

Are perseverance and self-efficacy costless? Assessing entrepreneurs' regretful thinking

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Summary

New business formation is a formidable and daunting task, which may require personal perseverance and self-efficacy. If this is indeed the case, will entrepreneurs and non-entrepreneurs differ on such attributes? Also, if high levels of perseverance and self-efficacy help entrepreneurs to overcome setbacks, snags, and obstacles, do these positive attributes co-occur with significant personal costs, such as the tendency to experience regretful thinking? This study uses a random sample of 217 patent inventors in the medical industry (surgery devices) to address these questions. Results indicate that entrepreneurs score significantly higher on self-efficacy and on two distinct aspects of perseverance—perceived control over adversity and perceived responsibility regarding outcome of adversity—than did non-entrepreneurs. Also, although entrepreneurs report the same number of regrets, their regrets are stronger and are qualitatively different from those reported by non-entrepreneurs. These findings suggest that perseverance and self-efficacy do indeed co-occur with regretful thinking. Finally, post hoc analysis reveals that the higher the overall perseverance scores of patent inventors, the higher their annual earnings. We conclude by examining the implications for theory, researcher, and practice. Copyright © 2005 John Wiley & Sons, Ltd.

Introduction

Shane and Venkataraman (2000) suggest that addressing why, when, and how some people and not others discover and exploit opportunities is a vital question in entrepreneurship research. For instance, Shane (2000) found that individuals from diverse technological backgrounds who assess the same technological invention recognize and then develop very different business opportunities. Sarasvathy, Simon, and Lave (1998) used verbal protocols to illustrate that entrepreneurs process information differently from bankers. Additional evidence suggests that entrepreneurs gather significantly less information, utilize less formal techniques to analyze problems, and follow less rational decision processes than managers do (Busenitz & Barney, 1997). Studying several biases, such as the *illusion of*

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control and the *law of small numbers* (Simon, Houghton, & Aquino, 2000), found that entrepreneurs fail to realize that certain tasks are beyond their control. To address environmental uncertainty, entrepreneurs rely on personal and external information whereas managers rely more heavily on internal and impersonal information (McGee & Sawyerr, 2003). Recent evidence also confirms that cognitive scripts explain not only similarities in decision-making among entrepreneurs across cultures but also behavioral differences between entrepreneurs and non-entrepreneurs within countries (Mitchell, Smith, Seawright, & Morse, 2000).

Although brief, the foregoing review suggests that recent research on individual differences has contributed substantially to our understanding of entrepreneurs. Notwithstanding such contributions, to advance theory and understanding of human variability in entrepreneurship contexts additional, finer-grain questions are being raised. One overlooked question is whether individual differences that are useful in entrepreneurship contexts are associated or co-occur with inadvertent personal 'costs.' For example, because the nature of entrepreneurial activity is characterized by long hours, heavy workload, and financial risk, it is likely that entrepreneurs exhibit substantially higher endurance and tenacity than non-entrepreneurs. While endurance and tenacity are valuable attributes, it is unclear whether such dedication to a venture also correlates with some unintended negative consequences. Put as a research question, are invaluable personal attributes—such as perseverance and self-efficacy—related to some personal costs, such as increased regrets or disappointments?

In addition to the desire to address this question, this study is also seeking to illustrate how a more stringent sample-selection methodology may be used in field research to distinguish between entrepreneurs and non-entrepreneurs. Paying attention to selection issues in entrepreneurship is important precisely because it is an overlooked practice that can yield inconsistent or even biased findings. For example, owing to the aura surrounding economic growth and success, many entrepreneurship studies share a common bias of over-selecting successful participants (McGrath, 1999). Another issue is that despite the importance of discovery and innovation, few studies that focus on individual differences control for participants' inventive capacity. Finally, a broader problem is the tendency to rely on convenience, usually overly heterogeneous, non-random samples of entrepreneurs who work in highly diverse and unrelated industries (Busenitz & Barney, 1997). Obviously, 'overly' convenient samples, absence of adequate controls, and inconsistent findings hinder theory development.

Hence, this study seeks to look at individual differences between entrepreneurs and non-entrepreneurs, to address the question of 'adverse co-occurrence,' and to illustrate how some of the methodological limitations mentioned above might be resolved. To this end, we rely on a random sample of 217 patent inventors who invent in the same technical area (surgery devices) to assess three attributes that appear to be particularly salient in entrepreneurship contexts. These include perseverance—perceived ability to overcome adverse circumstances (Stoltz, 1997); self-efficacy—the belief in one's ability to perform certain tasks successfully (Bandura, 1997); and regretful thinking—remorse about outcomes different from the ones hoped for (Baron, 2000). Investigating two positive attributes and one negative is important because of the link to the theoretical question mentioned earlier. That is, perseverance helps entrepreneurs to maintain a high staying power and to overcome snags and setbacks in their business (Brockner & Guare, 1983; McGrath, 1999) and self-efficacy strengthens their conviction that they can succeed (Bandura, 1997). However, perseverance and strong self-belief, or the commitment and obligations a business harnesses, imply that entrepreneurs might be forced to make considerable compromises, perhaps in other areas of their lives, and thus experience high levels of regretful thinking. As shown in the theory section, we deduce that when entrepreneurs exhibit higher levels of perseverance, self-efficacy, and regretful thinking (than non-entrepreneurs do), then this co-occurrence is an initial indicator that positive attributes might come with a 'cost,' in this case, regretful thinking.

Theory and Hypotheses

Perseverance

The concept of perseverance is not new (Clark, 1935), but most research on this topic has focused on cognitions—on how beliefs, thoughts, and attitudes persist in light of new information—and paid little attention to behavioral persistence such as action or work performance. More recently, Eisenberger (1992), Eisenberger, Kuhlman, and Cotterell (1992), and Eisenberger and Leonard (1980) have extended this line of work to the domain of work persistence. For example, the phenomenon of learned industriousness (Eisenberger, 1992) occurs when high effort on one task transfers to other contexts. High effort also reduces disruptive responses such as frustration, blame, and anger produced by early failure, and thus leads to greater subsequent tenacity and persistence (Eisenberger & Leonard, 1980). Like Eisenberger (1992), we define perseverance as one's tendency to persist and endure in the face of adversity. We propose that because individuals react differently to similar adversities, success, particularly in entrepreneurship contexts, is determined by the extent to which individuals persevere despite what appear to be insurmountable obstacles, or adversities (Stoltz, 1997).

