ADVERSITY QUOTIENT: THE ROLE OF PERSONAL BOUNCE-BACK ABILITY IN NEW VENTURE FORMATION

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ABSTRACT

As the process of transforming opportunities into commercial products or services is strewn with challenges, the undertaking of new venture creation requires determination and strong self-belief. This study assesses the adversity quotient (AQ), a measure of one's ability to prevail in the face of adversity, of 199 patent inventors. Findings offer strong support for the view that one's AQ, particularly as it relates to perceived control over adversities and to perceived ownership over the outcomes of adversities, reliably differentiated between technical inventors who build new organizations and those who merely work for organizations.

INTRODUCTION

Where do new businesses come into existence? While the entrepreneur has been mentioned in recent economic theory, its explicit role in this regard has been studied only in passing (Rosen, 1997). Gifford (1998) explains that this is so since the entrepreneur is a change agent yet much of the economic theory has emphasized market equilibria, where there is neither incentive nor opportunity for change. While other economists rejected market equilibrium models and recognized that the entrepreneur exploits profit opportunities (Walras, 1954), entrepreneurial behavior in economic theory remained rather passive. Krizner (1997), for example, emphasizes the role of the discovery of something that was not known to exist. He assumes that the entrepreneur does not have a priori knowledge and therefore he rejects the view that the entrepreneur deliberately searches for opportunities. This suggests that entrepreneurs are at the alert to new opportunities when they finally knock on their door; it requires that they at least pay attention and assess these random occurrences of opportunities (Gifford, 1998). While regional demographics or economic models predict a great deal of the variation in firm birth rates and have provided us with invaluable knowledge regarding the entrepreneurial potential, a longitudinal research project undertaken by multiple universities (a.k.a. the Entrepreneurial Research Consortium, or ERC) reports that people, not markets, create businesses. It is also intriguing to note that while organizations are an important part of our lives, different individuals elect to either work for them or to create them. Since more than 23% of the randomly sampled participants engage in a new business start-up, own an existing business, or have recently made an informal investment in someone else's business, shouldn't we know more about who these people are?

A recent and growing research stream in entrepreneurship suggests that entrepreneurs, particularly in rapidly changing competitive environments, recognize emerging opportunities. Shane (in press) shows that different individuals from different technological backgrounds who assess the same technological invention (i.e., 3DPä) recognize and then develop different business opportunities. His study confirms that different upbringing and vocational backgrounds shape and affect us differently, a fact that was supported by studies using verbal protocols. Indeed, Sarasvathy, Simon, and Lave (1998) used verbal protocol to show that entrepreneurs and bankers think and process information differently. The opportunity recognition theory suggests that while dynamic markets and technological innovations present diverse profit possibilities, the key is to identify and pursue the "right" opportunity. At the extreme, misidentification and the pursuit of obsolete opportunities is an error from which recovery is long, costly, and frequently impractical. This point is important as entrepreneurs start their venture with limited capital, new offerings that are constrained by

narrow windows of opportunity, meager organizational slack, and new and thus unfamiliar product or service. To echo West and Meyer (1997), while mature firms can err and pursue, at least for a while, low-margin opportunities, entrepreneurs – to survive and thrive – must place a premium on correctly recognizing the market for its emerging opportunities.

Grasping that opportunity recognition is at the core of, and perhaps even a precondition to, entrepreneurial efforts, it nevertheless remains unclear why even among persons who actually do recognize opportunities, only a relatively inconsiderable few found new ventures? The answer to this question begins with two overarching assumptions. First, our reaction to opportunities and adversities shapes our lives and careers, and second, the pursuit of opportunities – particularly in the domain of technical entrepreneurship – is fundamentally challenging. Using a random sample of patent inventors, building on research on individual differences, and relying on social-cognitive theory, this paper suggests that while the reasons for entrepreneurial pursuits are multidimensional, the ability to persevere and overcome seemingly insurmountable obstacles is fundamentally crucial (Bandura, 1997).

