WHAT FACTORS AND EXPERIENCES MOTIVATE INNOVATORS? AN EXPECTANCY-VALUE-COST APPROACH TO PROMOTING STUDENT INNOVATION

By

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A thesis submitted to the Graduate Program in Education
in conformity with the requirements for
the Degree of Doctor of Philosophy

Queen’s University
Kingston, Ontario, Canada
February 2020

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Abstract

This multi-manuscript dissertation integrated a systematic literature review, interviews, and a developed survey instrument to investigate the expectancies, values, and costs that are involved in motivating current Canadian innovators. Using the Expectancy-Value-Cost framework, the research investigated individual innovators' motivations, but also considered the relationship between individual motivations and the environments (e.g., climates, contexts, and the surroundings of innovators) and strategies (e.g., approaches, interventions, and decisions made by figures of importance within contexts) that they experience. This research offers unique insights in alignment with innovation education that address paucities within the innovation literature at large, particularly the relative lack of research addressing motivations of the innovative individual. The findings of this research nuance and advance the knowledge of promotive and hindering motivational factors that can inform the design of innovation promotion efforts. Innovator participants also identified specific strategies that they use to make their innovating more likely and gave advice to future innovators regarding maximizing expectancies and values, whilst mitigating perceived costs of innovation. Innovators also reflected on their educational experiences to identify the mechanisms that formal and informal education can provide in increasing the prevalence of innovation among Canadian students.
Acknowledgements

This dissertation is dedicated to the memory of Dr. John G. Freeman, a kind man, and a fierce advocate for a better world and graduate students everywhere. May his memory be eternal.

John was an incredible man, but even he would not have succeeded in getting me this far without helping hands. My work would not have been possible without the generous mentorship of the finest dissertation committee a graduate student could ever hope for. Dr. Benjamin Bolden who gave me the structure to succeed and provided unending kindness and perspective. I will never forget that he took a tremendous risk in taking me on after John’s passing and knowingly taking what would have been an absolute roller coaster ride as a committee member and deciding to turn it up to eleven as my supervisor. Dr. Don Klinger who told me in the darkest days that it would be okay and that we would finish what John and I started and do it well. Dr. Denise Stockley whose wise counsel has helped make my aspirations possible and has directly enabled a prosperous career path I had never imagined. I’d like to thank Drs. Theodore Christou, Rosa Bruno Jofré, Jamie Pyper, and Christopher DeLuca, and my friends at the Faculty of Education at Queen’s University for the opportunities, lessons, and community that kept me going. My friends in Health Sciences played a role by putting up with my antics and quirkiness and helping me persevere in my study, especially Dr. Richard van Wylick. Penultimately, I’d like to thank my parents, my brother, and my beloved for helping me become that man that I wanted to be.

I’ll end with John again. Such was his magic and wisdom that he introduced me to my beloved, whose love, support, and care has made my work possible. My Ph.D. was important but introducing me to Heather— I am convinced— was the greatest gift John ever gave me.
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List of Abbreviations

Expectancy-Value-Cost Theory - EVC
Expectancy-Value Theory - EVT
Self-Determination Theory - SDT
Intrinsic Task Value - ITV
Attainment Task Value - ATV
Utility Task Value - UTV
Exploratory Factor Analysis - EFA
Confirmatory Factor Analysis - CFA
Glossary

**Innovation** (An amalgam definition Amabile & Kramer, 2011; Baregheh, Rowley, & Sambrook, 2009; Berkun, 2017) - The process or act of effecting change through the novel execution of ideas likely to generate a process or product of value.

**Innovator** (Applying the definition above) - A person who effects change through the novel execution of ideas likely to generate a process or product of value.

**Innovator Identity** - The extent to which a person perceives themselves as an innovator.

**Expectancy-Value Theory** (Eccles, 1983) - a value of achievement motivation that conceptualizes an individual’s motivation to complete a task as a function of the acquired expectancies and values that an individual holds. Cost is a minor and negative value rather than its own construct.

**Expectancy-Value-Cost Theory** (Barron & Hulleman, 2015) - a revised version of Expectancy-Value theory that more deeply explores multidimensional and contextual costs as an equal consideration balanced against the expectancies and values of a given task.

**Environments** (Amabile, 1996) - Context climates, contexts, and the immediate surroundings of innovators.
**Strategies** (Amabile, 1996) - Approaches, interventions, and decisions made by figures of importance within contexts.

**Leaders** (Kremer, Villamor, & Aguinis, 2019) - Leading figures in a given learning context, namely teachers, managers, supervisors, and mentors.

**Expectancies** (Barron & Hulleman, 2015) - Expectations of Success, akin to self-concept and self-efficacy with respect to a particular task, in this case, innovation.

**Subjective Task Values** (Barron & Hulleman, 2015) - The specific values than an individual believes they would obtain from completing a specific task, in this case, innovating.

**Intrinsic Task Values** (Barron & Hulleman, 2015) - The perceived enjoyment, interest, or fun that a person would experience from completing a specific task.

**Attainment Task Values** (Barron & Hulleman, 2015) - The perceived fulfillment obtained, self-actualization found, or importance that a person attributes to completing a specific task.

**Utility Task Values** (Barron & Hulleman, 2015) - The perceived transferable benefit (e.g., monetary or non-monetary rewards) that a person believes they would obtain from completing a specific task.
**Costs** (Adapted from Flake et al., 2015) - The anticipated holistic effort, resources, and negative state an individual would have to expend to complete the task as well as the possibilities they would have to abandon to complete a specific task.

**Formal Education** (UNESCO Institute for Statistics, 2011) - Education that is primarily institutional, intentional, and planned thoroughly.

**Informal Education** (UNESCO Institute for Statistics, 2011) - Education that is characterized as taking place outside institutions and is, therefore, less structured and planned than formal education.
Chapter 1
General Introduction

Innovation in Recent Years

The Innovation Policy Platform, an initiative of the Organization for Economic Co-operation and Development (OECD) describes Canada as an economic power driven by investment in innovation and growth-minded initiatives in institutions and corporations (OECD, 2017). Indeed, recent policy documents within Canada refer to the importance of innovation to our way of life with particular reference to how innovation is central to our knowledge economy. (Council of Ministers of Education Canada (CMEC), 2019; Ontario Ministry of Education, 2014; OECD, 2017). Innovation scholarship paints a similar picture with some going so far as to argue that optimally supporting innovation will soon become a decisive factor in maintaining our very way of life (Catmull & Wallace, 2014; Council of Ministers of Education Canada (CMEC), 2019; Cramond & Fairweather, 2013; Emo, 2015; Jones, 2009). A 2016 report on the demographics of innovation commissioned by the Information Technology & Innovation Foundation drew much the same conclusion: policymakers should work to broaden and deepen the pool of potential innovators rather than increasing funding for existing innovators (Nager, Hart, Ezell, & Atkinson, 2016). Achieving Excellence (Ontario Ministry of Education, 2014) is another such work of policymakers. It describes innovation as a crucial pillar for economic and social development as well as calling for the development of a spirit of innovation among students. This spirit is a function of the motivation to innovate and it is built by formal and informal experiences in school and elsewhere.
As established in the innovation education and management of innovation literature (e.g., Lawrence, Phillips, & Tracey, 2012; Remtulla, 2007; Scott & Bruce, 1994), many individuals and groups loftily aspire to innovate; however, given that it is a risky affair psychologically (O’Shea & Buckley, 2007), socially (Harris, 2016), and materially (Emo, 2015), there are holistic costs to innovating beyond what can be considered the financial price. The perceptions of these psychological, social, and material costs and the specific methods to counteract their demotivating effects have been understudied and are a focus of this research. Studying and identifying methods to mitigate the risks while maximizing the promotive factors that motivate innovation can serve to inform the support of innovators, and thereby the societal progression that innovators drive. Given that secondary and postsecondary students are soon to enter the workforce and represent a significant component of an intellectual society, optimally mobilizing innovation starts with them and continues with the development of workforce learners.

In recent years, a loose consensus has formed around the notion of innovation as a process of applying practical or theoretical knowledge to novel contexts, which can facilitate discoveries, solve problems, improve designs, and generally enhance individual lives and society as a whole (Baregheh et al., 2009; Drucker, 2006; Pavitt, 2005). These ideas can be incremental innovations which are typically improvements of existing ideas or small-scale new ideas as compared to radical innovations which are original ideas that become famous, make large societal impacts in their own right, or are widely recognized. For example, incremental and radical innovators like Sheryl Sandberg (Incremental; Lean-in Foundation), Cluny Macpherson (Incremental; first battle gas mask), Norman Borlaug (Incremental; dwarf wheat), and Elon Musk (Radical; Tesla and incremental; Solar City) have been credited with advancing society and their achievements are held up as examples for others to strive to mirror. It has been widely
agreed among philosophers and scholars that innovation helps society thrive by combating obsolescence and promoting societal progression through new ideas (e.g., Carr, Kendal, & Flynn, 2016; Drucker, 2006; Glassman, 2001). These new ideas come from innovators and the cultivation of innovators is, therefore, a factor in driving society forward (Bhaduri & Kumar, 2011; Shavinina, 2012). How then do we effectively support the innovation of students in schools and other learning environments? In this dissertation, I will use the lens of motivation to examine how innovators conceptualize the process and factors relating to innovating. Motivation will thus be used as a theoretical framework that offers promise for understanding what is needed to support innovation and the education of future innovators. How do we motivate more learners to be innovative? How do we increase student innovators’ motivation? The answers may lie with those successful innovators who we want our learners to emulate. Efforts to understand the motivations of innovators can inform the structuring of supports and cost mitigating strategies necessary to help learners successfully convert their potential into innovation.

Although many researchers investigate innovation as an outcome (e.g., Berkun, 2017; Brusoni, 2006; Dodgson, Gann, & Phillips, 2013; Drucker, 2006), a much slimmer cross-section of scholars interested in innovation focus directly on how to promote or support innovation (Amabile, 1996; Amabile & Kramer, 2011; Carr et al., 2016; Mirvis & Googins, 2018; Shavinina, 2013c). Furthermore, the study of what motivates innovators to successfully propel their ideas forward and overcome the obstacles of mobilizing them has largely been overlooked in terms of informing programs in educational settings. When motivation has been addressed, research has tended to focus on the experiences of prodigies and gifted students (e.g., Shavinina, 2013c; Yun Dai, 2013) as opposed to identifying ways to leverage the potential of a wider
segment of society (e.g., Amabile & Pillemer, 2012; Mayhew, Selznick, Zhang, Barnes, & Staples, 2019; Scott & Bruce, 1994). This leaves a gap in the literature in understanding the motivations of existing innovators as a means to inform innovation education, specifically from a multidisciplinary view. This multi-manuscript dissertation will directly address the paucity of literature that addresses the motivations of innovators by examining the factors that underpin the motivation of existing innovators and using these findings to inform future innovation programs with students in schools.

The Need for Further Research

We know very little about who innovators are and where they come from, including demographic background, disciplinary study, or occupation. Disciplinary and population demographics on innovators are scarce, as what exactly constitutes an innovator is rarely agreed upon by scholars, even within the same discipline, never mind across disciplines (Baregheh et al., 2009). Studies on innovators often focus on the skills of the most extreme examples such as critical thinking, management acumen, or planning foresight (e.g., Fagerberg, 2005; Ito & Kawazoe, 2015; Noonan, 2013; Osburn & Mumford, 2006). A question as simple as what fields do innovators come from has received only cursory attention in the literature beyond that many come from STEM (Science, Technology, Engineering, and Mathematics) fields (Nager et al., 2016; Shavinina, 2013f). As noted elsewhere, there is more to innovation than just STEM subjects (e.g., Koch, Binnewies, & Dormann, 2014; O’Shea & Buckley, 2007; Self, Dalke, & Evans, 2012; Sousa, 2013). Regarding innovator characteristics, Nager et al. (2016) found in their survey of 900 American innovators that a significant minority of U.S. innovators were born outside the United States, only 8% of U.S. born innovators were from minority groups, and that only 12% of recognized innovators were women. These demographics have not yet been
researched in Canada and thus we do not know this crucial information about our population of innovators. The understandings that we do have come from creativity and innovation literatures as they report where society perceives innovation to commonly occur (e.g., Janger, Schubert, Andries, Rammer, & Hoskens, 2017; Nisula & Kianto, 2015; Sousa, 2013). Presently, one likely looks at technology, design, business, and engineering-centred organizations to find innovators, which disenfranchises the advances made by innovators that lie outside the societal zeitgeist of where innovation is expected to occur.

As current innovation development research is dominated by business literature (Soleas, 2018b), there is a need to focus on other disciplines as well to honour the consensus that innovation occurs between, across, and in many different disciplines (Baregheh et al., 2009). Education aimed at developing innovators before the workplace, innovation education, has not yet matured (Shavinina, 2012).

The field of innovation education—education aimed at nurturing nascent innovators—remains underdeveloped (Gunnarsdottir, 2013; Shavinina, 2012). Psychological underpinnings in innovation education are scarce. The developmental perspective and hence the scholarly ideas that do exist in innovation education do not have quite the firm grounding in theories of psychology that exist in other analogous fields such as creativity (O’Shea & Buckley, 2007).

Indeed, Ryan and Deci (2017) in their 40-year review of research in motivation, noted that change does not fundamentally begin at the organizational level, as hypothesized commonly in business literature (e.g., Amabile & Kramer, 2011; Siddiqi, 2017). Rather, it begins at the level of psychology (Hooker, 2017; Jiang & Thagard, 2014; Spanjol & Tam, 2010; Wigfield & Eccles, 2000), the level where costs, expectancies, and values are internally perceived and debated in the individual human mind. It is unclear from current studies how the expectancies
and values of innovating are internally mediated, nor do we fully understand the perceived costs at the individual level. Taking the lens of motivational psychology and investigating the motivations of innovators will inform the future of supporting innovation education.

In contrast to the focus of business-aligned literature on outcomes, a focus on developing the factors and motivation that increase the potential to reach those outcomes may more effectively support innovation. The current state of affairs internationally within innovation education is dominated by a focus on prodigies rather than students of all sorts (Noonan, 2013; Shavinina, 2012, 2013d). It makes much more sense and is likely to yield a better result if focus and investment are made for a wider segment of potential innovators. Past innovation instruments and studies focused primarily on determining whether someone was, in fact, an innovator (e.g., Bobic, Berman, West, & Martinez, 2014; Kirton, 1976; Nordin, Zain, & Samsudin, 2015). This focus on outcomes has not optimally facilitated the cultivation of support for innovation (Shavinina, 2012; von Hippel, 2005). In fact, it has contributed to the perception that only radical innovation is truly innovation (Ali, 1994; Norman & Verganti, 2014; Sandberg, 2013). Innovation education could expand its scope to build potential for all students. My research expands the scope of innovation education to determine the factors that would optimally cultivate innovators. This move to investigating the motivation to innovate demands a different type of inquiry than those that currently exist, one that consolidates the known findings of the disparate literatures and then fills in the gaps with an interdisciplinary sample that better aligns with the reality of the demographics of individuals who innovate.

My research will leverage Expectancy-Value-Cost Theory (EVC), which identifies the motivation to do something as the balance of the perceived benefits and supports versus the costs and risks (Atkinson & Feather, 1966; Barron & Hulleman, 2015; Eccles & Wigfield, 2002;
Expectancy-Value-Cost Theory identifies that the motivation to complete tasks involves balancing the expectancies of success (self-concept and self-efficacy) and the perceived values of the task (attainment, intrinsic value, and utility) against the costs of that task. The motivation for a given task can be explained through the interaction of expectancies—the confidence an individual has in their ability to succeed in a given task—and task values—the perceived importance (attainment), enjoyment (intrinsic), and/or usefulness (utility) an individual gains from a given task (Atkinson & Feather, 1966; Wigfield et al., 2009). If an individual expects to succeed and sees value in the task, they are more likely to be motivated to participate in and complete it. Complicating the simplicity of EVC is the concept of cost (Flake et al., 2015). Eccles (1983) seminally defined cost as the anticipated effort an individual would have to expend to complete the task as well as the possibilities they would have to abandon to complete the task.

**Purpose and Research Questions**

This multi-manuscript dissertation seeks to examine the expectancies, values, and costs that are involved in motivating current Canadian innovators. The following questions guide this study to identify the factors that support innovation among Canadian innovators and will have the potential to inform the design of learning environments and strategies that support innovation education:

1. What are the expectancies, values, and costs of innovating as identified by Canadian innovators?
2. How do Canadian innovators balance the costs of innovating so that they are able to see innovation projects through to completion?
3. How do Canadian innovators perceive education can help students balance the expectancies, values, and costs of innovating?

This dissertation will investigate individual innovators’ motivations but will also consider the relationship between individual motivations and the environments (e.g., climates, contexts, and the surroundings of innovators) and strategies (e.g., approaches, interventions, and decisions made by figures of importance within contexts) which they experience and their implications for learning.

**Rationale**

These questions offer unique insights that address ongoing gaps within the literature, particularly the relative lack of research addressing motivations of the innovative individual. Business adjacent literatures have instead focused on the motivations of organizations (e.g., Greve & Taylor, 2000; Hosseini & Narayanan, 2014; Radicic, Pugh, Hollanders, Wintjes, & Fairburn, 2016). This inquiry will examine expectancies, values, and costs at the individual level. It will also address systemic barriers and supports reported by individuals, which represents another relatively novel contribution for the field. The individual motivations for innovation, when addressed in the past, have typically been addressed peripherally through commercial context proxies, such as patents or profits (e.g., Brusoni et al., 2006; Maria Stock, Zacharias, & Schnellbaecher, 2017; Smith, 2005), rather than with a primary focus on the individual drivers of behaviour such as confidence, perceived value, or the costs that complicate higher-order thinking and action like innovative behaviour (Flake et al., 2015; Wigfield et al., 2009). By asking innovators from a variety of fields about their motivations, this dissertation will provide a snapshot of the potential factors at play for an interdisciplinary sample of innovators; another novel contribution that will inform innovation education efforts.
As identified above, studies of innovative behaviour have tended to be focused on a single domain, which could cue a reader to assume that the motivators of innovation are domain-specific. This study will examine this heretofore unchallenged assumption by recruiting innovators across domains, including sciences, arts and humanities, social services and community organizing, education, and business. This interdisciplinary approach and sample would likely provide evidence supporting or undermining this belief. It will also provide empirical evidence for a wider, more inclusive, and representative view of innovation by investigating the motivations of all innovators rather than focussing on prodigies or those who become famous for their innovating.

The following chapter will explore the state of affairs in the innovation and adjacent literature and consolidate the currently siloed knowledge from the wide variety of disciplines into the EVC framework and isolate the remaining gaps that require investigation to best inform the design of innovation promotion efforts.

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Chapter 2

The Literature on Motivating Innovation

Innovation will play a key role in confronting many of the issues facing humanity. It can be defined variously and tends to include problem-solving processes (Cramond & Fairweather, 2013), applied creativity (Horkoff, Maiden, & Asboth, 2019), and executing novel ideas to create societal value (Baregheh et al., 2009). The capacity to refine existing ideas and challenge existing ideas is a very important and thankfully human process drawing intense interest from a range of disciplines. The importance, variety, and outcomes of innovation have made it necessary for institutions, corporations, and educational systems to more effectively stoke this crucial skill. Although the interest is intense, the precise motivation factors underpinning this skillset remain siloed in various disciplines. As a first step, it would be important to isolate and evaluate all the available evidence across disciplines of the promotive and hindering motivating factors that would need to be addressed by those who seek to build learner capacity to innovate.

This interdisciplinary perspective necessitates a broader view of the environments where innovation promotion occurs and the strategies which leaders and decisionmakers can use to enact its promotion. Environments will include contexts, climates, and the spaces where innovation promotion can occur, whereas strategies will include the decisions, approaches, and interventions that the leading figures (leaders) in a given context, namely teachers, managers, supervisors, and mentors can utilize to make innovation more likely.

This chapter will consolidate the disparate literature pertaining to the support of innovation in the varied disciplines through the use of strategies or environments. It will identify the lingering gaps in knowledge that would need to be investigated to better inform innovation education efforts. As innovation is a multi-disciplinary common interest shared by business,
economics, education, engineering, management, manufacturing, psychology, and many more disciplines, the resulting thinking should be a shared understanding that reflects the diverse perspectives, goals, and aspirations of these disciplines (Baregheh et al., 2009; Green, 2013).

This chapter will show that innovation studies have previously taken a primarily business and quantitative view, typically, but not exclusively using proxy measures such as the outcomes of innovation from an economic perspective (e.g., Dodgson et al., 2013; Martin, McNally, & Kay, 2013; Quintane, Casselman, Reiche, & Nylund, 2011). This subset of studies on innovation has been disproportionately represented and therefore overshadows the contributions from other disciplines including those within business that consider motives (Amabile, 1996). Hence innovation has largely been defined by business, leading to a disciplinary imbalance. Business scholars naturally have specific and focused lines of inquiry that align with the valuable interests of their discipline and perhaps stand apart from the interests of other disciplines. As well, the studies have tended to be of a single area of study, which makes sense given that interest in innovation has strong origins from the business and economic literature. This leaves an opportunity to consider interdisciplinary studies which would be more likely to represent the diverse disciplinary backgrounds of innovators. Situating innovation as the convergence of multiple areas of study that regularly converse with each other facilitates a greater and deeper understanding of its study and pushes the field beyond the debate of outcomes and towards a complete understanding that can inform how schools and organizations can create and sustain environment and strategies that promote innovation.

**What Do We Know About Innovation?**

It has been known for some time that innovation is a primary source of renewal and revitalization and is vital to the long-term success of society (Dewey, 1997; Glassman, 2001;
Green, 2013; Sousa, 2013). Innovation has diverse definitions in different contexts, such as generating wealth through ideas in business settings or applying creativity in psychology (Baregheh et al., 2009). Complicating the divergent meanings is the ubiquity of the word; the word is used so commonly to describe different phenomena that people use it to mean one thing and their listeners often hear something else. The amorphous meaning of the word causes problems with a unified definition of innovation and knowing who exactly innovators are (Johannessen, Olsen, & Lumpkin, 2001; Nager et al., 2016; Soleas, 2018; U.S. Department of Education, 2014). There are, however, broad commonalities among definitions that separate divergent thinking, inherent in creativity, from the mobilization of a creative idea, inherent in innovation.

Most definitions of innovation reference creativity, and in addition there is almost always an execution, implementation, or application aspect that sets innovation apart from creativity (Baregheh et al., 2009; Carpenter, 2010; Soleas, 2018b). An amalgam definition that captures the general consensus concerning the construct (e.g., Baregheh et al., 2009; Kastelle, 2010; OECD, 2016) is that innovation is the process or act of effecting change through the novel execution of ideas likely to generate a process or product of value. This value can take many forms including monetary, personal, and societal. From this definition, priorities for the development of innovation emerge, namely, that creativity is key, but not enough; innovation also requires the drive to follow through to succeed. This drive has long been noted to depend on not so easily alterable personal factors as well as the very modifiable environment within which the innovation work takes place and the support of leaders and colleagues (Amabile, 1997; Ford, 1999; Scott & Bruce, 1994).
Research in business or economics has typically, but not exclusively focused on outcomes or measures of innovation, such as market share or profit (e.g., Dahlander & Gann, 2010; Quintane, Casselman, Reiche, & Nylund, 2011). However, there has been recent, significant literature into the motivations of social innovators- innovators motivated to make the world better (Anderson, Potočnik, & Zhou, 2014; Mirvis & Googins, 2018; Van Damme, Anseel, Duyck, & Rietzschel, 2019; van der Have & Rubalcaba, 2016). Within the fields of education and psychology, research into innovation development continues and tends to examine constructs such as creativity and the implications of creative activity for the individual and society (e.g., Amabile & Pillemer, 2012; Carr et al., 2016; Sousa, 2013). With these and other disciplines still continuing their work in promoting innovation, the tone has been set by the more established and robust business literature (Anderson et al., 2014; Scott & Bruce, 1994). In short, although there is a great societal focus in the output of innovation, there has not until recently been the same interest in examining how to support the development of innovators through environment and strategies.

Within the education context with the exception of robust bodies of literature in innovation education and (e.g., Anderson et al., 2014), the little research that has examined the development of innovators has tended, with some exceptions to look at the education of famous thinkers like Einstein, Edison, and Curie, rather than a broader population of potential innovators to determine what should constitute innovation education (Shavinina, 2013e). Similarly, factors that translate creativity into innovation within students have not been thoroughly examined within the educational context, with an even greater gap in motivational psychology. For instance, what events or experiences increase the value of innovating for some learners? What can reduce the costs of innovating to the point where more students are willing to give it a try?
Schools have the potential to leverage a much larger segment of society to have this critical skill. Indeed, as shown by the work of Amabile & Pillemer (2012), Bastian, Jetten, Thai, & Steffens (2018) and others in the field of innovation education have shown that innovation is not solely the domain of prodigies. Its underlying skills could be developed through teaching strategies and supportive learning environments.

**Who are Innovators and Why Do We Care?**

If innovation is the novel execution of ideas likely to generate a process or product of value to society, then anyone who executes these ideas is an innovator. Psychologically speaking, they are people who execute and carry out creative ideas (Ito & Kawazoe, 2015; Shavinina, 2013e). Innovation and those who innovate have been the focus of intensive interest for centuries, dating back to antiquity and likely beyond (Eide & Eide, 2006; Green, 2013; Janszen, 1950). Society recognizes the contributions of innovators because they drive society forward as they develop new ideas and revitalize past ideas (Shavinina, 2013b). Innovations can also help to unite society and drive it forward. As such, innovations have the potential to improve people’s lives. The magnitude of change of an innovation has been characterized as being either radical or incremental (Norman & Verganti, 2014). Some innovations acquire world-changing celebrity status (radical innovation), such as the Internet, social justice movements, smartphones, and laser eye surgery; while individuals often take for granted smaller, but still novel innovations (incremental innovations) such as sunscreen, local charities addressing an emerging need, staplers, and pontoons. While society has proven enamoured over the former, the latter have measurably improved our lives as well.

Innovation is not only about prodigies who make many historic, radical advances; it is also about incremental developments and non-prodigies who make radical contributions—less-
known but novel ideas that may not achieve public acclaim. Incremental innovation advances society steadily by applying knowledge from one context to others to create new resources. The world is often changed by such ideas that may go unnoticed (Kress & Selander, 2012). Incremental innovation, in particular, holds a wealth of promise. Canada owes its heritage of innovation to an educated citizenry able to design, refine, and mobilize ideas (Ontario Ministry of Education, 2014). These skills constitute the heart of innovation—skills that can be cultivated in future-oriented schools. As other countries transition from resource economies to become competing knowledge economies, the decisive factor in maintaining Canadian prominence in knowledge production will be effectively leveraging the potential of our future knowledge producers—our students. Analysing the motivations of existing innovators would provide the necessary insights to inform bespoke strategies and environments that would promote innovative behaviour of students and other aspirants.

As will be shown in the following literature review, there are some disciplinary studies, with robust representation from business and economic disciplines, but very few studies using a multidisciplinary perspective and none examining both promotive and hindering motivation factors for innovation from a multidisciplinary view. An Expectancy-Value-Cost motivation perspective guiding a study with a multidisciplinary sample would bring together a more representative perspective on the positive and negative motivation factors to be maximized and mitigated to optimize the innovation potential of learners throughout their learning lifespan. This has the potential to complement the robust bodies of work in the business sector as it focuses on the hindering and promotive factors that could explain the findings in other disciplines as well as business.
Motivating Innovation: An Expectancy-Value-Cost Theory Perspective

Very few innovation studies have used Expectancy-Value-Cost Theory (EVC) as a framework to study innovation and none of these studies examined methods for enhancing the property of environments or outcomes of strategies to support innovation potential. Monge, Cozzens, and Contractor (1992) used the precursor Expectancy-Value Theory (EVT) as a small portion of a theoretical framework for predicting whether business organizations would innovate. Their survey, looking at expectancies for successful outcomes as a prime motivator for innovation, and not task values, was similar to those of other organizational and business literature contributions that looked at innovation in terms of outcomes such as patents rather than considering individuals’ motivation for innovating. Wiklund, Davidsson, and Delmar (2003) considered EVT in identifying that business managers were not likely to look favourably on growth-oriented innovations that they thought were risky, instead preferring to choose safer options with fewer impending costs. Peterson’s (2014) doctoral dissertation used EVT as a framework for understanding the perceptions of teachers when implementing a new language program. As the new program was an instructional innovation, the dissertation shows that there is precedent for using EVT for analyzing the motives of innovative behaviour in individuals.

