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## ENTREPRENEURS AND PERCEPTIONS OF COMPOUND RISK: MODERATING EFFECTS OF EFFICACY AND CONTROL BELIEFS

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## **Abstract**

Based on the aggregated insights of the existing theories related to multiple sources of efficacy and locus of control, we introduce the theory of mixed control, a model of compound-risk perception. This theory considers outcome expectancies as being composed of expectancies regarding three distinct sources of risk (self, others, and chance). This reflects that entrepreneurship is a complex and dynamic activity, involving multiple sources of risk. Beliefs about the efficacy of these elements are weighted by the degree to which these elements are perceived to control the outcome. The interaction of efficacy and control beliefs is therefore at the core of our theory. Further, we discuss that risks are not only subjectively perceived but can be endogenous and depend on future decisions and actions of the entrepreneur.

**KEYWORDS:** compound-risk perception, theory of mixed control

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### **ABSTRACT**

Based on the aggregated insights of the existing theories related to multiple sources of efficacy and locus of control, we introduce the theory of mixed control, a model of compound-risk perception. This theory considers outcome expectancies as being composed of expectancies regarding three distinct sources of risk (self, others, and chance). This reflects that entrepreneurship is a complex and dynamic activity, involving multiple sources of risk. Beliefs about the efficacy of these elements are weighted by the degree to which these elements are perceived to control the outcome. The interaction of efficacy and control beliefs is therefore at the core of our theory. Further, we discuss that risks are not only subjectively perceived but can be endogenous and depend on future decisions and actions of the entrepreneur.

### **INTRODUCTION**

Entrepreneurship involves the establishment of new organizations and the development of new economic activities which are rife with risk and uncertainty. Those who engage in such activities have been considered as being willing to take on more risk and uncertainty than others. Empirical work, however, has demonstrated that entrepreneurs are not willing to take more risks than non-entrepreneurs (Busenitz & Barney, 1997; Miner & Raju, 2004; Palich & Bagby, 1995; Wu & Knott, 2006). Therefore, a corresponding difference in general risk propensity hypothesis is not supported by research findings. Alternatively, a difference in risk perception hypothesis has been suggested. In other words, even if entrepreneurs and non-entrepreneurs have similar risk preferences, entrepreneurs may perceive less risk by overestimating their chances for success (Baron, 1998). Differences in risk perception, or how an individual perceives patterns of odds and probabilities, has been of particular interest to economists dealing with economic decisions under risk and uncertainty (Bernardo & Welch, 2001; Felton, Gibson, & Sanbonmatsu, 2003; Puri & Robinson, 2007; Weber & Milliman, 1997; Wu & Knott, 2006) as well as management scholars examining entrepreneurial decision-making and entrepreneurs' positively-biased perceptions of their venture's risk (Baron, 1998, 2004; Busenitz & Barney, 1997; Forlani & Mullins, 2000; Keh, Foo, & Lim, 2002; Norton & Moore, 2006; Simon, Houghton, & Aquino, 2000).

#### **Risk Perceptions, Self-Efficacy and Internal Locus of Control**

The perception of risk and, thus, expectancies about the outcomes of an entrepreneurial activity, depend on various other expectancies, including the probabilistic estimates of outcomes and the controllability of outcome attainment (Sitkin & Pablo, 1992; Sitkin & Weingart, 1995). In particular, Miller (2007) describes how the outcomes of types of entrepreneurial processes (e.g., opportunity recognition, opportunity discovery and opportunity creation) are dependent on contingencies that can be unpredictable, unknowable, and uncontrollable. Bandura (1997) suggests a simpler model based on social cognitive theory, in which outcome expectancies depend on two

major elements that subsume Miller's three dimensions: self-efficacy, the belief of whether or not one is able to put required actions into practice, and locus of control, the belief of whether or not one's outcomes depend mainly on one's own actions or on factors not under one's control.

Empirical studies in the area of entrepreneurship provide initial justification for the inclusion of both self efficacy and locus of control in our model of risk perception. Regarding self-efficacy, Krueger and Dickson (1994) report that business executives that show greater self-efficacy will perceive opportunities and threats differently and will take more risks. Likewise, Simon, Houghton, and Aquino (2000) demonstrate for students and Keh et al. (2002) demonstrate for entrepreneurs that the evaluation of a business opportunity depends on control beliefs. While self-efficacy (Gatewood, Shaver, & Gartner, 1995; Gatewood, Shaver, Powers, & Gartner, 2002; Krueger & Dickson, 1994) and locus of control (Keh, et al., 2002; Simon, et al., 2000) have been investigated separately in entrepreneurship research, their joint effects have not. Further, other sources of efficacy and control have likewise received little or no attention.