THEORY AND HYPOTHESES

Despite that entrepreneurial undertaking is based on more than a "good idea" (Timmons, 1994), the opportunity – and particularly the process of opportunity recognition – remains fundamental to entrepreneurship research (Shane, in press; Shane & Venkataraman, 2000). Yet, assuming that inventions are proxies for commercial opportunities, the observation that even among inventors only a mere inconsiderable few actually attempt to commercialize their inventions hints that recognizing opportunity is perhaps necessary, but clearly insufficient. As opportunities recognition is largely an intangible cognitive process to be assessed only when the new venture is launched, the fundamental question is not how to *identify* opportunities as much as how to successfully *harvest* them. For example, although desalinization of seawater into tap water represents a lucrative opportunity, high risk due to investment horizon, technology, and capital daunts both entrepreneurs and investors. Indeed it is one thing to identify opportunities, but an entirely different matter to exploit them (Venkataraman, 1997). In a sense, identifying opportunities without pursuing them is a costless mental exercise, whereas the actual choice to venture coupled with the law of unintended consequences involves serious financial and social risks.

Personal perseverance refers to one's capability to persist in the face of difficulties, risks, and failure. Such persons consistently rise up and break through and as they persevere, they become more skilled and empowered to tackle the next adversity. Social cognitive theory proposes that since different individuals tend to sustain different levels of adversity, personal success – however defined – is the degree to which individuals move forward and upward despite what appears to be insurmountable obstacles and other forms of adversity (Stoltz, 1997). A corollary of this is that perseverance is a crucial – even if insufficient – personal attribute for developing new technology, and more importantly, for using new technology to create new businesses. Indeed, launching a new high tech venture requires a high level of conviction in one's ability to overcome unyielding challenges while undertaking uncertain and complex innovation projects and then successfully transforming the new technologies into attractive commercial products or services. This paper proposes that persons who identify similar opportunities and are exposed to very similar economic and business obstacles differ in the way they perceive – and react to – adversity.

I suggest that personal perseverance and willpower influence people's courses of action, their level of effort they put forth while pursuing their endeavors, how long they persevere and their resilience in the face of obstacles and failures. Such ability also impacts

how much stress and depression individuals experience while they cope with taxing environments, and the level of accomplishments they realize. In short, people's perceived determination and will power can substantially influence what they do and become and the power to originate actions for given purposes. As research shows, perseverant persons figure out ways to circumvent constraints or change them by their actions, whereas less dithering persons are easily discouraged by impediments and unexpected challenges (Bandura, 1997).

An interesting question, however, is what specific types of perseverance will be most useful to entrepreneurs? While the answer to this question depends, to an important degree, on the specific situation faced by any given entrepreneur, a careful review of available evidence (e.g., Stoltz, 1997) indicates that one's adversity quotient (AQ), the ability to prevail in the face of adversity, is comprised of four interrelated constructs. These include *perceived control over the adversity*; *perceived ownership of the outcome of the adversity* (regardless of its cause); *perceived range* or *scope of the adversity* (i.e., how far the adversity "bleeds" into other areas of one's life); and finally *perceived endurance of the adversity* (i.e., how long the adversity lasts). As discussed next, theory predicts that technical inventors who pursue new venture creation will perceive higher levels of control over their adversities, sense greater ownership regarding outcomes of the adversity; do not allow their adversities to "bleed" into other areas of their lives; and see adversities as temporary – rather than enduring – set backs. The next section, then, detail the theoretical rationale behind each of these four hypotheses.

Control: Perceived Control Over the Adversity

People strive to control events that affect their life circumstances because it provides innumerable personal, financial, and social benefits (Lam & Schaubroeck, 2000). Predictability and controllability foster adaptive preparedness, whereas inability to exert influence over adversity breeds apprehension, apathy, and even despair (Bandura, 1986). Also, since actions are based more on what people believe than on what is objectively true, perceived control is an important precursor to people's level of motivation, affective states, and actions. Specific perceived control over adversities is a major basis of action because it is mainly when people believe that they can attain certain outcomes that they have the incentive to act (Bandura, 1997).[1] Perceived control over adversities influences people's courses of action, the level of effort they put forth while pursuing their endeavors, how long they persevere and their resilience in the face of obstacles, failures, or hardship, and whether their thought patterns are self-hindering or self-aiding. Perceived control over adversities also impacts how much stress and depression individuals experience while they cope with taxing environments, and the level of accomplishments they realize. In short, perceived control over adversities influence what individuals do and become and their motivation to originate additional actions despite adversities.