Beyond these studies, however, very few make use of EVT. Even when extending the search to include creativity studies using EVT, only one additional study was found. Hong, O’Neil, and Peng (2016) briefly mention expectancies as a motivational factor, however, they did not fully utilize EVT in explaining why people are creative or innovative. This documented paucity of literature is directly relevant to the dynamic motivations to innovate and leaves a gap in understanding the motives of the individual. This gap was a major impetus for a systematic review of the innovation promotion literature to identify and categorize the available knowledge.
The lack of emphasis on cost in these studies also supports the need for research using the more encompassing theoretical framework of Expectancy-Value-Cost, which better considers the notions and impacts of cost.

In short, although EVC theory has widespread popularity for explaining complex phenomena in social sciences literature (e.g., Barron & Hulleman, 2015; Flake et al., 2015; Senko, Hulleman, & Harackiewicz, 2011; Wigfield, Tonks, & Klauda, 2009), it has been used very little in the study of innovation—and, surprisingly, not at all with respect to gaining insights into what environmental qualities or specific strategies could motivate innovation.

**The State of the Literature**

With the lack of available EVC-aligned literature, a larger and rigorously structured literature review encompassing more distant, but pertinent studies was necessary to consolidate the disparate studies done before and to organize them within the EVC framework. A typical literature review would not reasonably capture all the necessary information from such varied fields such as business, education, and psychology to name a few. Thus a review that would be systematic, replicable, and thorough was considered ideal to address this concern (Liberati et al., 2009; The Campbell Collaboration, 2017). Systematic reviews are structured literature reviews where researchers retrieve all available evidence on a given topic; they synthesize, categorize, and appraise all the extant knowledge pertaining to a topic of inquiry (Møller & Myles, 2016). In this case, the review sought all articles through an EBSCOhost all database search on environmental and strategic approaches for promoting individuals’ capacity to innovate. A systematic review is an ideal methodology, albeit an uncommon one in graduate education, for consolidating the already available knowledge in a domain with as much interdisciplinary interest as motivating innovation.
In reviewing literature for this dissertation, protocols for systematic reviews were followed as recommended by The Campbell Collaboration, a social sciences international collaboration that regulates and supports the conductance of rigorous systematic reviews of interventions in education and other settings (The Campbell Collaboration, 2017) as well as the PRISMA statement (Liberati et al., 2009). In this case, this registered systematic review (https://osf.io/up83s/) consolidated and analyzed empirical studies about the environments, which included context and situational factors, and strategies, which included purposeful interventions of leaders and colleagues that motivated innovation at the individual human level, guided by the following research questions:

1. What does the existing literature tell us about strategies and environments that motivate and sustain human innovative behaviour?
   a. What is found in the literature about strategies and environments that build self-efficacy of individual innovative behaviour?
   b. What is found in the literature about strategies and environments that build individual-held subjective task values of innovative behaviour?
   c. What is found in the literature about strategies and environments that mitigate the perceived costs of individual innovative behaviour?

Specific consideration was given to the design of environments and strategies that build human expectancies and values, and those that help mitigate the perceived and unperceived costs or risks of innovative behaviour. This systematic review followed an all databases (n=375) search through EBSCOhost performed on January 2nd, 2018 and finalized on April 6th, 2019 in addition to Google and Bing search engine use.
A challenge with the current literature on innovation and a key reason why a systematic review is necessary is the nebulous and often conjectural ideas defining and explaining the motivation of innovators. To manage this issue, only empirical studies with human participants that examined the motivations of individuals as a unit of analysis were included. Additionally, only English-language articles and articles with verified English-language translations were considered. There were no restrictions on the years of considered studies with the earliest studies dating back to 1967, and the most recent published in early 2019. Similarly, when contacting authors of included papers for additional sources to consider, there were no date-of-publication restrictions (See Figures 1 and 2). One hundred and eleven studies from outside the database search were obtained this way, while an additional 64 studies were found to be already included in the search and removed as redundant. Database searching was concluded on May 6th, 2019, and the last of the article-yielding author replies was retrieved by May 18th, 2019.

Search Strategy

For studies relating to strategies, that is, studies of approaches, interventions, instructional techniques, or active decisions made by a leader type figure that motivated innovation, the following Boolean logic was used:

In Abstract AND Paper: Innovat* AND (Motiv* OR Promot* OR Support*) AND (Strateg* OR Approach* or Interven* or deci*). Related word substitutions allowed.

For studies relating to environments, that is, studies of environments, climates, and contexts that motivated innovation, the following Boolean logic was utilized:

In Abstract AND Paper: Innovat* AND (Motivat* OR Promot* OR Support*) AND (Environment* OR Climat* or Context*). Related word substitutions allowed.
Using Boolean logic, the addition of an asterisk would enable the databases to search for all permutations of the rest of the word. For example, motiv* would enable the database to search for motivation, motivator, motivate, motivating as related terms. Next, the databases would move onto synonyms and collate the displayed results.

As secondary search procedures, Google and Bing were also searched using an analogous process with Boolean search code operators and web-scraping software that would isolate the information of papers for review. As well, authors with available email addresses were contacted, resulting in 47 previously undiscovered studies after eliminating redundant duplicates.

**Figure 1.** Flow of information in this systematic review study.
Research assistants were employed to facilitate the screening process by abstracts and titles. Study reviewers operated in dyads, with each member doing independent reviews of each abstract and title by deciding whether the title would be relevant and within the inclusion criteria. If the title was viewed as even remotely relevant, then the abstract was reviewed. Each abstract and title was therefore reviewed twice for the purposes of adjudicating inclusion or exclusion. Disagreements were resolved through the study being included in the full paper review to avoid removing a potentially eligible study. Cohen’s Kappas were calculated using the tabulated data in the aggregate review (See Table 1). The Kappa value (0.806) indicates very good agreement among the reviewers. A total of 249 studies were full-text reviewed of which 115 final studies were determined to be eligible for inclusion in findings extraction.

Table 1

<table>
<thead>
<tr>
<th>Screening Phase Relative Agreement as indicated by Cohen’s Kappa</th>
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</thead>
<tbody>
<tr>
<td>Aggregate</td>
</tr>
<tr>
<td>-----------</td>
</tr>
<tr>
<td>Reject</td>
</tr>
<tr>
<td>Keep</td>
</tr>
<tr>
<td>SE of Kappa = 0.021</td>
</tr>
<tr>
<td>95% CI = 0.764 to 0.848</td>
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</tbody>
</table>
Findings were extracted from the final papers using qualitative data analysis software, ATLAS.ti v8.3.16. In this way, salient hypotheses, methodologies, findings, conclusions, participant data, and other articles for consideration were isolated from the full-text PDFs. From the methodology, the paradigm (e.g., qualitative, quantitative, or mixed-methodology) and tradition (e.g., case study, experimental design, or pre-post-test) were isolated and extracted.

Business workers and employees were the most common study participants (40.0%), followed by students (15.65%), business leaders (13.91%), consumers (13.91%), entrepreneurs (7.83%), teachers (6.09%), and 0.87% from each of academics, librarians, and astronauts (See Table 2 for a complete listing of studies by participant type). Many studies examined the activities of leaders as crucial for promoting the innovative behaviour of other workers. For simplicity’s sake, the term leader will be used going forward for individuals who influence subordinate, worker, or learner groups in their care. In the case of schools, leaders would be those leading classes, namely teachers and administrators.

Table 2

Study Participant Type of the Included Studies

<table>
<thead>
<tr>
<th>Business Employees</th>
<th>Business Leaders</th>
<th>Entrepreneurs</th>
</tr>
</thead>
<tbody>
<tr>
<td>10. Chen et al. (2016)</td>
<td></td>
<td></td>
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<tr>
<td>11. Chen et al. (2019)</td>
<td></td>
<td></td>
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<tr>
<td>12. Curran et al. (2014)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. de Jong et al. (2018)</td>
<td></td>
<td></td>
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</tbody>
</table>

Students

2. Bastian et al. (2018)                   
3. Chi et al. (2018)
When comparing the results of analyzing articles by discipline, the disciplinary breakdown of articles mirrored the findings of Soleas (2018) including the disproportionate
representation of innovation conceptualized in business disciplines (55.56%) such as economics, management, and entrepreneurship compared to the public sector (13.04%), education (8.70%), higher education (8.70%), and psychology (6.96%), as well as small minorities from engineering (5.22%), design (0.87%) and environmental conservation (0.87%) (See Table 3 for a complete study listing by discipline).

Table 3

Disciplinary Context of the Articles

<table>
<thead>
<tr>
<th>Business</th>
<th>Public Sector</th>
</tr>
</thead>
<tbody>
<tr>
<td>17. du Toit et al. (2011)</td>
<td>2. Dee et al. (2002)</td>
</tr>
<tr>
<td>45. Mack et al. (2015)</td>
<td></td>
</tr>
<tr>
<td>46. Maria Stock et al. (2017)</td>
<td></td>
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<tr>
<td>49. Radicic et al. (2016)</td>
<td></td>
</tr>
<tr>
<td>50. Romero and Martínez-Román (2012)</td>
<td></td>
</tr>
<tr>
<td>51. Sergeeva and Zanello (2018)</td>
<td></td>
</tr>
<tr>
<td>52. Shane et al. (2003)</td>
<td></td>
</tr>
<tr>
<td>53. Smith and Sandberg (2018)</td>
<td></td>
</tr>
<tr>
<td>54. Song et al. (2011)</td>
<td></td>
</tr>
<tr>
<td>55. Spanjol and Tam (2010)</td>
<td></td>
</tr>
<tr>
<td>57. Susha et al. (2015)</td>
<td></td>
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</tbody>
</table>
The vast majority of studies in the sample were quantitative (73.04%), with qualitative as a sizable minority (19.13%), and mixed method studies as the least common (7.83%) (See Table 4 for a complete study listing by methodology type).

Table 4

Methodology Type of Included Studies

<table>
<thead>
<tr>
<th>Quantitative</th>
<th>Qualitative</th>
</tr>
</thead>
<tbody>
<tr>
<td>27. Bradley et al. (2018)</td>
<td></td>
</tr>
<tr>
<td>32. Bradley et al. (2018)</td>
<td></td>
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<tr>
<td>33. Bradley et al. (2018)</td>
<td></td>
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<tr>
<td>34. Bradley et al. (2018)</td>
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<tr>
<td>35. Bradley et al. (2018)</td>
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<tr>
<td>37. Bradley et al. (2018)</td>
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<td>38. Bradley et al. (2018)</td>
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<td>40. Bradley et al. (2018)</td>
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<td>41. Bradley et al. (2018)</td>
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<tr>
<td>42. Bradley et al. (2018)</td>
<td></td>
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<tr>
<td>43. Bradley et al. (2018)</td>
<td></td>
</tr>
<tr>
<td>44. Kung, &amp; Chao (2019)</td>
<td></td>
</tr>
<tr>
<td>45. Kuznetsov and Kuznetsova (2011)</td>
<td></td>
</tr>
<tr>
<td>46. Lam et al. (2010)</td>
<td></td>
</tr>
<tr>
<td>47. Lerner et al. (2018)</td>
<td></td>
</tr>
<tr>
<td>48. Li and Yu (2018)</td>
<td></td>
</tr>
<tr>
<td>49. Liu et al. (2017)</td>
<td></td>
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<tr>
<td>50. Lukoschek et al. (2018)</td>
<td></td>
</tr>
</tbody>
</table>
In terms of research design, surveys were by far the most common design (63.48%), followed by case studies (13.04%), interviews (8.70%), experimental and quasi-experimental
designs (7.83%), meta-analyses (6.09%) and then one lone sequential explanatory study (0.87%) (See Table 5 for a complete listing by design).

Table 5

**Research Design of Included Studies**

<table>
<thead>
<tr>
<th>Survey</th>
<th>Case Studies</th>
</tr>
</thead>
<tbody>
<tr>
<td>15. Dee et al. (2002)</td>
<td></td>
</tr>
<tr>
<td>17. Demircioglu et al. (2017)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>32. Yidong and Xinxin (2013)</td>
</tr>
<tr>
<td></td>
<td>33. Zheng et al. (2011)</td>
</tr>
<tr>
<td></td>
<td><strong>Experimental/Quasi-Experimental</strong></td>
</tr>
</tbody>
</table>

**Meta-Analysis**

2. Brandstätter (2011)
5. Ng et al. (2013)
6. Park et al. (2004)
7. Shane et al. (2003)

**Interview**

1. Armstrong et al. (2018)
2. Griffin et al. (2009)
3. Minarcine et al. (2016)
4. Naidoo and Sutherland (2016)
5. Jean et al. (2018)
Expectancies in the Literature: Can I do this?

Innovation stands as an interesting case for EVC as the factors that might potentially motivate innovation are numerous. In terms of the expectancies (self-efficacy and efficacy expectancies; see Bandura, 2001; Wigfield, 1994), persons who see themselves as potentially able to innovate because of an acquired efficacy or confidence should hold a higher expectation of themselves to be able to innovate and thus become more invested in the task of innovating.

Indeed, EVC, and expectancies as a construct, have been much clarified by the works of Bandura in explaining the role of self-efficacy (Bandura, 1986, 2001, 2006). Higher investment in the task results in a higher degree of motivation sourced from the self-held conviction that the individual can innovate. An expectancy of success begets confidence, which begets further expectancy of success, in innovation and elsewhere. Leaders, educators, and managers in organizations and institutions assigning simpler innovation tasks early in a program and then building to harder problems according to this logic line should steadily build esteem and self-efficacy.
**Strategies for building expectancies**

Researchers have considered expectancy-building strategies to promoting innovation and have studied the effects that careful managerial planning, engagement seeking, experimentation, teaching the process of innovating, management style, collaboration, available support, and training would have on the confidence and self-efficacy of innovators. The research on strategies for motivating innovation tended to be specific to disciplines and typically use survey methodologies of workers in businesses rather than specifically probing the motivations of innovators. Leader strategies include careful managerial planning, encouraging experimentation, managerial style, fostering collaboration, and providing supports.

**Careful planning and engagement seeking.** The literature on promoting innovation tends to come from business settings and proposed that a key consideration for actively stoking confidence to innovate was careful managerial planning, with specific consideration of consistent efforts maximizing engagement opportunities. These efforts were found by some studies to be most fruitful when they led to informal or even improvised activities (Song, Im, Van Der Bij, & Song, 2011). Monge et al. (1992) found that careful managerial planning of meetings as well as cognizance of the peaks and troughs throughout yearly or periodic cycles were necessary; otherwise, employers risked shorting the confidence of participants to innovate. Similarly, Messmann and Mulder (2014) found that managers need to carefully consider that no matter how innovative a person might be over time, innovation fatigue can set in unless confidence is sufficiently stoked.

Research has identified the importance of careful managerial planning as key to the maintenance and encouragement of worker engagement and thereby confidence, such as information days, group goal setting, and stakeholder consultations (Hartmann, 2006; Monge et
al., 1992; Pihlajamaa, 2017; Smith & Sandberg, 2018). Studies have shown that carefully curated interactions with others and having project teams that were crafted to include a variety of expertise tended to increase confidence in innovating (Marvel, Griffin, Hebda, & Vojak, 2007; Song et al., 2011). Other studies found that the organizational choices of leaders were also impactful in boosting innovation confidence (Almond & Power, 2018; Dee, Henkin, & Pell, 2002; Smith & Sandberg, 2018). Montani, Odoardi, and Battistelli (2014) pointed to the need for leaders to provide practical tools and structures for these engagement efforts such that they became habitual and a part of organizational muscle memory. In short, managers and those in supervisory roles need to take explicit and thoughtful action to build and sustain the confidence to innovate of those in their employ.

**Leader encouraging experimentation and innovators learning through experience.**

Research that examined strategies that built innovation confidence through the encouragement of experimentation tended to come from business settings and primarily consisted of survey studies. Demircioglu and Audretsch (2017) found that providing opportunities for experimentation coupled with feedback loops in work situations tended to build the expectancies of workers to innovate. Other studies found that experimentation was facilitated through the work environment and by the flexible allocation of work tasks that tolerated early failures (Almond & Power, 2018; Ederer & Manso, 2013; Messmann & Mulder, 2014; Muninger, Hammeci, & Mahr, 2019). These same studies found that this early investment of time and resources for pilot testing or at least tolerance of early mistakes overwhelmingly tended to yield long-term success in excess of less tolerant attitudes towards experimentation.

In the same vein, problem finding, problem clarification, and problem-setting were found to be effective catalysts for experimentation (Füller, Matzler, Hutter, & Hautz, 2012; Montani et
These initiatives were commonly found to be most effective when coupled with systematic evaluation strategies (Messmann & Mulder, 2014; Pihie, 2007). Demircioglu and Audretsch (2017) found that experimentation spurred innovative activity because it suited employee preference to feel in control over their actions. This recognition of the desire of innovators to be self-determining is congruent with the findings of decades of self-determination theory research (e.g., Deci & Ryan, 1987; Ryan & Deci, 2017). In summary, the contemporary thinking on encouraging experimentation is that it can be coupled with preliminary thinking exercises, consistent feedback, and then post-experimental systematic evaluations to be maximally effective in building innovators’ confidence and thereby supporting innovation.

**Leadership style: The effects of having innovation champions.** Research within the business field has identified leadership style and the efficacy of champions as key innovation confidence-building tools. Leaders who boldly pursued innovation (Hsu, 2009; Wang, Liu, Zhu, & Bastian, 2018), ensured that a variety of employees and resources were brought to bear on a given challenge (Aarikka-Stenroos, Jaakkola, Harrison, & Mäkitalo-Keinonen, 2017), held a tolerance for ambiguity (Koch et al., 2015; Shane, Locke, & Collins, 2003), and otherwise made space temporally, attitudinally, and organizationally for innovation were effective in building the confidence of their workforces (Song et al., 2011). This mirrors findings elsewhere that transformative leadership (known colloquially as visionary leadership; Kandiko, 2013) was effective in making innovation more likely (Abbas, Iqbal, Waheed, & Riaz, 2012; Bolderdijk, Brouwer, & Cornelissen, 2018; Sergeeva & Zanello, 2018; Wang et al., 2018; Yidong & Xinxin, 2013). These same leaders were found to diminish the deleterious effects of external rewards by setting the focus on the interest of the task and teamwork (Bolderdijk et al., 2018; Chen, Li,
Leung, 2016; Yidong & Xinxin, 2013). Amabile (1997) described this as leaders who nurture the spark of innovation, and who would build confidence at the same time as they diminished perceived costs. These costs sometimes involved innovation taking the form of an emotional roller coaster: effective champions temper or incite enthusiasm when the situation calls for it (Pihlajamaa, 2017).

Similarly, leaders who supported innovation tended to take a promotion focus (playing to win; Poskela & Martinsuo, 2009), rather than a loss prevention focus (playing not to lose; Manimala, Jose, & Thomas, 2006; Poskela & Martinsuo, 2009), thereby taking calculated risks and enabling their followers to do the same (Bowles & Hattie, 2013; Koch et al., 2015; Maria Stock et al., 2017; Sergeeva & Zanello, 2018; Spanjol & Tam, 2010). While a majority of studies found that the effect of champions was significant, Chen, Li, and Leung (2016) pointed out that two recent meta-analyses revealed that champions only had a small effect on the quantity of innovation by individuals. Naidoo and Sutherland (2016) nuanced this finding by determining in their sampling that the reported quality of innovations was improved rather than quantity when groups were led by champions. In summary, leaders who promoted confidence to innovate tended to provide the resources and spaces for innovation to occur and tended to lead efforts personally and model innovative behaviour rather than delegating.

Collaboration. By far the most common theme among analyzed research contributions and across disciplines was the widespread finding that collaboration served as a strategy for promoting innovation through building confidence (e.g., Bastian, Jetten, Thai, & Steffens, 2018; Bergendahl, Magnusson, & Björk, 2015; Curado, Muñoz-Pascual, & Galende, 2018; Curran & Walsworth, 2014; Fernandez & Pitts, 2011; Pihlajamaa, 2017). Effective collaboration was found to increase expectancies for innovation though necessitating the communication and
subsequent discussion of ideas (Bastian et al., 2018; Curado et al., 2018; Fernandez & Pitts, 2011; Hartmann, 2006; Jiang & Thagard, 2014; Monge et al., 1992; Pihlajamaa, 2017).

Collaboration was also found to involve diverse stakeholders (Aarikka-Stenroos et al., 2017; Costa, Páez, Sánchez, Garaigordobil, & Gondim, 2015; Kuznetsov & Kuznetsova, 2011; Sergeeva & Zanello, 2018; H. L. Wu, Su, & Lee, 2008), facilitate empowerment (Bolderdijk et al., 2018; Fernandez & Pitts, 2011), promote knowledge exchange (Aalbers, Dolfsma, & Koppius, 2013; Antikainen & Vaataja, 2010; Bastian et al., 2018; Curado et al., 2018; Muninger et al., 2019; Naidoo & Sutherland, 2016), facilitate co-designing (Hartmann, 2006; Sorice & Donlan, 2015), inspire friendly competition between teams (Lam, Cheng, & Choy, 2010; Naidoo & Sutherland, 2016; Öberg & Shih, 2014), as well as help team and coalition building which ensure that a person does not have to go it alone (Costa et al., 2015; Dee et al., 2002; Kirsten & Du Preez, 2010; Mc Fadden & Gorman, 2016; Öberg & Shih, 2014). These outcomes of collaboration, such as networking (McFadden & Gorman, 2016), all induced increases in confidence to innovate, especially in female entrepreneurial networks (Apergis & Pekka-Economou, 2010). Other studies chose to rely on outcome measures, such as Galia (2008) who found that the more innovative firms in their sample tended to make extensive use of teams, and Antikainen, Mäkipää, and Ahonen (2010) who pointed to community satisfaction based on inclusion on projects through collaboration.

While research has identified the significant benefits and articulated some risks of misusing collaboration, studies have shown that team chemistry is a key consideration in reaping the maximal benefit of collaboration to motivate innovation. Manimala, Jose, and Thomas (2006) identified that loose or informal team formation decreased the confidence of the individuals in a group as well as the efficacy of the group. As well, striking a balance of
collaboration and competition in a given work environment was seen as a way to make the most of teamwork while also encouraging accountability (Naidoo & Sutherland, 2016). Mehta, Clayton, and Sankar (2008) found that while it is often best to have a mixture of motivations and attitudes on teams when working under strict timelines or with budgetary concerns, having homogenous groups is typically the better decision.

Indeed, actor diversity helps to ensure that many ideas are represented when working in teams (Aarikka-Stenroos et al., 2017; Bastian et al., 2018; Bolderdijk et al., 2018; Dietrich, Znotka, Guthor, & Hilfinger, 2016; Kung & Chao, 2019; Pihlajamaa, 2017). Pihlajamaa (2017) extends actor diversity to recommend that teams be composed of innovators and non-innovators in a hammer and anvil model, where innovators strike ideas and non-innovators provide support and stability. In summary, contemporary research on collaboration as a tool to support innovation has identified that it has a wide range of significantly impactful benefits but needs to be applied with caution, as too much dependence on collaboration can result in a decrease of accountability. In addition, optimal team composition is extremely sensitive to the personalities of the members and the goals of the innovation.

**Support.** Support was a consistent consideration of research examining strategies that build expectancies and confidence to innovate (e.g. Kuznetsov & Kuznetsova, 2011). Common supports identified included creating a conducive innovation climate or culture (Dee et al., 2002; Hopkins, 2016; Kung & Chao, 2019; Montani et al., 2014; Susha et al., 2015), having reliable infrastructure (Susha et al., 2015), availability of mentoring (Apergis & Pekka-Economou, 2010), and inviting folks to engage with groups pursuing innovation (Apergis & Pekka-Economou, 2010; Curado et al., 2018; Messmann & Mulder, 2014; Radicic et al., 2016; Susha et al., 2015). Explicitly modelling flexibility and exploration (Amabile, 1997; Hartmann, 2006;
Montani et al., 2014; Sorice & Donlan, 2015), breaking a task down into smaller, manageable pieces (Dietrich et al., 2016; Pihie, 2007), and providing ample time and financial resources (Aarikka-Stenroos et al., 2017; Hartmann, 2006; Hosseini & Narayanan, 2014; Ozorhon & Oral, 2017) were also found to be crucial supports for confidence to innovate.

Studies also examined the importance of feedback as a support that increased individual and group confidence when innovating (Demircioglu & Audretsch, 2017; Ford, 1999; Hartmann, 2006). Other supports included innovation policies (Ozorhon & Oral, 2017), active inclusion of a problem-solving curriculum (Pihie, 2007), and actively enforcing a high quality of life balance (Minarcine & Shaw, 2016; Sorice & Donlan, 2015).

In summary, supports were widely positioned as methods or tools to build confidence and heuristics to make innovation as a process easier; these supports tended to divide innovation into manageable segments, scaffold the process of innovating, and otherwise decrease the costs of innovation. These strategies were typically identified in the discussions of studies, rather than as the subjects of studies, and often lacked a concrete explanation as to what these supports would look like. For example, while an innovation supportive culture, climate, or policy was often identified as a necessary factor in building confidence to innovate, explanation and articulation of what constituted such a culture, climate, or policy remained sparsely defined.

**Environmental characteristics that build expectancies**

Expectancies within the innovation literature were portrayed as being dynamic across contexts and to be related to individual demographics and personality at least as much as to the environment or situation where innovation was to occur (Monge et al., 1992; Ozorhon & Oral, 2017; Park, Nepal, & Dulaimi, 2004). The dynamism and relatively differential impact suggest that the current understanding is that there is not one universal strategy for building the
confidence to innovate, but rather that the environments need to be informed by the motivational dynamics of the individual and group at hand.

**Relevant experience and past success.** Studies found that environments that facilitated the use of relevant experiences and past successes tended to support innovative behaviour as a result of increased confidence. The effects of experience were varied. It was found in many studies that experience and past success tended to increase the efficacy of other expectancies as collaborations with a mixture of experiences tended to be more fruitful than homogenously-experienced teams (Bastian et al., 2018; Bolderdijk et al., 2018; Joy, 2004; Kraft & Bausch, 2018; Kung & Chao, 2019; Mc Fadden & Gorman, 2016; Park et al., 2004; Thapa, Niehaves, Seidel, & Plattfaut, 2015; Weisenfeld & Hauerwaas, 2018). Similarly, Füller et al. (2012), Chis et al. (2018), and Apergis and Pekka-Economou (2010) found that experience or training in creative settings tended to increase confidence when participating in the innovative process. Another idea in the innovation literature is that association of ideas, known as knowledge transfer in other literature, increased confidence and capacity for innovating (Jiang & Thagard, 2014).

Minarcine and Shaw (2016) and Park et al. (2004) found that it was exceedingly rare for people to be adventurous in careers where they had little or no experience. The increase in confidence was dependent on the relatedness between the two endeavours—the individual’s previous career and the endeavour they wished to undertake. For example, a cutting-edge hairstylist would be more adventurous when going out on their own to open a hair salon then they would be starting their own winery. Thus, innovators who had experience related to the endeavour they were considering were much more likely to attempt them. These experiences were found to impart or developed the confidence to be innovative (Armstrong, van der Lingen,
Lourens, & Chen, 2018; Chis et al., 2018; Griffin, Price, Maloney, Vojak, & Sim, 2009). There was universal agreement that confidence is built through past successes and the validation of past behaviours being met with success (Chi, Wang, Lu, & George, 2018; Griffin et al., 2009; Liu & Chan, 2017; Minarcine & Shaw, 2016; Montani et al., 2014; Park et al., 2004). The research suggests that aspiring innovators are most likely to attempt to innovate when they themselves have relevant experience or are working with peers with relevant experiences.