### **From a Single to a Multi-Dimensional Model**

Tversky and Kahneman (1992) list five empirical major phenomena that descriptive theories of decision making should deal with: framing effects, nonlinear preferences, source dependence, risk seeking, and loss aversion. It is interesting to note that of the five, only source dependence has not been incorporated into decision-making theories (compare, for example, Steel & König, 2006). Source dependency describes the fact that the evaluation of risk and uncertainty might depend on the source, which could be a through of a dice or a task that one has to solve based on the own competence. In fact, different combinations of sources of risk could explain why different people perceive the total risk differently. For example, entrepreneurship researchers including Busenitz and Barney (1997) and Janney & Dess (2006) have proposed that one reason why entrepreneurs and managers of large firms perceive risk differently is "that entrepreneurs face a different composition of risks than their non-entrepreneurial counterparts" (Janney & Dess, 2006: 387).

This empirical need to develop a more comprehensive model of risk perception that takes into account source dependency is demonstrated by research into the additional impact of efficacy beliefs regarding factors external to the individual (Gist & Mitchell, 1992; Wu & Knott, 2006), as well as efficacy beliefs regarding specific external factors including collective efficacy (DeTienne, Shepherd, & De Castro, 2008; Shepherd & Krueger, 2002) and belief in good luck (Day & Maltby, 2005). For example, in their study of banking market entry decisions, Wu and Knott (2006) are two of the first researchers to demonstrate that both one's own abilities and one's expectancies regarding external factors (in their case, market volatility) affect risk taking differently.

Similar to efficacy, external sources of control beliefs should also be addressed in a more comprehensive model of compound risk perception. The examples for efficacy beliefs mentioned in the paragraph above (i.e. internal vs. external and collective vs. luck) parallel Levenson's (1974, 1981) work on social activists, which proposes that external locus of control should distinguish between powerful others and chance. Further, Bandura's (1997) work on self-efficacy was strongly influenced by earlier work on control beliefs by Rotter (1966). Rotter (1966) discusses the role of beliefs about whether or not the reasons for success and failure are internal or external to a person, i.e. an internal or external locus of control. However, based on the analysis of socio-political activists (a form of social entrepreneur), Levenson (1974, 1981) and Levenson and Miller (1976) argue that one needs to distinguish external drivers of outcomes with respect to chance and powerful others. This is a critical distinction, as powerful others can be influenced by social action but chance cannot. Therefore, coping with powerful others differs from coping with bad-luck.

### The Theory of Mixed Control

In this paper, we follow Krueger's (2003) call for more theory-based research on entrepreneurial cognition and contribute by developing a model of compound-risk perception. Based on the aggregated insights of the existing theories related to multiple sources of efficacy and locus of control, we introduce the theory of mixed control, a theory developed by Urbig and Monsen (2009) that incorporates, both, efficacy beliefs and control beliefs to explain outcome expectancies and thus perceptions of risk. While both constructs have been anticipated in research on entrepreneurship, recent results reported in psychological research on the interaction of both constructs have not received attention by entrepreneurship research. Furthermore, self-efficacy has been frequently investigated in the entrepreneurial context, but beliefs regarding the efficacy of external factors of success are only beginning to receive attention from researchers.

The interaction of efficacy and control beliefs as well as a corresponding integration of beliefs regarding one's own efficacy and the efficacy of external factors is at the core of the theory of mixed control. This theory considers outcome expectancies as being composed of expectancies regarding three distinct sources of risk (self, others, and chance). Beliefs about the efficacy of these elements are weighted by the degree to which these elements are perceived to control the outcome. This reflects one important empirical observation that deviates from traditional decision theories: Entrepreneurship is a complex activity, involving multiple sources of risk. The second part of this paper deals with this multidimensionality. The paper concludes with a discussion of contributions of the theory of mixed control for more robust decision research.

### Distinctions and Definitions

In this paper three distinctions are vital: unconditional versus conditional expectancies, preference versus perception, and single- versus multi-dimensional conceptualizations of sources of risk.