Perseverance influences individuals' courses of action, the level of effort they put forth while pursuing their endeavors, the length of their endurance and their resilience in the face of setbacks and repeated failures (cf. Eisenberger & Leonard, 1980). Perseverance also influences how much stress individuals can endure while they cope with setbacks, and the level of accomplishments they eventually realize (Bandura, 1997). For instance, perseverant people discover ways to circumvent constraints or change them by their actions, whereas less resilient people are easily discouraged by impediments and unexpected challenges (Bandura, 1997; Eisenberger et al., 1992). Again, a corollary of this is that perseverance may be crucial for one's success in entrepreneurial settings, which are notoriously challenging (Baron & Shane, 2004).

Because starting a new venture is a daunting task (Aldrich, 1999), launching a new venture may require a high level of conviction in one's ability to overcome challenges. This proposition, however, raises an important theoretical question: What specific types of perseverance will be most salient in entrepreneurship contexts? Although the answer to this question depends on many factors, including the various situations entrepreneurs face, a careful review of the literature indicates that two constructs appear to be particularly relevant (Baum, Frese, & Baron, in press; Stoltz, 1997). These are perceived control over adversity and perceived responsibility of or accountability for the outcome of adversity. Next we derive predictions concerning these two types of perseverance.

Perceived control over adversity

People strive to control events that affect their life circumstances because doing so provides innumerable personal, financial, and social benefits (Lam & Schaubroeck, 2000). Being able to control events fosters adaptive preparedness, whereas inability to exert influence over adversity breeds apprehension, apathy, and at times desperation (Bandura, 1986). Because actions are based more on what is perceived than on what might be objectively true, control is an important precursor to one's level of motivation and actions. Specific perceived control over adversity is a major driver for action because people who believe they can attain certain outcomes have incentives to act (Bandura, 1997). Perceived control over adversity—which is the focus of this theory—should not be confused with the broad 'locus of control' construct; the former refers to a sense of control *specifically* over adverse circumstances (Stoltz, 1997) whereas the latter is an overall measure of one's sense of influence over one's own fate generally (Bandura, 1997). Perceived control over adversity influences one's course of action, effort, length of perseverance and resilience specifically in contexts of obstacles, hardship, or failures.

In short, perceived control over adversity influences what individuals do and become and their motivation and commitment to act in the face of clear impediments (Stoltz, 1997).

Theory and practice agree that when confronting setbacks, perseverant individuals intensify their effort and test new actions, whereas those who are less perseverant quickly give up (Bandura, 1997; Cervone, 1989). The development of new technologies as a basis for new components or end products is the outcome of intense work conducted by determined, self-disciplined individuals (cf. McGrath, 1995). Research with patent inventors confirms that a key challenge is to persevere while repeatedly troubleshooting vexing technological obstacles (Shane, 2000). Since launching a new venture entails both technological and business obstacles, we reason that entrepreneurs—as compared with non-entrepreneurs—would have stronger perceived control over their adversity. That is, discovering new technologies is certainly a challenging task, but launching a business based on such discoveries requires even additional tenacity and a stronger sense of control. Entrepreneurs must not only convert their new technological discoveries into working prototypes but also transform them into rent-yielding products and services. To be sure, it is likely that many inventors perceive some level of control over adversity related to their work, but we expect entrepreneurs to perceive even stronger control over adversity because the survival and longevity of their venture hinge on their perseverance and determination to convert their new technology into a business. Hence the following hypothesis:

Hypothesis 1: Entrepreneurs will show a higher level of perceived capacity to control adversity than non-entrepreneurs.

Perceived responsibility for adversity's outcomes

Perceived responsibility is the extent to which a person is accountable for the outcomes that occur under adverse circumstances (Stoltz, 1997). It also captures the extent to which individuals hold themselves accountable for improving their situation. Taking responsibility is important because when performance is deemed inferior due to lack of effort (rather than ability), a causal antecedent is set in motion whereby deploying additional effort enhances future performance. Indeed, responsible individuals focus on actions and outcomes they can take to circumvent setbacks or to overcome adverse circumstance (Stoltz, 1997). In short, regardless of who caused dire outcomes, a strong sense of responsibility 'mobilizes' individuals to commit into action and to rectify unfavorable outcomes (Peeters & Czapinski, 1990). In the context of this study, however, the question is whether entrepreneurs perceive a stronger sense of responsibility over adverse outcomes than do non-entrepreneurs.

Several rationales suggest that the answer to this question is 'yes.' First, though inventors may work equally hard to make new discoveries, their sense of responsibility may vary based on their level of ownership. Indeed, agency theory suggests that owners are more committed to and accountable for producing commercial outcomes than their agents (Deckop, Mangel, & Cirka, 1999). A corollary of this is that because entrepreneurs own both the business and the invention—they are more vested than non-entrepreneurs—they will experience a stronger sense of responsibility and accountability for their work.

Second, scholars explain that avoiding responsibility is an adaptive reaction aiming to reduce risk of failure (Schlenker, 1997; Schlenker, Pontari, & Christopher, 2001). Avoiding responsibility minimizes negative repercussions, including reduced negative affect (e.g., anger), damaged reputation, exposure to failures, and financial perils. Although failure is rarely intentional, individuals vary greatly in the way they *see* failure, and thus their tendency to take responsibility (Schlenker, Pontari, & Christopher, 2001). As founding a venture is notoriously difficult—a large majority of young businesses fail (Aldrich, 1999; *The State of Small Business: A Report to the President*, 1995)—a sense of responsibility and attitudes towards failure influence one's likelihood of launching new ventures.

Finally, the scope of work that entrepreneurs and non-entrepreneurs perform is highly asymmetrical. In contrast to non-entrepreneurs, entrepreneurs work with more diverse and interdependent stakeholders and they are responsible for deliverables and functions that may be beyond their control. The cross-functional nature of launching a new venture diverges from the more routinized work common in domains in which non-entrepreneurs work. The open-ended vocation and the uncertain nature of new-venture creation suggest that entrepreneurs probably hold themselves responsible for adversity they face, regardless of its origin. On the other hand, because employees have a 'job' or 'position' (rather than a firm and employees), they are probably more likely to shirk from assuming full responsibility for predicaments that are clearly not their doing. This reasoning is summarized by the following hypothesis:

Hypothesis 2: Entrepreneurs will perceive a higher level of responsibility for adverse circumstances than non-entrepreneurs.

