the need for cognition (Hypothesis 4) and entrepreneurial alertness (Hypothesis 5) would capture how reflective individuals are and moderate this indirect effect, however, these hypotheses were not supported. Taken together, these results provide some support for the general notion that bias-causing heuristics may prevent less reflective individuals from recognizing an opportunity because they consider less information about the opportunity. More highly reflective individuals, however, are not as affected by these heuristics.

### Theoretical Implications

Prior literature suggests heuristics may be advantageous in regard to opportunity recognition (Baron, 2004; Baron & Ensley, 2006; Baron & Ward, 2004). In contrast, I show that

bias-causing heuristics can be detrimental to forming the belief that one has recognized an opportunity (at least in the case of betrayal aversion as the source of bias). My results suggest that these heuristics negatively affect the ability to recognize an opportunity through their influence on the amount of information that one considers. These results provide empirical support for McMullen and Shepherd's (2006) model of entrepreneurial action that suggests considering additional information reduces uncertainty, which enables individuals to form the belief that they have recognized an opportunity (McMullen & Shepherd, 2006; Shepherd et al., 2007).

As would be expected based on dual process theories of cognition, the negative effect that heuristics have on the ability to recognize an opportunity through the consideration of information is conditional on how reflective an individual is. From a default-interventionist perspective, reflective individuals are better able to shift from their faster processing system to a more analytical cognitive process. I theorized that this ability to shift would allow reflective individuals to slow down, consider additional information about an opportunity, and thus be less negatively affected by bias-causing heuristics in regard to forming the belief that they recognition an opportunity. My results marginally support this relationship and suggest that being reflective may be important in the opportunity recognition process. My results also show that entrepreneurs tend to be more reflective.

It is interesting to note that although being reflective (as measured by the cognitive reflections test) is positively correlated with both the need for cognition and entrepreneurial alertness (see Table 7), neither of these individual differences moderated the indirect effect from

a bias-causing heuristic to opportunity recognition belief through the consideration of information. Although these individual differences are associated with being reflective, it does not appear as though alert or high need for cognition individuals are reflective enough to overcome bias-causing heuristics (Cacioppo et al., 1996; Gaglio & Katz, 2001; Stanovich, 2009a).

Another interesting finding was that being an entrepreneur (founding a business) negated the negative indirect effect from a bias-causing heuristic to opportunity recognition belief through the consideration of information. This finding is likely because entrepreneurs are significantly more reflective than non-entrepreneurs. From an investigation of the means, however, it is worth noting that, on average, entrepreneurs considered less information and were less likely to form the belief that they recognized an opportunity than non-entrepreneurs in the non-heuristic condition. In the heuristic condition, however, entrepreneurs did not reduce the amount of information they considered and only reduced their level of opportunity recognition slightly. On the other hand, non-entrepreneurs reduced each by a larger margin such that entrepreneurs and non-entrepreneurs considered about the same amount of information and were equally likely to form the belief that they had recognized an opportunity when relying on a bias-causing heuristic. A graphical representation is displayed in Figure 5.

This surprising finding may be in line with the idea that entrepreneurs focus on breadth (the number of opportunities they consider) and not depth (how much information they consider about each opportunity) when considering opportunities but are not as easily fooled by bias-causing heuristics. That is, entrepreneurs (those who have been through the founding process) may realize the importance of not spending much time on any one opportunity so they have the

ability to examine many opportunities. It is also possible that entrepreneurs rely on personal knowledge and experience more so than external stimuli as compared to non-entrepreneurs. Thus, entrepreneurs may make up for not considering information by using information that they possess. If this is the case, it would be unknown whether bias-causing heuristics cause entrepreneurs to spend less time considering information that they already have. An alternative explanation may be that the experience of going through the founding process and realizing that many opportunities are not worth pursuing may make entrepreneurs harder to impress. Thus, entrepreneurs may be more hesitant to form the belief that they have recognized an opportunity or to spend time considering one.

Overall, this study makes multiple contributions to the entrepreneurship literature. First, I show the potential negative effects of heuristics (specifically, the betrayal heuristic) on opportunity recognition and a process through which this relationship may work, the consideration of information. Second, I empirically show that considering additional information positively affects forming an opportunity recognition belief as proposed by McMullen and Shepherd's (2006) conceptual model of entrepreneurial action. Third, I integrate dual process theories of cognition into the entrepreneurship literature and show that being reflective may be essential in the opportunity recognition process. Fourth, I empirically provide preliminary evidence that suggests entrepreneurs are more reflective in their cognitive processing style, more alert and have a higher need for cognition than non-entrepreneurs. Lastly, I empirically show that bias-causing heuristics do not affect entrepreneurs and non-entrepreneurs in the same way. Specifically, I show that the reliance on a bias-causing heuristic does not cause entrepreneurs but

does cause non-entrepreneurs to consider less information about an opportunity and as a result be less likely to form the belief that they have recognized that opportunity.

### Practical Implications

This study also provides useful findings for entrepreneurs regarding the importance of information when considering the existence of an opportunity. That is, my results show that entrepreneurs tend to consider less information about a potential opportunity and that considering information about a potential opportunity is positively related to forming the belief that an actual opportunity does or does not exist. This belief is a prerequisite to determining if that opportunity is for the entrepreneur himself or herself. Although considering less information about a potential opportunity may be beneficial in some circumstances because it allows for more time to consider additional opportunities, it can also lead to the missing out on a great opportunity. Thus, current entrepreneurs should be aware that their tendency to consider less information about a potential opportunity could have serious implications such as missing out on the next great opportunity. This study also provides useful findings for potential entrepreneurs and entrepreneur educators. Specifically, although would-be entrepreneurs are often told to follow their gut regarding recognizing opportunities, their immediate reactions may not always be the best ones. Certainly, quick decisions may benefit entrepreneurs, particularly seasoned entrepreneurs, by allowing them to consider many opportunities. My results, however, suggest that seasoned entrepreneurs—perhaps because they are more reflective in their cognitive processing style—are less negatively affected than would-be entrepreneurs by bias-causing heuristics. Thus, would-be

entrepreneurs should be especially careful not to over-rely on their gut but to realize the importance of honing their ability to be reflective when searching for opportunities.

#### Strengths, Limitations, and Future Research Directions

My study has multiple strengths. Specifically, the experimental causal chain design that I used for Study 1 allows me to isolate my variables of interest and make strong inferences about the causal path of the hypothesized relationship. Further, using the application of a real technology being applied to the market that it was actually applied to helps with the generalizability of my theorizing. Further, using a sample of actual entrepreneurs also strengthens the generalizability of my findings and allows me to consider important differences between entrepreneurs and non-entrepreneurs.