Theory advises that dwelling on formidable and extremely challenging aspects of one's tasks weakens beliefs of control, but focusing on doable aspects of the same tasks raises such beliefs and success probability (Cervon, 1989). The stronger the beliefs, the longer people persevere, even in the face of repeated failure. Indeed, when faced with setbacks, perseverant individuals intensify their effort and experiment new actions; indecisive individuals, on the other hand, quickly give up. The development and use of new technologies to launch a new high tech firm is the outcome of toilsome self-disciplined effort that goes beyond opportunity recognition or perceptions of market attractiveness. Indeed,

[1] Although specific perceived control over adversities is central to most human behaviors and is the foci of this theory, it should not be confused with general "locus of control;" the former is a highly specific whereas the latter is usually a global measure of perceived control.

my interviews of patent inventors indicate that the difficulty is not one of scarcity of opportunities, but if anything, is that being pulled in too many directions, which mitigates one's ability to focus and execute. Stated differently, as starting a new venture is difficult, uncertain, and tedious, the ability to move from inventions to prototypes and then to products hinges on the strength of technical persons' perceived control over disruption and adversities. This suggests that perceived control over adversities, including technological problems and entrepreneurial challenges, is predictive of one's ability to undertake new business creation. In short, judgments of control over adversities represent a reasonable proxy of one's likelihood to push the opportunity from a mere invention into a full fledge new venture. This suggests the following hypothesis:

Hypothesis 1: Technical entrepreneurs perceive more control over adversities than technical non-entrepreneurs.

Perceived Accountability for the Outcome of the Adversity

Management scholars study extensively the costs of mistaken actions and strategies, but neglect to adequately scrutinize outlays associated with lack of individual accountability. This is probably so because the adverse outcomes due to underdeveloped personal responsibility are difficult to assess whereas the cost of venturesome missteps or failure are more noticeable and measurable. Experienced in response to both favorable and unfavorable events, accountability may manifest itself in such emotions as regret, disappointment, and blame (Roese 1997). For instance, individuals experience intense discontent when they fail to attain outcomes for which they have strong mental images (Medvec, Madey, & Gilovich 1995). Such strong emotions are important because growing empirical evidence suggests that emotions can have profound effects on our mood, understanding of cause-effect relationships, decision-making, and thus on task performance (Mandel & Lehman 1996).

Perceived accountability, despite its short-term negative affect (e.g., sadness and blame), is offset by inferential benefit that aid on a longer-term basis. This functionalist view is based on the assertions that personal accountability is activated by negative affect that comes to mind in response to those experiences where corrective thinking and action would be most beneficial. Generated spontaneously, perceived accountability tend to evoke short-term unpleasant feelings, which motivate us to make certain behavioral changes. Consider academic research as an example. When a manuscript is rejected due to lack of effort (rather than ability), a causally potent antecedent has been identified; deploying additional effort will subsequently enhance future performance. Perceived accountability is activated in response to inconsistent outcome, and since negative affectivity alerts us to a particular problem and prompt corrective thinking and action, perceived accountability has potent potential for future improvement (Schwarz, Bless, & Stacks, 1991). Accountable individuals focus on actions; they imagine steps that might have been taken that would have enabled them to avoid unpleasant past events. Accountability may be particularly strong if the outcome in question produces *repeated* negative outcomes (e.g., failing to secure a patent on a key invention and thus suffering from financial hardship, which may serve to continually reactivate accountability thoughts). The assumption is that accountability "mobilizes" us to response to negative events (Peeters & Czapinski, 1990), and when this permits identification, evaluation, and rectification of problems, then an adaptive reaction is established. Research suggests that accountability and the assignment of blame are particularly vivid in contexts involving product failure (Creyer, & Gurhan, 1997). Since technical entrepreneurs operate in highly dynamic environments where the process of transforming technological opportunities into innovative products or services rarely goes undisturbed, their reaction to setbacks and disappointments may be quite telling. An important question is whether technical entrepreneurs, in the presence of adversity and setbacks, show stronger accountability than

technical non-entrepreneurs do.

Lack of perceived accountability among technical entrepreneurs – particularly because of the substantial ownership and stake in their new venture – would lead to business risk and even to unnecessary failure. Implications from research in participative management (cf. Coyle-Shapiro, 1999) suggest that since technical entrepreneurs own substantial share, and actively participate in the daily management of their venture they will be more accountable. On the other hand, many labor laws and strong economic demands for skilled labor would probably shield technical employees and tenured incumbents from the need to take personal responsibility over the transformation of inventions into products. Thus, there is reason to expect that technical entrepreneurs will experience stronger sense of personal accountability than technical non-entrepreneurs will. This rationale leads to the following hypothesis:

Hypothesis 2: Technical entrepreneurs perceive stronger ownership for the outcome of the adversities than technical non-entrepreneurs.