Need supportiveness and stability. Need supportiveness as coined by Ryan and Deci (2000, 2002, 2017) aims to meet the fulfilment of self-determination and the innate psychological needs of individuals, namely autonomy, competence, and relatedness, as a means of providing a fulfilling environment where they are autonomously motivated as opposed to feeling controlled by external motivation which disenfranchises and often disengages individuals. Needs supportiveness was a consistent consideration of literature on promoting innovation and was found to be impactful on the confidence with which individuals undertook innovative endeavours in many disciplines of study including education (e.g., Kandiko, 2013; Lam et al., 2010), economics and business (e.g., Amabile, 1997; Chaiechi, 2014; Fischer, Malycha, & Schafmann, 2019), and creativity (e.g., Wang & Huang, 2015). It was found that organizations that hold holistic views of success that consider employee well-being, personal attainment, autonomy, and company pride, rather than specific outcome measures such as patents, production quotas, or profit, tended to feature more innovative behaviour (Kandiko, 2013; Lam et al., 2010). The availability of support and the feeling that your colleagues would support you if you pursued an innovative endeavour were found to be predictive of self-perceived capacity to innovate (Amabile, 1997; Costa et al., 2015; Delmas & Pekovic, 2018; Ford, 1999; Lettl, 2007; Mc Fadden & Gorman, 2016; Weisenfeld & Hauerwaas, 2018).
Stability and consistency, rather than tumult, were found to better support innovative behaviour, lending credence to the notion that safety and support are necessary criteria for environments that promote innovation (Chaiechi, 2014; Messmann & Mulder, 2014).

Environments that made aspirants feel that they were safe to make mistakes without severe consequences were those that fulfilled the innate psychological needs as posited by self-determination theory and were found to be especially conducive to innovation confidence (Aarikka-Stenroos et al., 2017; Bastian et al., 2018; Maria Stock et al., 2017; Messmann & Mulder, 2014; Pihie, 2007; Reznickova & Zepeda, 2016). The environments that created the sense of safety were characterized as ones that provided an opportunity for workers to pursue passion projects, created stability, gave resources to individuals to see their ideas through to completion, and who were flexible with methods used to meet goals.

**Perceived Values: What makes Innovation Worth Doing?**

Individuals tend to act in accordance with the perceived values that they see in the tasks at hand (Feather, 1992). The three value types: intrinsic, attainment, and utility subjective task value lend themselves well to an analysis of a phenomenon like innovation, as it is perceived differently by different people with different values (Green, 2013). For instance, individuals might have very different attainment valences than their peers regarding innovation. Some might see innovation as having a very high attainment value as it is of central importance to their sense of self or in constructing their identity. Similarly, innovation as an act may hold intrinsic value to some people as they enjoy the act of applying their ideas. People tend to be motivated to complete activities that they enjoy, hence if they enjoy the task of innovating and its sub-tasks, they are likely to continue to do so (intrinsic value). But what if an individual does not enjoy innovation yet still is motivated? This motivation might be a utility value. Even if people think
they can innovate, they might not have the motivation to innovate unless they see what is in it for them.

Innovation is often richly rewarded in society, even if many think innovation is a buzzword (Green, 2013; Lehmann-Ortega & Schoettl, 2005). This reward can be in the form of monetary pay, public recognition, and fame, although it varies widely by context. The lure of these rewards can beget a value for which individuals can strive, giving the act of innovation an inherent value for the individual who seeks these rewards. Of all these forms of value motivation, intrinsic is hypothesized to be the most powerful and most desired across a majority of contexts (Deci, Koestner, & Ryan, 1999), however, the relative potency varies from individual to individual.

**Intrinsic Task Values in the Literature**

Intrinsic task value is the subjective value of a task for enjoyment, interest, or fun (Barron & Hulleman, 2015; Eccles & Wigfield, 2002). Innovative activity has been known to have intrinsic value to individuals if they find the act enjoyable or interesting (Amabile & Kramer, 2011; Anderson et al., 2014; Fischer et al., 2019; Scott & Bruce, 1994). Research that addressed strategies that increased intrinsic task value itself was rare in the literature; instead, research tended to focus on tasks and their presentation to individuals as the means to better illustrate potential intrinsic task value already present in the task (Anderson et al., 2014; Fischer et al., 2019).

**Strategies for building intrinsic value.** The lone strategies found in the literature were to foster the interests and encourage the drive of individuals who undertook innovative endeavours.
**Interest, enjoyment, and novelty seeking as means to create drive.** The few strategies that studies examined pertaining to stoking innovation through intrinsic task value focused solely on feeding individuals’ interest and drive. Strategies that motivated innovation tended to be enjoyable, and hence very much specific to the interest of the participants (e.g., Antikainen & Vaataja, 2010; Bolderdijk et al., 2018; Galia, 2008; Wendelken, Danzinger, Mösllein, & Rau, 2014). Powerful manifestations of this motivation included informal and recreational settings (Antikainen & Vaataja, 2010), flexibility of choice (Cordero, Walsh, & Kirchhoff, 2005; Fischer et al., 2019), efforts to make otherwise dull tasks enjoyable (Wendelken et al., 2014), and participating in events and programs with the focus of being enjoyable (Bolderdijk et al., 2018; Fischer et al., 2019; Zheng, Li, & Hou, 2011). The findings of the studies point to efforts to make meetings, programs, and work settings to be enjoyable through curated informal settings. Additionally, understanding that flexibility of choice, and leader-led efforts to make tasks enjoyable tended to increase the intrinsic task value of a given task.

Personal interest and curiosity were found to be powerful motivators for innovation (Amabile, 1997; Bolderdijk et al., 2018; Fischer et al., 2019; Füller et al., 2012; Minarcine & Shaw, 2016; Öberg & Shih, 2014; Susha et al., 2015). When tasked with deriving new ideas, few other motivations matched the potency of being truly interested in the task (Amabile, 1997; Füller et al., 2012). In fact, interest was found to be one of the few intrinsic motivations that extrinsic motivation could not quell (Amabile, 1997; Minarcine & Shaw, 2016; Öberg & Shih, 2014). In summary, wherever possible, efforts should be made to strategically allocate personnel to tasks that they would find interesting.

Strategies that supported innovation were found to feed the novelty-seeking behaviour of many innovators. Studies suggested task variety (Duverger, 2012; Montani et al., 2014), thrilling
goals (Joy, 2004), imaginative involvement (Joy, 2004), and new experiences (Edwards et al., 2014; Joy, 2004; Wang et al., 2011) motivated innovation. Leaders making the efforts to design their strategies to provide these opportunities tended to fulfil intrinsic task value through fulfilling the “need for new” that many innovators feel.

**Attainment Values in the Literature**

Attainment task value is the value perceived as a result of completing a task; this aligns with the internal extrinsic motivation of Self-determination theory (Ryan & Deci, 2017).

**Strategies for building attainment value.** Attainment value was a frequent finding in the literature on motivation to innovate. Common trends for promoting attainment value included strategies like fostering autonomy, investment, recognition, optimized challenge, and perceived importance of innovative endeavours.

**Autonomy.** Strategies for building autonomy focused on the judicious delegation of decision-making processes and allowing workers to make planning decisions (Costa et al., 2015; Hartmann, 2006). Another tactic was encouraging followers to develop new ideas and put them into practice as a means of fuelling initiative (Yidong & Xinxin, 2013). Shane et al. (2003) argued that initiative building facilitated the added benefit of encouraging workers to think of themselves as being capable and this made innovation seem more valuable. While articles highlighted that providing autonomy was a way to increase the attainment value of innovation, the exact mechanism does not seem to be fully understood beyond the indication that giving people choice makes them more likely to commit to their new ideas.

**Investment.** Studies pointed to strategies that built investment to be highly effective in promoting innovation. These strategies included decision-making being proportional to the amount of investment in corporations where the board held a controlling interest in the company.
(Bessonova & Gonchar, 2017). When boards made up of employees held a controlling interest, innovation was more common than when they did not. Similar non-corporate situations where the decision-makers were personally and sometimes monetarily invested in the outcome of an endeavour tended to also be more likely to support innovation (Bessonova & Gonchar, 2017; Hartmann, 2006; Wendelken et al., 2014). In situations where individuals were personally invested in their endeavours, innovation tended to increase.

**Recognition.** Recognition, past, present, and future was found to be an important consideration when making efforts to motivate innovating. Research has shown that motivation to gain reputation was a central consideration of many aspiring innovators in the public domain (Fischer et al., 2019; Zheng et al., 2011), and in private business (Antikainen & Vaataja, 2010; du Toit, van Staden, & Steyn, 2011) and for teachers implementing problem-solving initiatives in their classrooms (Lam et al., 2010). This consideration was articulated as a combination of recognition of status, peer-respect dynamics, and enhancement of professional status (Fernandez & Pitts, 2011; Wendelken et al., 2014). Recognition of innovative efforts in the literature was split between being reported as a decisive factor in some articles, while not being a great consideration in others indicating that further study is needed to determine the dynamics mediating other factors.

**Self-improvement, achievement, and optimized challenge.** Research has also examined strategies for motivating innovation that involved feeding the desire of aspiring innovators to improve themselves. This strategy has been described as feeding a self-improvement drive (Aarikka-Stenroos et al., 2017; Antikainen & Vaataja, 2010; Piperopoulos et al., 2018) or as a hunger to take on new challenges (Edwards et al., 2014; Jain & Ali, 2012; Lopez & Snyder, 2003; Marvel et al., 2007). “Hunger” literature tended to portray innovators as constantly
looking for what others say cannot or should not be done and are engaged when experiencing the right balance of challenge and support. This Vygotskian idea (Glassman, 2001; Vygotsky & Kozulin, 2011) is also inferred in the self-improvement literature through self-scaffolding and a leader’s frequent and tactical provision of skill development opportunities for employees.

**Importance, relevance, and clear need.** The dominant attainment task value as gleaned from the literature is the importance, relevance, and clear need for innovative behaviour and goals (Aarikka-Stenroos et al., 2017; Hosseini & Narayanan, 2014). To this end, studies suggested that clear links to desired goals like careers or mastery and easy to see logic to how the innovation would be important to society (Aarikka-Stenroos et al., 2017; Edwards et al., 2014; Sorice & Donlan, 2015; Xie & Reider, 2014). There emerged a trend to consider social justice and conservation causes (Antikainen & Vaataja, 2010; Pihie, 2007; Reznickova & Zepeda, 2016; Sorice & Donlan, 2015). Leaders seeking to stoke innovation could infer from the literature that making the time to articulate the goals of an innovation and the way that it could benefit workers and society will increase engagement and increase the attainment value of the activity thus propelling the innovating of individuals and teams.

**Environments to build attainment value.** Attainment value was also found to be an impactful consideration of environments designed to motivate innovative behaviour. These considerations include efforts to ensure that an environment fosters self-determination and fulfilment, pride and recognition, need for achievement, and a sense of importance.

**Self-determination and fulfilment.** Much the same way that needs supportiveness contributed to confidence and expectancy, studies suggest that the pursuit of fulfilment and self-determination contribute to the attainment value (e.g., Galia, 2008; Wang et al., 2011; Zheng et
Findings from the literature suggest that attaining fulfilment has many faces to aspiring innovators: namely, autonomy (du Toit et al., 2011; Galia, 2008; Shane et al., 2003; Wang et al., 2011; Zheng et al., 2011), job satisfaction (Demircioglu & Audretsch, 2017; Fernandez & Pitts, 2011; Poskela & Martinsuo, 2009), and relatedness (Reznickova & Zepeda, 2016). Autonomy, in particular, was strongly represented in the literature as a method for motivating innovation as it fits with the need of innovators to have some form of freedom in decision making (Fernandez & Pitts, 2011; Hartmann, 2006; Minarcine & Shaw, 2016), the feeling of being your own boss (Brandstätter, 2011; Hartmann, 2006), being able to control one’s environment (Brandstätter, 2011; Mack & Landau, 2015), and taking charge of one’s career (Fernandez & Pitts, 2011; Minarcine & Shaw, 2016). Relatedness was also frequently referenced in the literature as a key consideration as innovative endeavours can be structured to fulfil needs for affiliation (Brcic, 2010; Hsu, 2009) and a shared vision among colleagues. These outcomes are linked to a feeling of driving one’s own destiny, meaningful connections to others, and the positive feelings that come from it. Competence was not found among study findings to be an impactful attainment task value.

Autonomy and relatedness are pursuits of individuals and are expressions of autonomous motivation that drive them to fulfil their innate needs (Roth, Assor, Kanat-Maymon, & Kaplan, 2007). Autonomous motivation, although a construct from Self-Determination theory for internally mediated motivation, would include elements of intrinsic and attainment task values from EVC. Internal motivation once stoked is thought to lead to needs fulfilment and happiness and a drive that deeply motivates individuals (Apergis & Pekka-Economou, 2010; Fernandez & Pitts, 2011; Gorozidis & Papaioannou, 2016; Minarcine & Shaw, 2016; Poskela & Martinsuo, 2009). Leaders who wish to highlight the subjective task value of innovation would, therefore,
benefit from creating ways to make work more fulfilling though autonomy, relatedness, and job satisfaction. However, the literature was sparse on the exact methods that leaders could use to accomplish these goals to support innovation outside of business contexts.

**Identity, pride, and recognition.** Another manifestation of attainment value found in the literature on motivating innovation are the related constructs of identity, pride, and recognition. Innovation as part of a company’s identity was found to create an environment that inspired employees to pursue innovating aspiration as part of their work (Galia, 2008; Manimala et al., 2006). Pride was also found to be a crucial motivation consideration (Manimala et al., 2006; Marvel et al., 2007; Wendelken et al., 2014). The findings of other studies suggested that a need for recognition for their work contributed to their choice to seek out opportunities to be innovative (Brcic, 2010; Hartmann, 2006; Wendelken et al., 2014). Manimala et al. (2006) found that a lack of recognition for innovations or for contributions decreased the perceived value of innovating. These motivations would point to the importance of personal drive, recognizing the achievements, and individuals’ personal motivation factors that leaders could try to consider with everyday work to help stoke these powerful personal motivations. Specific environments or strategies for building on personal identity, pride, or recognizing achievement as a means of building attainment value were not widely discussed within the literature.

**Need for achievement.** Need for achievement (NFA) is an internally-mediated compulsion for achievement satisfaction that in the case of innovation, makes the process of innovation irresistible for those with a high NFA (Pihie, 2007; Pihlajamaa, 2017; Shane et al., 2003; Skinner, 1996; Stewart Jr., Watson, Carland, & Carland, 1999). Innovators were commonly found to have a higher NFA than non-innovators (Gorozidis & Papaioannou, 2016; Marvel et al., 2007; Pihie, 2007; Shane et al., 2003; Stewart Jr. et al., 1999). The difference in
disposition has implications for motivating innovators; efforts need to be made to create environments for innovators to pursue their aspirations such as being left to their own devices for periods of time before bringing their ideas back to the group and being given responsibility for sections of projects or goals (Marvel et al., 2007; Skinner & Drake, 2003).

NFA was found to be most effectively stoked by long term goals and rewards as these long-duration effects encourage deep investment (Baranchuk, Kieschnick, & Moussawi, 2014; Jiang & Thagard, 2014; Lerner & Wulf, 2018; Ng & Feldman, 2013; Pihlajamaa, 2017) compared to short term rewards or goals which seem imposed and feel controlling (Curran & Walsworth, 2014; Gopal & College, 2011; Jermias, 2007; Jiang & Thagard, 2014; Lerner & Wulf, 2018; Park et al., 2004; Pihlajamaa, 2017). The resulting consensus in the literature is that NFA is a potent, internal achievement motivation that can be stoked by the implementation of long-term goals and rewards like maximum vesting periods or stock options for business executives. The findings have implications for leaders seeking to stoke motivation to innovate, however, the contexts outlined in the literature assume a business environment, which does not reflect the breadth of innovative endeavours across and amongst disciplines.

**Importance and engagement.** Innovation was often seen as important and therefore worthy of effort by aspirants. Contributing factors to innovation being seen as important were perceived societal impact (Demircioglu & Audretsch, 2017; Messmann & Mulder, 2014), importance to one’s life (Montani et al., 2014), moral duty (Jiang & Thagard, 2014), and convergent logic (Öberg & Shih, 2014). Certain topics were found to be more easily viewed as being worthy such as confronting health challenges or developing new technologies with the increasing influence of globalization and communication technologies (Demircioglu & Audretsch, 2017; Messmann & Mulder, 2014).
With an increased awareness of what is important for stakeholders, communication of what is important to others has entered the conversation of what influences the importance of a given innovative endeavour (Griffin et al., 2009; Hsu, 2009; Öberg & Shih, 2014). Monge et al. (1992) found that over time higher expectancies will induce higher investment and involvement. This parallels with the findings of Montani et al. (2014) which show that expectancies indirectly shape innovative work behaviour by altering envisioning and planning work processes to more directly engage workers in employment settings. Efforts to stoke the motivation to innovate should consider framing the goal with clear and transparent logic for why the endeavour is important, articulate the potential benefit to society of the innovation, and consider the views of stakeholders as a means of illustrating potential importance.

Utility Task Values in the Literature

**Strategies for building utility value.** The lone strategy explored in the literature to build utility value was through the medium of rewards. Rewards were, however, an extremely common theme in the literature being explicitly and implicitly examined in a majority of studies.

**Rewards.** Studies highlighted that offering monetary rewards for innovation encouraged participation in innovating collaborations (Aarikka-Stenroos et al., 2017; Antikainen & Vaataja, 2010; Fischer et al., 2019; Galia, 2008; Hartmann, 2006; Marvel et al., 2007; G. Smith & Sandberg, 2018; Susha et al., 2015; Zheng et al., 2011). Kandiko (2013) found in higher education contexts external rewards like grants were seen as necessary evils that created the space to innovate. Thus, the reward was a means to an end and not the desired outcome itself. The results of other studies supported this view of rewards as tools for creating space and opportunities for innovating (Wendelken et al., 2014; Xie & Reider, 2014). However, other studies pointed to the lack of empirical evidence on types of rewards outside of business case
The few studies on the empirical evidence of rewards argued that the most effective rewards tended to not be immediate in time, or directly in the form of monetary rewards (Baranchuk et al., 2014; Kay, 2011). Rather, rewards with a longer vesting period or with a longer duration before pay off tended to be more effective (Baranchuk et al., 2014; Lerner & Wulf, 2018). As a final level of complexity, Kay (2011) and Amabile (1997) found that the timing of rewards made a dramatic difference in the success of the innovation with early funding and rewards being much more effective in propelling innovations to success.

*Indirect rewards work better than direct rewards.* The findings of some studies nuanced this understanding to reflect that while monetary rewards and other extrinsic motivators generally worked at some level they were not as necessary as other motivations like career aspirations, fulfilment, interest, or non-monetary rewards in tandem with changes to organization or administration, which were considered to be more influential (Costa et al., 2015; Kandiko, 2013; Sorice & Donlan, 2015; Thapa et al., 2015; Wendelken et al., 2014). Curran and Walsworth (2014) found that pay-for-performance or high salaries were ineffectual in stoking the motivation to innovate, whereas indirect pay such as benefits or group pay increased motivation to innovate, findings corroborated elsewhere in the literature (F. Ederer & Manso, 2013; Lerner & Wulf, 2018; Ng & Feldman, 2013). The lone study to make concrete recommendations for indirect rewards was Hartmann (2006) who found that family health benefits, excursions, additional resources for their goal, and allowances for professional development were effective indirect rewards. Similarly, to the short-term rewards, performance pay was found to induce the feeling of being controlled, instigating decreased motivation to innovate whereas long term goals created autonomous motivation (Ederer & Manso, 2013).
Variety of rewards. Further still, some studies found that outcome rewards in any form were detrimental to the motivation to innovate (Antikainen et al., 2010; Poskela & Martinsuo, 2009). These other studies’ results tended to find that including a variety of rewards was the best strategy if rewards were necessary (Bessonova & Gonchar, 2017; Cordero et al., 2005; Maria Stock et al., 2017). Curran and Walsworth (2014) found that it was sometimes possible to increase innovation with compensation, but only with the correct compensation, which connects to the arguments of Hopkins (2016), who calls for material, communal, or related incentives to foster innovative behaviour. Hartmann (2006) similarly found that the major predictor of the efficacy of rewards was having a variety of rewards, findings echoed in other studies (Amabile, 1997; Cordero et al., 2005; Hopkins, 2016). In a study of innovation participants and non-participants, the non-participants placed the most emphasis on monetary rewards, while the innovator participants placed more emphasis on other more internal motivators (Wendelken et al., 2014). In summary, there is substantial evidence in the literature that monetary rewards may not attract the desired motivations and that the best course of action would be to offer a variety of rewards.

Cost in the Literature: What is between me and what I want?

Diminishing the potential intrinsic, attainment, and utility value of innovating are the inherent costs of being an innovator. Innovation, like other complex tasks, while potentially rewarding, also has contextual material and psychological costs, such as additional effort, investment of time, pressure, the implications of failure, and loss of both relative stability from the status quo and availability of other options (Flake et al., 2015). For instance, the process of innovating may very well require the investment of additional time and resources to design and operationalize. However, doing things as they have been done in the past does not. The cost of
the additional resources may serve to lessen the motivation or diminish the value of innovating. Innovation may itself place the individual or collaboration under pressure that may be undesirable for some individuals (Flake et al., 2015; Vansteenkiste, Lens, Witte, & Feather, 2005; Y. Wang et al., 2018). Innovation has been portrayed as a risky pursuit because of the possibility of failure, the stigma of being different, and a threat to the status quo (Green, 2013; Lehmann-Ortega & Schoettl, 2005). Even if someone innovates, the idea might not hold the same value to other people. Innovation does have a cost. To some, it constitutes the loss of non-innovative alternatives. To promote innovation development, the expectancies and values must exceed the costs and this balancing act may be facilitated using strategies or the design of environments.

**Strategies for managing costs.** In the literature, successful strategies for motivating innovation considered the costs of innovation including risk aversion and unbalanced focus on financial rewards. Costs are by far the least defined and studied strand from an EVC perspective on motivating innovation. Strategies informed and actively designed to mitigate the costs of innovation as identified in the findings of studies tended to be the most successful.

**Risk Aversion.** Studies promoting innovation demonstrated that a crucial conundrum is the mitigation of the perception of risk; innovation is seen as a risky thing by many aspirants (Kinney, Laux, & Newman, 2015; Phillips, 2004; Pihie, 2007). Study results pointed to risk as being needed to be managed by leaders for innovative behaviour to occur (Poskela & Martinsuo, 2009; Skinner & Drake, 2003; Stewart Jr. et al., 1999; Wang & Huang, 2015). Another path to the same idea, the promotion of risk acceptance was seen as a way to combat the corrosive effects of risk on the motivation to innovate (Manimala et al., 2006; Marvel et al., 2007; Messmann & Mulder, 2014; Shane et al., 2003). Marvel et al. (2007) nuanced this
understanding by showing that lack of risk aversiveness is shown to decrease motivation, however, risk acceptance was not shown to be particularly motivating. Risk acceptance is only visible in its absence; hence it is a cost mitigation factor rather than an expectancy. Research into the effects of risk on innovation was limited to directionality and the consensus is that the magnitude of risk deters innovative behaviour. However, this synthesis offers little insight into the strategies that leaders could use to mitigate the impact of risk.

**Obsession with financial rewards.** While financial incentives were hypothesized to have some positive benefits such as increasing interest, an organization or group with too much of a focus on monetary rewards actually increases the cost of innovating as a result of the cutthroat behaviour of some workers (Sorice & Donlan, 2015). To combat this, extrinsic rewards once utilized need to be used with increasing frequency and magnitude (Bessonova & Gonchar, 2017; Maria Stock et al., 2017; Sorice & Donlan, 2015) in a manner that seems reminiscent of a pattern of addiction. To have the same effect, increased amounts of rewards needed to be utilized to sustain the pattern of behaviour.

**Costs in the environment.** The study of innovation costs through environment was scant. Findings in the literature include the dangers of too much competition, the virtues of adopting a cost mitigation strategy, and the effects of fear, pressure, and stress on those aspiring to innovate.

**Too much competition.** Competition in the literature was found to be a cost of trying to innovate (Bessonova & Gonchar, 2017; Bolderdijk et al., 2018; Hasan, Lowe, & Petrovici, 2019; Naidoo & Sutherland, 2016). Environments that have too high levels of internal competition risk unethical behaviour of individuals or groups to succeed, limited knowledge sharing, duplication of efforts, and duplication of spent resources (Kraft & Bausch, 2018; Naidoo & Sutherland,
External competition also has a drawback on promoting innovation as firms often spent valuable resources differentiating themselves from their competition (de Jong & Flowers, 2018; Hasan et al., 2019; Naidoo & Sutherland, 2016). Other studies illustrated that some companies view innovation primarily as a means to escape from competition, making it a reaction rather than an aspiration (e.g., Bessonova & Gonchar, 2017). These findings point to the need for leaders to moderate the perception of competition, especially internal competition, as moderated levels were found to be helpful tools for stoking the motivation to innovate.

**Cost mitigation.** Costs were sometimes portrayed in the inverse, as cost mitigation strategies. These included additional articulation of the indirect benefits that were found elsewhere in the literature as key motivators. For example, effective strategies to innovation cost mitigation were found to include reasonably priced child care services (Apergis & Pekka-Economou, 2010), safety and harmony in the workplace (Apergis & Pekka-Economou, 2010; Brandstätter, 2011; Chaiechi, 2014; Messmann & Mulder, 2014; Todt, Weiss, & Hoegl, 2018), distributing costs as in socialized benefits (Baranchuk et al., 2014; Dietrich et al., 2016; Hopkins, 2016; Hosseini & Narayanan, 2014), and a leader who moderates obstacles (Amabile, 1997; Chen, Sharma, Zhan, & Liu, 2019). As an approach for leaders, actively seeking and mitigating the costs of innovating that they identify in their environment is a proactive measure endorsed by findings from the literature.

**Fear, pressure, and stress.** Fear was another common cost faced when attempting an innovative endeavour. Fears offered by the literature included a fear of making a product that no one would buy (de Jong & Flowers, 2018; Thapa et al., 2015), risk aversion (Ederer & Manso, 2013; Todt et al., 2018), consequences for failure (Chen et al., 2019; Minarcine & Shaw, 2016), and otherwise existing structures that punish failed or not fully successful attempts at innovation.
(Minarcine & Shaw, 2016). Only one study gave this fear a face, the status quo (Öberg & Shih, 2014). Innovation runs counter to the inertia of the status quo, making innovation often the more difficult option compared to maintaining what might be currently done (Ng & Feldman, 2013; Ozorhon & Oral, 2017; Susha et al., 2015). Confronting costs makes individuals behave differently (Hsu, 2009; Li & Yu, 2018); leaders seeking to motivate innovative behaviour would do well to consider them.

Innovation is portrayed as a stressful endeavour with many different kinds of pressure having an effect including emotional (Jiang & Thagard, 2014), controlling (Ford, 1999; Hsu, 2009), financial (Amabile, 1997; Minarcine & Shaw, 2016), and resource pressures (Aalbers et al., 2013; Amabile, 1997). Pressure was found to originate primarily within organizations as opposed to outside organizations. This finding places the mitigation of pressure squarely within the sphere of influence of leaders to provide adequate resources and a supportive environment to mitigate the impact of this factor.

**Discussion**

It is clear that there is a primacy in the innovation literature in favour of business and corporate settings with limited representation from the arts or social justice sectors. There is also a common trend of using surveys within a single discipline or organization, while interviews are rare. Although there is an emergent field of study on innovation education, this field continues to expand its consideration of the unique motivation of aspiring innovators (Anderson et al., 2014; Kim & Lee, 2013). At the moment, innovation promotion remains largely disciplinary and siloed as shown by the relative absence of interdisciplinary research on environments or strategies. The gaps in understanding the effects of various environments and strategies are detrimental to efforts to support innovation. The paucity of studying costs of innovation in the
literature is symptomatic of the primarily strengths-based approach taken by studies, rather than a framework like EVC which also looks at detractive factors like costs. As shown in the business-related literatures on innovation (e.g., Anderson et al., 2014; Manso, 2017; Scott & Bruce, 1994), efforts to support innovation in a variety of settings including education need to have a deeper understanding of the costs and prices paid by innovators so that they can be mitigated and addressed.

In terms of methodology, the field is dominated by surveys of employees in business settings, rather than of bona fide innovators. This focus on survey research precludes the possibility of having concrete details and rich articulation of narration from innovators on their thinking. Another manifestation is the lack of generalizable details about strategies and environments as the literature tends to focus on measurable outcomes rather than the latent considerations that underpin the decisions that aspiring innovators make as well as supports and barriers that they consider. The literature offers many discipline-specific ideas about what motivates innovation, but there has been very little open-ended investigation directly asking innovators what factors motivated them to reach for their prospective goals, nor are innovators effectively asked about their education. For this reason, additional research is required to investigate the specific motivations of innovators in a variety of disciplines.