My study, however, is not without limitations. To begin with, my sample for Study 1 was small; however, I did find the hypothesized relationships to be significant, and these results were replicated in the pretest with a sample of 201 participants. Further, my studies only provide a small glimpse into this very complicated opportunity recognition process. Specifically, throughout all of my analyses, I only used one bias-causing heuristics manipulation (i.e., the betrayal heuristic). Although I tactically chose this manipulation after multiple pretests, the use of one heuristic limits the generalizability of my findings, as other bias-causing heuristics may have a different effect on the consideration of information and the formation of an opportunity recognition belief. Beyond this, by only examining bias-causing heuristics, I limit myself to only considering one side of the coin. That is, I do not investigate the possible benefits of accurate heuristics on the consideration of information and the formation of an opportunity recognition

belief. Further, I only allowed individuals to collect up to five pieces of information, which may limit my ability to fully understand these relationships. That is, the nature of the relationship between information and opportunity recognition may change, as more information is available. Additionally, I only presented individuals with one technology/market combination that had previously been exploited and, as such, should have been rated high in regard to opportunity recognition belief. The relationship between bias-causing heuristics and both the consideration of information and opportunity recognition belief, however, may be different for non-exploited, poorly matched opportunities. Further, although the experimental design of Study 1 strengthens this research, it also limits the generalizability of my findings, which was exemplified by the inconsistent results in Study 2.

The unexpected findings and above noted limitations, however, provide interesting avenues for future research. Specifically, I suggest the effect of bias-causing heuristics should be explored in a sample of both would-be and current entrepreneurs. Further, the effect of alternative bias-causing heuristics should also be explored. Beyond that, the interesting finding that entrepreneurs may consider less information generally, and more importantly may be less likely to form the belief that they have recognized an opportunity, should be explored. Specifically, I suggest considering how entrepreneurs, as compared to non-entrepreneurs, trade off between breadth (the number of opportunities explored) and depth (how much information is explored about each opportunity) when considering opportunities.

## Conclusion

This study sheds light on the potential negatives of fast thinking and the benefits of considering information to would-be entrepreneurs. Seasoned entrepreneurs may trade off the depth of their search for greater breadth in their search, with little or no consequences. Seeing seasoned entrepreneurs' successes may cause would be entrepreneurs and entrepreneurship educators alike to advocate this type of fast thinking shallow search. Seasoned entrepreneurs, however, appear to use different cognitive processes that allow them to be successful when using this approach. Thus, would-be entrepreneurs should be cautious when relying on fast thinking during the opportunity recognition process.

**APPENDIX A:  
MEANS, STANDARD DEVIATIONS, RELIABILITIES AND  
CORRELATIONS FOR STUDY 1 AND STUDY 2**

Table 1 Means, Standard Deviations, Reliabilities and Correlations for Study 1 and Study 2

	Study 1						Study 2						
	Collection 1			Collection 2			Collection 1			Collection 2			
	<i>M</i>	<i>SD</i>	1	2	<i>M</i>	<i>SD</i>	2	<i>M</i>	<i>SD</i>	1	2	3	4
1. Betrayal Heuristic Manipulation	.51	.50						.45	.5				
2. Amount of Information Collected	3.35	1.85	-.29*		3.01	1		2.78	1.87	.015			
3. Opportunity Recognition Belief	3.72	1.06	-.24†	.34* (.93)	3.71	.83	.25** (.84)	3.38	.94	-.17†	.23* (.85)		
4. Need for Cognition								3.69	.58	-.15	.33**	.11 (.85)	
5. Entrepreneurial Alertness								4.02	.54	-.11	.14	.34**	.41** (.88)

Study 1: Collection 1 *n* = 55, Collection 2 *n* = 202. Study 2 *n* = 106. For the Betrayal Heuristic Manipulation 0 = *no betrayal* and 1 = *betrayal*.

Alpha reliabilities appear in parentheses.

† *p* < .10

\* *p* < .05

\*\* *p* < .01

**APPENDIX B:  
POISSON REGRESSION RESULTS FOR COLLECTION 1 OF STUDY 1**

Table 2 Poisson Regression Results for Collection 1 of Study 1

	Poisson		Tobit	
	Coefficient	SE	Coefficient	SE
Constant	1.36**	(.10)	5.64**	(.78)
Heuristic Manipulation	-.321*	(.15)	-1.99*	(.97)
Log likelihood	109.40		-91.53	
Likelihood-ratio chi-square	4.70*			

Unstandardized estimates are reported ( $n = 55$ ).

\*  $p < 0.05$

\*\*  $p < 0.01$

**APPENDIX C:  
BOOTSTRAPPING ANALYSES RESULTS FOR COLLECTION 1 OF  
STUDY 1**

Table 3 Bootstrapping Analyses Result for Collection 1 of Study 1

Predictor and Statistic	Dependent Variable: Information Collected		Dependent Variable: Opportunity Recognition Belief	
	Coefficient	SE	Coefficient	SE
Path A				
Heuristic Manipulation	-1.07*	(.48)		
Path B				
Amount of Information Collected			.17*	(.08)
Path C'				
Heuristic Manipulation			-.33	(.28)
R <sup>2</sup>				.14*
F				4.13
	Effect	SE	95% LL	95% UP
Amount of Information Collected Indirect Effect (a*b)	-18.*	.28	-.49	-.0005

*n* = 55. Bootstrap sample size = 10,000. LL = lower limit of confidence interval; UL = upper limit of confidence interval; SE = standard error.

\**p* < .05

\*\**p* < .01

**APPENDIX D:  
REGRESSION RESULTS FOR COLLECTION 2 OF STUDY 1**

Table 4 Regression Results for Collection 2 of Study 1

	Coefficient	SE
Constant	3.01**	(.18)
Information Manipulation	.211**	(.06)
R <sup>2</sup>	.06**	

Unstandardized estimates are reported ( $n = 202$ ).

\*  $p < 0.05$

\*\*  $p < 0.01$

**APPENDIX E:  
ALTERNATIVE REGRESSION ANALYSIS RESULTS FOR  
COLLECTION 1 OF STUDY 1**

Table 5 Alternative Regression Analysis Results for Collection 1 of Study 1

	Coefficient	SE
Constant	1.22**	(.14)
Heuristic Manipulation	-.458*	(.19)
R <sup>2</sup>	.10*	

Unstandardized estimates are reported ( $n = 55$ ).

\*  $p < 0.05$

\*\*  $p < 0.01$

**APPENDIX F:  
BOOTSTRAPPING ANALYSES RESULTS FOR STUDY 2**

Table 6 Bootstrapping Analyses Result for Study 2

Predictor and Statistic	Dependent Variable: Information Collected		Dependent Variable: Opportunity Recognition Belief	
	Coefficient	SE	Coefficient	SE
Path A				
Heuristic Manipulation	.074	(.36)		
Path B				
Amount of Information Collected			.12*	(.05)
Path C				
Heuristic Manipulation			-.32†	(.18)
R <sup>2</sup>				
F				
	<i>ab</i>	SE	LLCI	ULCI
Indirect Effects	.01	.05	-.0841	.1042
Conditional Indirect Effects				
Need for Cognition				
Low (-1 SD)	-.018	.06	-.1401	.0958
Mean	.030	.04	-.0508	.1284
High (+1 SD)	.077	.07	-.0401	.2381
Entrepreneurial Alertness				
Low (-1 SD)	-.008	.06	-.1278	.1306
Mean	.013	.05	-.0738	.1150
High (+1 SD)	.034	.07	-.0926	.1857

Note.  $n = 106$ . Unstandardized regression coefficients are reported. *ab* = bootstrapped indirect effect. LL = lower level. UL = upper level. CI = 95% confidence interval. Bootstrap sample size = 10,000.