Expectancies regarding an event describe beliefs of the likelihood of the occurrence of an event. Unconditional expectancies are related to a single event or a set of independent events (e.g.,  $P[A]$  and  $P[O]$ ). Both efficacy beliefs, the expectancy that a particular antecedent or source  $A$  will be helpful or useful (e.g.,  $e_A \approx P[A]$ ), positive outcome expectancy, the expectancy that a particular positive outcome  $O$  will occur (e.g.,  $\pi \approx P[O]$ ), and perceived risk, the expectancy that a particular positive outcome will not occur (i.e.  $\rho = 1 - \pi$ ) are considered unconditional expectancies. For example, in the entrepreneurship literature, risk has been defined as the probability or likelihood of a downside loss or upside gain from the pursuit of an opportunity (compare, Janney & Dess, 2006). In contrast, when defining locus of control, Rotter (1966) refers to the conditional expectancy that an event (e.g., outcome  $O$ ) happens given that another event (e.g., behavioral antecedent  $A$ ) occurs. An event is considered to "control" another event if the occurrence of the first event affects the likelihood of the second event. We therefore refer to the expectancy that both events are linked by a causal relation (e.g.,  $c_A \approx P[O|A]$ ) as control beliefs. This is reflected later in this paper in our theory of mixed control and model of compound-risk perception, in which "unconditional" perceived risk  $\rho$  is one minus positive outcome expectancy  $\pi$ , which is the sum of the products of multiple source-dependent "unconditional" efficacy beliefs and "conditional" control beliefs:

$$\rho = 1 - \pi = 1 - \sum_A e_A c_A \quad (1)$$

The second distinction to be made is between preference and perception. Whereas perceived risk reflects the expectancy or probability of an outcome, risk preference reflects the shape of the utility function for a series of related risky choices (Weber & Milliman, 1997). Kahneman and Tversky (1979) emphasize this point by distinguishing overweighing reflecting a preference from

overestimating reflecting a biased perception. Perceptions of risk and the sources of risk may not only affect the evaluation of businesses opportunities. Entrepreneurs may also have specific preferences regarding the both the level of risk they are willing to assume and the sources of that risk (Janney & Dess, 2006; Miller, 2007; Monsen, Patzelt, & Saxton, in press), which can moderate the impact of risk perceptions on decision making (Pablo, Sitkin, & Jemison, 1996). These can lead to counterintuitive results, which the core perception-only model in this paper does not address. For example, given that many entrepreneurs have a taste for variety (Astebro & Thompson, 2007), they may choose to take a risk in an area which they are low on efficacy, but do so with the confidence that they will quickly learn what they need to know. Furthermore, given that many entrepreneurs have a need for autonomy and control (Cromie, 1987; Kuratko, Hornsby, & Naffziger, 1997; Monsen, Saxton, & Patzelt, 2007), entrepreneurs may give more weight to control than non-entrepreneurs in evaluating opportunities. Before we address the role of risk preferences on decision-making, however, we need to better understand and have a better core model of how those risks are perceived, independent of preferences. Therefore, in this paper, we focus on risk perception and only consider the effects of control and efficacy beliefs on outcome expectancies.

The third distinction is between single- and multi-dimensional conceptualizations of sources of risk. Traditional research on self-efficacy and internal locus-of-control can be considered single-dimensional, in that it focuses on the individual self. However, entrepreneurial productivity (Parker, 2006) and persistence (DeTienne, et al., 2008) is affected by both entrepreneurial ability and market forces, thus, more dimensions should be considered. For example, Gist and Mitchell (1992) propose that self-efficacy is determined by both internal and external factors. Of particular interest for this paper, Gist and Mitchell propose that external factors can be attributed, factors “under the control of others” (1992: 196) and “luck-oriented factors” (1992: 197). Regarding dependence on others, recent research on entrepreneurship has identified collective efficacy as an important construct for explaining entrepreneurial intentions (Shepherd & Krueger, 2002) and persistence (DeTienne, et al., 2008). Furthermore, in a three-dimensional conceptualization of locus of control developed for research into social activists, Levenson (1974, 1981) introduces not only powerful others but also chance as an additional driver of outcomes (see also Bonnett & Furnham, 1991; Furnham, 1986). Closing the theoretical circle, Bandura (2001) outlines in a recent review article on social cognitive theory multiple sources of agency, including personal, proxy, collective, and fortune. All in all, this suggests that an individual’s perception of risk is not only driven by personal efficacy and control beliefs, but also by their beliefs of whether other people or chance rules the world and how these may help or hinder one’s success.

### **Roadmap for Paper**

Given the multidisciplinary nature of entrepreneurship research and its connection with disciplines as distinct as psychological and economic research, our discussion will follow two parallel and intertwined paths. First, we briefly review the current theoretical and empirical literature on efficacy, control, and risk perception and develop in a step-by-step manner our theory of mixed control. In parallel, to make our theory more precise and testable, we develop a corresponding mathematical formulation of our compound-risk perception function.