Self-efficacy

Although studies on individual differences recognize some unavoidable overlaps between perseverance and self-efficacy, evidence from theoretical and applied studies suggests that these constructs have unique features that merit their conceptual distinctness (Bandura, 1995, 1997; Nir & Neumann, 1995). Testing for the effect of self-efficacy, rather than self-esteem or locus of control, is important because research has shown that the former is a more robust predictor of task performance (cf. Bandura, 1997) and personal variability in entrepreneurship (Baum, Locke, & Smith, 2001; Chen, Greene, & Crick, 1998). Finally, testing for the unique effect of perseverance, over and above self-efficacy, provides discriminant validity between perseverance and self-efficacy. Hence, to advance theory below is a prediction regarding self-efficacy.

Self-efficacy involves the belief that we can effectively organize and execute certain actions (cf. Bandura, 1997; Chen et al., 1998; Gist & Mitchell, 1992). Self-efficacy impacts how much stress, self-blame, and depression we experience while we cope with taxing circumstances, and the level of accomplishments we realize. It also influences our courses of action, level of effort, our reaction to failure, and whether our thoughts are self-hindering or self-aiding (Bandura, 1999; Wood & Bandura, 1989). Vasil (1992) found that when the effects of experience, academic rank, and disciplinary affiliation are controlled, scholars high in self-efficacy excel. While many occupations call for high self-efficacy (Gist & Mitchell, 1992), making discoveries that yield patents is a good example since such undertaking is constrained by time, funding, and uncertain outcomes despite relentless intellectual effort. Moreover, inventions are scrutinized, challenged, and frequently refuted before (and sometimes after) they attain patent status. Since the process of discovery is strewn with technological obstacles, success in obtaining patents rests heavily on strong self-belief (Bandura, 1999; Gist & Mitchell, 1992; Wood & Bandura, 1989). In short, self-efficacy is central to most human functioning, but because actions are based more on what people believe they can do than on what is objectively true, self-efficacy might be a sound predictor of entrepreneurial pursuits.

Other reasons also suggest that self-efficacy will be related to entrepreneurial pursuits (cf. Chen et al., 1998; Markman, Balkin, & Baron, 2002). First, people avoid careers and environments they believe exceed their capabilities (regardless of the benefits these may hold), but they readily undertake vocations they judge themselves capable of handling, and the higher their self-efficacy, the more challenging the activities they pursue. Second, because entrepreneurs operate at the crux of change, innovation, and market perturbation, they personally realize higher financial, technological, and legal liabilities and uncertainties. On the other hand, inventors working as employees enjoy a more predictable work environment, and they are somewhat less exposed to the perils of competitors'

retaliation, conflicts with suppliers, or shifts in consumers' needs. Finally, research indicates that under taxing circumstances individuals with higher self-efficacy perform more adeptly (cf. Bandura, 1997). Since self-efficacy reliably predicts the scope of career options considered, occupational interests, and personal effectiveness, we suggest that it will also be related to the pursuit of entrepreneurial activity:

Hypothesis 3: Entrepreneurs will have a higher level of self-efficacy than non-entrepreneurs.

Regretful thinking

Regretful thinking occurs in response to unfavorable outcomes or unmet expectations (Zeelenberg et al., 1998). Because starting a new venture is a daunting task with substantial responsibilities for suppliers, buyers, investors, and employees, it stands to reason that entrepreneurs experience many and intense setbacks and thus regrets. Indeed, research shows that taking responsibility for unfavorable events can engender disappointment and blame (Roese, 1997). Pursuing poor opportunities, disbanding a failing venture, or caving in to competition and observing how others reap economic rents too can yield strong regrets. For instance, research shows that disappointments and blame are vivid in contexts involving product failure (Creyer & Gurhan, 1997). Since the founding process is replete with obstacles and setbacks, entrepreneurs experience substantially more regrets than others whose professional responsibility is considerably more restricted (Markman et al., 2002).

Although the popular media glamorizes entrepreneurs, what is less publicized is the fact that individuals can experience discontent, sadness, and intense regrets even with exceptional accomplishments. For instance, Olympic athletes who win a bronze medal are frequently more ecstatic than silver medal winners (Medvec, Madey, & Gilovich, 1995). Research explains that silver medal winners experience regretful thoughts because they imagined winning a gold medal (i.e., the outcome is less than expected), whereas bronze medallists are happier as they anticipated not winning at all (i.e., the outcome is better than expected). Thus, regardless of exceptional outcomes, regretful thinking is activated once the outcomes are below one's expectations (Baron, 2000).

Research on escalation of commitment (McNamara, Moon, & Bromiley, 2002; Staw, 1981) documents how individuals and entrepreneurs (McCarthy, Schoorman, & Cooper, 1993) continue to allocate funds to a losing course of action even in the face of undisputable negative outcomes. We reason that because entrepreneurs are highly vested in their ventures—particularly when their entire venture hinges on their inventions—their regrets, perhaps due to escalation, will be very intense. Inventors who work under the auspice of, and for, their R&D department or employers may be equally engaged at the intellectual, technical, or professional level, but they are less likely to have the authority to 'escalate' capital into a losing course of action. Their discoveries, however important, usually reflect only one factor in a business's total value chain, and as inventors they are unlikely to take a central role in commercializing their new technologies. For these reasons, we suggest that entrepreneurs experience not only more but also stronger regrets following setbacks than their counterparts:

Hypothesis 4a: Entrepreneurs will report a higher number of regrets than non-entrepreneurs.

Hypothesis 4b: Entrepreneurs will report more intense regrets than non-entrepreneurs.

Given that the qualitative nature of regrets is yet to be explored in a more systematic fashion, at this stage all one might predict with some theoretical support is that because entrepreneurs are highly vested in their new ventures (e.g., in many cases entrepreneurs *are* their ventures) they might experience different types of regrets than non-entrepreneurs. Unfortunately, it would be very difficult to predict, let alone fully justify, what types of regrets entrepreneurs and non-entrepreneurs experience or

how precisely these regrets might differ. Thus, while the previous hypotheses are rather specific and precise, the following hypothesis is exploratory:¹

Hypothesis 4c: Entrepreneurs and non-entrepreneurs will regret different decisions.