Numerous studies provide support for the notion that more internal motivations like intrinsic (e.g., interest) and attainment (e.g., importance, fulfilment) were more influential than external motivators like rewards as targets of strategies (Aarikka-Stenroos et al., 2017; Fernandez & Pitts, 2011). In an experimental study, Ederer and Manso (2013) found that pay for performance actively inhibited innovation precursor behaviours such as exploration and resulted in significantly fewer innovative events as compared to conditions where exploration was
rewarded. Namely, internal motivations were more effective as they were not seen as being as controlling as external rewards showing that individuals tend to see through direct rewards and recognize them as forms of external control (Aarikka-Stenroos et al., 2017; Fernandez & Pitts, 2011; Galia, 2008; Gorozidis & Papaioannou, 2016; Hartmann, 2006; Jermias, 2007). That being said, the more related the reward is to the activity itself in terms of subject matter the more effective the reward in promoting the desired behaviour (Cordero et al., 2005; Fernandez & Pitts, 2011). Rewarding someone who enjoys reading by giving them money would reduce internal motivation and might actually decrease the amount they read, as compared to rewarding someone for reading by giving them another book. These findings are supported by a history of research in the motivation literature (e.g. Kruglanski et al., 1975; Kruglanski, Friedman, & Zeevi, 1971; Ryan & Deci, 2017) showing that the nascent research into reward efficacy for promoting innovation has research precedent elsewhere.

Leaders were urged to focus on topics that engaged curiosity, interest, and satisfaction (Antikainen et al., 2010; Kandiko, 2013; Shane et al., 2003; Wang & Huang, 2015; Wu, Su, & Wang, 2013). These strategies recommended that leaders only assign topics to innovators that were of interest to them. Such strategies would not be applicable in many situations where the topic is not flexible. Additional research is needed to determine how intrinsic task value can be applied in situations where topics are not intrinsically interesting for innovators as well as to determine the mechanisms of intrinsic value and how it works to motivate innovation.

Forward-thinking companies exemplified in the literature had moved away from direct rewards like monetary bonuses and had instead moved towards recognition and indirect rewards like vacation time, paying for the professional development of the employee’s choosing, and flexible work time (Curran & Walsworth, 2014; Gopal & College, 2011). The general trend among
studies is that internal motivations and rewards that have longer vesting times or feed interest or attainment operate effectively long-term while external motivations like direct rewards or pay for performance tend to have short-term effects that are reliant on consistent rewarding of behaviour and can even actively hinder innovation. Leaders, if they choose to use rewards, should focus their strategies to give related rewards otherwise they risk sundering the internal motivation to innovate for already interested workers.

Another manifestation of the focus on organizations is the lack of specific and actionable takeaway messages about environments as the literature tends to focus on measurable outcomes rather than the latent considerations that underpin the decisions that aspiring innovators make and the supports and barriers that they consider. The literature offers ideas about what motivates innovation, but there has been very little open-ended investigation directly asking innovators what factors motivated them to reach for their prospective goals. Whereas the absence of consideration of values is almost a given when choosing to focus on environment rather than approaches and interventions, the paucity of studying costs of innovation in the literature is symptomatic of the primarily positive approach taken by studies, rather than a framework like EVC which also looks at detractive factors like costs. Efforts to support innovation in a variety of settings including education and professional development need to have a deeper understanding of the costs and prices paid by innovators so that they can be mitigated and addressed.

In alignment with the literature designers of environments should do their utmost to form teams with a mixture of experiences as mixed teams tended to be more productive in their innovating and were found to build the confidence of individual learners. Similarly, leaders like teachers or supervisors should welcome the utilization of past experiences, particularly those that
are likely to be at least partially transferable to the context at hand as this provides an effective way to build confidence among learners. The literature points to stability and consistency of environments, as provided by feeling safe and judging success holistically as opposed to solely by outcomes as being a crucial promoter of innovation. Safety also emerged as an important promoter of innovation in environments where learners felt safe to make mistakes. Leaders in a position to influence the environment can encourage the pursuit of passion projects and develop novel approaches by ensuring that it is reasonably acceptable to make mistakes. In short, an environment that encourages the use of past experiences and feels stable and safe was found by the literature to promote innovation.

It was unsurprising that utility task value-building was conspicuously absent from innovation promotion literature concerning environments as utility value-building tends to be a personally and socially-driven process rather than an environment-driven process without intervention (Barron & Hulleman, 2015). Literature tended to portray the costs of innovation as something that innovators avoided, however, the identified costs hint at the hindering factors that could make innovation more likely if they were to be addressed and mitigated. Environments that were less internally competitive were found to better promote innovation than those with higher levels of internal competition. External competition was found to be promotive. Influencers of environment could make innovation more likely by ensuring that learning and working environments would focus on competition external rather than internal to the institution.

Other key considerations to mitigate costs included providing indirect benefits like health insurance and subsidizing child-care as this proactively eliminated costs and time-drains that would distract workers and learners from their work and potential innovating. Leaders seeking to make innovation more likely should proactively mitigate these costs. This same principle
applies to the perceived fears, pressures, and stresses that occur within workplaces and learning spaces which leaders could counter by having a reasonable tolerance for failure and focusing initially on educational rather than punitive responses to non-optimal outcomes.

**Overview of Following Chapters**

The following chapter is the first of four manuscripts investigating the lingering needs of study into promoting innovation through EVC. The manuscripts culminate in how to apply the findings to promote innovative behaviour among learners. The first manuscript chronicles the development of the motivation to innovate inventory (MTI: see Appendix D) encompassing the expert consultations, think-alouds, and the recruitment of an international and a Canadian sample of innovators for determining the contextual validity and utility of the instrument. The second manuscript directly identifies expectancies, values, and costs of an interdisciplinary and diverse sample of innovators as determined through a mixed methods data gathering approach encompassing interviews and the closed and open-ended responses of a survey. The third manuscript answers previously understudied questions of how innovators balance the costs of innovating. The fourth (and final) manuscript explores what schools can do to promote innovation.

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Chapter 3

Manuscript 1 - Development of the Motivation to Innovate Inventory: An Inclusion-focused Interdisciplinary Innovation Promotion Research tool

*Will be refined and submitted with co-authorship as: Soleas E.K., Bolden B., and Klinger D.A

Abstract

There has been a surge in recent literature recognizing the importance of discovering the motivations of innovators as a means of promoting this necessary source of renewal. At present, however, this wave has not yet yielded an instrument that assesses the supporting and hindering motivational dynamics underpinning innovation at the levels of individuals. In the face of this lingering need, this instrument development study yielded an inclusive, psychometrically-sound inventory useful in multiple disciplines to assess the factors impacting motivation to innovate across educational and workplace contexts. It was developed with the critique and support of expert scholars and innovators to be useful for individual innovators, decision-makers, and educators as they consider reforms to existing practices to promote innovative behaviour.

Innovation and Motivation

It has become valuable for societies to cultivate an educated citizenry motivated to innovate by designing, refining, and mobilizing ideas. At its foundation, innovation is the difficult process of applying practical or theoretical knowledge to novel contexts that facilitates discoveries, improves designs, and generally enhances individual lives and society (Baregheh et al., 2009; Drucker, 2006). As a primary source of renewal and revitalization, innovation feeds the long-term success of society, promoting progress through new ideas and countering stagnation (Dewey, 1997). Hence it is crucial for societies and institutions to understand the motivation factors that make innovation more likely and manage factors that hinder innovation.

There has been a recent surge in research recognizing the importance of discovering the motivations of innovators as a means of promoting this necessary source of renewal (Bastian et al., 2018; Wang et al., 2018). At present, such research has yet to yield an instrument that
assesses the supporting and the hindering motivational dynamics underpinning innovation at the individual level. It is important to note that other emergent areas of educational interest have also examined two-pronged approaches encompassing promotion and hindrance-mitigation such as inclusive education which seeks to promote strengths of learners as well as mitigate their barriers to inclusion (CAST, 2018; Katz, 2013; Soleas, 2015). For the optimal promotion of innovation, barriers too must be evaluated in conjunction with actions that contribute to increased capacity.

Expectancy-Value-Cost theory (EVC) is the major motivation theory that considers both positive and negative valences of motivation (Barron & Hulleman, 2015; Flake et al., 2015). Self-Determination Theory, the major motivation framework among existing innovation studies (e.g., Agrell & Gustafson, 1994; Wang et al., 2018) stops at the state of amotivation (Ryan & Deci, 2000a, 2017), which is zero motivation, rather than exploring active aversion, or negative valences of motivation. For an instrument to be useful in assessing both promotive and hindering factors for an individual it would need to consider the EVC notion of cost. Cost is a motivational construct encompassing the perceived prices that a person would have to pay to complete a task (Flake et al., 2015)—in this case, innovating. These are hindering factors that have, in the literature, been identified to include additional effort, enduring elevated pressure, financial losses, and the loss of alternative options in the commission of the task, and other potential costs (Flake et al., 2015). For many aspirants, the cost of innovating is higher than the expectancies and values. To promote innovation development, decision-makers and teachers must optimally build the promotive motivational factors while also helping aspirants to manage the costs.

EVC has two promotive constructs: expectancies and values. Expectancies are an amalgam of confidence, self-concept, and self-efficacy that determine the belief an individual
has in their capacity to complete the task at hand. Subjective task-values consist of three groups of worth that a person might see in performing a task: intrinsic task-value, attainment task-value, and utility task-value. Intrinsic task-value is the perceived fun or interest in a task, while attainment is the pride, importance, or identity fulfilment one could attain from completing a task, and utility task-values are the direct and indirect rewards a person receives by doing the task.

To promote innovation development, learning and work environments must optimally build expectancies and values and help learners manage innovation’s costs. Research is needed that examines the expectancies, values, and costs of innovating as identified by practicing innovators. The findings can be leveraged to inform initiatives to help students balance the expectancies and values of innovating against the costs, thereby supporting their innovation work and development. To inform the work of those who support and promote innovative behaviour (e.g., educators, policymakers, mentors, and workplace leaders) as well as the work of innovators themselves, a tool is required that can examine the motivational dynamics that influence the innovation process.

**The Path to an Instrument**

The vast majority of innovation studies and instruments have been focused on business and work settings, often with already established innovators rather than building capacity and removing barriers for aspiring innovators (Costa et al., 2015; Soleas, 2018b). This limits the scope of innovation promotion to established innovators rather than leveraging a wider range of potential innovators. As innovation promotion efforts grow in scope, and more areas of endeavour to innovate are recognized, there is a growing need to adapt to a more inclusive vision of innovating. For the innovation needed to propel progress to confront global challenges such
as global warming, social inequity, and alleviating human suffering, innovation must become more commonplace in more disciplines. Thus, additional study reconciling other perspectives as well as business perspectives is required.

Most research measurement tools connected to innovation have focused on indicators and outcomes, such as patents or economic growth (Chaiechi, 2014; Curran & Walsworth, 2014; Ederer & Manso, 2013). Others have assessed the potential of teams to be innovative (Agrell & Gustafson, 1994; Siegel & Kaemmerer, 1978). As individuals are the building blocks of teams, their motivations, and hindrances to innovate must be understood to inform more effective design of innovation promotion activities.

A few instruments have looked at identifying innovators based on personality traits and preferences (e.g., Kirton-Adaption Inventory, Kirton, 1976). However, the tendency of these studies, as the standard practice of their time, was to have a homogenous sample of like-minded individuals of similar occupation and cultural background (e.g., Foxall & Hackett, 1992; Kirton, 1976). The drawback of these homogenous samples used in instrument and validation studies is a lack of validation with the diverse populations commonly found in today’s learning and workspaces.

The goal of innovation education and promotion is to both optimize and create new opportunities for innovation (Sandberg, 2013). Further, with the establishment of the field of innovation education seeking to make innovation more common across many areas of endeavour (e.g., Jones & Noriah, 2013; Shavinina, 2012), and an aligned instrument having not been developed, the time is ripe for an instrument designed to optimize varied learning environments for innovation. Such an instrument would need to be useful to decision-makers and teachers to inform decisions about approaches and environments that would support developing innovators
and make innovation more likely. To this end, a useful tool would assess the needs of aspiring innovators and also already successful innovators. This instrument would gain insight into the factors that encourage and diminish innovators’ motivation to innovate.

**Purpose**

This instrument development study adds to the tools available to decision-makers and teachers to help inform the promotion of innovative behaviour by providing:

1. An instrument that addresses the specifically missing ability to gainfully assess the motivation to innovate of a multidisciplinary sample of individuals;

2. A tool that elucidates the promotive and hindering factors at play in their motivation to innovate;

3. An instrument with demonstrated factor integrity in diverse samples more closely aligned with the realities of today’s learning and work environments.

This instrument would ideally function across disciplines, be culturally sensitive, and holistically consider the forces promoting and hindering the motivation to innovate experienced by established and aspiring innovators in their unique lived contexts.

**Methodology**

This instrument development study used qualitative and quantitative approaches to develop the Motivation to Innovate (MTI) instrument (see Figure 3). It was conducted over two years using international and Canadian samples. This instrument development study closely followed the *Standards for Educational and Psychological Testing* (American Educational Research Association, American Psychological Association, & National Council on Measurement in Education, 2014) and recommendations of Gehlbach and Brinkworth (2011),
Kline (2016) and Watkins (2018). This study received ethical clearance from the respective university. All participants provided active consent.

**Review of Literature and Previous EVC instruments**
- Consolidation of 153 papers pertaining to environments, climates, contexts, strategies, interventions, and approaches
- 6 EVC instruments from Previous Studies
- Result: Consolidated existing scholarly knowledge into 25 themes in 3 categories:
  - Expectancies
  - Values
  - Costs

**Interviews**
- 30 innovator interviewees with 6 each from business (1), arts/humanities/design (2), basic, applied, and health sciences (3), social services (4), and scholastics (5)
- Result: Coded thematically into 12 additional emergent themes grouped into 3 categories:
  - Expectancies
  - Values
  - Costs

**Review of Literature and Previous Instrument Analysis**
- The MTI was developed after a comprehensive literature review that examined the existing literature on motivating innovation. The 153 selected papers (see Chapter 2, this dissertation; (Soleas, n.d.-b, n.d.-a) ) were analyzed and distilled into 25 themes amongst 3 categories: expectancies, values, and costs. Six previous EVC instrument studies were analyzed for structure and to inform the questions that would be asked in the interviews with innovators.

**Figure 3.** The process of instrument development detailing the consultation and refinement steps.

This research integrated the inviting, interviewing (n= 30), and consulting (n=30) of Canadian participants from a range of faiths, ethnicities, equity-seeking groups, and identities to develop the instrument completed by 500 Canadian innovators.

**The Literature Review and Previous Instrument Analysis**

The MTI was developed after a comprehensive literature review that examined the existing literature on motivating innovation. The 153 selected papers (see Chapter 2, this dissertation; (Soleas, n.d.-b, n.d.-a) ) were analyzed and distilled into 25 themes amongst 3 categories: expectancies, values, and costs. Six previous EVC instrument studies were analyzed for structure and to inform the questions that would be asked in the interviews with innovators.
(Eccles, 1983; Flake et al., 2015; Harackiewicz, Barron, Pintrich, Elliot, & Thrash, 2002; Marinak & Gambrell, 2010; Pekrun, 1992; Wiklund et al., 2003).

**Interviews and Item Initial Development**

Building on the consolidated findings of the literature review and existing EVC instruments, interview protocols were developed to expand on the areas where there were gaps in knowledge among the studies. Namely, individual motives, specific confidence-building factors, perceived value-enhancing considerations, as well as the perceived costs of innovating. These semi-structured, hour-long interviews were conducted with an invited interdisciplinary sample (n=30; stratified purposeful) that included six innovators each from (1) business, (2) arts/humanities/design, (3) basic, applied, and health sciences, (4) social services, and (5) scholastics. Interviewees were eligible to participate if they were: Canadian, employed in an innovation-related occupation, considered themselves innovators and had participated in an innovation in recent memory. These interviewees included seventeen males, eleven females, and two genderfluid innovators. Additionally, seven of these interviewees identified as a visible minority, and four reported that they had an exceptionality. Interviewee responses were coded into themes, which were then sorted into the categories of the Expectancy-Value-Cost framework. Themes generated from analysis of the interviews and the literature were consolidated within the categories of EVC illustrated by Table 6 and were used to inform questionnaire items.
Table 6

Consolidated Themes from the Literature and Interviews by Category

<table>
<thead>
<tr>
<th>Expectancy-Related</th>
<th>Value-Related</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Learning environment</td>
<td>• Enjoyment of bringing an idea to fruition</td>
</tr>
<tr>
<td>• Past innovating experiences leading to future actions</td>
<td>• Enjoyment of confronting challenges/solving puzzles</td>
</tr>
<tr>
<td>• Supported and inspired by others</td>
<td>• Enjoyment of combining elements into a new creation</td>
</tr>
<tr>
<td></td>
<td>• Satisfying a compulsion</td>
</tr>
<tr>
<td><strong>Cost-Related</strong></td>
<td>• Fuels identity and purpose</td>
</tr>
<tr>
<td>• Innovating means losing out on alternatives</td>
<td>• Fulfilment through making a difference</td>
</tr>
<tr>
<td>• Additional efforts and exertions</td>
<td>• Necessary for societal progress and challenging status quos</td>
</tr>
<tr>
<td>• Risk of rocking the boat</td>
<td>• Innovating produces financial benefits and pays off</td>
</tr>
<tr>
<td>• Significant financial costs</td>
<td>• Innovating indirectly benefits me in some way</td>
</tr>
<tr>
<td>• Fear of failure and of success</td>
<td>• Innovating helps me do my job</td>
</tr>
</tbody>
</table>

Existing EVC questionnaires exist but they are primarily designed for students and focus on topics such as math anxiety and similarly distant areas of higher-order thinking endeavour (e.g., Eccles, 1983; Flake et al., 2015; Olivares, Saiz, & Rivas, 2013). In consultation with these previous EVC instruments, quotes and paraphrases were extracted and merged to form items for the innovator context. For example, a typical expectancy-item could investigate confidence based on past experiences. As interviewees and literature pointed to the importance of past events building the confidence to innovate in the future, a developed item was “I have had opportunities to be innovative in the past.” The resulting grafts, modifications, and adaptations resulted in 90 potential Likert-items spanning E, V, and C (29 expectancy-related items, 37 value-related items across ITV/ATV/UTV, and 24 cost-related items).

Following this preliminary phase of development, the instrument was refined through structured expert consultation (Cabrera-Nguyen, 2010; Garson, 2010; Gehlbach & Brinkworth, 2010).
Six audio-recorded focus groups were conducted for word-refining and concept clarification, with three groups of three innovators (n=9; award-winning) and three groups of three education scholars at a Canadian University (n=9; innovated for a living). These focus groups helped revise promising items and cull incoherent, unspecific, or unwieldy items, reducing the list to the 33 7-point Likert-scale items ranging from strongly disagree to strongly agree with a neither disagree or agree option in the middle. These items were piloted through six think-aloud protocols (Jääskeläinen, 2010; van Someren, Barnard, & Sandberg, 1994) to ensure that items were understood as intended, with two graduate students (educational psychology and arts education), two aspiring innovators (engineering and business), and lastly two award-winning innovators (sciences and community organizing). After making refinements as guided by the think-aloud, six expert consultations were made for final critique aimed at improving instrument science rigour (two measurement scholars), content validity (one creativity and one innovation researcher), and theoretical alignment with EVC (two seminal motivation/EVC theorists). These experts provided final comments and then were provided with revised copies of the items organized into scales based on construct (See Table 7). At the closing of consultation, each expert agreed that they were satisfied with the items and respective EVC construct scales in their current state.

The final drafts of the items were entered into Qualtrics, an online survey software application, then distributed to international and Canadian innovators using social media, email invitations, and email listservs through innovation interest groups. These responses would yield the data for Factor Analysis, a well-documented approach for instrument development that provides evidence of an instruments’ relative factor integrity and psychometric properties and its validity within the examined contexts. There were two phases to survey administration: a
preliminary phase for Exploratory Factor Analysis (EFA) and a larger main phase for Confirmatory Factor Analysis (CFA). Survey respondent demographics were screened by two assessors on the same disciplinary and contextual eligibility criteria as the interviewees, with respondent occupation and endeavours evaluated for inclusion in the sample. As this instrument was developed using items incorporating the style of previous EVC instruments and studies in item development (e.g., Barron & Hulleman, 2015; Eccles, 1983; Flake et al., 2015; Olivares et al., 2013), it was expected that the factor loadings would support a structure with strong similarities to past instruments.

Table 7

*The Categorized Scale Items for the Inventory*

<table>
<thead>
<tr>
<th>Constructs</th>
<th>1. I am skilled at solving problems in novel circumstances</th>
<th>2. I am knowledgeable about how to innovate in my field</th>
<th>3. My capacity to innovate has improved over time</th>
<th>4. I am confident that I can innovate in my field</th>
<th>5. I struggle with innovating because I don’t know enough about the process to feel comfortable</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Expectancies</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Intrinsic Values</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Attainment Values</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Utility Values</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. If I am not innovating, I am likely to be less effective</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Innovation is critical to the work that I do day-to-day
3. Innovation connects me to things that I want
4. External pressures drive my innovating more than my own desire
5. Innovation helps me stay a step ahead of the competition
6. To be successful, I must innovate
7. My ability to innovative can help me achieve my goals
8. My ability to innovate has improved my quality of life
9. Innovating is central to how I will make my living or be successful in my career/job

Costs
1. Innovative behaviour is usually worthwhile, despite the effort required
2. Trying to innovate places a lot of pressure on me
3. Innovation uses a lot of time that might be better spent elsewhere
4. Innovation is frequently less valuable than sticking to what works
5. I’m afraid to try out novel ideas because of the implications if I fail
6. Sometimes being innovative requires too much time and effort
7. Innovation can be difficult for me because it involves challenging the status quo
8. There is a strong chance that innovation could indirectly affect other people (e.g. loss of jobs, etc.)

For the EFA, the eligibility criteria were the same as the interviews with the exception that participants were international rather than Canadian verified innovators. Gorsuch (1997) recommends that the samples used in a validation of a scale be similar, but that they should have a distinct value-add for being included. This international inclusion for the pilot provided the opportunity to support the notion that the instrument could work outside the Canadian context as well, further differentiating this instrument from previous innovation instrument development samples which tended to be nationally homogeneous. Data from this smaller international pilot sample were analyzed before data from the separate Canadian sample although both sets of respondents completed the same survey. Analysis of variance did not reveal any significant differences between the means of the two samples, hinting that the geographical location of the participant was not likely to be impactful in aggregate survey results.

However, for the confirmatory sample, survey responses were verified for eligibility for study inclusion through a combination of reported location, identifying as being a Canadian
citizen, permanent resident, or indigenous Canadian, and the first three digits of IP address, which was checked to be country-specific to Canada. The survey results were cleaned and analyzed using the Statistical Package for the Social Sciences (v.24).

**Results**

Two-hundred and eighty-five international innovators completed the pilot instrument. These participants were screened by multiple trained graduate student assessors for eligibility and a 227-person sample with balance between established and aspiring innovators was verified once 58 were excluded for not meeting the threshold for considering themselves innovators or having participated in a reasonably innovative endeavour, or for incomplete responses. The open-ended responses were assessed for coherence as a measure of English-language skills. Given that some innovators were invited by social media, a complete response rate was not possible to calculate. This international sample contained 52.4% male respondents, 44.9% female, and 2.64% did not disclose information related to their gender. By discipline, the pilot sample was 37.4% business, 27.3% science, 13.2% community organizing, 11.9% academics and education, and 10.1% arts and design respondents.

Results indicated that no construct items were outliers by mean (between 4.36- 6.16; SD=0.95- 1.67). The distributions were slightly skewed towards agreeability given the sample was composed of innovators (-0.52 to 0.48) (kurtosis = -0.45 to 0.74). Additionally, no items were lacking item discrimination (all exceeding Kline's (2016) critical value of 4), indicating that the raw data was statistically suitable for factor analyses. Items within scales were correlated (r = 0.38 to 0.68) which exceeded the minimum EFA requirements recommended by Kline (2016). Additionally, Bartlett’s tests of sphericity (Bartlett’s = 6256, p <0.01), and the Kaiser-Meyer-Olkin test (KMO= 0.913), a test of sampling adequacy, indicated that these analyses were
appropriately powered by a normally distributed sample (Cabrera-Nguyen, 2010; Fabrigar & Wegener, 2012).

There were no missing data. There were no significant differences detected by MANOVA in the exploratory sample across geographical locations by demographics including age, gender, level of innovation, or parental education. Reverse-coded items, even once recoded, were found to compromise the internal consistency of the scales, and were marked for removal pending the results of the Exploratory Factor Analysis.

**Exploratory Factor Analysis**

Exploratory Factor Analysis was performed using maximum likelihood extraction followed by a direct oblimin rotation accounting for potential correlations between factors. This study implemented a cut score of 0.4 in the pattern matrix for cogent display of factor loadings. EFA following this method resulted in the four-factor solution closely resembling that originally found by Eccles (1983) explaining 70.7% of the variance (see Figure 4).

![Figure 4. Factor structure and items grouping revealed by the Exploratory Factor Analysis.](image)

It was notable that this model merged Attainment- and Utility-task value scale items into one factor diverging from Eccles’ (1983) model, whereas expectancy, intrinsic-task value, and cost scales each were found to be separate factors (See Table 8). The amalgamation of attainment- and utility-task values on a single factor has been noted elsewhere as a result of the
strong correlation between perceived usefulness and importance (Barron & Hulleman, 2015; Flake et al., 2015).

Items, EX5, IV5, AV3, UV4, and CST1, either substantially cross-loaded among factors or did not load strongly on factors and thus were dropped from the developing instrument. These items tended to be reverse coded and were also amongst the least supported by available EVC theory (e.g., Flake et al., 2015). These items were also found to decrease scale internal consistency and were the relative outliers in the skewness and kurtosis analyses.

Table 8

Oblique Pattern Matrix of the Exploratory Factor Analysis

<table>
<thead>
<tr>
<th>Items</th>
<th>Factor 1</th>
<th>Factor 2</th>
<th>Factor 3</th>
<th>Factor 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>EX1-I am skilled at solving problems in novel circumstances.</td>
<td></td>
<td></td>
<td>0.54</td>
<td></td>
</tr>
<tr>
<td>EX2-I am knowledgeable about how to innovate in my field.</td>
<td></td>
<td>0.72</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EX3-My capacity to innovate has improved over time.</td>
<td></td>
<td></td>
<td>0.59</td>
<td></td>
</tr>
<tr>
<td>EX4-I am confident that I can innovate in my field.</td>
<td></td>
<td></td>
<td>0.72</td>
<td></td>
</tr>
<tr>
<td>EX5-I struggle with innovating</td>
<td></td>
<td></td>
<td></td>
<td>0.54</td>
</tr>
<tr>
<td>IV1-In general, I find the process of innovating personally rewarding.</td>
<td></td>
<td></td>
<td></td>
<td>0.75</td>
</tr>
<tr>
<td>IV2-I take pride in innovating.</td>
<td></td>
<td></td>
<td></td>
<td>0.66</td>
</tr>
<tr>
<td>IV3-I like to innovate during my day-to-day work.</td>
<td></td>
<td></td>
<td></td>
<td>0.52</td>
</tr>
<tr>
<td>IV4-I enjoy being in an environment that fosters innovation.</td>
<td></td>
<td></td>
<td></td>
<td>0.71</td>
</tr>
<tr>
<td>IV5-I get bored when my work becomes routine.</td>
<td></td>
<td></td>
<td></td>
<td>0.52</td>
</tr>
<tr>
<td>AV1-Innovation is foundational to me feeling effective in my work.</td>
<td></td>
<td></td>
<td>0.73</td>
<td></td>
</tr>
<tr>
<td>AV2-Being innovative is important to how I am perceived</td>
<td></td>
<td></td>
<td>0.79</td>
<td></td>
</tr>
<tr>
<td>AV3-I am proud of my accomplishments</td>
<td></td>
<td></td>
<td>0.42</td>
<td></td>
</tr>
<tr>
<td>AV4-Being innovative is important to my identity.</td>
<td></td>
<td></td>
<td>0.81</td>
<td></td>
</tr>
<tr>
<td>AV5-Innovation is important to my own sense of self.</td>
<td></td>
<td></td>
<td>0.81</td>
<td></td>
</tr>
<tr>
<td>AV6-When I struggle to innovate, I feel like I am letting myself down.</td>
<td></td>
<td></td>
<td>0.70</td>
<td></td>
</tr>
</tbody>
</table>
UV1-If I am not innovating, I am likely to be less effective. 0.71
UV2-Innovation is critical to the work that I do day-to-day. 0.74
UV3-Innovation connects me to things that I want. 0.77
UV4-External pressures drive my innovating more than my own desire. 0.41 0.53
UV5-Innovation helps me stay a step ahead of the competition. 0.62
UV6-To be successful, I must innovate. 0.74
UV7-My ability to innovate can help me achieve my goals. 0.55
UV8-My ability to innovate has improved my quality of life. 0.53
UV9- Innovating is central to how I will make my living. 0.70
CST1-Innovative behaviour is usually worthwhile. -0.35 -0.36
CST2-Trying to innovate places a lot of pressure on me. 0.55
CST3-Innovation uses a lot of time. 0.77
CST4-Innovation is frequently less valuable than what works. 0.75
CST5-I am afraid to try out novel ideas. 0.81
CST6-Sometimes being innovative requires too much time and effort. 0.71
CST7-Innovation can be difficult for me. 0.69
CST8-There is a strong chance that innovation could harm others. 0.71

Notes. Extraction method: maximum likelihood; Rotation method: Oblimin with Kaiser Normalization. Loadings smaller than 0.40 are not shown.