## **STATIC THEORY OF MIXED CONTROL**

The theory of mixed control considers risk perception as a process and perceived risk, i.e. outcome expectancies, as the dependent variable. The theory describes how people’s overall perceived risk regarding desired or undesired outcomes are influenced by other more specific expectancies regarding the efficacy and control of three generic sources: self, others, and chance. Grounded in a review of the current theoretical and empirical literature on efficacy, control, and

risk perception, we develop our theory of mixed control in a step-by-step manner. Beginning with established research on the independent effects of self-efficacy and internal locus-of-control on risk perception, we then apply recent ideas and research on the interaction of self-efficacy and control beliefs to extend our model. Next, we go beyond the single-dimension of the self and first add a general external source of efficacy, followed by a division between others and chance as independent external sources of control. At the close of section, we discuss how our compound-risk perception function can be used to augment current existing decision-making theories.

In parallel, in order to make our theory more precise and testable, we develop a corresponding mathematical formulation of our compound-risk perception function and theory of mixed control, it parallels the formalization by Urbig and Monsen (2009). Mathematical modeling is not uncommon in the field of entrepreneurship (Minniti & Bygrave, 2001; Parker, 2006) and provides a useful second language to precisely express the meaning of the text-based theory and to test its consistency and coherence (Lévesque, 2004). To begin, we consider the function  $f(\cdot)$  that maps a set of independent variables onto positive outcome expectancy  $\pi$  and perceived risk  $\rho = 1 - \pi$ . If, for instance, positive outcome expectancy  $\pi$  depends positively on self-efficacy  $e_s$  we will write that the function  $\pi=f(e_s)$  is characterized by  $\delta f(e_s)/\delta e_s > 0$ . While  $\pi$  represents the perceived expectancy of a specific outcome, the function  $f$  could be considered as the perceived production of risks associated with a specific outcome. We will exemplify the general mathematical model with a specific function  $\pi=f(e_s)$ , e.g.  $\pi=e_s$ .

### Independent Effects of Self-Efficacy and Control Beliefs

To begin, typical models for including control beliefs and self-efficacy into entrepreneurship decision-making (Keh, et al., 2002; Simon, et al., 2000) and intentions (Wilson, Kickul, & Marlino, 2007; Zhao, Seibert, & Hills, 2005) models consider only self-efficacy, only control (Gatewood, et al., 2002; Krueger & Dickson, 1994), or an independent combination in form of the theory of planned behavior (Krueger, Reilly, & Carsrud, 2000). For example, in a recent revision of the theory of planned behavior, Ajzen (2002) defines the construct of perceived behavioral control as reflecting beliefs about self-efficacy and beliefs about controllability. This raises the question of whether self-efficacy or locus-of-control matters more in risk taking. Using three carefully designed economic experiments, Goodie and Young (2007) found that while both control and efficacy affect risk-taking behavior, perceptions of control played the more dominant role in risk-taking decisions. Therefore, we initially consider self-efficacy  $e_s$  and control beliefs  $c_s$  as independent drivers of risk perception  $\rho=1-\pi$  and outcome expectancy  $\pi$  in our mathematical model as:

$$\begin{aligned} \pi=f(e_s, c_s) \text{ with} \\ (1) \delta f(e_s, c_s)/\delta e_s > 0 \text{ and } \delta f(e_s, c_s)/\delta c_s > 0 \\ \text{Example: } \pi = c_s + e_s \end{aligned} \quad (2)$$

### Interaction of Self-Efficacy and Control Beliefs

Since self-efficacy and control beliefs appear to have very similar effects and are often correlated, some consider self-efficacy and locus-of-control to be reflective of the same univariate core construct (Judge, Erez, Bono, & Thoresen, 2003) or the same multivariate construct (Spreitzer, 1995; Thomas & Velthouse, 1990). However, researchers in the areas of job stress as well as general decision making have demonstrated that self-efficacy and locus of control are distinct constructs and can have not only additive but also interactive effects. In research on job stress, Schaubroeck and Merritt (1997) not only found an interaction effect between perceptions of control and

self-efficacy, but also found that this interaction moderates the relationship of job demands and job stress, measured by blood pressure. Given that being an entrepreneur is stressful, ambiguous and uncertain (Monsen & Boss, 2009; Schindehutte, Morris, & Allen, 2006), we expect to see a similar interaction effect between beliefs of self-efficacy and control and the evaluation of risky opportunities (for example, Mullins & Forlani, 2005; Norton & Moore, 2006).

Sharpening this line of thought, we claim that the effect of self-efficacy on outcome expectancies and perceived risk is moderated by control beliefs (Bandura, 1997; Krueger, 2003). Bandura (1997) argues that the judgment about the likelihood of an outcome is based on two types of expectancies: self-efficacy beliefs describe the belief that one's effort will produce a required performance, while control beliefs describe the strength of the belief that the performance will cause a specific outcome. In Bandura's (1997) words: "Controllability affects the extent to which efficacy beliefs shape outcome expectancies" (Bandura, 1997: 23).