As we move to the methods section it is important to reiterate the question raised earlier, on whether personal attributes that are vital for launching ventures co-occur with other, less desirable attributes. This is an important theoretical issue because of the following logic. Perseverance motivates entrepreneurs to remain on task despite business setbacks (Brockner & Guare, 1983; McGrath, 1999) and self-efficacy strengthens their belief that their venture will eventually thrive (Bandura, 1997). We predict that strong dedication for and conviction in one's business might also mean the experience of strong regretful thinking. This prediction hinges on two lines of research. First, studies show that commitment and dedication to a venture might come at a great social and personal price (Baron & Markman, 2003). Second, as documented by research on escalation of commitment, not all goals, despite the commitment and vested resources and capital, pan out (McCarthy et al., 1993; Staw, 1981). Indeed, it is a fact of life that most ventures actually fail (Aldrich, 1999). Thus, we predict that high perseverance and strong self-efficacy will co-occur with high levels of regretful thinking. Given the cross-sectional design of our study, we test this prediction by assessing whether entrepreneurs exhibit higher levels of perseverance, self-efficacy, and regretful thinking than non-entrepreneurs do. It is our view that when Hypotheses 1–4 are supported, then this is an initial corroboration of the 'adverse co-occurrence' prediction. Put formally:

Hypothesis 5: Entrepreneurs' perseverance and self-efficacy will co-occur with high levels of regretful thinking.

Organizational Context

The Context of Patents in the United States

The policy of the U.S. patent law is to promote the progress of scientific discovery by requiring the disclosure of invention and useful art so that an ordinary person skilled in the art would be able to make the invention. By disclosing information regarding inventions, knowledge flows into the public domain, thus enabling others to utilize inventions either after the patent term expires or through licensing agreements with patent holders. In this way, disclosure, knowledge sharing, and improvements on existing patents promote the progress of science.

While the patent law does not mandate disclosure of all inventions, to obtain a legal patent status and a temporary monopoly, inventions must be disclosed and meet worthiness requirements. Worthiness refers to the extent to which inventions are *novel*, *non-obvious*, and *useful* (utility value). Thus, inventions that are impractical (e.g., anti-gravity pills), replicating exciting discoveries (e.g., light bulbs), or trivial (e.g., pendulums) disqualify from receiving patent protection (Markman, Espina, & Phan, 2004). Disclosures, then, make a patent public knowledge, but they

¹We wish to note that our predictions intend to extend prior work (Baron, 2000). First, we focus on contexts where regretful thinking is likely to be higher, not lower. Second, in addition to conceptualizing regrets in terms of their strength (Hypothesis 4b) (as Baron did), we also conceptualize regrets as composed of two other attributes: quantitative (Hypothesis 4a) (a number count of regrets) and qualitative (Hypothesis 4c) (the type of regrets). We thank both referees for pointing this out.

also give a legal status of property rights that entitles patent holders to exclude others from making, using, or selling the patented invention for a limited time.

The Economic Efficacy of Patents

The literature on the economic effects of patents provides both pro and con arguments regarding the notion that patents create market monopoly. For example, because of their first-mover character, some pioneering patents enjoy a broader scope than otherwise would be granted, and consequently produce greater market power. However, such patents are a small minority; most patents do not confer full market monopoly. Some patents can be bypassed by ‘inventing around’ them, while others are granted on such small subcomponents of large or complex products that they have little effect on the total value of such larger products. Nonetheless, recent research shows that although few rise to the stature suggested by the word monopoly, some patents have a substantial economic effect (Espina & Markman, 2004). Also, the practice of bypassing by inventing around is not without risks (e.g., time and technological dead-ends).

Why Patents are Important for Entrepreneurs

The importance of patents for entrepreneurs should not be underestimated, which may explain why the pace at which patent-protected discoveries are being made is intensifying—in the United States a patent is issued every 3 minutes. The non-obviousness requirement is particularly noteworthy because it broadens the scope of patents by disqualifying alleged new inventions that are based on obvious change to existing patented inventions. In addition, the *doctrine of equivalents* declares that two products or services that accomplish the same outcome in essentially the same way are in essence the same products or services (Merges & Nelson, 1990). Consequently, the non-obviousness requirement makes trivial modification to an invention unpatentable. Another implication of non-obviousness is that each patent is actually broader than it reads, thereby giving patent holders substantial market power to exclude rivals’ products or services that hinge on similar inventions. Combined, these time and exclusionary rights give entrepreneurs who hold patents substantial advantage against even resourceful competitors.

Time

Data for the reported study was gathered in 1999.

Methods

Sample

As noted in the Introduction, the question ‘who is an entrepreneur and who is not’ (Robinson, Stimpson, Huefner, & Hunt, 1991), or identifying suitable samples and control groups, is a daunting methodological challenge in entrepreneurship research. We focus on a sample of patent inventors because patents are valuable, rare, costly to imitate, and costly to substitute (Markman, Espina, & Phan, 2004). Research views patents as a proxy for technological innovation, a precursor to a newly developed product, and an indication of technological capital (Balkin, Markman, & Gomez-Mejia, 2000; Somaya, 2003). Patents may also erect legal and technical barriers to rivals. For example, research on patent inventors (Markman et al., 2002), technology transfer executives (Shane, 2000), and the legal implications of patents (Merges & Nelson, 1990) suggests that patents may provide footholds to new technologies

and an important source of competitive advantage. Finally, patents are an indication of inventive capacity that benefits society (Trajtenberg, 1990) and recent research in entrepreneurship views patents as potential opportunities (Espina & Markman, 2004).

To reduce selection biases commonly found in entrepreneurship research, while obtaining evidence on the hypotheses, we relied on a random sample drawn from the population of 4861 patent inventors who invented during 1997 and 1998 in the area of surgery devices. Since the original list of 4861 inventors included only minimal contact information (i.e., only first and last name, city, and state), we used Visual Basic to scan the Nation Wide Phone Directory™ (NWPD) software that resides on CD ROMs and to retrieve complete contact information (e.g., full address and phone number) for each inventor.