†  $p < .10$

\*  $p < .05$

\*\*  $p < .01$

**APPENDIX G:  
MEANS, STANDARD DEVIATIONS, RELIABILITIES AND  
CORRELATIONS FOR THE POST HOC SAMPLE**

Table 7 Means, Standard Deviations, Reliabilities and Correlations for the Post Hoc Sample

			1	2	3	4	5	6
1. Betrayal Heuristic	.47	.50						
2. Amount of Information	3.03	1.87	-.08					
3. Opportunity Recognition	3.51	1.00	-.18*	.31** (.88)				
4. Need for Cognition	3.59	.64	-.10	.21**	-.06 (.87)			
5. Entrepreneurial Alertness	3.96	.57	-.03	.05	.27**	.48** (.88)		
6. Cognitive Reflections	.39	.40	-.07	.10	-.03	.32**	.17* (.77)	
7. Entrepreneur	.70	.46	-.00	-.2**	-.10	.18**	.21**	.24**

$n = 171$ . For the Betrayal Heuristic Manipulation 0=no betrayal and 1 = betrayal, Entrepreneur 0=non-entrepreneur and 1= entrepreneur  
Alpha reliabilities appear in parentheses.

†  $p < .10$

\*  $p < .05$

\*\*  $p < .01$

**APPENDIX H:  
POST HOC ANOVA RESULTS FOR BEING AN ENTREPRENEUR ON  
REFLECTIVE OUTCOMES**

Table 8 Post Hoc ANOVA Results for Being an Entrepreneur on Reflective Outcomes

Outcome	Non-Entrepreneur		Entrepreneur		<i>F</i>	$\eta^2$
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		
Entrepreneurial Alertness	3.77	.60	4.03	.55	7.687**	.04
The Need for Cognition	3.41	.68	3.72	.62	5.619*	.04
Cognitive Reflections Test	0.24	.38	0.45	.39	10.129**	.06

\* $p < .05$

\*\* $p < .01$

**APPENDIX I:  
BOOTSTRAPPING ANALYSES RESULTS FOR THE POST HOC  
ANALYSIS**

Table 9 Bootstrapping Analyses Result for the Post Hoc Analysis

	<i>ab</i>	<i>SE</i>	95% LLCI	95% ULCI	90% LLCI	90% ULCI
Indirect effects	.05	.05	-.1465	.0574	-.1284	.0280
Conditional indirect effects						
Entrepreneur						
Non-Entrepreneur	-.137	.09	-.3277	.0153	-.2901	-.0070
Entrepreneur	-.007	.06	-.1179	.1027	-.0971	.0842
Need for Cognition						
Low (-1 SD)	-.029	.06	-.1606	.0939	-.1367	.0708
Mean	-.030	.04	-.1262	.0526	-.1065	.0391
High (+1 SD)	-.031	.06	-.1701	.0892	-.1408	.0710
Entrepreneurial Alertness						
Low (-1 SD)	-.077	.06	-.2081	.0392	-.1886	.0213
Mean	-.043	.05	-.1400	.0421	-.1209	.0287
High (+1 SD)	.008	.07	-.1389	.1237	-.1150	.1001
Cognitive Reflections Test						
Low (-1 SD)	-.108	.07	-.2651	.0136	-.2339	-.0038
Mean	-.041	.05	-.1463	.0506	-.1251	.0343
High (+1 SD)	.027	.07	-.1023	.1717	-.0789	.1438

Note. *n* = 171. Unstandardized regression coefficients are reported. *ab* = bootstrapped indirect effect. LL = lower level. UL = upper level. CI = 90% & 95% confidence interval. Bootstrap sample size = 10,000.