Bandura's (1997) idea that control beliefs affect the extent to which self-efficacy influence outcome expectancies can be generalized to the idea that control beliefs moderate the extent to which efficacy beliefs influence judgments of outcome probabilities and corresponding risk perceptions. The idea is that if outcomes cannot be controlled, i.e. external factor control the outcome, then beliefs about the efficacy of external factors, drive a person's risk perception. While management researchers have been talking conceptually about this moderating effect for some time (compare Gist, 1987; Gist & Mitchell, 1992), none to our knowledge have empirically tested this interaction hypothesis in the context of risk perception and entrepreneurial decision making. Krueger (2003: 114) similarly emphasizes that the "more internal the attribution of causality (e.g. skill or effort)" and the more "controllable" the situation, the stronger the impact of self-efficacy on initiating and persisting in entrepreneurial activity. In other words, a multiplicative model suggests that if one perceives zero self-efficacy (or zero internal locus-of-control), the outcome expectancy will be zero and the individual will perceive maximum risk, irrespective of the perceived internal locus-of-control (or self-efficacy).

Our mathematical model thus needs to be extended as follows. The general formalization now utilizes an additional level of derivatives and it requires that these derivatives are zero if the second variable is zero. An example of this is a simple multiplicative combination of self-efficacy and control beliefs. This model closely reflects the description provided by Bandura (1997).

$$\begin{aligned} &\pi=f(e_s,c_s) \text{ with} \\ &(1) \delta f(e_s,c_s)/\delta e_s \geq 0, \delta f(e_s,c_s)/\delta c_s \geq 0, \text{ and } \delta \delta f(e_s,c_s)/\delta c_s \delta e_s \geq 0 \\ &(2) \delta f(e_s,0)/\delta e_s = 0, \delta f(0,c_s)/\delta c_s = 0 \end{aligned}$$

Example:  $\pi = c_s e_s$  (3)

### Adding External Sources of Efficacy and Control

Bandura's (1997) work on self-efficacy was strongly influenced by earlier work on control beliefs by Rotter (1966). Rotter (1966) discusses the role of beliefs about whether or not the reasons for success and failure are located within a person or outside a person, i.e. an internal or external locus of control. Rotter (1966) conceptualized locus of control as uni-dimensional, such that a low internal locus of control is equivalent to a high external locus of control:

$$c_e = 1 - c_s \leftrightarrow c_s + c_e = 1 \tag{4}$$

There is however a missing element: external efficacy beliefs that matter if one has an external locus of control. While Gist and Mitchel (1992) were one of the first to propose the need to con-

sider both internal and external sources of efficacy, Judge, Locke, Durham (1997) are to our knowledge among the first to operationally define these external factors, labeling them 'external core evaluations'. However, Judge, Locke, Durham, & Kluger (1998), conclude that after controlling for core self-evaluations, which includes self-efficacy and internal locus-of-control, external core evaluations do not have a unique effect on job attitudes. In contrast, testing the effects of external efficacy beliefs on dispositional optimism, Urbig and Monsen (2009) found significant effects and report that external control beliefs moderate the influence of external efficacy beliefs.

The basic idea is that in such situations where external factors control one's outcomes, beliefs about external factors instead of beliefs about internal factors should determine one's outcome expectancies and perceived risk. This empirical need to develop a more comprehensive model of risk perception that takes into external sources is likewise demonstrated by research into the additional impact of efficacy beliefs regarding factors external to the individual (Wu & Knott, 2006). For example, in their study of market entry decisions for the US banking industry, Wu and Knott (2006) are two of the first researchers to demonstrate in the same study that both one's own abilities and one's expectancies regarding external factors (in their case, market volatility) affect risk taking.

For the mathematical formulation of our theory we thus have to add beliefs about the efficacy and control of external factors. We furthermore include that an increase in control beliefs regarding one factor, i.e. self or external, moderates the influence of the corresponding efficacy belief.

$$\begin{aligned} \pi &= f(e_s, c_s, e_e, c_e) \text{ with} \\ (1) \quad &c_s + c_e = 1 \\ (2) \quad &\delta f(e_s, c_s, e_s, c_s) / \delta e_x \geq 0, \text{ and } \delta \delta f(e_s, c_s, e_e, c_e) / \delta c_x \delta e_x \geq 0 \\ (3) \quad &\delta f(e_s, c_s, e_s, c_s) / \delta e_x = 0 \text{ if } c_x = 0 \\ \text{Example: } \pi &= c_s e_s + c_e e_e \text{ with } c_s + c_e = 1 \end{aligned} \quad (5)$$

