

**Inventor Perseverance After Being Told to Quit:  
The Role of Overconfidence and Optimism**

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## **Inventor Perseverance After Being Told to Quit: The Role of Overconfidence and Optimism**

Abstract:

The Canadian Innovation Center offers advice to independent inventors regarding the commercial prospects of their inventions. They advise inventors to either continue work or to terminate investment of time and money. We find that while most inventors who were told to cease effort stop, many continue spending time and money on projects with little prospect for commercial success. Using survey data from 501 independent inventors who submitted their invention for evaluation, we analyze the role of optimism and overconfidence in the decision to continue. We find that optimism plays an important role in the decision to continue but that overconfidence was not a factor in the decision. We also find that experience contributes to the decision to ignore expert advice.

Inventing provides negative expected returns for inventors (Åstebro, 2003), however inventors still invent. For example, independent inventors are granted about 13% of all patents in the U.S. (USPTO, 1997), and approximately 2% of the U.S. working population switches to self-employment each year. If these activities have negative expected value, why do inventors continue to invent?

One reason that has been offered is that inventors are unrealistic optimists and that they greatly overestimate their abilities and likelihood of success (Arabsheibani, de Meza, Maloney, & Pearson, 2000). Others conclude that inventors are strongly motivated by non-pecuniary benefits (Blanchflower & Oswald, 1998; Frey & Benz, 2002; Hamilton, 2000), yet others raise the possibility that inventors are “skewness lovers” wanting to “strike it rich”. These theories would suggest that while inventors realistically assess their likelihood of success, they are attracted to the skewed distribution of innovative returns, which promise a low probability of a high payoff (Åstebro, 2003).

Rather than study why inventors begin a project, we evaluate the decision to continue spending time and money on projects after an independent evaluator has recommended termination. In other words, why do inventors throw good money after bad? In order to explain these phenomena, we evaluate two of the most robust of decision making biases: overconfidence and optimism. We collect data from real inventors who have paid the Canadian Innovation Centre (CIC) for a review of their inventions.

### ***Overconfidence and Optimism***

Overconfidence and optimism biases have been shown in a number of studies. For instance, Camerer and Lovallo (1999) show that students in an experiment forecasted below zero profits due to excess entry, but entered anyway and were more likely to enter when they scored high on a skills test. They explain this as an optimistic bias coupled with a neglect of the behavioral intent of others. In a similar experiment Moore and Cain (2004) show that entrants are greater optimists when the skill test is easy, thereby inducing greater rates of entry and lower post-entry profits. These authors go on to explain that the

excess entry and low returns in industries such as restaurants and convenience stores are caused by excess optimism coupled with perceived task simplicity.

We have chosen to evaluate the impact of overconfidence and optimism as we believe that these factors will be acting on individual inventors when they are determining the amount of time and money they will allocate to a project. We hypothesize that optimism will play a role when inventors are estimating the returns from their invention, while overconfidence will play a role when they are evaluating their skill at being able to successfully develop an invention.

***Optimism.*** Many people display a consistent belief that they are less likely than others to suffer from bad events and more likely to experience positive events (Weinstein, 1980). Such beliefs lead people to overestimate positive outcomes and underestimate negative outcomes. This optimistic bias has been shown across many domains, cultures, and age groups (Weinstein, 1987). Research has shown that entrepreneurs (who often start out as inventors) are more optimistic than employees about their future earnings, even though they realize lower earnings (Arabsheibani et al., 2000). These authors also found entrepreneurs to be extremely optimistic about their future earnings, much more so than employees, but realizing lower earnings than employees.

Optimism has been found to be quite resistant to many de-biasing interventions such as making people aware of the risks, changing the presentation mode of the risks, changing the intensity of the risks, and generating reasons why these risks might occur (see Weinstein & Klein, 1995). Consistent with the idea that debiasing optimists is difficult, we propose that optimistic inventors would pay less attention to the advice from the IAP and thus having higher expenses on their projects than pessimists. In the context of inventors we have no reason to believe that they will be immune to the optimistic bias found in the general population. An optimistic bias would tend to make inventors spend more on their projects because optimists believe they will be more successful than pessimists. An optimistic bias would also tend to raise the

expected return on a commercial product, raising the expected value of continuing with the project. In support of this hypothesis, Cooper et al. (1988) found that 81% of all entrepreneurs believe their chance of success to be 70% or above, while in actuality 2/3 of businesses fail within the first four years. Weinstein (1980) argues that two conditions must be fulfilled for an optimistic bias to arise: a) the event is perceived as controllable, and b) people have some degree of commitment or emotional investment in the outcome. Both conditions are likely to occur for inventors.