**APPENDIX J:  
FIGURE 1: CONCEPTUAL MODEL**

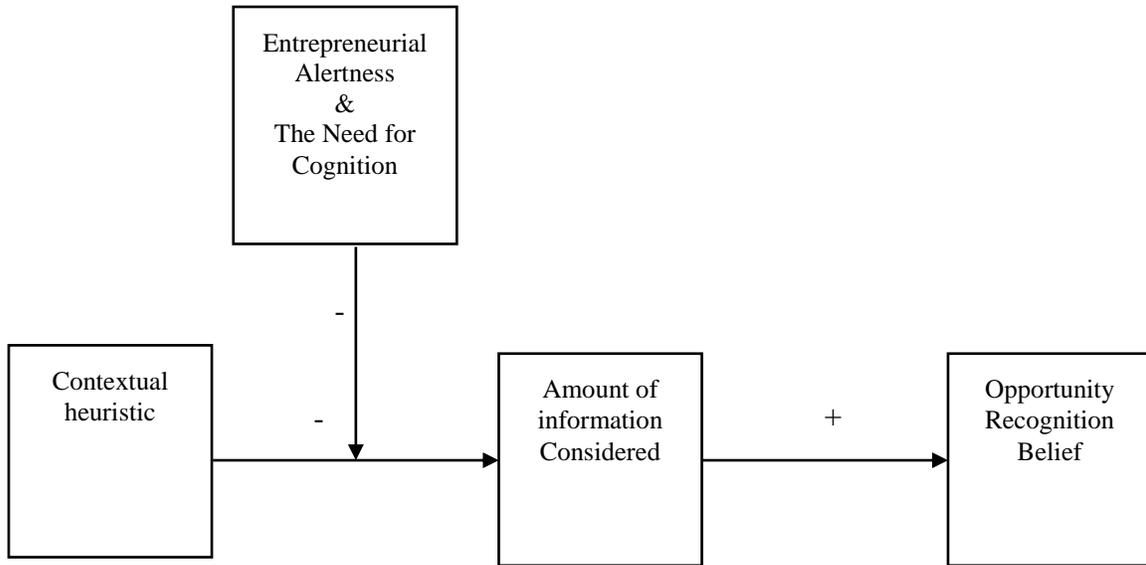


Figure 1 Conceptual Model

**APPENDIX K:  
FIGURE 2: DISTRIBUTION OF MODERATING AND DEPENDENT  
VARIABLE FOR COLLECTION 1 OF STUDY 1**

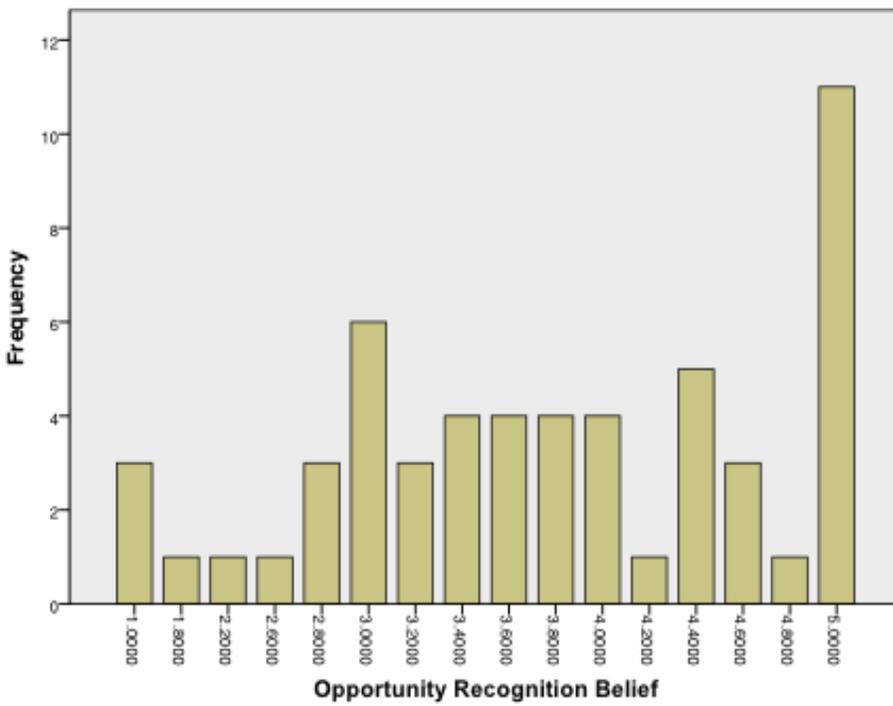
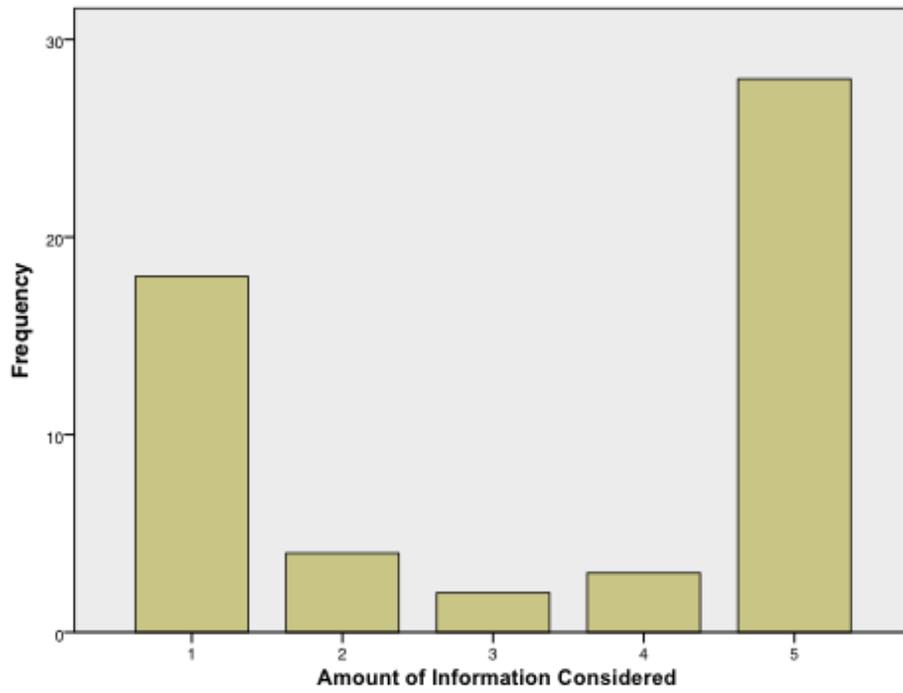


Figure 2 Distribution of Moderating and Dependent Variable for Collection 1 of Study 1