The Visual Basic output yielded 3491 non-duplicated entries. Then, using Excel spreadsheet and the 'randomize' command function, we sought to select a random sample of 600 patent inventors, but because 14 cases were invalid—deceased inventors and incomplete address information (house number, full street, or zip code)—the final sample included 586 inventors. Then, in 1999, all 586 patent inventors were contacted via telephone, were invited to participate in our study, and were sent a survey. Two weeks later we called all the non-respondents and then sent our second batch of survey mailing. We repeated the same procedure two to six additional times with all non-responding inventors. Although we sent surveys to a random sample of 586 patent inventors and received 233 surveys back (39.76 per cent response rate), 16 surveys were excluded from the analyses because of missing and incomplete information (217 surveys were usable).

Placed at the last section of the mail survey, a qualifying question asked inventors to indicate whether they used their invention to start their own business in 1997 or 1998. Such a qualifying question has been used successfully in previous studies (Carter, Gartner, & Reynolds, 1996). Of the 217 qualified inventors, 55 (25 per cent) used their invention to start a new company and therefore were classified as entrepreneurs (coded as 1), whereas the remaining 162 (75 per cent) did not, and thus were classified as non-entrepreneurs (coded as 0). This relatively high rate of entrepreneurship (25 per cent) may be attributable to the monopolistic nature of patents. Unlike traditional businesses, start-ups anchored in patents enjoy substantial technological protection, competitive insulation, legitimacy, and a relatively wider window of opportunity.

Before outlining additional procedures and operations, it is worthwhile to emphasize certain features that advance research methodology in this area. First, classification of patent inventors as *entrepreneurs* or as *non-entrepreneurs* was made on a post hoc basis—only after the surveys were collected and data were coded. In other words, there was no ex ante knowledge about group membership; on whether an inventor is an entrepreneur or not. Second, restricting the assessments of entrepreneurs and non-entrepreneurs to inventors who invent in the same technological space during the same time period (1997–1998) provides a more rigorous test of hypotheses outlined above. Third, although data were based on self-reported surveys, we verified some data consistency through phone interviews and cross-checks with the U.S. Patent and Trademarks Office website (e.g., patent count). Fourth, to account for non-response bias, we compared the random sample with, again, randomly selected 46 non-responding inventors on age, formal education, annual income, and number of patents developed. Data from non-responding inventors—obtained via phone calls—and a *t*-test analysis showed no significant differences between the two samples. Finally, because of potential covariation between opportunities and individuals, Shane (2000) advocates that studies on individual differences control for the characteristics of the opportunity. This is a valid concern, but using a random sample of inventors implies that the characteristics of the opportunities may also be randomly distributed between the two groups. Also, our measures of perseverance were not tied to an unspecified opportunity, but instead were based on common hypothetical scenarios described henceforth (see Appendix I). Finally, inventors in this study invented highly related patents (surgery devices), which to some extent represent a set of opportunities within the same industry domain.

Procedures and operational measures

Inventors were asked to complete a short questionnaire consisting of several scales adapted from widely used measures of perseverance (Stoltz, 1997), self-efficacy (Maurer & Pierce, 1998), and regretful thinking (Baron, 2000). The perseverance scale consisted of 20 items that were developed and validated by Stoltz (1997) with more than 100 000 participants from diverse organizations in a variety of industries. Each item consists of a statement representing hypothetical events (e.g., 'you apply for a job change and don't get it;' 'you fail to meet the deadline on a major project') followed by two questions, each representing the dimensions described earlier (i.e., control and responsibility). The inventors' task was to indicate, on a five-point scale, the extent to which the statements represented them (see Appendix I for a sample). Factor analysis showed that the two constructs, composed of eight items each, were reliable (e.g., control: $\alpha = 0.77$; and responsibility: $\alpha = 0.81$). Following Stoltz's recommendation (1997) we also created one additional variable: a composite of both scores of perseverance.

Despite the fact that self-efficacy measures have usually relied on scales relating to specific tasks, some research calls for broader measures, particularly when the tasks under consideration require a very diverse set of skills (cf. Bandura, 1997). Since starting ventures requires capabilities in diverse domains and validated self-efficacy scales for patent inventors are not yet available, we used a general scale, which captured self-efficacy in terms of the belief about what one can do under different conditions with whatever skills one possesses (Chen, Gully, & Eden, 2001; Eden & Aviram, 1993). This measure was an eight-item, seven-point scale (1 = strongly disagree; 7 = strongly agree) that was used successfully in previous research (Maurer & Pierce, 1998). Items in this scale included such statements as 'I am strong enough to overcome life's struggles,' 'I can handle the situations that life brings,' and 'I usually feel I can handle the typical problems that come up in life' ($\alpha = 0.89$).

To extend previous research on regretful thinking (Baron, 2000), this construct was treated as composed of three attributes of inventors' regrets: quantitative (count), qualitative (type), and magnitude (strength). The quantitative and qualitative measures were based on inventors' responses to an open-ended question: 'Think about your life and career and *list* the decisions that you regret most.' This single open-ended question generated two types of measures of regretful thinking: quantitative (count) and qualitative (type). First, because inventors could list as many regrets as they wished, the first measure was a simple count of the number of regrets inventors listed regardless of the content. Second, to identify the qualitative nature of participants' regretful thoughts, two management scholars—who are not the authors of this study—used content analysis to aggregate these regrets according to common themes. Because research on regretful thinking in this context is still exploratory, the themes emerge from the substance of the regrets themselves as inventors reported them. Although regrets were assessed independently, each rater has identified six common categories, including Business Opportunity, Education, Career, Value, Relationship, and Investment (see sample in Appendix II). Interrater consistency was high—92 per cent.

Finally, the third measure of regretful thinking focused on the magnitude (strength) of inventors' regrets. This measure was culled from inventors' ranking, on a seven-point scale (1 = little regret; 7 = much regret), the overall strength or level of their regretful thinking. This was an all-encompassing measure, regardless of how many regrets (quantity) inventors listed or the type of their regrets (quality).