Hypothesis 1: Inventors with higher levels of optimism will be more likely to continue spending time and money after receiving advice to stop activity.

Optimism may not necessarily be a bad thing. For example, Taylor and Brown (1988) reach the conclusion that optimism is both an indication of mental health and well-being, and a contributor of successful coping of everyday life. (Taylor & Armor, 1996) A signal of optimism may also attract outside financing, in-kind efforts and other resources that are useful to a venture. If convincing others to contribute by signaling high abilities is beneficial to the venture, then self-deceptive optimism may be the key to most effectively produce such signals (Arabsheibani et al., 2000). In addition, a high level of optimism may act to keep inventors going in the face of adversity (Armor & Taylor, 1998; Armor & Taylor, 2002).

***Overconfidence.*** Overconfidence is considered one of the most robust of all decision making biases (De Bondt & Thaler, 1995). Individuals display overconfidence in two ways, both representing an inflated sense of accuracy or ability in a specific domain. The first display of overconfidence is the use of too narrow a confidence interval. For example, when asked to create an interval such that there is a 90% chance that they are correct, people often set intervals that contain the correct value only 50% of the time (Lichtenstein, Fischhoff, & Phillips, 1977). Overconfident individuals are also shown to overestimate their accuracy on a general knowledge test. These same researchers found that individuals, who thought they were right 80% of the time were, on average, only correct 60%. It is also interesting to note that experience does not make people more accurate, but it does make them more confident in their ability (Camerer &

Johnson, 1991). Overconfident forecasts have been documented across a variety of decision-making situations and decision-makers (Griffin & Tversky, 1992), and we expect that inventors forecasting the success of their invention would also display a high degree of overconfidence.

Overconfidence may be such a robust phenomenon because of the many potential causes for it found in the decision making literature. Early work on overconfidence hypothesized that a lack of meta-knowledge was the reason for overconfidence (Oskamp, 1965). This work said that people were unaware of the limits of their knowledge and therefore tended to give forecasts that had too little variance. Another source of overconfidence arises from a phenomenon known as the confirmation bias (Klayman, 1995; Koriat, Lichtenstein, & Fischhoff, 1980, Jonas et al, 2001). People falling prey to the confirmation bias often selectively recruit information that favors their currently held hypotheses (e.g. “my invention will succeed”) and tend to not search for information that might reject these hypotheses. In addition, decision makers will often interpret ambiguous information in ways that support their current beliefs. These biases would tend to raise the prediction of success believed by inventors, leading to unrealistically high levels of confidence.

Another source of overconfidence comes from ease of recall biases (Kahneman & Tversky, 1973). This availability bias is formed by individuals producing likelihood estimates based on the “ease with which instances or associations comes to mind” (page. 164). In the context of inventors, we believe that they will often fail to see all of the ways that things could go wrong. Instead, many easy-to-think-of positive outcome scenarios might diminish the perceived uncertainty associated with successfully developing an invention.

We expect that all of these potential sources of overconfidence will be present in the population of inventors. If an inventor has inappropriately high beliefs in his ability to bring a product to market, this will raise the expected value of continuing with the project, making an overconfident inventor more likely to spend additional time or money on developing the invention.

Hypothesis 2: Inventors with higher levels of overconfidence will be more likely to continue spending time and money after receiving advice to stop activity.

We believe that overconfidence and optimism in this case are different, even though many have claimed that they are at least highly correlated, and others have even questioned whether they are different constructs. In this research, we believe that optimism is a more global construct, in other words, a general feeling that good things will happen to a person. Overconfidence is specific to the individual (as is optimism) but more domain specific, in our case, the likelihood of successfully commercializing and invention. As such, overconfidence would apply to an inventor's perceived ability rather than an overall measure of belief in the expected occurrence of positive outcomes.