Scope: How Far Will the Adversity Reach?

Social psychologists show that the moderating influences of perceived strain on coping resources and pessimism can be detrimental to task performance and that some persons are better able to "quarantine" negative emotions than others (cf., Seligman et al., 1995). In fact, helplessness and pessimism is positively correlated with performance decline such as decrease in execution accuracy and speed. Adversities are said to have a wide scope when they encumber adaptive functioning. For example, a dreadful meeting ruins one's day; an interpersonal conflict hinders professional relationship; and a poor performance on a weeklong project appears like a career failure. Perceived range or scope of adversities asks how far will the adversity "bleed" over into other facets of one's life (e.g., professional, social, and emotional)? The higher the perceived scope of the adversity, the more people "catastrophize," thus allowing adversities to spread into other areas of their lives and work. These include pessimistic outlooks, reduced peace of mind, sleeplessness, bitterness, helplessness, poor decision-making, and social and professional isolation (cf. Stoltz, 1997). When goes unchecked, high-span adversity can be self-handicapping; it "takes over" one's life and thus hinders functioning and performance.

Many empirical studies in the area of social psychology and work functioning suggest that inability to cope with setbacks is reflected as negative symptoms such as pessimism, sadness, helplessness, and inactivity. Specifically, people who respond to their setbacks with substantial ruminative thoughts will have longer and more severe episodes of negative mood than people who utilize response styles that are more action-oriented (Lyubomirsky, Caldwell, & Nolen-Hoeksema, 1998). Preoccupation with setbacks enhances the negative effects of moods on thoughts, thus leading to low expectations, negative introspections, and inaction (Nolen-Hoeksema, 1998). Because "high-spread" adversity swells into other areas of one's life it frequently interferes with crucial human competencies such as problem-solving skills. Clearly, the ability to keep perspective regarding adversities benefits individuals regardless of occupation or social status, yet since entrepreneurs are "on their own" and they encounter countless and repeated obstacles, their ability to react to, fend off, and quickly quarantine adversity is advantageous.

Crucial in technical entrepreneurship is excellence in research, development, and engineering (RD&E), yet RD&E is a complex and tedious process that is strewn with difficulties and prolonged setbacks. Another issue is that technical entrepreneurs frequently introduce disruptive technologies, which often enable something that previously had been

deemed impossible (Christensen, 1997). When such innovations initially emerge, neither manufacturers nor buyers know how or why the new products or service will be used. Thus, when technical entrepreneurs finally overcome their technological problems and first introduce their new product or service, they may experience tremendous amount of rejection. Social cognitive theory predicts that their response to the adversity will determine whether they will ultimately concede to or conquer the adversity. For example, allowing the adversity to hemorrhage into other areas of one's life lead to helplessness that prolongs the duration of negative moods, distracts task performance, and hinders one's ability to capitalize on opportunities. Alternatively, isolating the negative emotions and preventing adversities from reaching into other areas of one's life, provide umpteenth benefits. For instance, failure to raise capital to launch a new company is just a temporary setback; it is indicative that more effort and preparation are needed. I therefore predict the following hypothesis:

Hypothesis 3: Technical entrepreneurs perceive adversities as more limited in scope than technical non-entrepreneurs.

Endurance: How Long will the Adversity Last?

Paradigms that describe the innovation process as a linear progression inevitably fail to capture its messiness and serendipitous nature. Innovation projects are characterized by unremitting irregularity, disorder, and complexity, where the solution to scientific puzzles or applied problems yields no immediate economic rents. This is so since innovation is the complex outcome of not only basic and applied research but also product development, engineering, manufacturing, marketing, distribution, servicing, followed by product adaptation and upgrading. As the process contains innumerable leaps ahead, feedback loops, sudden and unexpected lacunae, and interactions among the above components, adversities and snags may seem not only unsolvable but enduring as well. This point is important, as technical non-entrepreneurs are normally only responsible for the inception phase, whereas technical entrepreneurs are accountable to what may arise throughout the value chain, from product inception to its sales and service.