Consistent with previous research on individual differences in entrepreneurship, the survey obtained additional control variables such as age, education, and personal annual income for 1998. Since, by definition, patents are novel, non-obvious, and useful discoveries, a new construct in this line of research is a measure of one's inventive capacity—captured here by the number of patents granted to each inventor (Romer, 1996).

Analyses

A MANOVA examined the relationship between entrepreneurs and non-entrepreneurs (as the fixed factor) on a set of five dependent variables: magnitude of regrets; number of regrets; control over adversity; responsibility regarding outcomes of adversity; and self-efficacy, where age, years of education, innovation (i.e., number of patents), and income included as covariates. Content analyses and discriminant analysis examined the relationship between entrepreneurs and non-entrepreneurs on all qualitative data regarding inventors' regretful decisions.

Results

Table 1 presents means, standard deviations, and correlations for all the inventors, regardless of group membership. As shown in Table 1, the average inventor in this study was 47 years old, had almost 19 years of formal education, and at the time of the survey had been granted over 13 patents. In 1998, the average inventor earned approximately \$118 000 a year. Entrepreneurs and non-entrepreneurs were closely matched on education, age, income, and innovations, and the inventors who also became entrepreneurs started their firms with two cofounders and raised, on average, \$6 million to build their company.

The results of the MANOVA revealed statistically significant differences between entrepreneurs and non-entrepreneurs on the sets of dependent variables (Pillai's trace = 0.05, $F = 3.80$, $p < 0.02$). The size of the multivariate effect of entrepreneurship on the five dependent variables, as indexed by partial eta squared, was 0.09. Univariate ANOVAs revealed that group membership (i.e., entrepreneurs versus non-entrepreneurs) was significantly related to perceived control over adversity ($F = 8.03$; $p < 0.005$) and perceived responsibility regarding outcomes of adversity ($F = 4.07$; $p < 0.05$), thus providing support for Hypotheses 1 and 2 respectively. Specifically, mean perceived control over adversity and perceived responsibility regarding outcomes of adversity were significantly higher for entrepreneurs than for non-entrepreneurs. Consistent with Hypothesis 3, entrepreneurs report significantly higher self-efficacy ($F = 5.27$; $p < 0.02$). Finally, univariate ANOVAs confirmed

Table 1. Means, standard deviations, and correlations among study variables^a

| | Mean | SD | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|-------------------------|---------|--------|--------|--------|--------|--------|--------|------|-------|--------|------|
| 1. Group ^b | 0.25 | 0.42 | | | | | | | | | |
| 2. Regrets' strength | 5.77 | 1.21 | 0.10 | | | | | | | | |
| 3. Count of regrets | 2.87 | 1.62 | 0.16* | 0.02 | | | | | | | |
| 4. Control | 3.40 | 0.59 | 0.19** | 0.16* | 0.11 | | | | | | |
| 5. Responsibility | 3.99 | 0.51 | 0.17* | 0.23** | 0.17** | 0.41** | | | | | |
| 6. Self-Efficacy | 6.01 | 0.99 | 0.17* | 0.14* | -0.01 | 0.18** | 0.18** | | | | |
| 7. Age | 48.11 | 10.81 | 0.03 | -0.07 | 0.12 | 0.04 | 0.06 | 0.03 | | | |
| 8. Education | 18.94 | 3.22 | 0.23** | 0.08 | 0.00 | -0.07 | -0.08 | 0.01 | -0.04 | | |
| 9. Innovation | 13.21 | 16.37 | 0.03 | 0.10 | -0.13* | 0.03 | -0.04 | 0.05 | -0.01 | 0.24** | |
| 10. Income ^c | 118 273 | 83 845 | 0.04 | 0.16* | -0.06 | 0.18** | 0.12 | 0.11 | 0.04 | 0.10 | 0.10 |

*Correlation is significant at the 0.05 level (2-tailed).

**Correlation is significant at the 0.01 level (2-tailed).

^a $N = 217$.

^bGroup refers to entrepreneurs versus non-entrepreneurs.

^cIncome is annual earnings in dollars.

Table 2. MANOVA Analysis: Dependent variable means^a for entrepreneurs and non-entrepreneurs

| Dependent variable | Entrepreneurs | Non-entrepreneurs | F-value | eta ² |
|---------------------------|---------------|-------------------|---------|------------------|
| (H1) Control | 3.65 | 3.32 | 8.03* | 0.05 |
| (H2) Responsibility | 4.20 | 3.90 | 4.06* | 0.03 |
| (H3) Self-efficacy | 6.30 | 5.90 | 5.41* | 0.03 |
| (H4) Number of regrets | 3.21 | 2.90 | 1.44 | 0.01 |
| (H5) Intensity of regrets | 6.15 | 5.67 | 6.01* | 0.03 |

Multivariate effect: Pillai's trace = 0.09; $F = 2.80^*$; $\eta^2 = 0.09$.

* $p < 0.05$.

^aMeans adjusted for covariates: age, education, annual income, and number of patents.

that entrepreneurs had significantly stronger regrets ($F = 6.01$, $p < 0.05$), but the two groups did not differ on the number of regrets ($F = 1.44$, $p = \text{n.s.}$). Thus, Hypothesis 4b was supported, but Hypothesis 4a was not.

As described earlier, a content analysis of the qualitative measure of regretful thinking identified six types of regretful decisions, including *business opportunities*, *decisions regarding career, education, investments, personal values*, and *personal relationships*. A discriminant analysis suggested that entrepreneurs regret more decisions regarding business opportunities whereas non-entrepreneurs list more regrets about education and career decisions (chi-square = 30.84; $p = 0.01$). The discriminant function accounted for 78 per cent of the between-group variability. This finding is consistent with Hypothesis 4c, which predicted that entrepreneurs and non-entrepreneurs would regret different decisions.

If perseverance predicts personal effectiveness under diverse tasks and careers (cf. Bandura, 1997; Eisenberger, 1992; Stoltz, 1997), does it also explain variability in inventors' annual earnings—a crude proxy of personal success? To address this question, we performed a hierarchical regression, in which we regressed annual income on the control variables (age, education, innovation), then on self-efficacy, and finally on perseverance as captured by an aggregate measure of perceived control over adversity and responsibility for the outcome of adversity. This post hoc analysis showed that highly perseverant inventors earn significantly more than inventors whose perseverance was very low (adjusted $R^2 = 12$ per cent; $F = 4.40$; $p < 0.01$). Earnings of highly perseverant patent inventors (perseverance score in the top 20 per cent) are approximately \$128 692 versus \$93 933 for the least perseverant inventors (score in the bottom 20 per cent)—almost \$35 000 per year difference.