### **Data Source**

We gathered information from real inventors who had sought advice from the Inventors' Assistance Program (IAP) at the Canadian Innovation Centre (CIC). This centre was established in Waterloo in 1976 to help evaluate early stage inventions and the likelihood of market success (Åstebro & Bernhardt, 1999; Åstebro & Gerchak, 2001). The Canadian IAP evaluates potential entrepreneurs and their projects on 37 different cues and provides advice on how and whether to continue. To have a project evaluated, the entrepreneur fills out a questionnaire and pays a moderate fee (\$250 USD in 1994 and \$750 USD in 2001). In addition to background information about the entrepreneur, the questionnaire asks for a brief description of the idea and supplementary documentation such as patent applications, sketches and test reports. An in-house analyst compares the project with other similar projects in their library of previous reviews and searches various databases. Personal contact with the entrepreneur beyond the provided documentation is avoided by the analyst to ensure that these discussions do not bias the evaluation. In addition to scores on the 37 cues, the analyst also derives an overall score for the project using intuitive judgment and assigns one of five possible scores shown in Table 1.

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Insert Table 1 about here  
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Columns 2 and 3 of Table 1 report the frequency distribution of the IAP’s overall rating from a survey conducted prior to this one (Åstebro, 2003). A majority of ventures (rating D and E) are advised to terminate efforts: 75%. Two per cent received the most favorable overall score (A), 4% were given an intermediate positive recommendation (B), and 19% were advised that the project is suitable to launch as a limited (i.e. part-time) effort (C). The frequencies in our study were similar, with 1% receiving an “A” rating, 4% receiving “B”, 10% receiving “C”, and 85% receiving a “D” or “E” (cease activity) rating.

Table 1 also reports the probability of commercialization for each of the different overall scores (column 4). As seen, the probability of commercialization and the estimated return on investment are strongly correlated with the IAP advice, with a clear difference between those rated D and E (advised to stop) and those rated A, B or C. These data are evidence of a high diagnosticity of the advice. Other research has shown that both positive and negative advice have similar accuracy rates (Åstebro & Chen, 2002). In a survey of 559 projects the IAP correctly forecasted 75.8% of the successes and 79.3% of the failures. This means that both types of advice (continue and cease) are equally reliable. Given this high level of diagnosticity, inventors that receive negative advice (e.g. a “D” or an “E”) should cease developmental efforts and move on to other activities rather than spending additional time and money on an unlikely success.

The phenomenon we are studying can be seen in Table 2. Even though most inventors that receive the advice to terminate their efforts follow that advice (64% and 63% for money and time respectively), a significant proportion of inventors continue to invest time and money in these endeavors. Interestingly, 36% and 37% of inventors spent more money and time respectively after receiving negative advice. We expect that differences in overconfidence and optimism can explain this phenomenon.

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We started by identifying 5,008 inventors who had submitted ideas for review at the Canadian Innovation Centre's IAP between 1994 and 2001. Of this number, we were able to obtain current addresses for 1,842. Surface mail to 72 of these addresses were returned as undeliverable, reducing the final sample to 1,770 at survey time. Our final sample was 780 completed surveys for a response rate of 61%. Of this sample we study those who have spent a total amount of CDN \$10,000, at most (80<sup>th</sup> percentile), and received a negative rating; reducing the sample to 501. These participants were surveyed over the telephone by the Survey Research Center at the University of Waterloo.

### *Dependent Measures*

To measure the money spent by inventors after receiving the IAP report, we use the proportion of R&D cash outlays after the report relative to the total spent. We asked for all costs for product development, marketing research, making of prototypes, etc. We further asked respondents to anchor these expenditures in time to the year in which they spent the majority of the development costs, in order to roughly approximate a cost at a fixed date. We normalize all of these expenses to 2003 dollars by using the Canadian CPI. By using a ratio rather than an absolute amount we were able to control for the magnitude of the project. In other words, some projects require a larger amount of total capital outlays and thus we would expect the amount spent after receiving advice to be higher than that for smaller scale inventions. By using the ratio we can get a purer measure of the relative spending before and after receiving advice.

To measure time investment, we use a similar measure by computing the ratio of time spent after the report to total time spent on the particular invention. While spending time is a manifestation of the inventor's intentions and behaviour, the time spent by the inventor carries low or no opportunity cost. Research work in the area of time shows that individuals find it difficult to account for time (Soman, 2001). However, the inventor is operating in an environment where he/she is not likely to be able to sell their inventive abilities on a spot market. Since the effort has a low opportunity cost the time spent may reflect

many other decision making biases or non-monetary factors, such as the intrinsic value of inventing. While for the purposes of this analysis it may be a noisy measure, it is still included.