While many activities demand effort, ingenuity, and endurance, it is clear that the paths to innovative achievements and successful entrepreneurial pursuits are strewn with even more lasting holdups and inherent short-term disincentives than are the paths to more traditional occupations. Innovation projects demand heavy personal investments that go beyond intellectual effort (e.g., emotional and social sacrifices and so on), while the benefits – if and when they are finally realized – come through a lengthy process of refinements with numerous setbacks. Adverse market reactions, unresponsive suppliers, and what appear to be unapproachable buyers represent another disincentive to debuting unconventional products and services. Since new inventions often clash with existing products and services they threat constituencies who have vested interests in preserving current technological standards. Similarly, as new technologies – particularly during early stages when capital and resource availability is most important – frequently fail to make sense, conventional investing wisdom constitutes entry and mobility barriers that entrepreneurs must overcome. Yet, establishing the merit of new ideas, inventions, and technologies, can be a long and disheartening journey. As innovative efforts frequently bring social and market rejection before they bring fame and fortune, to succeed, technical entrepreneurs' conviction that they can overcome enduring and prolonged hardships is paramount. In sum, the ability to buoy through prolonged adversity is paramount.

Perceiving adversity as non-enduring is an adaptive reaction regardless of one's occupation, but since technical entrepreneurs ran their companies, rather than merely work for them, they do endure more hostility and unfavorable conditions. These hostile

environments include political, legal, regulatory, and economic conditions that can reduce a firm's degrees of freedom in mapping and pursuing strategic choices (Zahra & Neubaum, 1998). As entrepreneurs lead their fledgling firms they also encounter hostile rivals that jockey for position within an industry. Finally, entrepreneurs must also overcome technological hostility due to radical shifts in resources deployment techniques and the technological standards (Zahra & Neubaum, 1998). As entrepreneurs confront with these diverse types of hostilities, perseverant commitment is clearly important. The theory suggests that entrepreneurs' perseverance to mobilize effort needed to convert ideas into products and services is prolonged when adversities are seen as short-lived rather than enduring. That is, when the perceived adversities are non-enduring technical entrepreneurs would be more likely to make an effort. Also, as suggested earlier, perceptions are an important precursor to people's level of motivation and actions. One's perception is a major basis of action because it is mainly when adversities are perceived and processed as short-lived and surmountable that individuals have incentive to act. Hence the last hypothesis:

Hypothesis 4: Technical entrepreneurs tend to perceive adversities as more short-lived than technical non-entrepreneurs.

RESEARCH STRATEGY AND METHODOLOGY

To confine the study to the domain of innovation yet to reduce selection biases I used a random sample of 199 inventors, all of whom developed patents during 1997 and 1998. Then, I identified technical entrepreneurs from technical non-entrepreneurs based on respondents answer to a qualifying question, asking whether they used their invention to start or continue to build their own business (Carter, Gartner, & Reynolds, 1996). Thus, I had no pre-study knowledge whether some – or even any – of the participants were indeed entrepreneurs. I reasoned that sampling patent inventors is appropriate as patents are a proxy for important technological innovation, a precursor to newly developed products, and an indication of intellectual property and technological capital (Balkin, Markman, & Gomez-Mejia, 2000). Patents are a manifestation of inventive activity that benefit society (Trajtenberg, 1990)

Procedures: All participants were asked to complete a questionnaire consisting of 56 five-point scale items that assessed their adversity quotient (cf. Stoltz, 1997). The questionnaire was developed and validated by Stoltz (1997) with over 100,000 participants from diverse organizations in a variety of industries including Abbott Labs, Kaibab National Forest, Boehringer Ingelheim, W. L. Gore & Associates (makers of Gore-Tex), Deloitte & Touche LLP, Minnesota Power, ADC Telecommunications, and US West. Each item consisted of a statement representing hypothetical events (e.g., "you apply for a job change and don't get it" or "you fail to meet the deadline on a major project") followed by four questions, each representing the four dimensions described earlier (i.e., control, ownership, scope, and endurance). Respondents' task was to indicate, on a five-point scale, the extent to which statements represented them. To assess demographic variability and to provide sample control additional items were also included in the questionnaire. The control variables were age, education, innovation experience (i.e., number of patents developed), entrepreneurial experience (i.e., number of companies founded), and annual income. These additional items were developed and selected for use in this investigation on the basis of results of a pilot study (Baron & Markman, 2000) conducted with 87 patent inventors.