**APPENDIX L:  
FIGURE 3: DISTRIBUTION OF DEPENDENT VARIABLE FOR  
COLLECTION 2 OF STUDY 1**

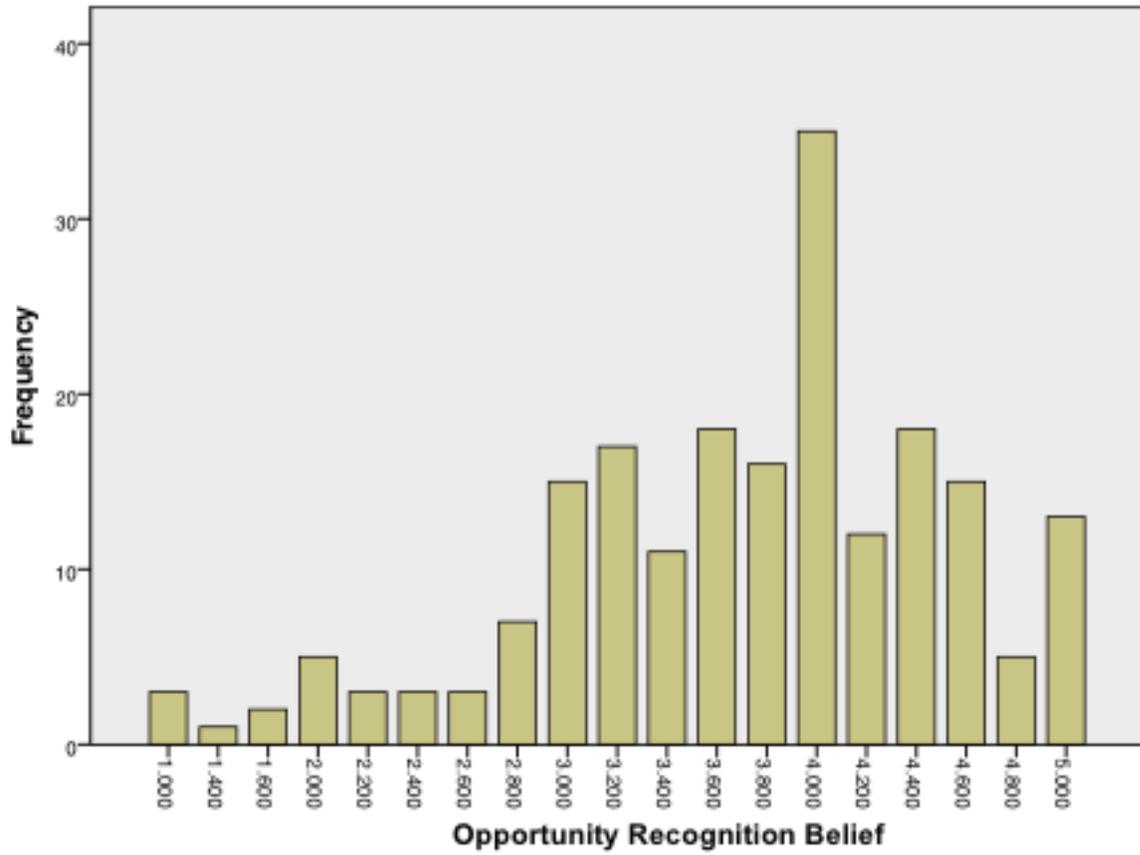


Figure 3 Distribution of Dependent Variable for Collection 2 of Study 1

**APPENDIX M:  
FIGURE 4: DISTRIBUTION OF MODERATING AND DEPENDENT  
VARIABLE FOR STUDY 2**

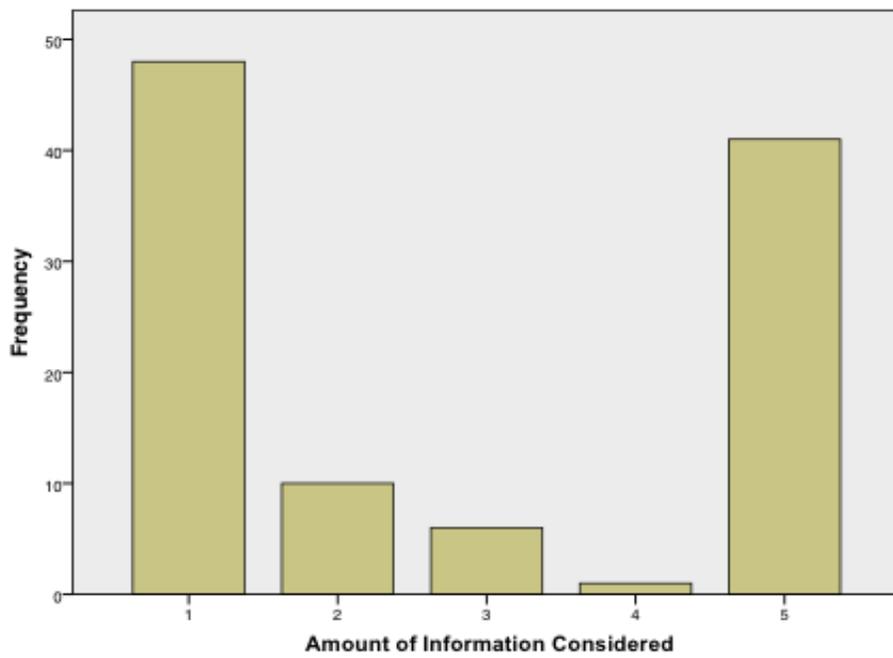
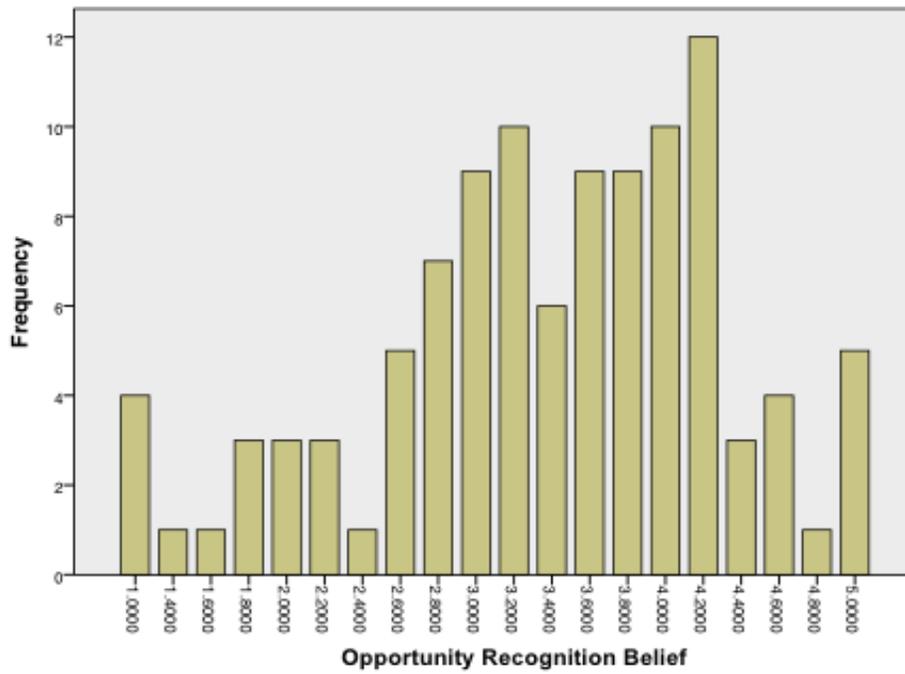
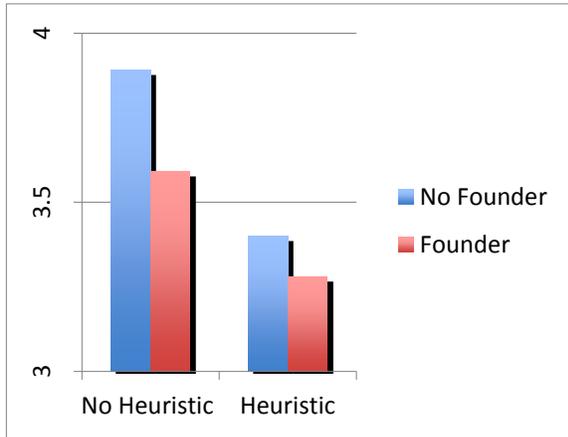


Figure 4 Distribution of Moderating and Dependent Variable for Study 2

**APPENDIX N:**  
**FIGURE 5: MEAN COMPARISON OF FOUNDER AND NON-FOUNDER**  
**ON RECOGNITION/INFORMATION COLLECTED**

Opportunity Recognition



Information Collected

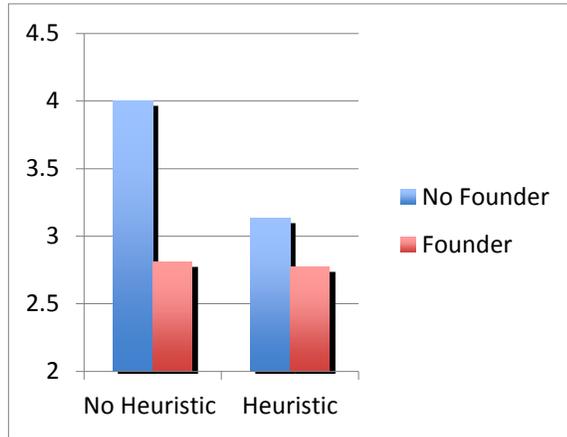


Figure 5 Mean comparison of founder and non-founders on recognition/information collected.