### ***Independent Measures***

To measure optimism we chose six out of the ten optimism items from the International Personality Item Pool (IPIP, 2001; Scheier, Carver, & Bridges, 1994) personal attributes survey. Two examples are “I just know that I will be a success” and “I am often in a bad mood”. Pretests results indicated respondents’ difficulty with the items “I fell blue’ and ‘I dislike myself’. After careful deliberations on the possible effects of the two items on the questionnaire response and reliability, we decided to exclude these items and two other items that are matched with them. Respondents were asked the extent to which they agree/disagree with each of these statements on a five-point scale, with 1 representing strongly disagree and 5 representing strongly agree.

Consistent with recent research (Griffin et al., 1992) we measured over-confidence as the degree to which an individual expects that they have made a correct judgment on a judgment task divided by the average degree of correct judgments in the population. We ask respondents to judge which one of two cities that has the larger population and to indicate the confidence in their judgment being correct on a half-range probability scale (50% to 100% certain). Five city comparisons were elicited; three pairs of cities were Canadian, while two pairs were foreign. The order of the five comparisons was randomized across subjects. The overconfidence measure was constructed as

$$overconfidence = \sum_k (a_{ik} - \bar{b}_k) / 5$$

where  $a_{ik}$  is respondent  $i$ 's estimated confidence of being right on judgment  $k$  and  $\bar{b}_k$  is the average percent correct choice of judgment  $k$  in the population.

***Other Variables.*** We measured risk attitudes, believing that those people with higher risk tolerance would be more likely to continue spending time and money on the inventions. To measure risk attitude we

used seven of 17 items of risk taking aspects from the Jackson Personality Inventory (JPI-R) (Jackson, 1977). These seven items were also chosen as being the most germane to the domain of inventing. This instrument has been used to successfully measure risk-taking propensity in general, and for entrepreneurs in particular (Begley & Boyd, 1987; Busenitz & Barney, 1997). Two examples are: “I would participate only in business undertakings that are relatively certain” and “I consider security an important element in every aspect of my life”. We removed questions that were not be related to business risks, such as questions on general thrill seeking: skin-diving in the ocean.

We also measured self-efficacy. We believe that during the invention process inventors will develop perceptions of competence and believe in their capacity to perform the specific tasks they face (Bandura, 1997, 1986). A self-efficacious inventor is more likely to perceive the feasibility (Krueger et al, 2000) of his invention’s success. We used the self-efficacy items from Markman et al (2002). Two examples are: ‘I feel competent to deal effectively with the real world’ and ‘I often feel there is nothing I can do well’.

We had reason to believe that some people may invent because they enjoy it. Therefore, we created a 6 item scale regarding the intrinsic motivation to invent after reviewing the work of Deci et al. (1999). Two examples are: “I invent because I enjoy it” and “I enjoy the feeling of solving problems”. We included this variable because we believe that ‘love of inventing’ may affect time spent on the invention, but it should not have a major effect on the amount of cash R&D expenditures, except through its impact on the time spent. Our final personality variable was adapted from work on opportunity recognition (Gaglio & Katz, 2001). These authors hypothesized that inventors would be better than the general population at recognizing new ideas or ways in which existing items could be improved. Finally, we also asked questions regarding experience with inventing. We believed that more experienced inventors would have a more accurate estimation of the success of their inventions ex-ante and also be in a better position to accurately interpret the feedback from the IAP.

We also asked a series of demographic questions. We believed that people with more money to spend would be more willing to spend their money on inventions and we therefore gathered household income information. We also measured education levels, believing that education levels could proxy for the availability of outside job options that could pay more (i.e. more educated people have more job opportunities). It is also possible that inventors with higher education levels might be better able to interpret the report from the IAP.

### Results

Respondents reported spending an average of \$610 (Std. Dev. \$1,152) before obtaining a review and \$422 (Std. Dev. \$1,263) after obtaining a review<sup>1</sup> With maximums of \$6,500 and \$10,000, respectively. In addition, 50% spend less than \$150 before the review, indicating that a majority of inventors have not done much development work before approaching the IAP. As indicated earlier 64% spent \$0, indicating a majority of inventors stop development efforts after obtaining the report. Considering time spent developing their ideas, on average, inventors spend 15% of the development time after receiving the review, and 50% spend less than 1% of their time on the inventions after the review.