Although the initial data set included 3491 contactable inventors who developed patents in 10 distinct patent classes, to reduce mailing costs I randomly selected only 579 of them. Of the 199 useable surveys (34.4% response rate), 52 (26.1%) used their invention to start a new company and therefore were classified as technical entrepreneurs (coded as 1).

The remaining 147 (73.9%) did not, and thus were classified as technical non-entrepreneurs (coded as 0). Reliability analysis confirmed that all the AQ scales were highly reliable (α>.85)

RESULTS

Table 1 provides the descriptive statistics and correlation matrix and it suggests that the average inventor in this study was about 47 years old, had almost 20 years of formal education, and at the time of the survey invented more than 13 patents, and earned almost $120,000 annually. Although not reported in the table, the average entrepreneur had started 1.5 firms with two cofounders and had raised more than $6 million to build his or her company. Entrepreneurs and non-entrepreneurs were closely matched on age, education level, and the number of patent they invented.

Table 1: Descriptive Statistics and Correlation Matrix

	Mean	s.d.	1	2	3	4	5	6	7	8
1. Group	0.26	0.44								
2. Age	47.23	9.33	.047							
3. Education	19.69	2.69	.158*	.145*						
4. Innovation	13.14	17.00	-.025	.047	.109					
5. Income	11827.3	8384.5	.002	.057	-.011	.053				
6. AQc	3.36	.59	.262**	.148*	.031	.089	.233**			
7. AQo	3.99	.51	.199**	.117	-.095	-.022	.170*	.422**		
8. AQr	3.86	.56	.024	.078	-.009	-.021	.079	.071	.381**	
9. AQe	3.19	.50	.115	-.014	-.031	-.098	.137	.075	.222**	.276**

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).
N = 199

The differences between technical entrepreneurs and technical non-entrepreneurs on AQ were investigated using a structural equations modeling approach, where education, age, innovation, and personal income were included as control variables. The fit of the model was evaluated with AMOS (Version 4) using the sample covariance matrix as the input and a maximum likelihood solution. For the model, the measures are subject to measurement error, which can introduce bias in the estimates of the structural coefficients. The effects of measurement error were explicitly modeled using a strategy suggested by Hayduk (1987). This strategy involved first estimating the proportion of measurement error for each scale. One minus the Cronbach's alpha for a measure was used as a convenient estimate of the proportion of measurement error. The measurement error for each measure in the model was then fixed to equal the variance of the measure times the estimated proportion of measurement error.

The fit of the data to the model was assessed using three types of fit indices: absolute (χ^2 test, standardized RMR, GFI), parsimony (RMSEA, test of close fit), and relative fit (CFI). The chi-square test (χ^2) tests the null hypothesis of a zero residual matrix. A non-statistically significant χ^2 value is consistent with a good model fit; i.e., the sample variance\covariance

matrix is adequately reproduced. Standardized Root Mean Squared Residual (RMR) measures the absolute squared residual correlation. A standardized RMR value of .05 is commonly accepted as an upper acceptable value. The goodness of fit index (GFI) is an absolute measure of fit that ranges from 0 to 1. GFI values greater than .90 are generally considered to be consistent with a good model fit. The Root Mean Square Error of Approximation (RMSEA) is a parsimony index that penalizes the model for too many causal paths. RMSEA values range from 0 to infinity with RMSEA values less than .80 generally considered to be an indication of a good model fit. A *p* value for test of close fit is a second parsimony index and a value that is not statistically significant is consistent with a good model fit. Finally, the Comparative Fit Index (CFI) compares the tested model to a "null" or "independence model". The CFI ranges from 0 to 1 and values greater than .90 are consistent with a good model fit.

The overall chi-squared test of model fit was not statistically significant (χ^2 (10) = 20.63, p = .08). The RMSEA was .05 with 90% confidence intervals of .00 and .17. The *p* value for the test of close fit (RMSEA < 0.05) was .0; RMR was 1.47 and the Standardized RMR was .048. The CFI was 0.95 and the traditional GFI was .98. Inspection of the residuals and modification indices revealed no points of stress or ill-fit in the model. Overall, the fit indices and residuals point toward a good model fit. Importantly, the variance explained by each of the dependent variables was as follows, perceived control over the adversity explained 22% of the variance; perceived accountability over the outcomes of the adversity explained 22.4% of the variance; perceived scope of the adversity accounted for 9% of the variance; and finally, perceived endurance of the adversity explained 5.3% of the variance.