This formula, where the outcome expectancy is a sum of efficacy beliefs which are weighted by the degree of control they have, can be transformed into the following form:

$$\text{Example: } \pi = (e_s + e_e) / 2 + (c_s - c_e)(e_s - e_e) / 2 \quad (6)$$

This formula demonstrates that the effect of differences in efficacy beliefs depends on the difference of internal (self) and external control beliefs. The first term, i.e. the average of self-efficacy and external efficacy beliefs, reflects the positive direct effect of efficacy beliefs on outcome expectancies. The second term describes that the effect of efficacy beliefs on outcome expectancies and perceived risk is moderated by the difference in control beliefs.

### **Distinguishing Between Others and Chance as External Sources of Efficacy and Control**

At this stage, where outcome expectancies are positively influenced by efficacy beliefs regarding internal as well as regarding external factors and where these effects are moderated by corresponding control beliefs, we have finished the developed of the basic version of the theory of mixed control. There is, however, one extension that is useful and necessary to remain consistent with existing literature, i.e. external factors need to be differentiated with respect to other people and chance. For example, Gist & Mitchell (1992: 193) discuss external factors such as "group interdependence" (others) and "distractions such as noise" (chance). Bandura (2001) similarly talks about multiple sources of agency, including personal, proxy, collective, and fortune. To distinguish between the efficacy (or expected helpfulness) of other people and the efficacy (or expected helpfulness) of good luck, we introduce the more precise terms: other efficacy and chance efficacy

plus other control and chance control.

Not only has literature already suggested distinguishing efficacy beliefs with respect to other people and chance, but there is also an older stream of literature suggesting differentiating external control with respect to others and chance. Specifically, based on analyses of socio-political activists (a form of social entrepreneur), Levenson (1974, 1981) and Levenson and Miller (1976) argue that one needs to distinguish external drivers of outcomes with respect to chance (natural environment) and powerful others (social environment). This idea of distinguishing between powerful others and chance are later applied to the economic (Furnham, 1986) and entrepreneurship education context (Bonnett & Furnham, 1991). At the heart of this is a critical distinction is the idea that powerful others can be influenced by social action but chance cannot. Therefore, coping with dependency on powerful others differs substantially from coping with bad-luck. For example, the accumulation and leveraging of social capital is one strategy to address the former and the application of a real options approach is one strategy to address the latter (Janney & Dess, 2006).

Regarding other efficacy and other control, recent research on entrepreneurship has identified collective efficacy as an important construct for explaining entrepreneurial intentions (Shepherd & Krueger, 2002) and persistence (DeTienne, et al., 2008). Collective efficacy refers to beliefs about whether or not a group of people is able to implement required actions to succeed, and thus incorporates self-efficacy and efficacy beliefs regarding other people. In addition to collective efficacy as a source of agency, Bandura (1997, 2001) additionally talks about proxy control. Proxy control refers to the internalization of external control through social networking. Proxy control is therefore a socially mediated control, where a person convinces another person with influence to exert this influence to the benefit of the person out of direct control. In this paper we introduce the concept of other efficacy and control, which separates the self from the collective and respectfully refers to the likelihood that others will help the individual and degree of control others can exert regarding attainment of the desired outcome. For extra clarity, it should be noted that Bandura (1997, 2001) (see also, Fernández-Ballesteros, Díez-Nicolás, Caprara, Barbaranelli, & Bandura, 2002), as well as DeTienne et al (2008) and Krueger and Shepherd (2002), define collective-efficacy as a group's shared belief in its capabilities to organize and execute required actions to produce a given level of attainment. In contrast, we consider an individual's own beliefs and perceptions about the efficacy and control of others (compare, Schaubroeck, Lam, & Jia Lin, 2000).

Moving forward, external efficacy and control beliefs do not only comprise beliefs about other people but also beliefs about nature, fortune and chance. If not other people help, it might still be fate or luck that makes things happen. While literature on collective efficacy refers to the first, entrepreneurship literature and general psychology research has rarely and inconsistently investigated beliefs in good luck (Day & Maltby, 2005; see also the discussion in Urbig & Monsen, 2009), despite the important role good luck, fortune, and random chance always play both in entrepreneurship (Minniti & Bygrave, 2001) and in life (Bandura, 1982, 1998, 2001).