***Decision to Spend Time and Money.*** We analyzed two decisions, the extensive decision if they continued at all, and the intensive decision; how much time and money they spent after receiving advice to stop. To do this, we conducted two levels of analyses. We ran a logistic model to determine the likelihood of continuing to spend money and time after feedback. For this regression, we use measures of optimism, self-efficacy, over-confidence, risk attitudes, and intrinsic motivation. We also include the demographic variables for income (median split), prior expenditure, education, and experience with inventing. The results can be seen in tables 3 and 4.

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<sup>1</sup> All dollar figures reported in this paper represent 2003 dollars Canadian.

We found optimism to increase the odds of spending more money after receiving negative feedback. Optimistic inventors were more likely to continue spending money than less optimistic ones ( $\beta = 0.36, p < 0.05$ , odds = 1.64). They were also moderately more likely to spend additional time ( $\beta = 0.32, p = 0.08$ , odds = 1.38). As inventors reported more experience developing inventions, they were more likely to continue to spend money. ( $\beta = 0.25, p < 0.002$ , odds = 1.29). These experienced inventors were also likely to spend more time ( $\beta = 0.17, p < 0.05$ , odds = 1.19). Interestingly, we found that higher education increased the odds of spending more time than lower educational levels ( $\beta = 0.14, p < 0.05$ , odds = 1.15). We however found no effects for education on the likelihood of spending more money. Finally, to investigate the possible evidence of sunk cost fallacy, we controlled for dollar expenditures prior to evaluation. We found that inventors who spent more money before approaching the evaluation agency were more likely to continue spending money than those who put in lower amounts ( $\beta = 0.32, p < 0.01$ , odds = 1.39). We found no evidence for overconfidence, self-efficacy, intrinsic motivation, opportunity recognition, risk-taking, and the background variable, high income class.

For the intensive decision, we performed a multivariate regression model to determine how much additional time and money were allocated to the project (see results in Table 5).

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We found again that overconfidence had no power in predicting the amount of money and time that was spent after the receipt of negative advice. Therefore, we do not consider overconfidence as affecting the decision to continue work on a project in this study. Using our measure of optimism we found that, in addition to increasing the odds of continuing to spend, having a positive outlook leads to an increase in both time and money spent on a project after receiving advice to stop. As inventors become more positive in

their outlook, they spend more money ( $\beta = 0.11, t = 2.88, p < 0.01$ ) and more time ( $\beta = 0.06, t = 2.37, p < 0.05$ ) even when experts say that they should not spend anything more.

Table 5 also shows that the more experienced inventors spend more money ( $\beta = 0.03, t = 2.00, p < 0.05$ ) and time ( $\beta = 0.03, t = 3.51, p < 0.001$ ) on inventions for which they have been advised to stop. In our extensive analysis, we did not find the odds of spending more money increasing with high income class. However, in our intensive model we find that when inventors do continue investing in the project, those earning higher income spend more money after receiving negative feedback ( $\beta = 0.10, t = 2.26, p < 0.05$ ). As expected, there was no effect of income on the amount of additional time spent on the development of lower quality inventions.

Here again, we found no evidence of intrinsic motivation; no evidence that inventors, will spend additional time on a low quality invention simply because they enjoy inventing. We believe that they enter the profession based on an interest in inventing, but they don't waste time on inventions with less potential. We find support for this argument in the negative coefficient on opportunity recognition ( $\beta = -0.03, t = -1.014, p < 0.31$ ). Risk-taking which also had a negative coefficient ( $\beta = -0.067, t = -1.930, p = 0.55$ ) seems to support the argument as well. There is the indication that those inventors that are able to recognize other potential inventions are less likely to spend more money on inventions with low potential. They rather go on to develop other ideas.

### **General Discussion**

We evaluated the impact of inventors' overconfidence and optimism on their decision to continue investing resources in inventions with low commercial value. We found that the more optimistic were more likely to continue spending and actually spent a larger proportion of money and time after receiving negative advice than those who had a less positive outlook on life. We found that experience with inventing also explained this additional allocation of resources. As experience inventing increased, so did the

propensity to spend money and time on inventions that had received negative evaluations. Most experienced inventors were expected to have made a few costly mistakes in the past and therefore more appreciative of expert advice. However, the results suggest that experience makes inventors more likely to disregard outside expert advice and place more weight on their own assessment of the quality of their invention. We do not expect that this makes them any better at evaluating their invention but simply that it makes them more likely to place less weight on expert advice.