As suspected, past EVC research has consistently shown that the constructs are correlated, which supported the use of an oblique rotation thus accounting for potential correlation between factors (Gorsuch, 1997). The findings from this study illustrate significant small to medium correlations amongst the factors (See Table 9).
Table 9

**Correlations among the Constructs in the Exploratory Survey Sample of Innovators**

<table>
<thead>
<tr>
<th></th>
<th>ITV</th>
<th>ATV</th>
<th>UTV</th>
<th>Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expectancies</td>
<td>.50**</td>
<td>.50**</td>
<td>.55**</td>
<td>-.23**</td>
</tr>
<tr>
<td>Intrinsic_Task_Value (ITV)</td>
<td>.51**</td>
<td>.56**</td>
<td>-.24**</td>
<td></td>
</tr>
<tr>
<td>Attainment_Task_Value (ATV)</td>
<td>.68**</td>
<td>0.04</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Utility_Task_Value (UTV)</td>
<td></td>
<td></td>
<td></td>
<td>0.01</td>
</tr>
</tbody>
</table>

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

**Confirmatory Factor Analysis**

For the Confirmatory Factor Analysis, 504 invited Canadian aspiring and established innovators completed the instrument with the EFA refined structure (see Figure 5). Once validation of the sample was complete, four responses were removed because of incomplete responses yielding a final sample of precisely 500 Canadian innovator respondents. There were no missing data in these responses. Further, there were no significant differences between the confirmatory and exploratory samples when compared by MANOVA. Additionally, given the 28 items of the instrument and the 500 respondents, this CFA used a sample constituting 17.86 respondents per item, well above Schreiber et al's (2006) and Mundfrom, Shaw, and Ke's (2005) sample size recommendations for Confirmatory Factor Analyses.

Given that most innovators were invited by social media, a comprehensive response rate was not possible to calculate. However, of the 207 directly emailed Canadian innovators, 94 completed the questionnaire (45.4% response rate among this sample segment). There was relative parity across innovator discipline representation with 23.6% business, 21.4% sciences and engineering, 21% social services, 18.8% academia, and 15.2% arts and humanities. Gender respondents were 48.6% male, 42.0% female, 8.8% who declined reporting their gender identity,
and 0.6% who identified as outside the gender binary. There were no significant differences between motivation constructs by the international and Canadian samples.

Figure 5. Proposed factor structure examined by Confirmatory Factor Analysis.

In the CFA, maximum likelihood estimation was used as the data met the assumptions for normality (Bartlett’s = 6266, p <0.01) and sample adequacy (KMO= 0.925). Following the advice of Cabrera-Nguyen, (2010) and Schreiber et al. (2006), multiple fit indices were utilized. The four-factor model fit first illustrated by the EFA and shown above resulted in acceptable model fits in the CFA with strong factor loadings and acceptable fit indices (Garson, 2010; RMSEA, <0.5; GFI = 0.97; CFI= 0.96; TLI=0.96, CMIN/df= 2.94; df =289) in the Canadian sample. This study implemented a cut score of 0.4 in the Factor loading table as recommended by Kline (2016) (See Table 10). Additionally, the internal consistencies of the final model as measured by Cronbach’s alpha (ranging from 0.816 to 0.893) were improved as a result of the removed items as compared to the items used in the EFA.

The CFA illustrated the strong loadings of the instrument neatly onto four factors, which are named as follows: Extrinsic task value (1), which encompasses attainment and utility task
values, perceived costs (2), intrinsic task value (3), and expectancies (4). This diverges from the previous EVC models by combining attainment and utility task values onto one factor while supporting the exact structure coalesced statistically by the EFA.

Table 10

Confirmatory Analysis Factor Table—Four Factor Solution Showing Grouped Items

<table>
<thead>
<tr>
<th>Item</th>
<th>Factor</th>
<th>Dimension</th>
</tr>
</thead>
<tbody>
<tr>
<td>EX1-I am skilled at solving problems in novel circumstances.</td>
<td>0.73</td>
<td>Expectancies</td>
</tr>
<tr>
<td>EX2-I am knowledgeable about how to innovate in my field.</td>
<td>0.78</td>
<td></td>
</tr>
<tr>
<td>EX3-My capacity to innovate has improved over time.</td>
<td>0.63</td>
<td></td>
</tr>
<tr>
<td>EX4-I am confident that I can innovate in my field.</td>
<td>0.74</td>
<td></td>
</tr>
<tr>
<td>IV1-I find the process of innovating personally rewarding.</td>
<td>0.81</td>
<td>Intrinsic Task Values</td>
</tr>
<tr>
<td>IV2-I take pride in innovating.</td>
<td>0.73</td>
<td></td>
</tr>
<tr>
<td>IV3-I like to innovate during my day-to-day work.</td>
<td>0.74</td>
<td></td>
</tr>
<tr>
<td>IV4-I enjoy being in an environment that fosters innovation.</td>
<td>0.79</td>
<td></td>
</tr>
<tr>
<td>AV1-Innovation is foundational to me feeling effective in my work.</td>
<td>0.81</td>
<td>Attainment and Utility Task Values</td>
</tr>
<tr>
<td>AV2-Being innovative is important to how I am perceived by my peers.</td>
<td>0.89</td>
<td></td>
</tr>
<tr>
<td>AV4-Being innovative is important to my identity.</td>
<td>0.79</td>
<td></td>
</tr>
<tr>
<td>AV5-Innovation is important to my own sense of self.</td>
<td>0.78</td>
<td></td>
</tr>
<tr>
<td>AV6-When I struggle to innovate, I feel like I am letting myself down.</td>
<td>0.81</td>
<td></td>
</tr>
<tr>
<td>UV1-If I am not innovating, I am likely to be less effective.</td>
<td>0.82</td>
<td></td>
</tr>
<tr>
<td>UV2-Innovation is critical to the work that I do day-to-day.</td>
<td>0.80</td>
<td></td>
</tr>
<tr>
<td>UV3-Innovation connects me to things that I want.</td>
<td>0.74</td>
<td></td>
</tr>
<tr>
<td>UV5-Innovation helps me stay a step ahead of the competition.</td>
<td>0.81</td>
<td></td>
</tr>
<tr>
<td>UV6-To be successful, I must innovate.</td>
<td>0.74</td>
<td></td>
</tr>
<tr>
<td>UV7-My ability to innovative can help me achieve my goals.</td>
<td>0.71</td>
<td></td>
</tr>
<tr>
<td>UV8-My ability to innovate has improved my quality of life.</td>
<td>0.80</td>
<td></td>
</tr>
<tr>
<td>UV9-Innovating is central to how I will make my living or be successful</td>
<td>0.74</td>
<td></td>
</tr>
<tr>
<td>CST2-Trying to innovate places a lot of pressure on me.</td>
<td>0.74</td>
<td>Cost</td>
</tr>
<tr>
<td>CST3-Innovation uses a lot of time that might be better spent elsewhere.</td>
<td>0.77</td>
<td></td>
</tr>
<tr>
<td>CST4-Innovation is frequently less valuable than sticking to what works.</td>
<td>0.76</td>
<td></td>
</tr>
<tr>
<td>CST5-I am afraid to try out novel ideas because of the implications if I fail.</td>
<td>0.81</td>
<td></td>
</tr>
</tbody>
</table>
Discussion

This instrument development study was guided by the Standards for Educational Psychological Testing (American Educational Research Association et al., 2014) and developed an inclusive, psychometrically-sound inventory useful in multiple disciplines to assess the factors impacting motivation to innovate across educational and workplace contexts. It was developed with the critique and support of expert scholars and innovators to be useful as a personally reflective tool for individual innovators but also to be useful in carrying out research to support the work of decision-makers and educators as they consider reforms and alterations to existing practices in the promotion of innovative behaviour.

Strengths of the Study

Much of the previous instrument development pertaining to innovation has been dominated with white, male, and business samples (e.g. Agrell & Gustafson, 1994; Kirton, 1976). This instrument development study had a diverse, heterogeneous sample comprised of individuals of many cultures and faith groups, balancing gender, and spanning many disciplines, thus enabling it to better approximate the demographics of Canadian and global society (Nager, Hart, Ezell, & Atkinson, 2016; OECD, 2017). The specific integration of multiple disciplines created the circumstances for the development of a tool likely to be useful across multiple disciplines in research and efforts aiming to make innovation more likely. Additionally, the psychometric properties of the instrument are sound in terms of factor structure and internal consistency.
Attainment and utility task value loading on one factor in both samples is interesting as it diverges from other EVC analyses (e.g., Barron & Hulleman, 2015; Flake et al., 2015; Harackiewicz et al., 2002). In alignment with the findings of other studies in motivation, attainment and utility values were found in this study to be associated with internal and external extrinsic motivation as described by Self-determination theory (e.g., Ryan & Deci, 2000, 2017). Attainment and utility task value although different in practice share being external to the task of innovating, compared to intrinsic task value being drawn directly from constant participation in the task. This would corroborate the finding that attainment- and utility-task value coalesced onto a single factor in both the exploratory and confirmatory factor analyses.

The theoretical and practical differences between expectancies, intrinsic task-values, and costs as well as utility- and attainment-task values (Barron & Hulleman, 2015; Flake et al., 2015) were clearly shown in these findings and instrument refinement study. There were limited differences by national context and disciplinary context between the international sample of innovators in the exploratory factor analyses and the Canadian sample in the confirmatory factor analysis. By virtue of using both samples in the factor analyses and yielding identical factor structures, this instrument was shown to work with both of these national and international groupings enhancing its demonstrated suitability for use in multiple contexts.

**Validity Argument and Trustworthiness**

One of the challenges for this instrument development study was its use of self-report data, albeit this is in alignment with a majority of motivation studies as it is a latent construct (Antikainen et al., 2010; Maehr & Meyer, 1997; Ryan & Deci, 2017). Further, as this instrument was developed to function as an individual’s inventory of motivation factors, self-report data is necessary and appropriate. Response rates for the whole sample could not be calculated given
the method of participant recruitment; however, for the portion where this was possible, it was 45.4%. The exploratory phase was of modest sample size for most scale development, however, the sample adequacy and normality metrics were found to be within the acceptable range of contemporary literature.

Traditionally, a factor analysis-driven instrument development uses two almost identical samples. This study was conducted with an international sample of validated innovators followed by a Canadian sample of validated innovators. Although this may have diminished the consistency between the two samples, results illustrate that the instrument improved from the explored to the confirmed factor loadings as shown by the superior psychometric (Cronbach’s), theoretical (stronger item groundings in theory), and brevity (fewer items on the scale) metrics after eliminating the revealed weaker items. However, the unorthodox, but precedented decision to use two slightly different samples (e.g., Kline, 2016; Watkins, 2018) resulted in an instrument designed for Canadian innovators that also works effectively with international innovators. The goal of innovation education is to make innovation more common by breaking down barriers and silos (VanTassel-Baska, 2013), therefore an instrument that is not exclusive to one cultural, disciplinary, or ethnic group meaningfully furthers that goal.

Lastly, this instrument strays from the comparative and preference-driven discipline-specific items of other expectancy-value instruments (e.g., Eccles, 1983) in favour of contextually-transferable Likert-style statements that are more applicable to more circumstances they are not as coded to a specific context such as math anxiety (Eccles, 1983) or class performance (Barron & Hulleman, 2015). In this study, the internal consistencies and standard deviations of the responses compared favourably with other EVC instruments ( Flake et al., 2015;
indicating that the decision to use Likert-statements did not introduce instability into the instrument.

**Implications**

In a first for the field of innovation education and promotion, this study used an Expectancy-Value-Cost conceptualization of innovation that accounted for both promotive and hindering factors, giving a more complete picture of the dynamics at play in a given individual’s motives. This balanced consideration of motivating and de-motivating factors has strong potential to be helpful to those who seek to make innovation more likely. Given, the robust study of motivation to innovate in business and management settings, this instrument offers a means to apply these understandings from the literature (e.g., Amabile, 1996; Anderson et al., 2014; Scott & Bruce, 1994; Struckell, 2019; Swayne, Selznick, McCarthy, & Fisher, 2019) and inform the efforts of decisionmakers to make innovation more likely. For example, if the inventory illustrates that individuals perceive high costs of innovating, the organization’s reactions to setbacks, investments of resources, or guiding policies may need to be altered. As well, this works better accounts for the motives of social innovators in this surging area of interest (e.g., Lawrence et al., 2012; Mirvis & Googins, 2018).

This study also showed that the expected factor structure of previous EVC instruments was largely intact, with the exception of attainment and utility task values coalescing on one factor representing extrinsic motivation. This externally-mediated motive was therefore distinct from the internally-mediated motive of interest, curiosity, or enjoyment that originated from innovation itself. The division of externally-mediated values and internally-mediated values gives decision-makers and teachers cause to think about innovation as potentially personally, but also pragmatically valuable to their charges. Decision-makers and teachers would, therefore,
benefit from making the tasks they assign as intrinsically-rewarding, whilst also highlighting their importance and usefulness for their charges.

Conclusions

This research has demonstrated that the MTI instrument is psychometrically sound with an interdisciplinary, inclusion-oriented sample and holistically considers both promotive and hindering factors in a new way for the innovation education and promotion literature. The holistic approach of developing this instrument enables the two-pronged approach advocated in the literature to make innovation more likely by identifying the extent of different supports and barriers to innovating that can be respectively maximized or mitigated (Chaiechi, 2014; Manso, 2017; Soleas, 2018c). This instrument can be used in alignment with the existing understandings of methods to promote innovation from business, innovation education, and psychology among others. This instrument can be conceptually useful to both aspiring innovators, decision-makers, and researchers as a way of identifying numerous contextual-grounded potential avenues in support of innovation promotion efforts.

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Chapter 4

Manuscript 2: Expectancies, Values, and Costs of Innovating Identified by Canadian Innovators: A Motivational Basis for Supporting Innovation Talent Development

Abstract

Current studies in innovation are often siloed to specific disciplines, precluding a generalizable understanding useful in identifying the factors that promote and hinder individual motivation to innovate. This study integrates analysis of 30 interviews and 500 surveys of Canadian innovators from a variety of disciplines as a means of understanding the avenues that education could use to develop innovation talent. The results of this study point to the overstated role of rewards as drivers of developing innovation talent. These findings support the idea that programs that wish to support innovation for all learners should be guided by the primacy of decisions that build confidence, fulfill interest and perceived importance of the task at hand, as well as those mitigating the costs of innovating. The implementation of promotive and cost mitigating strategies should be a high priority for educational efforts to stoke the development of innovation talent for learners in multiple contexts.

Keywords: Expectancy-Value-Cost Theory; Innovative Behaviour; Interdisciplinary Perspectives; Mixed Methods; Talent Development

The Importance of Developing Innovation Talent

Innovation is a process of applying practical or theoretical knowledge to novel contexts to facilitate discoveries, improve designs, and generally enhance individual lives and society (Baregheh et al., 2009; Drucker, 2006; Pavitt, 2005). This process is an application of developed skills such as creativity, critical thinking, and domain knowledge. As a primary source of renewal and revitalization, innovation promotes progress through new ideas, counters stagnation, and in so doing is vital to the long-term success of our society (Dewey, 1997), so much so that
developing the capacity to innovate is now one of the new transferable skills on Ontario’s redesigned report cards (People for Education, 2017). It is clear that developing innovation talent is understood to be too important to be left to chance and must be more optimally stoked for all learners to become more prevalent.

Furthermore, the study of what motivates innovators to successfully propel their ideas forward and overcome the obstacles of mobilizing them has been largely overlooked in terms of informing programs in educational settings. Although some studies investigate innovation as an outcome (e.g., Berkun, 2017; Brusoni, Cefis, & Orsenigo, 2006; Dodgson, Gann, & Phillips, 2013; Drucker, 2006), few focus directly on how to promote or support innovation (e.g., Carr, Kendal, & Flynn, 2016; Shavinina, 2013b), particularly in relation to educational programs such as school or afterschool programs, and those that do tend to centre on the experiences of prodigies and gifted students (e.g., Shavinina, 2013c; Yun Dai, 2013) as opposed to identifying ways to leverage the potential of a wider segment of society starting from their time in school.

A gap in the literature exists in understanding the motivations of existing innovators as a means to inform innovation education. As scant research examines how to optimally support innovation in learning contexts (Bolderdijk et al., 2018; Fischer et al., 2019), this study investigated the experiences and motivation of innovators in order to better inform future innovation education initiatives. The current study directly addressed the limited research concerning the motivations of innovators by examining the factors that underpin the motivation of existing innovators. As current innovation development research is dominated by business literature, there is a need to focus on other disciplines as well to honour the consensus that innovation occurs between, across, and in many different disciplines (Baregheh et al., 2009).
This paper will examine the motivations of an interdisciplinary sample of innovators to provide transferable understandings of the motivational forces at play that drive talent development.

**From Expectancy-Value Theory to Expectancy-Value-Cost Theory**

A variety of types of motivation propel individual innovation (Bhaduri & Kumar, 2011; Emo, 2015). Expectancy-Value Theory (EVT; Eccles, 1983) offers a valuable (and fresh) perspective on promoting innovation as it considers motivational factors that both enhance and hinder innovation. EVT, as seminally defined by Eccles (1983), identifies that the motivation to complete tasks (such as innovation) involves balancing the expectancies of success (self-concept and self-efficacy) with the perceived subjective values of the task including attainment, intrinsic, and utility value, and cost. The cost construct would later be vastly expanded in scope and applicability by Flake et al. (2015). The motivation for complex tasks can be explained through the interaction of individuals’ confidence in their ability to succeed in a given task, expectancies, and the perceived importance, enjoyment, and usefulness they associate with that task—task values (Barron & Hulleman, 2015; Wigfield et al., 2009). In other words, individuals who expect to succeed based on their skills and experiences and who see value in innovating are more likely to try innovating. Ascertaining the reported expectancies and values that motivate existing innovators can help educators understand how to focus support and enhance student innovation potential.

Although highly valued, innovation also has contextual and psychological costs for the individual (and by extension students), such as effort, time, pressure, and implications of failure (Flake et al., 2015; Shavinina, 2013b). Therefore, for many students, the cost of innovating is higher than the expectancies and values. To promote innovation development, our learning and work environments must optimally build expectancies and values and help learners manage
innovation’s costs. Until recently, the impacts of costs on individuals’ motivation to complete tasks were only an afterthought (Barron & Hulleman, 2015). Flake et al. (2015) argued that the impact of cost was underestimated and proposed a more comprehensive Expectancy-Value-Cost (EVC) approach when investigating motivation factors.

In sum, this study addresses the paucity of research on individual motives in research on innovation education and is guided by the following research question: What are the expectancies, values, and costs of innovating identified by Canadian innovators? The study’s findings can be leveraged to inform innovation education initiatives that help balance the expectancies and values of innovating against the inevitable costs that aspiring innovators — including our students — will have.

**Methodology**

This study used a convergent mixed methods approach (Creswell & Creswell, 2017) combining semi-structured interviews and then a survey of Canadian innovators. For clarity, the interviews were conducted with a diverse, multidisciplinary sample of Canadian innovators (called ‘interviewees’; n=30) and informed the development of the survey, administered to a larger sample of Canadian innovators (called ‘survey respondents’; n=500). The findings were then analyzed in tandem to comprehensively answer the research questions. This study received ethical clearance from the Queen’s General Research Ethics Board and was conducted in strict compliance with the best practices of the Tri-Council Research Agency of Canada. Questions about participants’ employment, endeavours, and past achievements informed decisions about their eligibility to participate in the study in alignment with the criteria of Kaufman and Beghetto (2009) in their works on creativity. As innovation and creativity are entangled concepts, Kaufman and Beghetto’s continuum of creativity (Mini-c, Little-c, Pro-c, and Big-C) was
applied to innovation (Mini-I, Little-I, Pro-I, and Big-I; see Table 12 for category description) to provide a conceptual hierarchy for approximately categorizing innovation based on scope and prominence. Participants who did not meet the criterion of at least nascent innovative behaviour such as innovating while learning (Mini-I; analogous to the Mini-c level of Kaufman and Beghetto) were not eligible for inclusion in the study sample and were thanked for their interest.

**Interviews**

Interviewees were aspiring or recognized Canadian innovators invited to participate in the study. A list of Canadian innovators was compiled by the researcher and reviewed by a panel of critical colleagues based on a variety of awards, achievements, and lists of innovators to watch as compiled by innovation interest groups, and then judiciously invited to reach balanced quotas aspiring for disciplinary, cultural background, and gender representation. Invitations yielded six innovators from each of science, technology, engineering, and mathematics (1), social services (2), education and academia (3), arts (4), and business settings (5) for a total of 30 interviews ranging from 45 to 96 minutes. Interviewees were written detailed rationales for their invitation and almost all accepted the invitations however two did not acknowledge the invitation. Interviewees represented a variety of disciplinary (see Table 11) and innovator level groups (see Table 12). Seventeen innovators identified as being men, while 11 identified as being women; two innovators did not identify within the gender binary.

During the interviews, innovators were asked to answer eight open-ended questions about their motivations, experiences, and conceptualizations about innovation, followed by supplementary queries to capture latent details. Interviews were transcribed verbatim and thematically coded (Basit, 2010; Braun & Clarke, 2006) using ATLAS.ti v8.3.16 qualitative analysis software. Open codes were deductively clustered into sub-themes organized into the
established groups of expectancies, values, and costs as overarching categories. There was 97% coder agreement between the researcher and a researcher colleague on the first three interviews. A discussion to reconcile the differences in the first three interviews led to the establishment of a codebook to be used to code the remaining interviews.

**Survey Responses**

Similarly to the interviewees, survey respondents (n=500; more completed but excluded on partial eligibility grounds) also were an interdisciplinary, multicultural sample of Canadian innovators invited to complete the 15-minute questionnaire composed of open responses addressing barriers, supports, and experiences complemented with closed-ended items including demographics and EVC Likert-like scales. The scales were developed and heavily modified from a mix of novel and items from previously validated instruments. Items were isolated from the findings of a literature review of reported motivations for innovative behaviour (Soleas, n.d.-b). Items were then iteratively reviewed in interviews with think-aloud protocols with non-interviewed innovators to help promote item coherence (Jääskeläinen, 2010; van Someren et al., 1994). Eight think-aloud interviews were held, with revisions made after each iteration. Draft items were then reviewed by expert measurement (n=2), innovation promotion (n=3), and EVC scholars (n=2) who suggested changes to increase the construct integrity of the Likert-items. Lastly, the final scales were shared with all the previous experts for review, none of whom made further suggestions.

Survey respondents were invited to participate by email and social media. Responses were verified for eligibility for study inclusion through a combination of reported location, first three digits of IP address, occupation, and role description and then sorted into disciplinary (see Table 11) and innovator level groups (see Table 12; Kaufman & Beghetto, 2009). The survey
sample featured 243 male respondents, 210 female respondents, and 3 who identified outside the gender binary. Open-ended items were coded thematically in ATLAS.ti v8.3.16 and in alignment with the analysis of the interview responses. Closed-ended item response values were organized and statistically analyzed using SPSS v25.0. Statistical and instrument development tests included calculating internal consistencies (Cronbach’s alpha’s ranged between 0.81 and 0.90), exploratory factor analyses (items loaded on constructs as expected by past EVC instruments; Flake et al. 2015), MANOVA (at 99% confidence; given the number of comparisons), and descriptive statistics. Innovator identity, expectancy, value, and cost items were combined together (See Appendix D) and averaged without weighting to create sub-scale scores that were used in the statistical analyses. Cohen’s d was calculated for each significant difference and his magnitudes were used as benchmarks for illustrating the scale of a given difference (Cohen, 1988).

Table 11

<table>
<thead>
<tr>
<th>Disciplinary Representation</th>
<th>Interviewees</th>
<th>Survey respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applied, Health, and Basic Science</td>
<td>6</td>
<td>107</td>
</tr>
<tr>
<td>Social Services and Community Organizing</td>
<td>6</td>
<td>105</td>
</tr>
<tr>
<td>Arts, Design, and Humanities</td>
<td>6</td>
<td>76</td>
</tr>
<tr>
<td>Business, Management, and Venture Capitalists</td>
<td>6</td>
<td>118</td>
</tr>
<tr>
<td>Scholastics, Education, and Academia</td>
<td>6</td>
<td>94</td>
</tr>
</tbody>
</table>

Table 12

<table>
<thead>
<tr>
<th>Adapted Kaufman Framework— “Level” of Innovator</th>
<th>Interviewees</th>
<th>Survey respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mini-I (Preliminary-level innovation)</td>
<td>N/A</td>
<td>31</td>
</tr>
<tr>
<td>Little-I (Personally notable innovation)</td>
<td>10</td>
<td>241</td>
</tr>
<tr>
<td>Pro-I (Professional innovation)</td>
<td>15</td>
<td>180</td>
</tr>
<tr>
<td>Big-I (Broadly recognized innovation)</td>
<td>5</td>
<td>48</td>
</tr>
</tbody>
</table>
Results

The results are presented here, organized by EVC construct with interview and survey sample findings nested together as preceded in sequential mixed methods designs (see Maxwell, 2016; McKim, 2015; Mertens, 2007) instead of solely by phase. For clarity, the term ‘participant’ draws from both samples, whereas when exclusive to one sample, they are termed ‘interviewees’ or ‘survey respondents’ respectively.

Innovator Self-Concept

Innovator self-concept did not differ between survey respondent groups by learning exceptionality, visible minority status, age group, parental level of education, gender, or discipline as per a MANOVA (See Appendix E for detailed statistical results). However, comparing groups by level of education illustrated significant differences as individuals with graduate degrees reported the highest aggregate innovator self-perception (F= 4.94, p=0.001, d=1.12; large effect size vs. lower credentials). Additionally, respondents categorized as higher levels of innovator (i.e., being Pro-I or Big-I innovators) reported a higher innovator self-concept than their peers evaluated to be Mini-I or Little-I innovators (F= 25.32, p= 0.001, d= 0.55; medium effect size). In short, the extent to which individual respondents thought of themselves as innovators was found to be related to their level of education and their past success.

1 Appendix E was included as an appendix for this manuscript as submitted to the Journal of Advanced Academics
Expectancies

Expectancies (i.e., measures of confidence and self-efficacy) did not differ between survey respondent groups by learning exceptionality status, level of education, visible minority status, age group, parental education, or gender (See Appendix E for detailed statistical results and post-hoc tests results). However, respondents categorized as higher levels of innovator (i.e., being Pro-I or Big-I innovators) reported higher expectancies than peers evaluated to be Mini-I or Little-I innovators ($F = 12.84, p = 0.001, d = 0.33$; small effect size). A significant effect was found for expectancies based on areas of endeavour ($F = 4.86, p = 0.004, d = 0.34$). Post-hoc tests revealed that expectancies for those in the arts and humanities were significantly higher than the values reported by those in the sciences. Post-hoc tests did not identify any other significant disciplinary differences with or amongst business, scholastics and education, and social services whose values ranged between the highest (arts and humanities) and lowest (sciences) means. In sum, amongst survey respondents, self-esteem and confidence when trying to innovate appeared to be influenced by their level of education, past success, and discipline.

Analysis of the interviews and open-ended responses of the surveys identified sources of interviewee confidence and self-efficacy when innovating: the learning environment, past experiences leading to future actions, and being supported and inspired by others (see Table 13).