At first the term chance efficacy might sound strange, however, it has been used to describe beliefs of jazz artists in the popular press who practiced an artistic technique called aleatory or aleatoricism (Henahan, 1988: 36). Jazz has been used as a metaphor for improvisation and creativity in the management (Crossan, Cunha, Vera, & Cunha, 2005) and in the entrepreneurship literatures (Hmieleski & Corbett, 2008). Jazz is a particularly relevant metaphor for our theory of mixed control, as jazz combines individual (self) and group (other) skills and abilities with the chance of the moment (Crossan, et al., 2005: 140). Therefore, based on our review of research on sources of external efficacy and control beliefs, we conclude that it is appropriate to distinguish at least three dimensions of control: self, others, and chance. Our formal model is thus enhanced as follows:

$\pi=f(e_s, c_s, e_o, c_o, e_c, c_c)$  with

$$(1) c_s + c_o + c_c = 1$$

$$(2) \delta f(e_s, c_s, e_o, c_o, e_c, c_c) / \delta e_x \geq 0, \text{ and } \delta \delta f(e_s, c_s, e_o, c_o, e_c, c_c) / \delta c_x \delta e_x \geq 0$$

$$(3) \delta f(e_s, c_s, e_o, c_o, e_c, c_c) / \delta e_x = 0 \text{ if } c_x = 0$$

$$\text{Example: } \pi = c_s e_s + c_o e_o + c_c e_c \text{ with } c_s + c_o + c_c = 1 \quad (7)$$

Similar to the transformation from Equation 5 into 6, where only internal and external dimensions were considered, we can perform the same transformation for the three-dimensional version.

$$\begin{aligned} \text{Example: } \pi &= (e_s + e_o) / 2 + (c_s - c_c)(e_s - e_o) / 2 + (c_o - c_c)(e_o - e_c) / 2 \\ \text{with } e_e &= (e_o + e_c) / 2 \text{ and } c_e = (c_o + c_c) \end{aligned} \quad (8)$$

Comparing the two- with the three-dimensional example of the outcome expectancy function, only the third term is new. We thus have a formal representation where the different models, starting from self-only models, to inter-versus-external models, to three-dimensional models are nested into each other. One can thus use the three-dimensional model and explicitly test whether or not splitting of the external factors is statistically significant in a particular context or not.

### An Alternative Full-Multiplicative or Production Function Model

Up to this point, we have simply added together the terms representing the three sources of risk perception (i.e., self, other, chance). One potential limitation of this functional form is that a zero-level expectancy regarding one source does not result in corresponding zero-level expectancy for the overall outcome. In other words, expectations associated with different sources are independent of one another, an assumption that could lead to positively-biased predictions of outcome expectancies and correspondingly negatively-biased predictions of perceived risk. An alternative, multiplicative variation of our TMC theory assumes that source-specific risks are not independent. This implies that that a zero-level expectancy regarding one source results in corresponding zero-level expectancy for the overall outcome, independent of the other sources. A Cobb-Douglas-style function, a form commonly used in the economics literature to represent economic production and growth (Cobb & Douglas, 1928), can represent this variation of the model:

$$\pi = f(c_s, c_o, c_c, e_s, e_o, e_c) = e_s^{c_s} e_o^{c_o} e_c^{c_c} \quad (9)$$

### Augmenting Current Decision-Making Theories

Our model of the joint effects of efficacy and control can be used not only to predict risk perception, but it can also be used to augment decision making models and theories which are based on subjective probabilities. These models include but are not limited to expected utility theory (Schoemaker, 1982), prospect theory (Kahneman & Tversky, 1979), security-potential/aspiration theory (Lopes, 1987; Lopes & Oden, 1999), and cumulative prospect theory (Tversky & Kahneman, 1992).

Expected utility theory, as reviewed by Schoemaker (1982), states that people maximize the sum of the utilities (as opposed to absolute monetary gains) associated with outcomes weighed by the probabilities of the occurrence of these outcomes. Later empirical work has revealed that people do not weight utilities with the exact probabilities, but that they attach a decision weight that is a monotonic but never the less a nonlinear function of probabilities, e.g. overweighing of small and underweighing of large probabilities (e.g., Prospect Theory by Kahneman & Tversky, 1979).

While those early theories assumed that people hold precise beliefs about the probability of occurrence of an event, later theories relaxed this assumption and integrate uncertainty which implies that people do not need to have precise probability judgments, for example, Cumulative Prospect Theory (Tversky & Kahneman, 1992).