Another variable that generated interest was higher education. Inventors who had obtained higher post secondary education had increased odds of spending some more time possibly cross-checking issues raised in the evaluation report. However, they seem to quickly confirm the facts in the evaluation reports and actually spend less time overall. We found prior expenditure to increase the odds of spending more resources, an indication of sunk cost bias (Arkes and Blummer, 1985). Inventors who have spent a considerable amount of resources prior to receiving evaluation were likely to decide to spend some more resources.

Our results for overconfidence did not confirm our hypothesis. Contrary to our predictions, there were no effects of overconfidence on the likelihood and actual expenditures of time or money. One potential explanation is that extremely overconfident inventors may not approach the IAP since they believe (incorrectly) that their invention will be a success, and thus additional information is of little value. This could reduce the range of overconfidence in our sample and lower the chance of finding an effect. In their paper, Weick and Eakin (2005) suggest that the data in Astebro (1998), which shares the same source with data in this paper, may only include inventors who attach value to invention evaluation assistance. If more overconfident inventors don't approach the IAP because they do not see the need for evaluation, then it could provide an explanation for why we saw no effect of our overconfidence measure on the decision to

continue investment of time and money. It would also explain the effects we found for optimism as these supposedly 'less confident inventors' rely on a positive outlook to continue inventing when advised to stop.

### ***Limitations and Future Research***

We believe that this sample is representative of serious inventors that are looking to commercialize their inventions. Informal surveys by the CIC suggest that nine of ten inventors that approach the Canadian IAP abort the submission process after considering the fee to be too high, suggesting that low value inventions are excluded from the sample. This is a positive way to trim the sample, because we believe that this limits our sample population to only serious inventors.

There may however be some sampling biases that we could control. For example, inventors that are already well informed about the commercial prospects of their invention may consider the additional information from the IAP to be of marginal value. This could imply that the frequency of IAP ratings in our sample is incorrect; although it could be misstated in either direction. Those that know their invention has little success will stay away, thus lowering the frequency of negative ratings. However, inventors that have already determined a high likelihood of success may also stay away from the CIC, lowering the frequency of positive ratings. While this is a possibility, we don't feel that it damages the results we find within those inventors receiving the advice to cease effort.

Another limitation of our study is that we are drawing conclusions about how the inventors that approach the Canadian IAP are at an early stage of their development process. They are a subset of all inventors/technological entrepreneurs, where the expected value of their invention at least that of the examination fee, which was approximately U.S. \$250 in 1994 and U.S. \$750 in 2001. There are therefore several sample selection biases that we are unable to control for. We make no claims that the sample is representative of the general population of inventors. However, there is no alternative efficient method of

obtaining a representative sample of inventors and our method allows us to efficiently obtain a reasonably large sample that is likely to represent a fairly broad cross-section of independent inventors.

### **Conclusion**

Previous research has found large effects of overconfidence on decision-making processes. Most previous research has been experimental, where large effect sizes can be obtained through manipulations. In this research we find similar behavioral changes as those found in the laboratory. The magnitude of the optimistic biases is quite large and on the same order as that obtained by Arabsheibani et al. (2000).

This paper is important because it begins to explain the reasons why inventors continue to expend resources on projects with a low likelihood of success. We find optimism to be an important explanation of continued efforts on bad ideas.

This paper contributes to innovation research by showing the effects of optimism on increased entry, in this case the continuation of inventor effort in pursuit of negative returns. While inventing activity creates a net benefit to society, understanding the factors that lead to the decision to continue on less than promising inventions could provide a positive step in the better utilization of inventor effort.

**Table 1**  
**Base Rates and Diagnosticity of Invention Reviewed by the CIC, 1976-1993**

<b>Rating</b>	<b>Sample Total</b>	<b>Percent of all</b>	<b>Probability of Commercialization</b>	<b>Median return among commercial*</b>
<b>(1)</b>	<b>(2)</b>	<b>(3)</b>	<b>(4)</b>	<b>(5)</b>
A - recommended for development.	24	2%	50%	26.0%
B - may go forward, but need to collect more data.	45	4%	16%	26.0%
C - recommended to go forward, returns likely modest.	204	19%	16%	-13.2%
D - doubtful, further development not recommended	657	60%	4%	-28.5%
E - strongly recommend to stop further development	163	15%	0%	N/A
Weighted Average			7%	-7.3%
Total	1091	100%		