Table 13

*Sub-Themes Associated with Innovators Feeling Expectancies*

<table>
<thead>
<tr>
<th>Sub-theme</th>
<th>Interviews with relevant quotes (%)</th>
<th>Interview sub-theme quotes</th>
<th>Surveys with relevant quotes (%)</th>
<th>Survey sub-theme quotes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Learning environment</td>
<td>30 (100%)</td>
<td>219</td>
<td>433 (86.66%)</td>
<td>458</td>
</tr>
<tr>
<td>2. Past experiences leading to future actions</td>
<td>30 (100%)</td>
<td>165</td>
<td>395 (79%)</td>
<td>417</td>
</tr>
<tr>
<td>3. Supported and inspired by others</td>
<td>30 (100%)</td>
<td>232</td>
<td>419 (83.8%)</td>
<td>425</td>
</tr>
</tbody>
</table>
**Learning environment.** Innovators reported that the learning environment was one source of their confidence while innovating. Across interviews and survey responses, it was consistently reported that environments with enough support or situations with critical mass explained as having “lots of ideas bouncing around” (Interviewee-29), incubators, scenes, or having “a diversity of backgrounds” (Interviewee-2) were conducive to innovation confidence. Participants additionally noted that their confidence in innovating was bolstered by a variety of types of learning structures, including studio models, small group learning, debates, and seminar-style facilitations with blocks of time. Participants also tended to value variation between different types of facilitation, indicating that the preferred learning environment was not predicated on any one median, but rather having access to several different learning medians.

Participants elaborated that confidence-building spaces provided an opportunity for learners to fail and experience consequences safely termed by interviewee 19 as “psychological safety.” Participants were clear in their need to be able to fail without negative consequences and underscored how context safety was a central reason for their confidence when innovating.

Many participants also spoke of their innovating confidence as being supported by learning environments in which their work was grounded in real-world relevance. Interviewee 29 described this environment as one that empowered aspirants “to grab hold of their destiny” and provided opportunities to experience “real-world outcomes, as anything attached to the real world is immediately going to spark a different kind of engagement.” Participants commented that activities in learning environments were most transferable when they connected to their actual lives with particular praise for those extending beyond typical classroom learning structures. Participants praised situations involving co-construction or co-teaching in a
classroom and reported the need for environments like field trips, excursions, and chances to “attack a problem head-on rather than read about it” (Interviewee-23).

To summarize, innovator interviewees reported gaining confidence in innovating through carefully prepared learning environments, specifically spaces in which they could interact with other innovator colleagues, experience a variety of types of learning structures, make mistakes and fail safely, and connect their work to real-world contexts.

**Past experiences leading to future actions.** Interviewees were quick to credit past experiences from their youth and early adulthood as being catalysts for their current confidence when innovating. Innovators explained that the source of their confidence was a childhood spent innovating. Interviewee 25 explained, “my parents didn’t have money to buy me a bicycle, so I’d go with my brother to the scrapyard and cannibalize other bicycles to put together, so we’d have one.” Participants described stretching their childhood allowances to pursue their early hobby innovations and discussed how these crucial early events predisposed them to later innovating. Other participants similarly described having to accomplish their early goals with limited resources and that overcoming these challenges contributed to their confidence when approaching future innovating goals.

Participants also acknowledged their formative lived experience of taking risks in order to sate their curiosity. Recognizing the value of engaging in these behaviours, despite risks, fueled their later confidence. Participants told stories of “sneaking out of school to watch the eclipse” (Interviewee-20) or “taking apart my dad’s pocket watch and then learning how to run away very quickly” (Interviewee-4), illustrating how they learned to capitalize on opportunities to learn and experience new things despite potentially negative repercussions. Participants described these early experiences as precursors to their current capacity and confidence when
innovating. These early experiences were credited with instilling both motivation and confidence for future innovating.

When interviewees were asked how and when they learned to be innovative, all but one (29/30 interviewees) commented on learning from doing and trying new things. For example, interviewee 13 explained that “you learn to anticipate how people will react to change.” Interviewee 10 mused, “I tried out a new style of drawing, and my whole class hated it. I learned to only bend the rules a little at a time, and that has made me more successful in the present.” Interviewees described the process of learning to innovate as being an incremental process built on experiences, particularly those that introduced new ideas or change and required them to negotiate reactions.

In sum, participants reported past experiences as being catalysts for their present confidence when innovating. Participants gained confidence through their lived experiences of accomplishing early innovation goals with limited resources, recognizing the benefit of taking risks, and learning how to test boundaries and introduce change cautiously.

**Supported and inspired by others.** Most participants strongly credited their family and close friends with boosting their confidence in innovating. Interviewee 21 identified the importance of “enablers”: “If nobody close was supportive, you’d start thinking you were crazy.” Most interviewees directly credited their upbringing and household norms, such as innovation being modelled by parents or family, for their confidence. Others similarly outlined how innovating was expected from them and that they were required to confront real-world challenges from an early age. As interviewee 1 explained, their parents “wouldn’t solve problems for me; I had to do that myself.”
Participants also noted that peer and mentor actions inspired their innovation confidence. Interviewee 21 cited an invitation from a mentor “to join in on pushing knowledge and showing that it’s attainable to be someone pushing the wall of what is known.” Interviewee 26 similarly reported that he “got into physics because of an inspirational high school teacher.” Participants also reported working with like-minded colleagues as crucial support because it built their confidence and acted as what was variously described as a peer safety net. Interviewee 7 credited a “network of people, [who] made me see that I was not alone.” Interviewee 9 credited their innovating confidence to a teacher who developed a particular aspect of knowledge useful for innovating, specifically, knowledge of “systems thinking and ingraining critical thinking into the way we do everyday things.”

In addition to gaining confidence through social and emotional support from others, interviewees also acknowledged the importance of financial support. Interviewee 21 commented, “if you look at start-ups, about one in 10 succeeds, but if you look at the ones which were measurably financially supported, it’s better than 50%.” Speaking more broadly about financial aid programs that helped him realize his specific innovation, interviewee 26 commented that “I think we’re very fortunate to have successful support for innovation in this country.” Securing funding or financial support greatly contributed to the confidence among participants.

To summarize, participants reported gaining confidence as a result of various supports, including family members and friends who believed in them and in the value of innovating, peers and mentors who modelled and promoted innovating, and financial support.
Values

As posited by EVC theory, subjective task values are disentangled into intrinsic, attainment, and utility task values. This section integrates the findings of the survey with the results of the interviews into these categories.

**Intrinsic task value.** Intrinsic task values—the perceived pleasure, interest, or satisfaction derived from an activity—did not differ between survey sample groups by learning exceptionality status, visible minority status, age group, parental education, gender, or level of education (See Appendix E for detailed statistical results and post-hoc test results). Survey respondents who were categorized at higher levels of innovating (i.e., Pro-I or Big-I) reported higher intrinsic task values than Mini-I or Little-I innovators (F= 20.76 p <0.001, d= 0.42; small effect size). A significant effect was found for intrinsic task values based on discipline (F= 7.56, p <0.001, d= 0.51; medium effect size between business and social services). Post-hoc tests revealed that intrinsic task values for those in the business sector were significantly higher than the intrinsic task values reported by those in the social sciences. Post-hoc tests did not identify any other significant differences by discipline and that arts and humanities, education, and sciences whose values ranged between the highest and lowest means. Universally, intrinsic task values were higher than any other values by discipline. In short, among survey respondents, the extent to which they enjoyed innovating correlated with their innovator categorization and discipline.

Analysis of the interviews and survey responses delved into reported sources of intrinsic value, namely enjoyment of bringing an idea to fruition, enjoyment of confronting challenges/solving puzzles, enjoyment of combining elements into a new creation, and satisfying a compulsion (see Table 14).
Table 14

Sub-Themes of What Made Innovators Perceive Intrinsic Task Value

<table>
<thead>
<tr>
<th>Sub-theme</th>
<th>Interviews with relevant quotes (%)</th>
<th>Interview sub-theme quotes</th>
<th>Surveys with relevant quotes (%)</th>
<th>Survey sub-theme quotes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Enjoyment of bringing an idea to fruition</td>
<td>30 (100%)</td>
<td>154</td>
<td>410 (82%)</td>
<td>476</td>
</tr>
<tr>
<td>2. Enjoyment of confronting challenges/solving puzzles</td>
<td>27 (90.00%)</td>
<td>52</td>
<td>368 (73.6%)</td>
<td>401</td>
</tr>
<tr>
<td>3. Enjoyment of combining elements into a new creation</td>
<td>24 (80.00%)</td>
<td>39</td>
<td>357 (71.4%)</td>
<td>384</td>
</tr>
<tr>
<td>4. Satisfying a compulsion</td>
<td>22 (73.33%)</td>
<td>91</td>
<td>311 (62.2%)</td>
<td>337</td>
</tr>
</tbody>
</table>

At a general level, all the interviewed innovators and almost all survey respondents reported finding the experience of innovating to be intrinsically valuable because it was fun or interesting. Interviewee 27 said, “it’s fun to find the path like that. I don’t know; it’s really fun.” Interviewee 24 echoed this view: “It’s delicious, it’s fun. I think innovating does something really fun to the brain.” Interviewee 10 said, “When I get to actually play with the things that I want to do it’s like it doesn’t feel like work anymore.” At a more specific level, participants also provided vivid examples of why they felt innovating was fun, interesting, or satisfying.

*Enjoyment of bringing an idea to fruition.* Participants enjoyed opportunities to make their ideas “come alive.” Interviewee 3 said, “I love the rush. I love feeling that I’ve got a great idea and that now I’m going to make it happen.” Survey respondents analogously described feeling “excited,” “enticed,” and “thrilled” by their attempts to innovate. Interviewee 16 described appreciating how “you get to start the idea, and then take it through all the way to the finish.” Other participants described the process of innovating as being personally rewarding because it provides clarity to their experiences. Innovation was consistently portrayed as enjoyable and participants were cognizant that they were having fun.
**Enjoyment of confronting challenges/solving puzzles.** Participants also reported that a major motivator was the joy of confronting challenges. Interviewee 4 said, “What drives me is figuring out how I can do this thing I want to do.” There was a tendency for participants to be drawn to “figuring out the way forward,” as described by interviewee 6, while both interviewees and survey respondents characterized confronting challenges as “the fun part.” Innovators were consistent in reporting the excitement they felt when meeting a challenge that no one had overcome before. For example, interviewee 29 said, “I’m going to take on this challenge of teaching writing, and I’m going to do it by using Twitter.” Innovators tended to exhibit the mindset of finding challenges exciting and considered them part of innovation’s draw.

**Satisfaction of an addiction.** Participants indicated that the intrinsic value of their innovating was in satisfying a compulsion, which they often characterized as an addiction. Interviewee 14 described “frankly finding innovating addictive.” Many respondents similarly articulated feeling that innovation was assuaging an addiction. Interviewee 27 explained that they felt “I have to. Like a shark . . . I’ve got to move forward, or I’d die from inactivity.” Voicing a parallel compulsion to innovate, interviewee 20 exclaimed, “It is beyond extent! There’s no scale on it, and it’s beyond enjoyment. It is like life or death. It’s like breathing. How do you ask, ‘to what extent do you enjoy breathing?’” In this sense, the intrinsic value of innovating for many participants was in fulfilling an addictive need.

**Summary: Intrinsic task value.** Participants described experiencing intrinsic task value when innovating as a result of bringing an idea to fruition, confronting challenges, or solving puzzles, combining elements into a new creation, and satisfying a compulsion.

**Attainment task value.** Attainment task values (i.e., the perceived importance of a task or the identity fulfillment and pride experienced from completing a task) did not differ between
survey respondent groups by learning exceptionality status, visible minority status, age group, parental education, gender, or level of education (See Appendix E for detailed statistical results and post-hoc test results). Respondents categorized as higher levels of innovator (Pro-I or Big-I) reported higher attainment task values than their Mini-I or Little-I innovator peers ($F = 22.30$, $p < 0.001$, $d = 0.53$; medium effect size). A significant effect was found for attainment task values based on discipline ($F = 6.375$, $p < 0.001$, $d = 0.67$; medium effect size between arts and humanities and social service innovators). Post-hoc tests revealed that attainment task values for those in arts and humanities were higher than those in social service disciplines. Post-hoc tests did not identify any other significant disciplinary differences and that business sector, education, and sciences whose values ranged between the highest (arts and humanities) and lowest (social sciences) means. In short, among respondents, the perceived fulfillment and pride felt when trying to innovate appeared to be influenced by the participant’s past success and discipline.

Analysis of interviews and survey responses shed light on participants’ attainment value when innovating, namely how innovation fuels identity, provides fulfillment through making a difference, and being seen as necessary for societal progress and challenging status quos (see Table 15).

Table 15

<table>
<thead>
<tr>
<th>Sub-Theme</th>
<th>Interviews with relevant quotes (%)</th>
<th>Interview sub-theme quotes</th>
<th>Surveys with relevant quotes (%)</th>
<th>Survey sub-theme quotes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Fuels identity and purpose</td>
<td>25 (83.33%)</td>
<td>130</td>
<td>463 (92.6%)</td>
<td>496</td>
</tr>
<tr>
<td>2. Fulfilment through making a difference</td>
<td>18 (60.00%)</td>
<td>69</td>
<td>302 (60.4%)</td>
<td>338</td>
</tr>
<tr>
<td>3. Necessary for societal progress and challenging status quos</td>
<td>24 (80.00%)</td>
<td>116</td>
<td>319 (63.8%)</td>
<td>375</td>
</tr>
</tbody>
</table>
Fuels identity and purpose. Participants reported feeling a sense of purpose and identity when they innovated. This manifested as feelings of “agency” for interviewee 5, who described feeling freest when innovating. Most interviewees also defined themselves as participants, much like interviewee 11, who stated, “I’m a doer, I learn by doing, and I’m okay with failure.” Interviewees frequently based their identity on being seen as innovators. Interviewee 13, for example, explained that “I’ve only ever seen my career as a bit of a change agent.” Participants felt like their work brought them “prestige,” recognition, and reported feeling validated for what they did.

Participants described another aspect of the relationship between identity and innovation: a desire to prove themselves. Interviewee 29 recalled confronting a peer group that had given up on an idea: “And so it’s kind of like, ‘just watch me. I refuse to say that this cannot be done.’ I took joy out of that.” Interviewee 4 indicated their innovating was fueled by a desire to “find a rush by working against a system . . . like out of spite, I suppose.” Instead of being an isolated case, nearly one-third of interviewees (9/30) and 31.2% of survey respondents reported being driven to fulfill their perceived identity as a direct result of others’ discouraging remarks. Interviewee 10 exclaimed, “It’s so much spite, you have no idea,” adding, “I will draw every day, and I will be successful at it, and you can’t stop me.” Participants found significant attainment value from the pursuit of their innovations, often as a result of the identity fulfilment they drew from their work, and especially in defiance of others who did not have confidence in their ability to succeed.

Fulfilment through making a difference. Participants also reported feeling a sense of attainment value when their innovating made positive contributions to society. Interviewee 29 said “with huge privilege comes huge responsibility. You have to do something with it that will
positively impact the world.” Interviewee 7 offered, “At the start, it can’t just be change for change’s sake or innovation for innovation’s sake.” Interviewee 3 drew value from knowing that through innovation, “You do good. You do good in the world.” Interviewee 5 described being motivated by a desire for social justice: “I push myself because I see marginalized people in the world that I can help; I can speak up for them.” Interviewee 23 noted with pride the difference they had made, exclaiming, “We even have politicians who’ve said that they learned more from us in two and a half hours than they did in all their high school!” These descriptions of fulfillment as a result of innovative actions appeared frequently and as potent drivers for future innovative behaviour.

*Necessary for societal progress and challenging status quos.* The attainment value participants gain from making a positive contribution could also take on a more adversarial tone. As interviewee 6 reported: “Innovating is important because it is a threat to the status quo.” Participants believed that innovation pushes society forward on social and other issues and involves “challenging norms and balancing assumptions” and also as “provoking needed change.” Interviewees explained that such advancement frequently begins with “troublemakers” (Interview-1-5, 7, 9, 22) who saw their innovation as the way to generate renewal in society. As interviewee 6 elaborated, “The status quo is large and in charge; either you push hard and make a difference, or it will steamroll you and then laugh about it.” Participants thus saw their endeavours as being worthy and necessary, but also tenuous and personally risky. Despite such hurdles, about 60% of both samples of participants underscored the need for innovation and its ability to combat obsolescence. Interviewee 25 joked that “We didn’t leave the stone age because we ran out of rocks. We did it because we discovered bronze and it made life better.” Interviewee 8 summarily noted: “It’s just required in this day and age.” A large majority of
participants shared this sentiment, including interviewee 1, who proclaimed, “I think it’s the only way that people can move forward because if there’s not a culture that fosters innovation, you’re stagnant.”

**Summary: Attainment task value.** In summary, participants described experiencing attainment task value when innovating as a result of feeling identity and purpose, fulfilment from confronting challenges or solving puzzles, and the belief that it was necessary for societal progress and challenging the status quo.

**Utility task value.** Utility task values (i.e., perceived usefulness or the possibility of obtaining material rewards for completing the task) did not differ between survey respondent groups by learning exceptionality status, visible minority status, age group, parental education, gender, or level of education (See Appendix E for detailed statistical results and post-hoc test results). Respondents categorized as higher levels of innovator (Pro-I or Big-I) reported higher utility task values than their Mini-I or Little-I innovator peers (F= 16.55, p <0.001, d= 0.37; small effect size). A significant effect was found for utility task values based on disciplinary background (F= 6.078, p <0.001, d= 0.61; medium effect size between arts and humanities and social services). Post-hoc tests revealed that the utility task values for both of arts and humanities and business disciplines were higher than for those in social services. Post-hoc tests did not identify any other significant disciplinary differences with or among scholastics and education, and sciences whose values ranged between the highest (business) and lowest means (social services). Among respondents, the perceived utility and transferability of benefit felt when trying to innovate appeared to be influenced by the innovator’s past success and discipline.
Analyses of participant responses delved into reported sources of perceived utility and transferability when innovating, namely producing financial benefit and payoffs, indirect benefits, and helping innovators do their jobs (see Table 16).

Table 16

*Sub-Theme of What Made Innovators Perceive Utility Task Value*

<table>
<thead>
<tr>
<th>Sub-theme</th>
<th>Interviews with relevant quotes (%)</th>
<th>Interview sub-theme quotes</th>
<th>Surveys with relevant quotes (%)</th>
<th>Survey sub-theme quotes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Innovating produces financial benefits and pays off</td>
<td>17 (56.67%)</td>
<td>38</td>
<td>311 (62.2%)</td>
<td>331</td>
</tr>
<tr>
<td>2. Innovating indirectly benefits me in some way</td>
<td>14 (46.67%)</td>
<td>32</td>
<td>308 (61.6%)</td>
<td>325</td>
</tr>
<tr>
<td>3. Innovating helps me do my job</td>
<td>13 (43.33%)</td>
<td>41</td>
<td>339 (67.8%)</td>
<td>367</td>
</tr>
</tbody>
</table>

*Innovating produces financial benefits.* In addition to acknowledging intrinsic and attainment values, participants also held utilitarian, financial, and pragmatic values of innovation, thus positioning innovation as a necessary part of staying in business. Interviewee 8 reported that “It comes down to the bottom line. The cost of everything just keeps increasing—raw materials, labour expenses, everything keeps going up.” The view of a need for competitiveness was widely shared among the surveyed, indicating that innovation had a perceived quality to escape, evade, and overcome competition indicating that innovation in some measure was done to avoid stagnation rather than for its own sake or to fuel progress. In the same vein, interviewee 25 articulated that “status quo in my business is a disaster because in a competitive environment, like Kodak that didn’t innovate, you go out of business.” A survey respondent succinctly summarized this view that innovation “allows you to be more competitive. It also allows you to satisfy a number of your strategic priorities including staying in business long enough to be profitable.” Interviewee 14 was more direct, stating they valued innovating because “I want to make money.” Although certainly not socially desirable to say in an
interview, this view was significantly more common in the anonymous reporting of the survey, indicating that monetary considerations were a widespread (37.8%) consideration of respondents. 

*Innovating indirectly benefits me in some way.* While participants frequently acknowledged the financial benefits of innovating, they more passionately commented on other pragmatic, indirect benefits. Some reported that innovating lets them be their own boss and control the nature of their work. Interviewee 20, for example, explained that innovating “pays off in the agency” while interviewee 30 said it “brings you to the tables where you might not otherwise be invited.” Participants would add the benefits of networking and opening doors you did not know existed.” Interviewee 30 shared this view when he identified innovating as an “opportunity to hopefully have other opportunities,” indicating a widely held belief that innovating propels other desirable outcomes directly, but perhaps covertly linked to their innovating. Participants were cognizant that innovation would have indirect and implicit benefits and considered these positive outcomes as part of their motivations.

*Innovating helps me do my job.* Some interviewees (7, 11, 22) and some survey respondents used innovating as “time-saving measures,” while interviewee 6 said it made their job “easier from a selfish perspective” because it enabled them to accomplish work tasks more efficiently. Interviewee 2 conceptualized innovation as a valuable tool in their employment role: “Innovation was useful for me because no matter the context that I go into ... that’s how I approach problems and interactions.” Interviewee 28 described how innovating helped them succeed as a swimming instructor who “couldn't get 6-year-olds [to learn] how to do the first stage of a deep dive”; this interviewee described how they innovated by experimenting with a variety of games to get the children to dive properly into the water. Respondents and interviewees described how they were forced to improvise, which they equated to innovating,
linking the two skillsets in their minds and actions. Participants, therefore, recognized innovating as a valuable tool used to fulfil the requirements of their employment.

Summary: Utility task value. Participants described experiencing utility value when innovating in order to produce financial or other indirect benefits and to help them do their job.

Costs

Perceived costs (i.e., the drawbacks, consequences, or risks of innovating) did not differ between groups by parental education, age group, gender, or level of education (See Appendix E for detailed statistical results and post-hoc test results). Respondents categorized as higher levels of innovator (Pro-I or Big-I) reported lower perceived cost than their Mini-I or Little-I innovator peers (F= 8.897, p= <0.001, d= 0.43; small effect size). A significant effect was found for perceived costs of innovative behaviour based on discipline (F= 4.42, p<0.001, d= 0.71; medium effect size between business and scholastics and academia). Post-hoc tests revealed that the costs for those in business settings were significantly higher than the values reported by those in scholastics and academia. Post-hoc tests did not identify any other significant disciplinary differences with or amongst sciences, social services and arts and humanities whose values ranged between the highest (business) and lowest (scholastics and academia) means. Among respondents, the risk and perceived drawbacks when trying to innovate correlated with the participant’s past success and discipline.

Respondents who identified as visible minorities reported feeling the perceived costs of innovating significantly more than their peers who did not identify as visible minorities (F=32.17, p= 0.001, d= 0.83; large effect size). Similarly, respondents who identified as having a learning exceptionality also reported greater sensitivity to the perceived costs of innovating (F=4.42, p <0.001, d= 0.61; medium effect size). Respondents who identified either as a visible
minority or as having a learning exceptionality reported feeling the effects of perceived costs more so than their peers who did not identify with these characteristics.

Analyses of the interviews and surveys delved into reported sources of perceived costs when innovating, including losing out on alternatives, additional efforts and exertions, pressures and risks, financial costs, and fearing failure and success (see Table 17).

Table 17

<table>
<thead>
<tr>
<th>Categories of What Made Innovators Perceive Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sub-theme</td>
</tr>
<tr>
<td>Innovating means losing out on alternatives</td>
</tr>
<tr>
<td>Additional efforts and exertions</td>
</tr>
<tr>
<td>Risk of rocking the boat</td>
</tr>
<tr>
<td>Significant financial costs</td>
</tr>
<tr>
<td>Fear of failure and of success</td>
</tr>
<tr>
<td>Interview sub-theme quotes (%)</td>
</tr>
<tr>
<td>Interview sub-theme quotes</td>
</tr>
<tr>
<td>Surveys with relevant quotes (%)</td>
</tr>
<tr>
<td>Survey sub-theme quotes</td>
</tr>
<tr>
<td>1. Innovating means losing out on alternatives</td>
</tr>
<tr>
<td>2. Additional efforts and exertions</td>
</tr>
<tr>
<td>3. Risk of rocking the boat</td>
</tr>
<tr>
<td>4. Significant financial costs</td>
</tr>
<tr>
<td>5. Fear of failure and of success</td>
</tr>
</tbody>
</table>

**Innovating means losing out on alternatives.** Participants described a wide variety of costs of innovating, with a vast majority perceiving that the major cost is time (26/30 interviews; 454 survey responses). As interviewee 22 noted: “Life happens, sometimes even when you’re busy innovating.” The notion of “missing out” manifested in most interviews and survey responses, including the “fear of losing something that’s valuable to you that you might have to give up if you innovate” (Interviewee-29). Participants highlighted that innovating might mean foregoing other things they valued; as interviewee 14 quipped, “I guess the biggest drawback is relative to some other thing that you could be doing, like lying out on a beach.” Participants in these ways displayed obvious awareness of the alternatives they were losing when they chose to innovate.
**Additional efforts and exertions.** Interviewees made a note of their physical, intellectual, and emotional efforts to innovate. A few interviewees referred to others’ reticence and indecision as “analysis paralysis” (Interviewees-3, 5, 26) and a constant drag on their ability to innovate and bring their peers along to their way of thinking as did fourteen respondents. Interviewee 30 described the process of innovating as “a fatigue, just mental and physical fatigue and just a constant living, eating, breathing, sleeping, dreaming of what you think about when you go to bed, what you think about when you first get up.” Other participants shared similar views on those who opposed innovation, with interviewee 9 offered the “mildly offensive but honest answer of straight-up laziness.” Such peers were viewed by participants as being unwilling to put in the effort, meaning that participants had to make up the difference to make progress.

**Risk of rocking the boat.** Participants also reported feeling intense pressure and risk when innovating. Interviewee 6 described “this massive pressure that there isn’t that much room to really make changes or mistakes.” Interviewee 7 similarly highlighted the “uncertainty and risk” of innovation as “change will have consequences.” As a result, participants identified that they often felt it was safer, but not necessarily a better decision, to *not* innovate.

Interviewees were aware of the social pressures not to innovate, including the social undesirability of “rocking the boat” (Interviewees-1, 5, 30; and 7 respondents) even when they thought innovating was better. In a similar vein, respondents commented that not everybody buys into change. Or as interviewee 13 put it, “Some people won’t get on the bus for the ride.” Interviewee 20 noted that playing it relatively safely is a “highly successful strategy to seek social acceptance.” Participants were wary of the detractions and risks of their attempts at innovative behaviour and compensated with a learned caution.
**Significant financial costs.** In addition to physical and intellectual costs, 77% of interviewees and 92.6% of respondents believed that innovating could also incur significant financial costs. Interviewee 30 stated that “Definitely [for] any big innovation there’s financial cost.” Other participants articulated that although they overcame the costs, not everyone may be able or willing to do so: “If they think innovation is a waste of time because you got to spend a lot of money on it and R and D . . . those are . . . reasonable objections I think” (Interview-19). The financial costs of innovating were on the minds of most interviewees, even those who reported strong intrinsic and attainment task value.

**Fear of failure and of success.** As a final cost, interviewees reported a tangible fear of both failure and success in relation to innovating. Participants told stories of past failures, with interviewee 12 explaining that “not everything you dream of or . . . want comes through, so you got to learn how to handle when your projects don't work.” Participants identified the cost of failure as being significant; interviewee 28, for example, shared: “I can tell you dozens of cases where people tried something, it didn't work very well, and maybe it was their first time of innovating, and they will never try it again.” The punishing cost of failure when innovating was very present in both the interview and survey data.

Participants also reported that they feared success, as it could have unforeseen and associated costs. Respondents reported unintended drawbacks of successful innovation, such as inventing a new work-related process that rendered colleagues redundant. Interviewee 12 commented on how innovating made other aspects of their work comparatively less interesting: “Once you’ve innovated and made something big or won that big, couple million-dollar deal and getting that thrill out of that, it’s really hard to go back and sometimes write those reports.” Interviewee 4 offered a humorous example of the cost of success as a cautionary tale of
innovating: “Or even worse, the stupid thing takes off, and you end up having to carry a sousaphone around for the rest of your [strong obscenity] life.” As much as failure was deeply feared by innovators, a substantial minority among interviewees and survey respondents were also cautious about the mostly unintended implications of their success.