## **APPENDIX O: BIAS-CAUSING HEURISTICS**

Type of Heuristic	Definition	Example(s)
Availability Heuristic	When one estimate of probabilities or frequencies is based on the ease to which something comes to mind (Tversky & Kahneman, 1973).	<ul style="list-style-type: none"> <li>• People overestimate the possibility of deaths due to dramatic events such as tornadoes (Sutherland, 2007).</li> <li>• Managers' reactions to HR procedures are based on the availability of their experiences with the HR system (Taylor, Masterson, Renard, &amp; Tracy 1998).</li> <li>• Managers base performance appraisals on more vivid or recent acts (Bazerman &amp; Moore, 2012).</li> <li>• Managers base perceptions of environmental uncertainty on the availability heuristic (Ireland, Hitt, Bettis, Porras, &amp; Auld, 1987).</li> <li>• Participants estimate the frequency of seven- letter words with the sixth letter "n" to be lower than the frequency of seven-letter words ending in "ing" (Tversky &amp; Kahneman, 1983).</li> </ul>
Representativeness Heuristic	When one estimates probabilities about something because it is very similar to a prototype of that category (Kahneman & Tversky, 1974).	<ul style="list-style-type: none"> <li>• Patients ignore base rates and believe that a positive result for a test that is 99% accurate at diagnosing a disease that only occurs in 1 out of 10,000 people in the population means that there is a 99% chance that they have the disease when there is really only a 1% chance that they have the disease (Axelsson, 2000).</li> <li>• Entrepreneurs ignoring base rates of business failure in difficult markets (Moore, Oesch, &amp; Zietsma, 2007).</li> <li>• Individuals are insensitive to the sample size when determining how likely it would be for the percentage of male births on any given day to differ from the mean percentage of male births in a small hospital</li> </ul>

		<p>where there are few births each day compared to a large hospital where there are many (Tversky &amp; Kahneman, 1974).</p> <ul style="list-style-type: none"> <li>• Individuals expect sequences of random events to appear random and as such judge the likelihood of a sequence of events such as coin flips that appear to be less likely (e.g., people judge coin flip pattern 1 (HTHTHT) as less likely than pattern 2 (HTHHHT) (Kahneman &amp; Tversky, 1972).</li> <li>• Based on the conjunction fallacy, individuals assume that the probability of multiple conditions is more likely than the probability of one of those conditions (see my discussion of the Linda problem) (Tversky &amp; Kahneman, 1983).</li> </ul>
Confirmation Heuristic	The tendency to seek and interpret information that supports an individual's belief or expectation (Nickerson, 1998).	<ul style="list-style-type: none"> <li>• (Confirmation Trap) Individuals with conservative political views tend to seek out conservative pundits, such as Sean Hannity, and individuals with liberal political views tend to seek out liberal pundits such as Bill Maher (Bazerman &amp; Moore, 2012).</li> <li>• (Confirmation Trap) When given information about the effectiveness/ineffectiveness of the death penalty deterring crime, those who supported the death penalty found information suggesting that it was effective to be credible and found reasons to disregard the information suggesting it was ineffective. Whereas the opposite happened for people that did not support the use of a death penalty (Lord, Ross, &amp; Lepper, 1979).</li> <li>• (Anchoring) Randomly generated numbers affecting</li> </ul>

		<p>individuals' estimates of the number of African countries belonging to the UN (Kahneman &amp; Tversky, 1974).</p> <ul style="list-style-type: none"> <li>• (Anchoring) Positive first impressions by an interviewer leading to an interview behavior more likely to confirm that belief (e.g. selling of the company during the interview, collecting less information from the applicant) (Dougherty, Turban, &amp; Callender, 1994).</li> <li>• (Hindsight) Believing that one would correctly assess the outcome of a battle that they were (truthfully or falsely) told an outcome of, if they had not known the outcome. Results showed that no matter what outcome (the true or false outcome) people were told, they believed that was the outcome they would have picked had they not been told any information (Fischhoff, 1975).</li> </ul>
Affect Heuristic	Relying on one's affective state when making a judgment (Finucane, Alhakami, Slovic, & Johnson, 2000).	<ul style="list-style-type: none"> <li>• A CIO of a large financial firm investing tens of millions of dollars in a company because he liked the firm (Kahneman, 2011).</li> <li>• Attractive entrepreneurs and their ideas being rated more favorably due to an increase in affect of the evaluator (Baron, Markman, &amp; Bollinger, 2006).</li> </ul>
Outrage Heuristic	When determining punishment, people consider the outrageousness of a crime (Kahneman & Frederick, 2002).	<ul style="list-style-type: none"> <li>• People punish legally identical crimes differently (e.g., the robbery of a child being punished more than the robbery of an adult) (Shah &amp; Oppenheimer, 2008).</li> </ul>
Betrayal Heuristic	In making judgments one punishes and does not reward betrayals of trust	<ul style="list-style-type: none"> <li>• Choosing not to purchase the overall safer of two cars because the safer car is equipped with an air bag (i.e.,</li> </ul>

	(Sunstein, 2005).	<p>a safety device) that betrays the people it is supposed to protect and causes death (Koehler &amp; Gershoff, 2003).</p> <ul style="list-style-type: none"> <li>• Choosing to punish identical crimes differently when they betray a trust (e.g., a bank robbery by a bank security guard being punished more than a bank robbery by a taxi cab driver) (Koehler &amp; Gershoff 2003).</li> </ul>
Effort Heuristic	When quality judgments are based on the evaluators' perception of the amount of effort that was put into creating the thing being evaluated (Kruger, Wirtz, Van Boven, & Altermatt, 2004).	<ul style="list-style-type: none"> <li>• Rating the same painting as being of higher quality because it took more time to create (Kruger et al., 2004).</li> </ul>
Scarcity Heuristic	When things are valued based on how easily they are to obtain (or lost) (Cialdini, 1988).	<ul style="list-style-type: none"> <li>• People finding a new appreciation for life after a near death experience (King, Hicks, &amp; Abdelkhalik, 2009).</li> <li>• Job candidates believing that jobs with fewer openings paid a higher wage than jobs with more openings (Highhouse, Beadle, Gallo, &amp; Miller, 1998).</li> </ul>
Simulation Heuristic	When the ease to which one can create a mental construction of an imagined reality determines how likely they believe it is to happen (Kahneman & Tversky, 1982).	<ul style="list-style-type: none"> <li>• The more easily patients could picture a negative event, the more likely they believed that event was going to happen to them (Raune, MacLeod, &amp; Holmes, 2005).</li> <li>• The ease to which one could imagine a weather disaster related to how likely they believe it is that disaster would occur (Greening, Dollinger, &amp; Pitz, 1996).</li> </ul>