While recent empirical work suggests that the decision weights associated with various outcomes of a behavior may depend on whether or not one can influence the outcome (e.g., Heath & Tversky, 1991; Kilka & Weber, 2001), recent descriptive theories do not incorporate these findings. Building on the suggestion of Kilka and Weber (2001) that control beliefs and self-efficacy might influence the decision weighting in prospect theory, our production of perceived risk function based on the theory of mixed control provides a unified framework to explain how these beliefs interact. We thus provide a rationale for Goodie and Young (2007) finding that sometimes self-efficacy and sometimes control beliefs are more relevant. Furthermore, by replacing the single variable for subjective probability (risk or expectancy) in the respective model with our multivariate function for the risk perception, the yet unresolved issue of source dependence raised by Tversky and Kahneman (1992) and discussed earlier in this paper is resolved. Moreover, the issue of source dependence is resolved within the context of established decision making theories and without having to design and validate a risky new decision making theory.

The functional form of the subjectively perceived risk can for instance be embedded into Cumulative Prospect Theory (CPT) (Tversky & Kahneman, 1992) by replacing the argument of the probability weighing function with the risk production function suggested above. The source dependency is then combined with those characteristic captured by the CPT, e.g. the underweighting of small probabilities of extreme events. We believe that such models are a promising path for future research and will be better able to measure and predict entrepreneurs' risk-taking behavior in situations that are more complex and driven by multiple sources of risk (Mullins & Forlani, 2005; Norton & Moore, 2006; Simon, et al., 2000; Wu & Knott, 2006), instead of the simpler examples of single-risk-source situations, such as flipping coins or strategizing against opponents (Bernardo & Welch, 2001; Camerer & Lovallo, 1999; Forlani & Mullins, 2000)

## CONCLUSIONS

As we have outlined in this paper, existing decision theories cannot account for the typical characteristics of entrepreneurial decisions (multiple sources of risk, partial control, and endogenous risk). Our Theory of Mixed Control and compound risk-perception framework make two key contributions. First, we explicitly combine efficacy and control beliefs into a formal model of risk perception and account for the moderating effect of control on the relationship between efficacy and expected outcomes. Second, we show that the three-dimensionality of self, others, and chance should not only be incorporated into control beliefs, but also into efficacy beliefs. Control beliefs describe the extent to which different sources of risk affect outcomes and efficacy beliefs describe the expectations associated with these sources. In summary, our framework can explain more heterogeneity in entrepreneurial behavior than previous models and can therefore be applied in research and practice to better understand, improve, and increase the entrepreneurial performance of individuals and organizations.

Beyond these two explicit contributions, our paper provides theoretical and empirical support for other model and theories of entrepreneurship. For example, our model complements the alertness model of opportunity recognition from Gaglio (1997) (see also, Gaglio & Katz, 2001), which proposes that entrepreneurs need to alert to opportunities, have necessary skills (i.e. efficacy), and be able to extract a gain (i.e. control). In the mythical example related by Brännback and Carsrud

(2008: 69), this system includes not only the Thor, the entrepreneur or self, but also Jormungander, the government official or powerful other. Our model, however, would suggest that Brännback and Carsrud should also consider adding Loki, a mischievous Norse deity, and the Norns, the Norse demi-goddesses of destiny, to their Nordic tale of entrepreneurship.

There is, of course, room for future research. For example, Monsen and Urbig (2009) augment our static view with a dynamic perspective and explain how risk-perceptions can dynamically change over time and contexts, depending on the evolution of efficacy and control beliefs. That said, our theory of mixed control is only one among other building blocks of a theory of entrepreneurial decision-making. The question for antecedents of those control and efficacy beliefs that form the core of the theory of mixed control as well as the question how the perceived risk finally affects an entrepreneurial decision need to be addressed in much more detail. For instance, Harper (1998) argues that 4 factors within the institutional framework influence control beliefs: constitutional rules (political, legal, and economic system), operating rules (nature of economic policies), normative rules (cultural and social attitudes and norms), and characteristics of the family and educational environment during the development phase in an individual's life.

To empirically test the theory, adequate measures have to be developed. It is well-established that task-specific measures of self-efficacy (Bandura, 1997) and locus of control (Furnham, 1986; Spector, 1988) are more reliable than general measures in specific outcomes. Therefore, general measures of efficacy and control beliefs, such as, those used by Urbig (2008) and Urbig and Monsen (2009) in testing the theory of mixed control in a general context, need to be refined for more reliable use in the entrepreneurship context. In entrepreneurship research, there exist reliable measures of entrepreneurial efficacy beliefs (see, for example, Baum, Locke, & Smith, 2001; Chen, Greene, & Gene Crick, 1998; De Noble, Jung, & Ehrlich, 1999; Forbes, 2005), however, a corresponding set of measures for entrepreneurial control beliefs has not yet attained a correspondingly broad degree of acceptance (see, for example, Bonnett & Furnham, 1991). Future research should therefore focus on the development and integrated testing of multi-dimensional efficacy and control belief measures that are more specific to the context and activities of entrepreneurship.

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