**Summary: Costs of innovating.** Participants identified several perceived costs of innovating, including losing out on alternatives, additional efforts and exertions, risks when rocking the boat, significant financial costs, and fear of both failure and success.

**Discussion**

This mixed methods study identified the expectancies, values, and costs of innovating perceived by Canadians who innovate, integrating the findings of 30 interviews and 500 survey responses. These motivation constructs were also examined for differences and interactions across groups to identify which demographic, educational, and disciplinary factors were impactful.

**Innovator Identity and Expectancies**

In terms of innovator identity and expectancies of success, the only demographic factors that differentiated groups were level of innovation (Mini-I and Little-I vs. Pro-I and Big-I) and level of education (graduate degrees vs. all others). Stronger self-identification of being an innovator and expectancies corresponded to higher levels of education and innovation level, which contrasts anecdotal societal beliefs that most innovators are prodigies with minimal education (Shavinina, 2013b). Additionally, disciplinary background differences were found to affect expectancies, but not innovator self-concept hinting at differences in how innovation confidence is built in different disciplines. Minority status, learning exceptionality reporting, age, and parental education did not result in different levels of innovator self-identity or
expectancies; however, level of education did, aligning with findings in the literature that suggest investment of higher education can make innovation more likely, especially amongst minority and other historically scantily investigated populations of potential innovators (Nager et al., 2016). It also parallels the findings elsewhere in EVC literature that suggest increased education and training tend to be excellent predictors of confidence in approaching complex tasks (Barron & Hulleman, 2015; Flake et al., 2015). At the same time, it challenges ideas that innovation is largely the domain of the gifted or prodigies (e.g., Fredricks, Alfeld, & Eccles, 2010; Heller, 2007; Noonan, 2013); instead, findings from this study suggest that past success as well as further education, tended to increase confidence and identification as an innovator for individuals regardless of visible minority status, learning exceptionality reporting, age, parental education, or disciplinary background differences. Making innovation supportive programming more widely available to more individuals could, therefore, represent an underutilized approach in making innovation more likely through educational programming.

In addition, participants of all levels tended to credit learning environment and learning from past events as being crucial to their developing confidence as innovators, as did Shavinina (2013c) in her examination of the early life of prodigious innovators. This research indicates that the same early life events and learning environments that enabled those anointed as prodigies were also crucial to the early development of most innovators and could be replicated in more types of educational programming. These learning environments tended to be blends of traditional classroom learning as well as informal or less-structured learning environments like field trips, innovation hubs, or consortiums that fostered “outside-the-box” thinking and the vigorous debate of ideas that would contribute to the possibilities for educational programming to support innovative behaviour. Perhaps the arts and humanities respondents reported the
highest expectancies because the studio, seminar, or ensemble model of learning is common in the arts. The results of this research suggest analogous structures could be beneficial to other disciplines in educational programming.

Another key pillar of support of innovation was the relative intellectual safety of a learning environment—termed innovation-supportive. This mirrors the findings of the needs-supportive literature, in which Ryan and Deci (2017), among others, found that need-supportive environments tended to promote autonomous motivation to accomplish short- and long-term goals. These environments needed to be a safe place to make mistakes and created situations in which unique, often “off-beat” approaches were needed. As noted elsewhere in the literature (e.g., Bergendahl, Magnusson, & Björk, 2015; Curran & Walsworth, 2014; Pihlajamaa, 2017), collaborative environments were praised, making the taking of necessary risks—like volunteering ideas or trying new less-tested approaches—easier and safer, acting as a cost mitigating safety net that can inform the design of educational programming that seeks to promote innovation talent development.

Values

Survey respondents in this study were much more likely to report primary emotions and considerations associated with intrinsic task value (e.g., excitement, enjoyment, satisfaction, interest, or feeling energized) or attainment task value (e.g., pride, accomplishment, identity, and belonging) than utility task value (e.g., thrill of making money, material benefits, or pragmatism). These trends were also mirrored in the interviews, where intrinsic and attainment task values appeared more often, had more quotations and codes, and were presented by interviewees as being more impactful than utility value.
People also tended to hold a mosaic of values rather than be driven primarily by one value. In general, the pattern tended to be intrinsic values reported as the highest motivation, followed by attainment values and then utility value. This pattern held across disciplinary contexts. Participants, therefore, tended to see value in innovating for more than one reason, suggesting that a singular, monetary-driven model would be ineffective compared to a multi-value approach. This finding parallels Antikainen, Mäkipää, and Ahonen’s (2010) study that found that too much of one type of reward (money) actually decreased the likelihood of innovating, instead recommending the provision of a variety of rewards as also proposed by Maria Stock, Zacharias, and Schnellbaecher (2017). By extension, fulfilling multiple value types in educational settings would be powerful in stoking the motivation to innovate.

Intrinsic task value. The strongest value themes by quotation-count and presence in surveys and interviews were intrinsic task value related, which is surprising given the lack of emphasis in the literature when compared to the pervasive focus on utility values (e.g., Manso, 2011, 2017). Innovators tended to find innovating fun for its own sake but were largely driven by the thrill of the process, including mobilizing ideas, solving puzzles, and combining elements in new ways.

A finding seldom noted in the literature but resounding from the experiences of participants in this research was innovation as a fulfillment of a compulsion, and seeking the thrill of confronting challenges, sometimes out of spite. Innovators often claimed they felt compelled by interest or curiosity to try new things, which thus places more of an emphasis on self-drive as a propellant for innovation, mirroring the collective push for self-directed learning in a range of educational disciplines. For example, innovating was portrayed by participants as similar to the immersive state of “flow” (Csikszentmihalyi, 1975, 1991; Csikszentmihalyi,
Abuhamdeh, & Nakamura, 2005), where other pursuits melt away and hyperfocus sets in. The connected reports of participants indicated that there was instant and sustained gratification or a “rush” that was highest among long-time innovating participants.

**Attainment task value.** Participants strongly perceived pride, identity, and fulfilment through innovating, in alignment with the findings of the literature. It was a primary driver, at a level just below the magnitude of intrinsic motivation, that could be a focus of innovation support or promotion in classrooms or other contexts where innovation is desired. Although innovation was strongly found to be fun, a similarly powerful motivator was fulfilment of identity or the pursuit of social justice (or making the world better). Participants reported drawing great motivation from having a real impact, making activities in which ideas could tangibly have a positive impact especially motivating. For example, instead of hypothetical challenges, a given class group could work on topics currently in the news or otherwise connected to their reality.

**Utility task value.** Monetary benefits or financial resources as reported by participants, tended to behave as cost mitigation factors rather than motivators, as they did not seem to drive motivation significantly on their own but rather only mattered in their absence. Utility values were exceedingly rare among respondents as being principal drivers for innovating, although they did frequently occur as supporting considerations, corroborated by utilitarian values being peripheral considerations when mentioned in the interviews. The lack of motivating quality of financial benefits, in particular, stands in opposition to the results of business-dominated literature, where monetary incentives have been touted as a decisive factor in making the prospect of innovation appealing (e.g., Aarikka-Stenroos, Jaakkola, Harrison, & Mäkitalo-Keinonen, 2017; Galia, 2008; Zheng, Li, & Hou, 2011). Innovators in this study’s
interdisciplinary sample did not place nearly the same emphasis on the motivation induced by the prospect of monetary gain or other more externally regulated motivators, which could hint at the overstatement of influence that financial factors and external extrinsic motivators could have on stoking innovation in educational programs aiming to develop innovation talent.

Cost

Costs were the least defined category of ideas reported by participants. As identified by Flake et al. (2015), this nebulous category included drawbacks such as effort, implications of failure and success, loss of alternatives, and pressure and stress contributing to the growing literature on these principal costs of complex action. These described costs were consistent across areas of endeavour, age, and life histories, indicating that promotional and educational efforts should consider the potential universality of the need to mitigate these costs.

Higher levels of innovators reported lower perceived costs of innovating than their peers at the lower levels of innovator, hinting that past successes and the affordances of these successes created perceived safety and willingness to attempt innovation despite the costs. A wrinkle in this trend was that business innovators reported the highest costs among disciplines, while academia reported the lowest perceived costs. The possibility of losing money or succumbing to competition were the most prevalent costs offered by participants. This notion of innovation’s risk was found in both the quantitative and qualitative results. In the survey, by age, respondents reported increasing costs from school age until 30 years of age, which tapered off gradually into middle age and beyond, mirroring the pattern commonly associated with increased job security and potential familial considerations including dependents. This lends credence to innovating being perceived as riskier when dependants are involved. Grouping respondents by level of education did not result in statistical differences, supporting the idea that
despite innovator credentials, innovating never gets less risky for aspiring innovators such as students.

Additionally, innovation’s costs were felt more by visible minorities and those who reported a learning exceptionality, despite having similar levels of expectancies and values as individuals who did not identify as having a learning exceptionality or being visible minorities, meaning that the costs of innovation disproportionately affect the drive to innovate of society’s already marginalized individuals. A source of optimism was with cost mitigation, for which minorities and those with exceptionalities have all the same positive drivers as their peers who are not visible minorities or do not report having a learning exceptionality hinting at cost mitigation through confidence building and the provision of opportunities to develop their talent in safe spaces levelling the playing field for all aspiring innovators.

Conclusions

Although studies have highlighted the role of rewards in supporting the drive to innovate, there is a dearth of data pertaining to interest, fulfillment, and particularly cost, given that this study vividly shows their importance among respondents and interviewees, particularly as highlighted during their school-age years. The truly effective supports encourage aspiring innovators to pursue things that are fun and interesting, which typically are partially controllable by leaders and teachers, while the factors which can be controlled mostly relate to mitigating costs (Manso, 2017; Soleas, 2018a). If leaders and teachers are truly interested in making innovating more likely, they should first look to mitigating its perceived costs. This cost mitigation could begin in schools to stoke the motivation earlier than entry into the workforce.

Of note, innovators of all disciplines, ages, and genders reported that stability and safety made innovation more likely, as identified by Chaiechi (2014) and Soleas (2018b). The
importance of stability and safety flies in the face of the societal zeitgeist, which has in the past gravitated to the notion that disruption, genius, and necessity are major drivers of innovation (e.g., Bendell & Thomas, 2013). Collaboration, a safe learning environment that can be created in schools, as well as opportunities to pursue interests and fulfillment are needs-supportive elements of a safe, stable environment that participants and the literature report as making innovation more likely, which could include assignment choice and needs-supportive teaching. The creation of such environments should be a high priority of educational efforts to stoke innovation and the underlying skill and talent development across contexts.

Respondents at the Pro-I and Big-I level tended to report higher innovator identity, expectancies, and intrinsic-, attainment-, and utility-task values, while also reporting lower costs than their peers at the Mini-I or Little-I level. Innovators earlier in the lifespan or less experienced with innovation are most in need of positive experiences, value-building, and cost mitigation efforts, especially with equity-seeking groups. These efforts could be made most impactful during the education of aspiring innovators, with special consideration given to providing the necessary early opportunities to build attainment and intrinsic task values and by encouraging the pursuit of fulfilling and individually and communally exciting endeavours in schools.

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Chapter 5

Manuscript 3: How Innovators Mitigate the Costs of Innovating: Strategies Built on their Experiences

Abstract

Context: A nascent field dedicated to the development of innovation—called “innovation education” seeks to promote innovation among students. A key aspect of promoting innovation in context is understanding how and why innovators are motivated to innovate. However, even in the emerging literature on motivating innovation, there is a paucity of information on established innovators’ motivations for innovating.

Methodology: This two-phase, primarily qualitative study addresses this knowledge gap by investigating the strategies that innovators used to make innovation more likely, combining semi-structured interviews and a survey of Canadian innovators. Interviews were conducted with a diverse, multidisciplinary sample of 30 Canadian innovators which informed the development of the survey administered to a larger sample of 500 Canadian innovators.

Results: Participants reported costs of innovating and from their perspectives offered advice for aspiring innovators. Specifically, innovators detailed advice and approaches for aspiring innovators to maximize expectancies, maximize values, and proactively mitigate costs.

Discussion: This study calls for innovation education to focus on building capacity for developing innovators based on the strategies of successful innovators. These promotive and mitigating strategies are useful guides for educators, leaders, and of course for innovators themselves. Study results direct attention to approaches that should be integrated into programs designed to promote innovation across disciplines, organizations, and learning contexts.

In contrast to researchers’ sustained interests in the outcomes of innovation (e.g., Cravens & Shipp, 1991; Drucker, 2006; Pihlajamaa, 2017), only a few studies have focused on the education and motivation of innovators (e.g., Fischer, Malycha, & Schafmann, 2019; Manso, 2017). A nascent field dedicated to the promotion of innovation in schools—called “innovation education” (Shavinina, 2013) seeks to promote innovation among students. A key aspect of promoting innovation in schools is understanding how and why innovators are motivated to innovate. However, even in the emerging literature on motivating innovation, there is a paucity of information on established innovators’ motivations for innovating. This study addresses this
knowledge gap by investigating the strategies that innovators use to make innovation more likely. The research was undertaken with the view that the self-motivating strategies innovators use to counteract the challenges and obstacles they encounter during their creative endeavours could inform the curricula of education systems seeking to nurture aspiring innovators. Schools may be able to make innovation more likely by teaching learners the strategies innovators use to mitigate factors that hinder innovation.

**Why Expectancy-Value-Cost Theory?**

Expectancy-Value-Cost theory (EVC; Barron & Hulleman, 2015; Flake et al., 2015) offers a valuable (and novel) perspective on promoting innovation by considering motivational factors that make innovation less or more likely to occur. EVC identifies that the motivation to complete tasks (including innovation) is influenced by expectancies of success (self-concept and self-efficacy) and the perceived values of the task (intrinsic, attainment, and utility value; Barron & Hulleman, 2015). The motivation for complex tasks can be explained through the interaction of individuals’ confidence in their ability to succeed in a given task (expectancies) and the enjoyment, importance, and usefulness they assign to the task—task values (Wigfield, Tonks, & Klauda, 2009). In other words, if individuals expect to succeed and see intrinsic or extrinsic values in innovating, they are more likely to try innovating. Research that explores the various expectancies and values that motivate existing innovators has the potential to help educators understand how to support and enhance students’ innovation potential effectively.

Innovation, while often highly valued, also has contextual and psychological costs for the individual. Costs, in the motivation circumstance, holistically goes beyond the common conception of monetary price and includes other dimensions such as the effort, time, and pressure as well as the implications of failure (Flake et al., 2015). For many students, the
perceived costs of innovating may be higher than the expectancies and values. To make innovation more likely, educators must help students maximize their expectancies and values of innovating and help them mitigate the costs. This research examines the expectancies, values, and costs of innovating (as identified by practicing innovators). The findings can be leveraged to inform the innovation education of learners as they aspire to innovate in their work and lives.

Methodology

This study adopted a two-phase, primarily qualitative design combining semi-structured interviews and a survey of Canadian innovators. Interviews were conducted with a diverse, multidisciplinary sample of Canadian innovators (referred to here as “interviewees”; n = 30), which informed the development of the survey administered to a larger sample of Canadian innovators (“survey respondents”; n = 500). The following research question and sub-questions guided the investigation:

1. How do Canadian innovators mitigate the costs of innovating so that they can see innovation projects through to completion?
   a) What do they primarily identify as the costs of innovating?
   b) How do they mitigate and overcome these costs?

This study received ethical clearance from the Queen’s University General Research Ethics Board and was conducted in strict compliance with the ethical principles of Canada’s Tri-Council Research Agency. Questions about participants’ employment, current innovation endeavours, and past achievements guided decisions about their eligibility to participate in the study. In alignment with Kaufman and Beghetto’s (2009) model of creativity that encompasses four levels of proficiency on a continuum ranging from Mini- to Big-C creativity, a framework was designed to establish each participant’s level of innovation proficiency. In this study, the
continuum was applied to innovation as follows: Mini-I innovation constitutes innovative student behaviour (e.g., in-class problem solving); Little-I is local or common innovative behaviour (e.g., inventing a new baking recipe); Pro-I includes professionals who innovate for a living (e.g., surgeons refining an existing technique); and Big-I innovation corresponds to those who have made renowned innovative contributions (e.g., inventing a new renewable energy source). Participants who did not demonstrate at least Mini-I innovation (innovative student behaviour) were deemed ineligible for inclusion in the study sample and were thanked for their interest.

**Interviews**

Interviewees were aspiring or recognized Canadian innovators and represented a variety of innovator level groups including Little-I (n= 10), Pro-I (n=15) and Big-I innovators (n=10). Invitations yielded six innovators from each of five disciplines—(a) science, technology, engineering, and mathematics; (b) social services; (c) education and academia; (d) arts; and (e) business—for a total of 30 interviews ranging from 45 to 96 minutes. Seventeen innovators identified as being men, while 11 identified as being women; two innovators did not identify within the gender binary.

During the interviews, innovators were asked to answer eight open-ended questions about their motivations, experiences, and conceptualizations about innovation, followed by supplementary queries to capture latent details. Interviews were transcribed verbatim and thematically coded (Basit, 2010; Braun & Clarke, 2006) using ATLAS.ti v8.3.16 qualitative analysis software. Open codes were clustered into subthemes organized into groups of expectancies, values, and costs.
Survey Responses

Survey respondents (n=500) were invited to participate by email and social media. Respondents completed the 15-minute questionnaire composed of open responses (barriers, supports, and experiences) and closed-ended items (demographics and EVC Likert-like scales; not used in this study.) Responses were verified for eligibility for study inclusion through a combination of reported location, first three digits of IP address, occupation, and role description and then sorted into disciplinary (sciences, technology, engineering, and mathematics = 107; social services = 105; education and academia = 94; arts = 76; and business= 118) and innovator level groups (Mini-I= 31; Little-I = 241; Pro-I= 180; Big-I = 48). In terms of gender, 243 respondents identified as male, 210 identified as female, 3 identified as non-gender binary, and 44 preferred not to disclose their gender. Like the interviewees, survey respondents were also an interdisciplinary, multicultural sample of Canadian innovators. Open-ended items were coded thematically in ATLAS.ti v8.3.16 and in alignment with the analysis of the interview responses.

Results

Participants from both the interview sample (interviewees; n= 30) and the survey sample (respondents; n= 500) reported costs of innovating, and from their perspectives offered advice for aspiring innovators. The advice was organized into themes that reflect maximizing expectancies, maximizing values, and mitigating costs. Each theme is introduced below with a brief overview of the costs of innovating that survey respondents and interviewees identified and that align with the respective theme and subthemes. Next, the interviewee advice that countered the perceived costs is discussed using the survey and interview responses as sources of corroborating and supporting evidence. Each section closes with a synthesis summarizing both data sources.
Maximizing Expectancies

Surveyed innovators indicated their perception of costs that related to innovation expectancies: 36% reported fear of failure as a cost and 55% reported as a cost the increased pressure caused by engagement in innovation. Interviewees reported analogous expectancy-related costs. Innovators from both data sources offered various means of countering these confidence-related costs by maximizing their expectancies. Prevalent themes amongst these data included advising aspirants to (a) develop support networks and (b) be disciplined in regulating the innovation process in order to make innovation more likely.

**Build your own support network.** Innovators recommended building a support network as a means of maximizing expectancies. They described a need for diverse types of connections with people, including both like-minded and constructive skeptics, as well as seeking support beyond people (i.e., material and contextual resources).

**Make diverse types of connections.** Successful innovators painstakingly built diverse networks of people that would provide them with feedback and support. Interviewee 7, a professor, described the importance of “a lot of serendipity—frankly, a lot of luck—interacting and meeting people.” This luck sometimes took the form of innovators seeking out partners with different skill sets. Innovators also valued finding constructive skeptics who would challenge their ideas and provide feedback. Interviewee 16 outlined that he benefitted from hearing “your idea is dumb” or “something’s not working. That’s how you fix it.” Innovators were consistent in their belief that local support was as or more crucial than the potential support of famous innovators. For example, interviewee 22 recommended networking “with people that are around you. People who are working just as hard as you that are already easily accessible to you” (sometimes described as networking in parallel) rather than only “networking up, thinking that
you need to talk to Oprah or Bill Gates—it won’t work.” Innovators recommended building support networks that included people with complementary skill sets, people who were constructively skeptical, and people who were local as a crucial strategy to maximizing expectancies and making success in innovation more likely.

**Seek support beyond people.** Innovators did not limit their support network to only people, they also counselled aspirants to identify the material factors that they would need. Although the significance of financial support was particularly prominent in the survey data, with respondents describing the value of a “monetary safety net,” and citing the advantage of “not living month to month” they also noted that “non-monetary benefits make the risk tolerable.” Interviewee 10 articulated that an innovator “who has money saved up and stability in their life is way more likely to take risks because you have a safety net.” Innovators advised aspirants to make sure to have the resources they need before attempting to innovate. Successful innovators planned ahead and deeply considered their current level of support as a measure of their capacity to commit to their idea making the teaching of this planning skill important in schooling.

**Be disciplined in regulating your process.** As a means of maximizing innovation expectancies, innovators were disciplined in their innovation process, specifically by focusing attention on a manageable number of projects, approaching problems deliberately, and managing time carefully. As an example, interviewees and survey respondents suggested focusing attention on a manageable and curated selection of endeavours. They consistently advised future innovators to pick and choose their endeavours and to recognize that the time may not be right for some.
**Pick and choose what and when you start.** Key to this prioritization was the suggestion that aspiring innovators should not “bite off more than they could chew” (respondent 259). More generally, they should be cognizant of the work climate/environment so as not to get carried away with ideas that could be great but were unlikely to succeed. Interviewee 21 stated that “an important part of successful innovating is picking what you start.” Innovators counselled aspirants to be choosy in their endeavours and consider a variety of support, time-based, and optimal condition factors when starting their work. Consistently, interviewees and survey respondents articulated the need to prioritize a few projects at a given time. Interviewee 19 stated: “Always have a major, big, long-term goal and then, smaller stuff that comes from it. But never forget about that big goal.” This process of focusing attention was deemed crucial by a majority of surveyed innovators (77%) and interviewees (84%), as exemplified by interviewee 11’s advice to “put 95% of ideas on pause and action 1-5%.” Innovators advised aspirants to be disciplined and focus their attention on fewer projects rather than dividing their attention across too many endeavours at once.

**Recognize when the timing is not right and move on.** Similar to the advice to focus attention to maximize potential productivity, innovators counselled aspirants to recognize when the timing and context were not right for their idea to prosper. Interviewee 28 recognized that her idea was solid, but it would not work in the financial climate of her institution. She resolved to “shelve it, grumble a little bit because of the short-sighted thinking of my colleagues, but to come back to it.” Interviewee 6 offered a heuristic approach for thinking about timing: “Is it the right time for the organization? Or is there a compelling reason to do this now?” Innovators advised that it was important to have the courage to shelve ideas as prudent or necessary. Innovators were consistent in praising this kind of inhibitory-control as a way of proactively
avoiding unwinnable and detrimental situations that would diminish the ability to invest resources elsewhere.

**Approach problems deliberately.** Innovators described the importance of approaching problems deliberately, advising aspiring innovators to approach problems contextually, to think problems all the way through, and to proactively define success criteria as a means of maximizing expectancies.

**Approach your problem contextually.** Surveyed and interviewed innovators considered and adjusted their approach based on the context of a problem as a first step to innovating. Survey respondent 481 advised aspiring innovators to consider pertinent stakeholders: “What are the things that they think they admire or that they cannot live without?” Innovators were careful to choose the best approach based on the available evidence and understood that different contexts would benefit from specific-approaches indicating a form of context literacy. Interviewee 4 claimed that selecting the best approach “depends on what field you’re in and what’s going on with other people in it.” The advice of innovators points to a need to develop contextual knowledge and to be able to vary approaches to reflect the field in question.

**Think your problem all the way through.** Innovators understood that innovation rarely occurs by chance, rather it is the result of an iterative and sophisticated process. Multiple interviewees and survey respondents described “analysis paralysis” as the result of not fully understanding a problem. Interviewee 25 explained, “You don’t just embark on a project without having a charter, without having the right people, without having the right objective and scope, and without knowing what your ultimate goal is.” Other innovators explained that thinking before starting and mapping out the costs and return on time invested lessened wasted time later on in their endeavour. Interviewee 6 described the tactic of first developing
constituent parts as opposed to “tackl[ing] the whole issue at once.” Innovators posited that effective innovators knew where they were going because they had thought about the obstacles that they might face beforehand.

**Build a pathway to your success criteria.** Innovators tended to recommend having clearly and holistically defined what the desired outcomes of the project could look like. As an example, interviewee 7 cautioned, “I don’t think innovation can be done unless you have spent some time thinking about, well, how you are going to determine if the innovation is working.” Once in possession of a guiding conception of what success could look like innovators described proceeding with more focus and clarity. As a case in point, while financial gain is an obvious way to measure success, it may not be the most pertinent to the project; innovators tended to recognize that financial gain was only one method of measuring success. Innovators from both samples were clear that a holistic view of what success could look like was crucial in guiding the actions that innovators take and emphasized that economic benefit was not the only way to measure success.

**Manage your time carefully.** Innovators identified that innovation is as much a matter of focussed productivity as it is of protecting one’s personal time advising future innovators to prioritize a balanced lifestyle and protecting their time.

**Prioritize a balanced lifestyle.** Innovators recognized that their home life was every bit as important as their innovating life. Surveyed innovators almost universally offered the axiom that innovation was most worthwhile when it facilitated a better life holistically. Interviewee 14 described his view that “To actually see the projects through, what you need to do is balance your lifestyle.” Innovators were passionate about their goals, but their goals were also primarily in service of their home life. Interviewee 30 put this need for balance more directly: “If you’re at
work more, you’re not at home . . . you’re not doing other healthy life stuff.” Innovators believed that although innovation was possible without a balanced lifestyle, they simply found it less worthwhile.

**Be protective of your time.** Innovators identified the real possibility that innovating can monopolize their time if they were not careful. They recognized protecting one’s time as a crucial support for innovation and a contributing factor for a balanced lifestyle. Interviewee 23 explained that “The hardest thing is probably the time commitment.” Interviewee 3 offered a heuristic for deciding if she can innovate: “Do I have the time—multiplied by two because it is always more than you think.” Innovators were consistent in emphasizing the importance of protecting one’s time as a means of giving themselves the best possible chance to make their ideas work.

In summary, innovators responded to confidence-related innovating costs by advising aspiring innovators to maximize expectancies through (a) developing support networks that included a variety of people as well as supports beyond people such as financial resources, and (b) being disciplined in regulating their process, by focusing attention on a manageable number of tasks, approaching problems deliberately, and managing time carefully.

**Maximizing Values**

Compared to expectancies, value-related costs were less prominent in the data. Amongst surveyed innovators, only 5% questioned whether innovation was worth the effort required and 22% reported their belief that innovating was always more valuable than sticking to what worked. Nevertheless, interviewees described these same costs and offered advice related to balancing value-related costs—that is, advice related to maximizing the value of innovating.
Interviewees advised aspirants to (a) know what is driving you, and to (b) critically analyze if the return on investment was worthwhile as strategies for making their innovating more likely.

**Know what is driving you.** Survey respondents and interviewees described the importance of being aware of one’s motives when innovating as a means of ensuring that the plan aligns with the desired outcomes. Innovators recommended that aspirants define what aspect of the cause they really care about, identify if innovating is necessary to stay competitive, avoid innovating for financial gain alone, and consider whether the innovating provides personal fulfilment. Innovators explained that each of these values comes with different assumptions and goals and that they shape the challenges and outcomes that an innovator will experience.

**Define what aspect of your cause you really care about.** Surveyed innovators offered examples of identifying value, such as “a chance to help my fellow man,” or “it was going to be wild fun,” or “I could smell a payday.” Regardless of which value they desired from their innovating, innovators tended to home in and assiduously work towards obtaining it. Interviewees described the importance of identifying the desired value from innovating such as “producing progress as long as it is done the right way” (Interviewee 25) or even just realizing that you might be “in too deep to quit” (Interviewee 1). Another identified value was the avoidance of dull tasks, as exemplified by interviewee 18 who described non-innovative tasks as “So tedious that it hurts. I had one of those jobs where any innovation got absolutely crushed immediately, and it was the most deflating thing I’ve ever done in my life.” Innovators made the most of their innovating by having a clear vision of the aspects they particularly cared about.