Table 2 shows the parameter estimates of the structural coefficients for the single indicator model. Standardized estimates appear on each path, with unstandardized coefficients in parentheses. An asterisk beside a path coefficient indicates that the path coefficient is statistically different from zero.

Table 2: Parameter Estimates of the Structural Coefficients

Hypothesis	Path	Coefficients
H1	Entrepreneurs _ AQc	0.373 (0.327)**
H2	Entrepreneurs _ AQo	0.267 (0.257)**
H3	Entrepreneurs _ AQr	0.033 (0.030)
H4	Entrepreneurs _ AQe	0.122 (0.124)
	Age _ AQc	0.008 (0.154)*
	Education _ AQc	-0.012 (-0.067)*
	Innovation _ AQc	0.003 (0.101)
	Income _ AQc	16.694 (0.281)**
	Age _ AQo	0.007 (0.139)*
	Education _ AQo	-0.032 (-0.192)
	Innovation _ AQo	-0.001 (-0.035)
	Income _ AQo	16.976 (0.314)**
	Age _ AQr	0.005 (0.088)
	Education _ AQr	-0.005 (-0.030)
	Innovation _ AQr	-0.002 (-0.053)
	Income _ AQr	11.837 (0.205)**
	Age _ AQe	-0.001 (-0.030)
	Education _ AQe	-0.008 (-0.050)

Innovation _ AQe	-0.003 (-0.125)
Income _ AQe	12.127 (0.237)**

Standardized structural coefficients are in parentheses.
* $p < .05$; ** $p < .001$; N = 199

Table 2 suggests three important findings. First, patent inventors' success, as measured by personal income was significantly and positively related to each of their AQ scores. Second, while patent inventors' age was significantly and positively related to their perceived control over the adversity and accountability over the outcome of the adversity (two of their AQ scores), their education was significantly but negatively related to their perceived control over the adversity (one of the four AQ scores). Finally, and most importantly, while findings lend strong support for hypotheses one and two, there was no empirical support for hypotheses three and four. More to the point, technical entrepreneurs scored significantly higher on their perceived control of the adversity and accountability over the outcomes of the adversity as compared to their counterparts. On the other hand, technical entrepreneurs and technical non- entrepreneurs scored somewhat similarly on their perceived scope of the adversity and perceived endurance of the adversity. This suggests that while hypotheses one and two were supported, hypotheses three and four were not.

DISCUSSION

The social cognitive theory holds that persons try to exercise control over adversities for the benefits they gain by it; bounce-back ability and overcoming impediments enable one to predict events and shape them to one's liking (Bandura, 1997). The assumption is that high personal perseverance affects not only choices but also the success with which action are pursued and executed. This study confirms that patent inventors' high personal perseverance as measured by (a) *perceived control over*; (b) *ownership of the outcome of* (c); *scope of*; and finally (d) *perceived endurance of the adversity*, was associated with higher success as measured by personal income. Stated differently, regardless of group membership, the higher patent inventors' AQ – which is an acquirable skill – the more financially successful they are. Although all the participants in this study invented patentable technology, entrepreneurs were only those who converted their patents into commercial products or services; they exploited their technical inventions through firm formation. This study shows that even among persons who recognize opportunities (e.g., patents), success in converting ideas into tangible inventions is related to inventors' ability to move forward and upward despite obstacles and challenges. In particular it was shown that perceived control over the adversity and accountability for the outcome of the adversity were significantly higher among technical entrepreneurs.

Limitations

There are three main limitations to this study. First, although aggregating patent inventors into technical entrepreneurs and technical non-entrepreneurs simplifies the methodology, it is an oversimplification. In reality, particularly over time, inventors may "migrate" from working for others to working for themselves and vice versa. Also, as the survey also did not collect data on the organizations in which participants work, it is possible that some inventors that were classified as technical non-entrepreneurs actually work for young startup firms. In other words, the division of participants into only two dichotomous groups may fail to capture a richer spectrum that ranges between what we traditionally term technical entrepreneurs and technical non-entrepreneurs. A second limitation stems from the reliance of patent count as a proxy of innovation. Economists note that patent count is a rather poor proxy for economically viable innovation; the distribution of patent batting