## **APPENDIX P: HEURISTICS IN ENTREPRENEURSHIP**

Cite	Theoretical/ Empirical	Heuristic/s	Relevant findings/propositions
Baron, R. A. (1998)	Theoretical	Affect heuristic Self-serving bias Planning fallacy	<ul style="list-style-type: none"> <li>• Entrepreneurs may be more susceptible to the affect heuristic which can lead to serious errors in judgment.</li> <li>• Entrepreneurs may be more susceptible to the self-serving bias that can lead to overconfidence and interpersonal friction. Successful entrepreneurs, however, may be less susceptible to the self-serving bias than less successful entrepreneurs.</li> <li>• Entrepreneurs may be more susceptible to the planning fallacy that can lead to unrealistic timetables.</li> </ul>
Baron, R. A. (2004)	Theoretical	Styles of cognitive processing	<ul style="list-style-type: none"> <li>• Entrepreneurs may be prone to using heuristic type processing.</li> <li>• Successful entrepreneurs may be particularly able to switch from their heuristic based processing system to their slower cognitive process and such have particularly effective heuristics.</li> <li>• Successful entrepreneurs may be less susceptible to biases that lead to poor decisions than less successful entrepreneurs.</li> </ul>
Baron, R. A. (2006)	Theoretical	Prototype heuristic	<ul style="list-style-type: none"> <li>• Prototypes may allow entrepreneurs to</li> </ul>

			see patterns in what seem to be unrelated things and such may be beneficial in regard to recognizing opportunities.
Baron, R. A., & Ensley, M. D. (2006)	Empirical	Prototype heuristic	<ul style="list-style-type: none"> <li>Experienced entrepreneurs have more clearly defined mental prototypes of opportunities than less experienced entrepreneurs. Further, experienced entrepreneurs' mental prototypes are richer in context and focus more on realizing financial gain than less experienced entrepreneurs.</li> </ul>
Baron, R. A., & Ward, T. B. (2004)	Theoretical	Styles of cognitive processing	<ul style="list-style-type: none"> <li>Entrepreneurs are not immune from cognitive biases.</li> <li>Entrepreneurs' preference for heuristic based thinking and their ability to switch back and forth between their fast and slow cognitive processing system should be explored.</li> </ul>
Burmeister, K., & Schade, C. (2007).	Empirical	Status quo heuristic	<ul style="list-style-type: none"> <li>Entrepreneurs were no more biased than other groups. Specifically, entrepreneurs were equally as biased by the status quo heuristic as students but less affected by the status quo heuristic than bankers.</li> </ul>
Busenitz, L. W. (1999)	Empirical	Representativeness Overconfidence	<ul style="list-style-type: none"> <li>Entrepreneurs were found to be more likely to use the representativeness heuristic and be more overconfident than managers in large organizations.</li> </ul>

			<ul style="list-style-type: none"> <li>• These results suggest that entrepreneurs deal with risky situations in a different way than managers.</li> </ul>
Busenitz, L. W., & Barney, J. B. (1997)	Empirical	Representativeness Overconfidence	<ul style="list-style-type: none"> <li>• Entrepreneurs were found to be more likely to use the representativeness heuristic and be more overconfident than managers in large organizations.</li> <li>• Individuals most susceptible to heuristics may be the type of people who are most likely to become entrepreneurs.</li> </ul>
Cooper, A. C., Woo, C. Y., & Dunkelberg, W. C. (1988)	Empirical	Overconfidence	<ul style="list-style-type: none"> <li>• Both well-prepared and poorly prepared entrepreneurs were found to be overconfident when considering the potential for success of their business.</li> </ul>
Forbes, D. P. (2005).	Empirical	Overconfidence	<ul style="list-style-type: none"> <li>• Different types of entrepreneurs display different degrees of overconfidence.</li> <li>• New venture founder-managers were found to be more overconfident than new venture non-founder managers.</li> <li>• Younger entrepreneurs were found to be more overconfident than older entrepreneurs.</li> <li>• Entrepreneurs in smaller and younger ventures were found to be more overconfident than entrepreneurs in larger and older ventures.</li> </ul>
Shepherd, D. A., Haynie, J. M.,	Theoretical	Confirmatory search strategy	<ul style="list-style-type: none"> <li>• Confirmatory search strategy may be a</li> </ul>

& McMullen, J. S. (2012).			useful heuristic for entrepreneurs when considering opportunities.
Simon, M., Houghton, S. M., & Aquino, K. (2000).	Empirical	Overconfidence Illusion of control Belief in small numbers	<ul style="list-style-type: none"> <li>• MBA students who scored more highly in the illusion of control or the belief in small numbers perceived less risk regarding a potential venture and such were more willing to pursue it.</li> </ul>
Ucbasaran, D., Westhead, P., & Wright, M. (2009).	Empirical	Heuristics and information search	<ul style="list-style-type: none"> <li>• The use of heuristics may lead entrepreneurs to consider less information regarding opportunities which allows them to consider more opportunities in a given time period. This assertion was not supported.</li> </ul>
Zahra, S. A., Korri, J. S., & Yu, J. (2005)	Theoretical	Heuristics and international opportunity recognition	<ul style="list-style-type: none"> <li>• Past experience may enable entrepreneurs to develop heuristics that allow them to understand situations quickly. This may explain why entrepreneurs consider some venture ideas and ignore others in international markets.</li> </ul>

## **APPENDIX Q: MANIPULATION USED IN COLLECTION 2 OF STUDY 1**

Low Information Condition	High Information Condition
<p>Researchers at a large university created low-temperature oxidation catalyst filters to convert carbon monoxide to nontoxic carbon dioxide. The inventors of this technology did not want to personally pursue business opportunities because they are purely scientists. This technology is now part of a university's technology transfer program that makes the technology available for a licensing deal with a new or existing firm. One possible market that researchers suggested this technology could be applied to is the fire safety and protection market through a personal rescue hood. The university technology transfer office has done some research related to the application of the technology to this market. We are asking <b><u>you as a potential entrepreneur</u></b> to evaluate this potential opportunity. On the next page we provide you with the executive summary about the opportunity. <b><u>Please carefully consider all of the information provided.</u></b></p>	
<p style="text-align: center;"><b>Executive Summary</b></p> <p><b><u>General Information:</u></b> There is a 5% chance that homeowners in a serious fire will be killed due to smoke inhalation. Scientific tests indicate, however, that there is only a 1.5% chance of death due to smoke inhalation when a personal rescue hood is used. The rescue hood, however, could also cause minor side effects such as a temporary rash.</p> <p><b><u>Risk Analysis:</u></b> State and Federal law is clear that manufacturers, producers, distributors and retailers of fire safety equipment are not legally culpable for death or injures when the overall effect of the safety equipment results in a decrease in death from fire. That is, if a customer is injured or dies from using a fire safety hood they can not sue.</p>	<p style="text-align: center;"><b>Executive Summary</b></p> <p><b><u>General Information:</u></b> There is a 5% chance that homeowners in a serious fire will be killed due to smoke inhalation. Scientific tests indicate, however, that there is only a 1.5% chance of death due to smoke inhalation when a personal rescue hood is used. The rescue hood, however, could also cause minor side effects such as a temporary rash.</p> <p><b><u>Risk Analysis:</u></b> State and Federal law is clear that manufacturers, producers, distributors and retailers of fire safety equipment are not legally culpable for death or injures when the overall effect of the safety equipment results in a decrease in death from fire. That is, if a customer is injured or dies from using a fire safety hood they can not sue.</p> <p><b><u>Distribution:</u></b> This type of product could be used during emergencies at home, work, and school, as well as for professional firefighting and rescue efforts. The home fire safety market was responsible for over 6 billion dollars in revenue last year alone.</p> <p><b><u>Market Validation:</u></b> Preliminary market research has shown that homeowners are overwhelmingly interested in a product like this. Specifically, a poll of 5,000 consumers showed 90 percent would be interested in purchasing this type of product at \$40 per hood.</p>