To recap, the data offered support for all the hypotheses but Hypothesis 4a; number of regrets did not distinguish entrepreneurs from non-entrepreneurs. The fact that perseverance, self-efficacy, and two measures of regretful thinking distinguish between entrepreneurs and non-entrepreneurs provide some support for Hypothesis 5, which refers to the question of 'adverse co-occurrence.' Table 2 shows the adjusted means for the five dependent variables broken down for entrepreneurs and non-entrepreneurs. The discriminant function of the structure matrix and the test of group means for the qualitative data are reported in Table 3.

Table 3. Discriminant analysis: structure matrix of regret variables^a

| | Function | Wilks' lambda | F | Sig. |
|----------------------|----------|---------------|-------|-------|
| Business opportunity | 0.85 | 0.94 | 23.58 | 0.001 |
| Education | -0.43 | 0.99 | 4.00 | 0.05 |
| Career | -0.35 | 0.98 | 6.07 | 0.01 |
| Value | 0.12 | 1.00 | 0.45 | 0.50 |
| Relationship | 0.03 | 1.00 | 0.02 | 0.88 |
| Investment | -0.01 | 1.00 | 0.58 | 0.45 |

^aDependent function: entrepreneurs versus non-entrepreneurs.

Discussion

This study sought to advance ongoing research on individual differences in entrepreneurship. Our results indicate that entrepreneurs and non-entrepreneurs do indeed differ on two dimensions of perseverance (perceived control and responsibility for adverse circumstances), self-efficacy, and two indices of regretful thinking (types of regrets and their strength). As such, the study illustrates that valuable personal attributes—such as perseverance and self-efficacy—do indeed co-occur with personal costs, such as stronger regrets. Results also show that, over and above self-efficacy, perseverance is related to new venture formation; each of the three constructs—self-efficacy ($\eta^2 = 0.03$); control over adversity ($\eta^2 = 0.05$); and responsibility for the outcome of adversity ($\eta^2 = 0.03$)—accounted for unique variance that was not captured by the other constructs. Thus, one modest contribution this study makes is to illustrate that self-efficacy and perseverance are distinct constructs despite their relatedness.

We also found that entrepreneurs and non-entrepreneurs report almost identical numbers of regrets. However, we learned that entrepreneurs experience stronger and different regrets (i.e., business opportunities versus career and education decisions) from their counterparts. These findings, which diverge from past research (Baron, 2000), illustrate the importance of sample selection; we relied on a random national sample of inventors who work in the same domain and used qualitative measures of regrets. In contrast, Baron (2000) employed a heterogeneous, local sample of entrepreneurs, few of whom were inventors. Different sampling techniques and measures can generate different results. The lesson here is that future research and theoretical development might benefit from pursuing qualitative measures that tap into the actual meaning of regretful thoughts rather than merely counting them. Such research will also help to establish more standardized measures of regretful thinking.

The finding that entrepreneurs regret mostly decisions about business opportunities has high face validity (e.g., pursuing opportunities is a core entrepreneurial activity). Less clear, however, is why non-entrepreneurs expressed greater regret over career and education decisions. Although this question should be fully addressed by further research, we offer the following explanation. Job autonomy, particularly in inventive capacity, dramatically influences how incumbents perceive their work and experience career-related regrets. Unlike entrepreneurs, non-entrepreneurs work and invent for their employers, and as such they may encounter stronger barriers to career mobility, limited discretionary power, and, of course, restricted autonomy. Despite years of fruitful experience, even astute inventors can face a career plateau. Good engineers have strong problem-solving skills in technical domains; however, promotion into higher-level positions requires new skills in management, decision-making, business strategy, and working well with a diverse workforce. Thus, one's early decision to become a skilled scientist or engineer might limit one's future chance of being groomed for leadership roles and succession to a top management team (Daily, Certo, & Dalton, 1999). This proposition is beyond the scope of our study and thus waits further empirical testing. It is also worth noting that this proposition is based on the conjecture that inventors wish to become members of the management echelon, an assumption that is yet to be validated.

Implications, Limitations, and Future Research

This study has several implications for research, theory, and practice. For example, it shows that even among inventors who discover novel, useful, and non-obvious technologies, those who undertake the daunting task of creating new ventures are more perseverant and more efficacious than those who work as employees. Also, and despite favorable social views of perseverance and self-efficacy,

it appears that such positive attributes co-occur with increased tendencies to engage in regretful thinking. As such, future research on regretful thinking might seek to explore where these thoughts come from and how they affect decisions and actions. Future research might also seek to explain whether some people, but not others, reject the possibility of starting a new venture because of regretful thinking. Indeed, people are generally risk-averse and this tendency is stronger under conditions of possible gains than possible losses (Kahneman & Tversky, 1982). One might speculate, therefore, that opting *not* to start a new business might limit disappointments and regretful thinking (van Dijk, Zeelenberg, & van der Pligt, 1999). In other words, the prospect of increased disappointment and regrets might motivate risk-averse career paths. On the other hand, playing it 'safe' means expecting less, obtaining what was expected more easily, and therefore avoiding the perils of becoming chagrined with disappointments. Clearly, these issues await further investigation.

The evidence that people are not victims of their adversities strikes a hopeful note. Unlike stable personality and trait characteristics, perceptions of adversity are open to modification. As perseverance enables action, people are the architects of their own destinies (Bandura, 1986). Assuming all else equal, one's reaction to adverse circumstances is—with the appropriate support, education, and training—improvable (Stoltz, 1997; Waldroop & Butler, 2000). For example, a sense of control and responsibility is strengthened when individuals alter the reasons they assign for their circumstances (Mifflin & Schulman, 1986; Seligman, Reivich, Jaycox, & Gillham, 1995). Seligman and his colleagues (1995) suggest that providing individuals with such cognitive tools can help transform helplessness into mastery that bolsters self-efficacy and perseverance. Teaching individuals to challenge their thoughts and assumptions can 'immunize' them against the adverse impact of setbacks (Eisenberger, 1992; Stoltz, 1997). Thus, perseverance may be another fruitful area for future research, as it seems to be grounded in strong theory and has practical implications.