N/A. No inventions succeeded. Return on investment are not applicable, or alternatively, negative infinity.  
 \*Data for inventions rated A and B not possible to compute separately. Numbers on returns are for A and B combined

**Table 2****Percentage of Resource Expended After Negative Evaluation**

<b>Percentage of Total</b>	<b>Money</b>	<b>Time</b>
0%	64%	63%
1%-20%	4%	8%
21%-40%	8%	12%
41%-60%	9%	8%
61%-80%	6%	5%
81%-100%	9%	4%

**Table 3**  
**Likelihood of Spending Money after Evaluation**

	Initial Model		Final Model	
	Coefficient	Exp(B)	Coefficient	Exp(B)
Optimism	0.36 (0.33)	1.44	0.49* (0.23)	1.64
Self-Efficacy	0.32 (0.45)	1.38		
Overconfidence	0.75 (1.16)	2.12		
Opportunity Recognition	-0.11 (0.21)	0.89		
Intrinsic Motivation	0.27 (0.30)	1.31		
Risk-taking	-0.36 (0.22)	0.69		
Experience developing inventions	0.24 ** (0.09)	1.27	0.25** (0.08)	1.29
Annual Income over \$50K	0.41 (0.30)	1.50		
Highest Education Level	0.03 (0.07)	1.03		
Prior expenditure before evaluation	0.37 ** (0.12)	1.45	0.33** (0.11)	1.39
Constant	-5.10 ** (1.61)	0.01	-4.20*** (1.04)	0.02

†  $p < 0.100$    \*  $p < 0.05$    \*\*  $p < 0.01$    \*\*\*  $p < 0.001$

**Table 4**

**Likelihood of Spending Time after Evaluation**

	Initial Model		Final Model	
	Coefficient	Exp(B)	Coefficient	Exp(B)
Optimism	0.17 (0.30)	1.19	0.32 <sup>†</sup> (0.18)	1.38
Self-Efficacy	-0.08 (0.39)	0.93		
Overconfidence	0.90 (1.10)	2.45		
Opportunity Recognition	0.24 (0.20)	1.27		
Intrinsic Motivation	0.11 (0.27)	1.12		
Risk-taking	0.13 (0.21)	1.14		
Experience developing inventions	0.17 <sup>*</sup> (0.08)	1.19	0.17 <sup>*</sup> (0.08)	1.19
Annual Income over \$50K	-0.30 (0.27)	0.74		
Highest Education Level	0.14 <sup>*</sup> (0.07)	1.15	0.14 <sup>*</sup> (0.07)	1.15
Prior expenditure before evaluation	0.39 <sup>**</sup> (0.15)	1.48	0.39 <sup>**</sup> (0.14)	1.47
Constant	-3.24 <sup>*</sup> (1.33)	0.04	-2.33 <sup>***</sup> (0.65)	0.10

†  $p < 0.100$     \*  $p < 0.05$     \*\*  $p < 0.01$     \*\*\*  $p < 0.001$

**Table 5**  
**Resources Spent after IAP evaluation**

	Money		Time	
	Initial Model	Final Model	Initial Model	Final Model
Optimism	0.08 (0.05)	0.11** (0.04)	0.06 <sup>†</sup> (0.04)	0.06* (0.02)
Self-Efficacy	0.06 (0.07)		0.02 (0.05)	
Overconfidence	-0.11 (0.18)		-0.01 (0.13)	
Annual Income over \$50K	0.10* (0.05)	0.10* (0.04)	-0.02 (0.03)	
Time Developing Inventions	0.03* (0.01)	0.03* (0.01)	0.03** (0.01)	0.03*** (0.01)
Highest Education Level	-0.01 (0.01)		0.00 (0.01)	
Opportunity Recognition	-0.04 (0.03)		0.02 (0.03)	
Intrinsic Motivation	0.03 (0.04)		-0.02 (0.03)	
Risk-Taking	-0.06 (0.04)	-0.07 <sup>†</sup> (0.35)	-0.03 (0.03)	
Constant	-0.29 (0.22)	-0.18 (0.16)	-0.19 (0.15)	-0.19 <sup>†</sup> (0.11)

<sup>†</sup>  $p < 0.100$    \*  $p < 0.05$    \*\*  $p < 0.01$    \*\*\*  $p < 0.001$

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