## **APPENDIX R: BOTH MANIPULATIONS**

Manipulation used in Study 1 and Study 2	Earlier Manipulation Used in pretest
<b>No Betrayal Condition</b>	
<p>There is a 5% chance that homeowners in a serious fire will be killed due to smoke inhalation. Scientific tests indicate, however, that there is only a 1.5% chance of death due to smoke inhalation when a personal rescue hood is used. The rescue hood, however, could also cause minor side effects such as a temporary rash.</p>	<p>Smoke inhalation from noxious products of fire combustion is the number one cause of death related to home and work fires. A personal rescue hood, incorporating a filtration system that utilizes a low-temperature oxidation catalyst, would reduce smoke inhalation death by 10%. The hood, however, could also cause minor side effects such as a temporary rash.</p>
<b>Betrayal Condition</b>	
<p>There is a 5% chance that homeowners in a serious fire will be killed due to smoke inhalation. Scientific tests indicate, however, that there is only a 1% chance of death due to smoke inhalation when a personal rescue hood is used. The rescue hood, however, may also kill some homeowners. Specifically, some rescue hood users may die due to hood suffocation caused by the hood itself. Tests indicate that there is an additional one chance in 200 (0.5%) that someone who is in a serious fire, who uses the rescue hood, will be killed due to hood suffocation.</p>	<p>Smoke inhalation from noxious products of fire combustion is the number one cause of death related to home and work fires. A personal rescue hood, incorporating a filtration system that utilizes a low-temperature oxidation catalyst, would reduce smoke inhalation death by 20%. The hood, however, would also kill, due to suffocation from the hood itself, one half (50%) of the people who would have otherwise died from smoke inhalation.</p>

## **APPENDIX S: RATIONALITY MANIPULATION**

Researchers at a large university created low-temperature oxidation catalyst filters to convert carbon monoxide to nontoxic carbon dioxide. This technology is now part of a university's technology transfer program that makes the technology available for a licensing deal with a new or existing firm. One possible market that researchers suggested this technology could be applied to is the fire safety and protection market through a personal protection hood. The university technology transfer office has created two prototype personal protection hoods (Hood A and Hood B). They are identical in regard to cost, price, production time and so on. Please consider the below and which prototype Hood A or Hood B you would be more interested in licensing as a potential entrepreneur.

Statistics indicate that there is a 5% chance that homeowners in a serious fire will be killed due to smoke inhalation. Scientific tests indicate that there is only a 2% chance that homeowners that use Hood A in a serious fire will be killed due to smoke inhalation from the fire. These tests also indicate that there is only a 1% chance that homeowners that use Hood B in a serious fire will die due to smoke inhalation. However, Hood B may kill homeowners who would not have died if they were using Hood A. Specifically, some Hood B users may die due to hood suffocation caused by the hood itself. Tests indicate that there is an additional one chance in 200 (0.5%) that someone who is in a serious fire who uses Hood B will be killed due to hood suffocation.

## **APPENDIX T: COGNITIVE REFLECTIONS TEST QUESTIONS**

1. A bat and a ball cost \$1.10 in total. The bat costs \$1.00 more than the ball. How much does the ball cost? \_\_\_\_Cents
2. If it takes 5 machines 5 minutes to make 5 widgets, how long would it take 100 machines to make 100 widgets? \_\_\_\_Minutes
3. In a lake, there is a patch of lily pads. Every day, the patch doubles in size. If it takes 48 days for the patch to cover the entire lake, how long would it take for the patch to cover half of the lake? \_\_\_\_days

**APPENDIX U: IRB APPROVAL LETTER**



University of Central Florida Institutional Review Board  
Office of Research & Commercialization  
12201 Research Parkway, Suite 501  
Orlando, Florida 32826-3246  
Telephone: 407-823-2901 or 407-882-2276  
[www.research.ucf.edu/compliance/irb.html](http://www.research.ucf.edu/compliance/irb.html)

### Approval of Exempt Human Research

From: **UCF Institutional Review Board #1  
FWA00000351, IRB00001138**

To: **Chaim R. Letwin and Co-PIs: Cameron M. Ford, Robert G. Folger**

Date: **February 27, 2014**

Dear Researcher:

On 2/27/2014, the IRB approved the following activity as human participant research that is exempt from regulation:

Type of Review: Exempt Determination  
Project Title: Thinking fast and missing the opportunity: An investigation into cognitive processing style and opportunity recognition belief.  
Investigator: Chaim R Letwin  
IRB Number: SBE-14-10101  
Funding Agency:  
Grant Title:  
Research ID: N/A

This determination applies only to the activities described in the IRB submission and does not apply should any changes be made. If changes are made and there are questions about whether these changes affect the exempt status of the human research, please contact the IRB. When you have completed your research, please submit a Study Closure request in iRIS so that IRB records will be accurate.

In the conduct of this research, you are responsible to follow the requirements of the Investigator Manual.

On behalf of Sophia Dziegielewski, Ph.D., L.C.S.W., UCF IRB Chair, this letter is signed by:

Signature applied by Joanne Muratori on 02/27/2014 09:41:42 AM EST

IRB Coordinator

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<sup>i</sup> It is notable that authors such as Gerd Gigerenzer and Ralph Hertwig have criticized the Linda problem based on its wording, however, similar results have been found in many follow-up studies including collaborations between Kahneman and Hertwig (Mellers, B., Hertwig, R., & Kahneman, D., 2001).

<sup>ii</sup> I fully concede that from a default-interventionist perspective, errors could also occur because the analytical system affirms an inaccurate judgment by the heuristic system or even because the analytical system overrides a correct judgment by the heuristic system. I only suggest errors are most likely when the analytical system does not intervene to correct a heuristic-based error

<sup>iii</sup> An alternative way to test Hypothesis 1 would be to use the log of the amount of information considered as the dependent variable in a standard regression (Delmar & Shane 2006). Thus, I also followed this procedure, which further supported my predictions in Hypothesis 1. Specifically, regression analyses revealed a negative relationship between the reliance on a cognitive heuristic (the betrayal condition) and the log of the amount of information considered ( $\beta = -.458, p < .05, \Delta R^2 = .10^*$ ). Results are presented in Table 5

<sup>iv</sup> A major limitation of collection 1 of Study 1 is the sample size ( $n = 55$ ). It should be noted, however, that these findings were replicated, using a 90% bootstrapped confidence interval, using the earlier version of the manipulation provided in Appendix M with a sample of 270 student and non-student participants.