Trade-offs made between representativeness of and confidence in results mean that no study is simultaneously completely generalizable and perfectly accurate. Using a random sample of inventors who were then divided into entrepreneurs and non-entrepreneurs reflects a departure from methodology that is based on convenience samples, but it does raise new issues. To illustrate, over time non-entrepreneurs may start a venture and become entrepreneurs and entrepreneurs may disband their ventures and start working as employees. Thus, viewing entrepreneurs and non-entrepreneurs as a categorical construct may be questioned. Such an issue recognizes that dividing a random sample of inventors into entrepreneurs and non-entrepreneurs provides a prudent test that improves on past methodology, but it also points to possible idiosyncrasies regarding divisions into entrepreneurs and non-entrepreneurs.

Another limitation of our study is the question of causality. Since data were collected after inventors had begun building their ventures, and due to the cross-sectional design, it is unclear whether founding a new firm increases one's perseverance and self-efficacy, and whether this leads to regrets, or whether scoring high on all three attributes leads to founding new ventures. While addressing causality questions is beyond the scope of the current study, three points—and a rich research stream on the causal efficacy of human thought (cf. Bandura, 1995)—suggest that perseverance and self-efficacy precede the act of new venture formation rather than being the result of it, and that personal sacrifices required for launching a business may elicit regrets. First, since perseverance and general self-efficacy are based on lifelong experiences they are quite stable by the time individuals mature and launch their ventures. Second, as we obtained data shortly after inventors had launched their new ventures, such a short-term business activity, in and of itself, probably did not elevate one's perseverance and self-efficacy in any meaningful way. Finally, as we noted in the theory section, entrepreneurs face overwhelming and frequently conflicting demands on their resources, including time, assets, and capital. Reconciling such relentlessly taxing demands suggests that entrepreneurs frequently make displeasing decisions (e.g., firing employees, litigating patent infringements, negotiating late payments to suppliers, bankers, and lenders), many of which might yield lasting regrets. Naturally, longitudinal methods and experimental research design

might fully address questions of causality; hence in the meantime, we merely suggest that among entrepreneurs perseverance and self-efficacy co-occur with regretful thinking.

Notwithstanding these limitations, it is important to recognize the recent resurgence of interest in individual differences in the field of entrepreneurship (Baron, 1998, 2000; Baum et al., 2001; Busenitz & Barney, 1997; Chen et al., 1998; Honig, 1998; Sarasvathy et al., 1998; Stewart, Watson, Carland, & Carland, 1999; to name a few). In this context, this study makes theoretical and methodological contributions. Most importantly, it illustrates that valuable attributes—such as perseverance and self-efficacy—do indeed co-occur with an increased tendency to experience intense regrets. It also indicates that perseverance, self-efficacy, and regretful thinking distinguish entrepreneurs from non-entrepreneurs. Contributions to methodology focus on sample selection. The study was based on a random national sample of inventors, all of whom had patents in the same technological space, at the same time period, and we—the researchers—did not know ahead of time which inventors were entrepreneurs and which were not. The use of income data was also revealing; it showed that perseverance might be related to personal success as proxied by annual earnings. For example, highly perseverant patent inventors enjoyed almost \$35 000 more in annual earnings than less perseverant inventors. Thus, being highly perseverant, regardless of group membership, is significantly related to having higher personal income. Naturally an ad hoc analysis provides merely an initial assessment, but it hints that research on perseverance and the use of income as a proxy for personal success might be a fruitful area for future research, in and outside the area of entrepreneurship. Finally, since perseverance explains additional variance that was not captured by self-efficacy, our study confirms earlier notions about the divergent validity between the two constructs. To the extent that perseverance is central in diverse contexts, we suspect that Confucius was right when he suggested that our greatest glory is not in never failing, but in rising every time we fail.

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Appendix I: Sample Items Used to Measure Perseverance

Inventors used a 5-point scale to indicate the extent to which they agreed with each of the statements following the situations described below.

Situation: Someone you consider important is not receptive to your ideas.

| | | |
|--|----------------------------|----------------------------|
| <i>Control:</i> How much control do you feel you have in this situation? | 1 = no control | 5 = complete control |
| <i>Responsibility:</i> To what extent do you feel responsible for dealing with the outcome(s) of this situation? | 1 = not responsible at all | 5 = completely responsible |

Situation: You apply for a job change and don't get it.

| | | |
|--|----------------------------|----------------------------|
| <i>Control:</i> How much control do you feel you have in this situation? | 1 = no control | 5 = complete control |
| <i>Responsibility:</i> To what extent do you feel responsible for dealing with the outcome(s) of this situation? | 1 = not responsible at all | 5 = completely responsible |

Situation: You fail to meet the deadline on a major project.

| | | |
|--|----------------------------|----------------------------|
| <i>Control:</i> How much control do you feel you have in this situation? | 1 = no control | 5 = complete control |
| <i>Responsibility:</i> To what extent do you feel responsible for dealing with the outcome(s) of this situation? | 1 = not responsible at all | 5 = completely responsible |

Appendix II: Sample of Regret Statements by Categories

| Regret categories | Regret statements |
|-------------------------|---|
| 1. Business opportunity | Missed opportunities due to fear of failure/ridicule Not starting a business by 40 Venturing out with others Not going into business for myself Failing to patent important inventions |
| 2. Education | Not learning and maintaining more foreign language skills Did not pursue an advanced degree Not completing PhD degree Not having more education Where I went to college |
| 3. Career | Invest too much time in work Not going into the armed forces Not taking a job in a pharmaceutical company My career was too consuming at times Not going to work for Microsoft |
| 4. Value | Not discovering Christianity sooner Not enjoying my childhood more Not going around the world in a sailboat when I could Not getting more involved with community programs Smoking for a few years |
| 5. Relationship | Not spending enough time with my kids Not taking my grandfather to Israel Not telling my parents when I got married Hitting my son when he was 4 years old Not having children |
| 6. Investment | Trusting my former money manager too much Spending so much on my first house Not understanding how to invest properly earlier in life Not buying and holding MSFT and INTC in 1989 Not being better at making money |