average is highly skewed toward the low end with a long thin tail into the high-value end (Trajtenberg, 1990). Records of technology transfer offices show very low batting average; less than 10% of all patents are exploited. A corollary of this is that a patent impact on the market is driving asymptotically towards the random. This is not surprising since many patents have no market value until they are crossed with several other patens, and many others are filed for reasons totally different than innovation impactedness. While some inventors obtain patents for curiosity or intellectual reasons, scores of companies pursue patents to passively "protect" market share, and yet countless others use patents to strategically position themselves in a particular technological space. My interviews of technical entrepreneurs, high tech executives, intellectual property attorneys, and technology transfer directors suggest that patents allow their owners to cajole rivals into to alliances, partnerships, and concessions that are not of the rivals' initial liking. In short, as a measure of innovation, patent count is probably too imprecise to capture the innovation richness described above.

The third limitation is the untested assumption that patents represent stochastic distribution of technical opportunity or that they represent a random distribution of business opportunities. Thus, assessing whether some persons, but not others, start new companies without controlling for the opportunity is conceptually and empirically challengeable. This is so particularly because of the episodic nature of new business formation and the findings that personal characteristics correlate with the invention. More to the point, Shane (in press) reports that entrepreneurs from different vocational backgrounds discover different opportunities despite that they were relying on the same-patented technology (i.e., 3DPä). This suggests that future research on individual differences in entrepreneurship should exert control over the opportunity.

Implications

Notwithstanding these limitations, this study has important implications to research, theory, and practice. As suggested above, the study provides guidance for future research on individual differences in the context of new product development and innovation. It makes an important contribution to our understanding of the entrepreneurial process as it shows that even among persons who identify opportunities, the mere few who undertake the daunting journey of building new ventures are perseverant individuals. Personal determination by which entrepreneurs overcome adversity is vital; it supports Edison's famous account that innovation is 95% perspiration and only 5% inspiration. Furthermore, this study made no effort to assess organizational performance, yet as new business creation is to a large extent a personal expression (cf., Shaver & Scott, 1991), it would be interesting to see whether technical entrepreneurs' AQ is predictive of the venture performance. At another level, evidence suggests that a "can-do" attitude rubs off; that being around dynamic individuals who keep adversity in perspective is infectious (cf., Smith & Muenchen 1995). This suggests that entrepreneurs can use their pattern of thinking (e.g., "can-do") to inspire and motivate their top management team and others who work with them.

This paper suggests that assessing entrepreneurs' AQ, and educating them and their inventors about it is worthwhile. As investors and venture capitalists interact extensively with prospective entrepreneurs who present them with new, complex, and uncertain technology (that often only few experts can understand), measuring technical inventors' adversity quotient may substantially improve backers' investment portfolios. Another important point in this context is the fact that perceptions of adversity – unlike personality and trait characteristics – are noticeably more open to modification. One's reaction to adversity is – with the appropriate support – highly improvable (Stoltz, 1997). For example, developing perceived control and accountability is accelerated when individuals alter the reasons they assign for their successes and failures. When persons change their explanations for why

important and impactful outcomes occurred, they improve their expectations for positive outcomes in the future (Seligman, Reivich, Jaycox, & Gillham, 1995; Mifflin & Schulman, 1986). Seligman and his colleagues (1995) provide startling evidence that providing individual with tools and skills can help them transform helplessness into mastery that bolsters self-efficacy and perseverance. In other words, teaching individuals to challenge their thoughts can "immunize" them against adverse impact of setbacks. Improving AQ reduces the risk of helplessness as it boosts performance, improves physical health, and provides individuals with the self-reliance as they approach new challenges (Stoltz, 1997).

Ultimately the power and tools to improve economic and social states judge research and theories. This study – its focus on one's reaction to adversity, use of social cognitive theory, and the ample evidence that people are not victims of their adversities – provides explicit guidelines on how inventors can enable or influences their work. As such, it provides a rich social and economic utility that goes beyond correlates of perceived control. Many theories are concerned with discovering principles about how to shape environmental influences to promote human adaptation and change. As personal perseverance enables human action, at least to some extent people are the architects of their own destinies (Bandura, 1986). This study reports that high AQ is associated with higher personal earnings and that technical entrepreneurs, as compared with technical non-entrepreneurs, experience significantly higher levels of perceived control and accountability. These findings are important as they corroborate the social cognitive theory that strong self-beliefs (AQ) regulate aspirations, courses of action, mobilization and maintenance of effort, and affective reactions. How companies are created? This study suggests that enduring and perseverant persons build them.

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