**Do it to stay competitive.** Innovation was not always portrayed as aspirational, sometimes it was proactive defence among surveyed and interviewed innovators. Interviewee 25 represented this mindset as he stated, “I would say that first of all, if you’re not innovating,
you’re stagnating.” Interviewee 12 explained that “You will not be able to stay in business for a long time, unless you innovate, because the other person who’s innovating will get ahead of you.”

**Do not do it just for the money.** Many participants also advised against pursuing innovation for purely monetary gains. As an example, interviewee 16 counselled, “if you’re just doing it for money reasons, there are a lot better or less painful ways to make money.” Interviewee 8 offered, “Seriously, there are easier ways to make money; if you’re in it for the money do something else.” Innovators were clear in their belief that innovation should not be for money, but rather as the answer to a specific challenge, necessity, or calling.

**Innovating feels great.** Interviewees identified value in feeling fulfilled by the process of innovating or finding it fun, hence much of their advice was to either be passionate about the endeavour or move on. Interviewee 18 explained, “I’d rather not have my job than having a job without innovation in it.” Others described having “a lot of internal drive” (Interviewees 1, 3, 16, 29). Interviewee 4 described some people as “needing to be innovators” as part of their identity. These views articulate the importance of recognizing that the value in innovating is in fulfilling a personal need, and if aspiring innovators do not have this need, they should do something else.

**Critically analyze if the return on investment is worthwhile.** As a complementary means of maximizing value, innovators counselled aspirants to holistically consider if their innovation is going to return an investment that makes the endeavour worthwhile. Interviewee 25 advised, “if you have an innovative idea, you need to also think of what the costs are and what’s the return on that investment.” Innovators tended to give many examples of how they had learned the hard way that innovation was not worthwhile for them. Interviewee 21 gave an example where he made the risk-reward calculation to make a decision between two potential
opportunities: “Yes, I took a big risk by leaving my job to start a company, but I didn’t take all
the big risks. I took the one I could take.” Innovators described the virtues of being cautious in
the risks that they took to ensure they obtained the value that they forecasted.

In summary, innovators from the survey and interviews advised ways to maximize the
value of innovating, including (a) knowing what the main drivers are that you care about, such as
innovating to stay competitive, not innovating just for monetary reasons, and innovating because
it is personally fulfilling; and (b) critically analyzing if your return on investment is worthwhile,
thus balancing the costs to make innovating more likely.

**Mitigating Costs**

Survey respondents associated innovation with various costs: 28% reported thinking that
innovating consumes too much time and effort, 37% identified feeling intimidated because
innovating involves challenging the status quo, and 27% believed there was a strong chance that
innovation could harm other people. Innovators from both samples offered various means to
mitigate these potential costs, including (a) knowing what you are getting into; and (b)
recognizing and being willing to make the hard choices.

**Know what you are getting into.** Surveyed and interviewed innovators described being
most comfortable when they firmly understood what they were getting into. A survey respondent
explained that “knowing is half the battle.” Innovators explained that their prior experiences and
awareness helped prepare them for the struggles of innovating.

**Recognize that you will have to put in the hard hours.** Innovators were well aware that
innovation was not an easy endeavour and understood that they would confront varied
challenges. Respondents advised recognizing that innovation has costs and bluntly counselled
aspirants to “accept it” and “deal with it,” counselling awareness and a realistic outlook as a
means to mitigate the costs of innovating. Interviewees shared this perspective and advised aspirants to accept that innovating is hard work and at times unpleasant. Interviewee 30 cautioned, “if you’re ambitious there is a point in time where you got to put in the hard hours.” Interviewed and surveyed innovators counselled accepting the necessity of toil as a means of mitigating the related costs of innovation.

**Recognize that failure is a distinct possibility and don’t be afraid of it.** Innovators also advised that innovators develop a high tolerance for the high probability of temporary failure when pursuing innovative behaviour. Survey respondents gave various reasons for this inevitable temporary failure and the need to adjust, including “wrong people in unsuitable spots,” and noting that “your original idea isn’t normally your final idea.” Interviewee 20 advised: “Figure out how to deal with your failure.” Numerous interviewees and respondents offered examples of notable innovators who experienced failure yet chose to persist and later triumphed. Innovators advised aspirants to recognize the probability of temporary failure and to continue their work as a cost-mitigation strategy to maintain motivation for long-term innovation.

**Be pragmatic.** Innovators portrayed unmanaged expectations and inflexible idealism as making innovation more psychologically punishing. Survey respondents overwhelmingly recommended considering practical aspects such as “adding or subtracting small bits” as compared to radical wholesale change. Interviewee 17 advised aspirants to “stick to what works or makes your life easier.” Innovators often reported the strategy of only slightly extending what had worked previously. Innovators emphasized the importance of staying sensible and grounded in reality, thereby avoiding unpragmatic outcomes that decrease the likelihood of innovating.

**Be willing to make the hard choices.** Surveyed and interviewed innovators counselled aspirants to be open to making hard choices; for example, balancing a willingness to persist in
difficulty versus dispassionately letting go of an idea. Innovators considered the savvy
navigation of these choices as a way to conserve creative energy.

**Stick with it when the going gets tough.** Innovators counselled aspirants to persist with
their ideas. They articulated a sense that good things awaited those who did not prematurely give
up on their idea when faced with adversity. Interviewee 1 personified this view throughout his
interview: “If it were easy everyone would do it; I remember hanging tight with my idea for 2
years. I went hungry at points; that’s how much I believed.” Innovators told stories of making
exorbitant expenditures in time and resources to keep their ideas alive and described peers who
had given up prematurely.

**Be willing to let go of something else.** Contrasting this valuing of persistence, however,
sometimes even from the same participants, was an oppositional view that letting ideas go was
necessary to stay productive. Innovators described the hard lesson that some ideas take
precedence over others, and some should be discarded. Interviewee 29 described this difficult
aspect of decision-making: “Let’s imagine you have a finite budget and you want to do
something to innovate . . . You might have to stop doing something else.” Surveyed and
interviewed innovators portrayed the process of innovating as having real costs, sometimes in the
form of sacrificed ideas.

**Take intelligent risks.** In making hard choices, innovators described the importance of
taking intelligent risks. One survey respondent described these moments as “evidence-based
leaps of faith.” The risk aspect was significant; interviewees counselled aspirants to be bold and
to take chances, but to do so thoughtfully. Interviewee 3 encouraged aspirants to “take intelligent
risks if you aren’t already.” Survey respondents provided examples of intelligent risks as
decisive as “doing a complete pivot” or as subdued as “a really simple switch.” Innovators
described the decision to let go of a current idea or persist with an endeavour once committed as an intelligent risk.

In summary, innovators from the interview and survey sample advised aspirants to mitigate the costs to make innovating more likely by (a) taking a reflective approach to what they are getting into, including a recognition of the need to put in the hard hours, recognizing that failure could happen, and being pragmatic; and (b) having an awareness and willingness to make difficult decisions, including sometimes sticking with your endeavours when the going gets tough but in other cases being willing to let go of past endeavours, and taking intelligent or warranted risks.

**Discussion**

The purpose of this study was to investigate the strategies that innovators used to make innovation more likely.

**How Innovators Maximized their Expectancies**

To make innovation more likely, innovators maximized their innovation expectancies by developing support networks and being disciplined in their process. While literature has emphasized the importance of the support leaders provide to innovators (Aarikka-Stenroos et al., 2017; Dietrich et al., 2016), this research also identified the importance of support from the innovators’ peers. Innovators in this study reported seeking support from similarly minded and constructively critical colleagues and extended their networking to include both local innovators and non-innovators—as also recommended by Pihlajamaa (2017). In addition, innovators in this study increased their innovating confidence by using problem-solving techniques like problem-setting to approach problems deliberatively, as has been identified in other literature (Füller et al., 2012; Montani et al., 2014; Susha et al., 2015).
**How Innovators Maximized their Various Values**

To make innovation more likely, innovators maximized innovation values by focusing on desired outcomes and making clear plans to obtain them. In this study, innovators described the strategy of focusing on outcomes that held intrinsic value, such as topics of personal interest and seeing the fun in the tasks that need to be done. Intrinsic-task values in the innovator samples acted as major drivers of behaviour as has been identified in scholarly literature for decades (Deci & Ryan, 1987; Fischer et al., 2019; Gorozidis & Papaioannou, 2016; Minarcine & Shaw, 2016). Fernandez and Pitts (2011) and more recently Minarcine and Shaw (2016) similarly noted that internal motivations were more impactful than external motivations in sustaining engagement in complex thinking tasks. This finding contrasts extrinsic and rewards approaches to supporting innovation including pay for performance and increased salary (e.g., Manso, 2011). Innovators in this study who held intrinsic values were engaged and interested, so much so that the costs were simply ignored.

Innovators in this study also identified attainment-task values as potent drivers of innovation, such as fulfilment and perceived societal importance of the task. Chaiechi (2014) and Wang and Huang (2015) have reported similar findings that emphasized the fulfilment, importance, and innovation compulsion that some innovators feel. Innovators in both study samples also described utility-task valuation particularly in the form of risk-reward calculations pursuant to benefits like economic competitiveness or avoiding boredom. The primary consideration of the value of indirect rewards (attainment-task and utility-task values) as opposed to principally monetary considerations, contrasts the predominantly business literature that consistently extols the virtue of monetary-focused rewards schemes promoting innovations (e.g., Curran & Walsworth, 2014; Manso, 2011). In the smaller pool of literature from outside business
contexts, however, monetary considerations tended to be of secondary importance in motivating innovators and are notable only in their absence (e.g., Costa, Páez, Sánchez, Garaigordobil, & Gondim, 2015; Kandiko, 2012; Sorice & Donlan, 2015). This contrast hints at an overstatement of the impact of financial considerations on innovative behaviour in the literature.

Of note in the findings of this study, innovators emphasized expectancy-building strategies more than value-building strategies as a means to support innovation.

**How Innovators Mitigated Their Costs**

To make innovation more likely, innovators mitigated the costs by being proactive in (a) identifying those costs thereby knowing what you are getting into and (b) recognizing that they would have hard choices to make. Innovators counselled aspirants to make the best decisions and take intelligent risks that they could based on the evidence that they had, to avoid giving up too soon on their ideas, and conversely to avoid pursuing an idea too far. Innovation promotion literature has thoroughly documented that innovators frequently experience fear, anxiety, and stress (e.g., Ederer, Patt, & Greiff, 2016; Minarcine & Shaw, 2016; Thapa, Niehaves, Seidel, & Plattfaut, 2015) but such studies infrequently provide strategies for mitigating these negative emotional states.

Innovators in this study described the strategies of making themselves aware of the risks and preparing to experience negative emotions (i.e., “forewarned is forearmed”). Literature related to promoting innovation often urges innovators to be pragmatic (e.g., Costa et al., 2015; Maria Stock, Zacharias, & Schnellbaecher, 2017; Sorice & Donlan, 2015). This counsel aligns with the advice of innovators in this study who extolled pragmatic behaviours such as incremental rather than wholesale change in order to reduce the risk of peer rejection of innovative efforts. These conflicting pieces of advice are both supported by literature; some
recommend taking chances in ambiguous situations (e.g., Koch, Binnewies, & Dormann, 2015; Shane, Locke, & Collins, 2003) while other literature advises avoiding unnecessary risks (e.g., Spanjol & Tam, 2010).

**Implications**

This study calls for specific inclusion and consideration of the factors that shaped successful innovators as a means to build capacity for developing innovators in schools. For example, teachers could explicitly demonstrate for learners how to obtain material and social support through networking and careful planning. Students can practice developing plans and receiving critique from peers and mentors to hone this crucial skill. Teachers can also model innovation processes using case studies and examples for aspiring innovators to illustrate how to identify and obtain their desired return. It is especially important that learners are shown the ways that being disciplined in their pursuit of goals pays dividends in the long run. The findings of this research indicate that teachers can support developing innovators by helping them identify and take intelligent risks in a safe environment, thus nurturing this crucial strategy that is demonstrated by innovators. Teachers can resolve not to punish mistakes, but rather outline methods for making more effective choices in the future. Teachers can also demonstrate how innovators persist in innovative endeavours by proactively mitigating costs and anticipating the setbacks that they might encounter. This can take the form of articulating thinking and explicit modelling. These promotive and mitigating strategies are useful guides for teachers and others who seek to support innovators (e.g., leaders in professional and business contexts) and of course for innovators themselves.
Study Limitations and Strengths

This study had three main limitations. As with many motivation studies, this research relied on self-assessment and self-reported data to investigate a latent construct: the motivation to innovate. Although this study illustrates many perceived strategies for making innovation more likely, the reports are anecdotal and were not verified through direct observation. Finally, although yielding a large sample, recruitment through social media precluded the ability to calculate a response rate and definitively determine the representativeness of the survey sample.

The study also has notable strengths. The multiple data sources (survey and interviews) allowed for the triangulation of inferences thereby increasing the trustworthiness of the findings. Additionally, this study achieved relative balance in terms of participant gender and disciplinary background, resulting in a sample more aligned with the diversity of perspectives of innovators working in multiple fields in society and in schools. The interdisciplinary and equity principles guiding the design of this study allow the findings to be informative to innovation development programs in many settings. Finally, the two-pronged approach of illustrating the innovation promotive and innovation cost mitigating strategies of successful innovators is relatively novel for the field.

Future Research

Future research should evaluate the elucidated strategies through interventions in educational settings to demonstrate their potential efficacy in increasing expectancies and values of aspiring innovators or in mitigating costs. An experimental design would be useful for teachers and decision-makers as they make choices about what strategies to use in their efforts to nurture and support innovation and young innovators. It would also be illuminating to examine
whether these strategies work across cultural groups and learning contexts as they do across disciplines.

**Conclusions**

Innovators’ perceptions of the costs of innovating and corresponding countermeasures used to mitigate such costs naturally fit within the EVC framework. However, this study is among the first to ask innovators what they identify as the costs of innovating and how they have overcome them. The results of this study, therefore, contribute to the literature on motivating innovation as it is among the first to (a) consider both promotive and hindering factors as a means of giving a more thorough picture of the dynamics at play in supporting innovation, (b) be fuelled by rigorously developed interview and survey protocols made freely available under creative commons usage, (c) integrate narrative insight from innovators themselves, and (d) be interdisciplinary in participant scope providing insights that sometimes challenged the established innovation promotion literature.

The findings of this study point to an underrepresentation of the impact of expectancies and costs and a corresponding overemphasis on the reward-derived value in the innovation literature. They also illustrate a need for a conversation about interdisciplinary innovation, which would add to the existing literature clusterings that currently exist in disciplines. This study’s holistic view of motivation to innovate at the individual level enables a more thorough consideration of the countermeasures successful innovators can use to balance the costs of innovation. These behaviours direct attention to approaches that should be integrated into programs designed to promote innovation across disciplines and learning contexts.


Füller, J., Matzler, K., Hutter, K., & Hautz, J. (2012). Consumers’ creative talent: Which


https://doi.org/10.2224/sbp.2015.43.7.1147

Chapter 6

Manuscript 4: What Helped Me Innovate: Identified Motivation Factors from Canadian Innovators’ Education Experiences

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Abstract

Past innovation research has focussed on business contexts and innovator prodigies leaving the insights of today’s successful innovators in a range of fields overlooked as a means to inform the education of our next generation of innovators. This mixed method study involved analysis of interviews (n=30) and surveys (n=500) of Canadian innovators to identify motivation factors in formal and informal education that can make innovation more likely. The findings point to methods of maximizing expectancies and values, while proactively mitigating the costs of innovating. Recommendations are made for teachers, mentors, and decision-makers for better stoking the capacity to innovate through education.

Motivating Innovation in Education

The interest in capable thinkers who can devise, develop, and implement ideas is valued across disciplines and has transcended decades of scholarly efforts (Amabile, 1996; Fischer et al., 2019; Janszen, 1950; Soleas, 2018b). The study of innovation since its inception in the 1950s has tended to focus on innovation in business settings and institutions using the metrics of outcomes such as patents (Baregheh et al., 2009). Much more recently, innovation education has emerged as a discipline seeking to make innovation more likely (Gunnarsdottir, 2013; Shavinina, 2012). When it has focused on the individual, innovation education has tended to make excellent use of the lessons learned from prodigies and famous thinkers (e.g., Shavinina, 2013b; Yun Dai,
as opposed to less known, more numerous innovators who lack the same name recognition whilst making their impact on humanity. In the shadow of this focus on prodigy, the insights of today’s successful innovators are overlooked in their utility to inform the education of our next generation of innovators.

Examining the K-12 education experiences of today’s innovators can shed light on the motivation factors, both promotive and hindering, that influence the development of young innovators. Understanding these factors can enable educators to leverage more of the innovation potential in today’s students. The innovators of today have reported that they acquired their skills and built their capacity in both formal and informal educational environments (e.g., Koloniari, Vraimaki, & Fassoulis, 2018; Liu & Chan, 2017). Although the motivational factors are the principal focus of this paper, this study also explores these factors in the context of their differential occurrence in formal and informal settings as a useful means of exploring reported differences when they occurred. Whereas formal education has been defined by the UNESCO Institute for Statistics (2011) as primarily institutional, intentional, and planned thoroughly; informal education is characterized as taking place outside institutions and is, therefore, less structured and planned than formal education. Identifying and examining the motivation dynamics of both formal and informal education as identified by existing innovators in promoting their development can help optimize both types in their conversion of innovation potential to innovation capacity.

**Expectancy-Value-Cost (EVC)**

EVC (Barron & Hulleman, 2015; Flake et al., 2015) offers a valuable (and novel), holistic perspective on promoting innovation because, unlike many motivation theories it considers motivational factors that make innovation more likely to occur as well as evaluating
those that make it less likely to occur. EVC identifies that the motivation to complete tasks (including innovation) is influenced by expectancies of success (self-concept and self-efficacy) and the perceived values of the task (intrinsic, attainment, and utility value; Barron & Hulleman, 2015). The motivation for complex tasks can be explained through the interaction of individuals’ confidence in their ability to succeed in a given task (expectancies) and the enjoyment, importance, and usefulness they assign to the task—task values (Wigfield, Tonks, & Klauda, 2009). In other words, if learners expect to succeed and experience intrinsic or extrinsic values in innovating, they are more likely to try innovating of their own volition. Research that explores the various expectancies and values that motivate existing innovators has the potential to help educators understand how to motivate students to innovate and thereby enhance students’ innovation potential.

Innovation, while often highly valued, also has contextual and psychological costs experiences by learners. Costs, in relation to motivation, go beyond the common conception of monetary price and include other detractive dimensions such as increased effort, time expenditure, pressure as well as the implications of failure (Flake et al., 2015). For many students, the perceived costs of innovating may be higher than the expectancies and values, resulting in a deficit of motivation to innovate. EVC enables a two-pronged approach to innovation education: the identification of motivating factors enables easier promotion while the identification of demotivating factors provides targets for mitigation. To make innovation more likely, educators must help students maximize the expectancies and values of innovating and help them mitigate the costs. This research examined the educational experiences of innovators to identify the innovation expectancies and values that education can build, and the costs of innovating that education can mitigate. The findings can be leveraged to inform the innovation
education of learners so that they can realize their personal potential to innovate in their work and lives.

**Research Questions**

This study used EVC to investigate the educational experiences of innovators as guided by the following question and two sub-questions:

1. How do Canadian innovators perceive education can help students balance the expectancies, values, and costs of innovating?
   
   a. What educational experiences and factors do Canadian innovators consider important in the promotion of innovation?
   
   b. Were informal or formal educational experiences seen as more positively impactful in helping aspiring innovators?

**Methodology**

This study adopted a two-phase, primarily qualitative design combining semi-structured interviews and a survey of Canadian innovators. Interviews were conducted with a diverse, multidisciplinary sample of Canadian innovators (referred to here as “interviewees”; n=30), which informed the development of the survey administered to a larger sample of Canadian innovators (“survey respondents”; n=500). This study received ethical clearance from the Queen’s University General Research Ethics Board and was conducted in strict compliance with the ethical principles of Canada’s Tri-Council Research Agency.

Questions about participants’ employment, current innovation endeavours, and past achievements guided decisions about their eligibility to participate in the study. In alignment with Kaufman and Beghetto’s (2009) model of creativity that encompasses four levels of
proficiency on a continuum ranging from Mini- to Big-C creativity, a framework was designed to establish each participant’s level of innovation proficiency. In this study, the continuum was applied to innovation as follows: Mini-I innovation constitutes innovative student behaviour (e.g., in-class problem solving); Little-I is local or common innovative behaviour (e.g., inventing a new baking recipe); Pro-I includes professionals who innovate for a living (e.g., surgeons refining an existing technique); and Big-I innovation corresponds to those who have made renowned innovative contributions (e.g., inventing a new renewable energy source). Participants who did not demonstrate at least Mini-I innovation (innovative student behaviour) were deemed ineligible for inclusion (not included in the n=500) in the study sample and were thanked for their interest.

**Interviews**

Interviewees were aspiring or recognized Canadian innovators and represented a variety of innovator level groups including Little-I (n= 10), Pro-I (n=15) and Big-I innovators (n=5). Invitations yielded six innovators from each of five disciplines—(a) science, technology, engineering, and mathematics; (b) social services; (c) education and academia; (d) arts; and (e) business—for a total of 30 interviews ranging from 45 to 96 minutes. Seventeen innovators identified as being men, while 11 identified as being women; two innovators did not identify within the gender binary. During the interviews, innovators were asked to answer eight open-ended questions about their motivations, experiences, and conceptualizations about innovation, followed by supplementary queries to capture latent details. Interviews were transcribed verbatim and thematically coded (Basit, 2010; Braun & Clarke, 2006) using ATLAS.ti v8.3.16 qualitative analysis software. Open codes were clustered into subthemes and then organized into groups of expectancies, values, and costs.
Survey responses

Survey respondents were invited to participate by email and social media. Respondents completed the 15-minute questionnaire composed of open responses (barriers, supports, and experiences) and closed-ended items (demographics and EVC Likert-like scales; not used in this study.) Responses were verified for eligibility for study inclusion through a combination of reported location, first three digits of IP address, occupation, and role description and then sorted into disciplinary (sciences, technology, engineering, and mathematics = 107; social services = 105; education and academia = 94; arts = 76; and business= 118) and innovator level groups (Mini-I= 31; Little-I = 241; Pro-I= 180; Big-I = 48). In terms of gender, 243 respondents identified as male, 210 identified as female, 3 identified as non-gender binary, and 44 preferred not to disclose their gender. Like the interviewees, survey respondents (n=500) were also an interdisciplinary, multicultural sample of Canadian innovators. Closed-ended items were data cleaned and analyzed in SPSS v24. Open-ended items were coded thematically in ATLAS.ti v8.3.16 and in alignment with the analysis of the interview responses.

Results

Innovators described their experiences and made recommendations based on these experiences. These responses were thematically analyzed and then categorized into the EVC theoretical framework. The closed-ended items of the surveys were primarily used to answer whether informal or formal educational environments were more highly reported to be more promotive of innovation. All survey closed-ended item scales were found to have Cronbach’s alpha values in the range of very good to excellent (α= 0.81- 0.90).
Educational Factors that Build Expectancies

Education can build expectancies as a means of supporting innovation education. Innovators in the surveys and interviews described six ways: 1) building a culture of innovation, 2) providing stable access to opportunities, 3) stimulating thinking through offbeat activities, 4) fostering meaningful mentorship and peer relations, 5) modelling innovation, and 6) directly teaching innovation-relevant knowledge and skills.

A culture of innovation. Surveyed and interviewed innovators explained that some contexts had supportive cultures that made people feel more comfortable, confident, and capable when innovating. Within the more formal education settings, innovators praised classrooms where an innovation culture encouraged learners to experiment. In more informal settings, they praised co-curricular settings, crediting examples like debate club and robotics for exposing them to new ideas. Interviewee 25 described the importance of “Creating a culture where people are free to think differently, they're not punished, they're not demeaned.” Indeed, the aegis of safe spaces in an innovation culture was described consistently by interviewees as crucial to their confidence in taking chances and thus building their capacity. Interviewee 28 described a tangible example of an innovation culture in a past institution where “everywhere there were posters that said, ’we ask why not?’ It was part of the culture that that's what everybody started doing all the time.” Innovators depended on these early safe spaces and innovation-friendly cultures to develop into the resilient thinkers who would later innovate in their areas of endeavour. In order to build expectancies in an education context, participants indicated the benefits of developing an innovation culture that encourages aspirants to try new things and community initiatives that establish innovation as a norm.
Stable access to resources, spaces, and opportunities. In both formal and informal educational settings, innovators extolled well-equipped self-directed exploration of the world’s knowledge which helped them make a habit of exploring and pushing boundaries of contemporary thinking. In more formal settings they credited teachers that encouraged and provided access to opportunities like bringing in guest speakers, internet exploration assignments, and other means to explore ideas in an engaging and collaborative manner. Innovators identified the value of informal education environments such as science clubs and improvisation groups as providing stimulating learning environments and ideas. Interviewees recalled that these environments helped them develop their innovation potential. Interviewee 1 explained, “You've got to have places where people can talk, where they can work, there's tools that they can use to prototype.” This thread was found elsewhere as several innovators (Int 2, 5, 6, 17, 24 and 30) commented on the need for hubs for prototyping. It was innovators’ consistent access to these opportunities, resources, and spaces that helped them build their innovation expectancies, and which they in turn recommended for the support of future innovators.

Offbeat activities. Surveyed and interviewed innovators credited offbeat learning activities including robotics competitions, science fairs, and school musicals with building their confidence to innovate. In more formal education settings, innovators fondly recalled classes that went “outside the box” by, for example, adopting flipped classrooms, makerspaces, and studio models with long blocks of time to make learning more authentic and immersive. They also credited offbeat tasks like designing zoos for biology, planning cities, and other open-ended assignments that really made students think. These offbeat or informal activities and contexts fuelled innovation by breaking routine and creating opportunities beyond the norm of conventional classrooms. Extolling the virtue of more informal and offbeat learning spaces,
interviewee 2 described his work travelling to schools with a mobile makerspace: “we wanted the trailer because we didn't want the feel of their regular classroom” elaborating that “in their own schools, they already have a dynamic set up in their classroom.” Innovators across disciplines credited informal learning opportunities, especially those that facilitated offbeat approaches to learning, even within formal education, as building their innovation expectancies.

**Mentorship and peers.** Innovators retrospectively credited the mentors and peers they connected with through formal education as being crucial supports in their early innovating endeavours. They frequently explained that structured collaboration in their schooling helped them grow accustomed to working with their peers on projects and accomplishing goals, crediting it with building their later capacity to innovate. Collaborating with peers was held in high regard by interviewees, as exemplified by Interviewee 24: “I think working with other people is valuable for innovating because it involves analyzing ideas because now, you're in a situation where the ideas aren’t just coming from you.” In informal settings, innovators found that mentoring in libraries, clubs, and extracurriculars aided them with finding new perspectives and building a network of colleagues which they credited with building their later capacity to innovate. Interviewee 23 credited mentors for her innovating and likened innovation “to jumping off a cliff with the parts and assembling it on the way down. If you don’t have people that can help guide you on that way down, it is less likely to end well.” Interviewees elaborated that mentors often articulated belief in their potential and would encourage them to follow through on their ideas. Innovators of all disciplines credited peers and mentors with building their expectancies in learning contexts as nurturing their capacity to innovate through building their capacity for teamwork and providing informed support.
Modelling innovation. Innovators described innovating as initially seeming like an ambitious or impossible goal to them during their schooling, but teachers and speakers modelling innovating helped to humanize the process and make it seem reachable. Without an example, even one outside their area of interest, innovators were uncertain if they would have done the innovating that they did. Interviewee 16 explained that “I think it's especially helpful to hear about the struggle and the hard stuff that they've gone through. They don't seem superhuman.” From the responses of innovators, modelling innovation in schools can show students not only how to innovate, but that innovation is something within their capability—something that real people like their teachers and they themselves can achieve thus building their expectancies.

Direct teaching of innovation knowledge and skills. Innovators in both the survey and interviews credited formal education with contributing to their expectancies and perceived capacity to innovate as a source of necessary content foundation, process skill development, ideas, and design training, and developing systems and critical thinking.

Content-specific skills. Interviewees found strategy, writing, leadership, cost accounting, communication as well as specific disciplinary content knowledge especially pertinent for them to learn to innovate successfully (e.g., dance techniques for a dancer or basic mechanics for a bicycle builder). Such content knowledge was reported by the surveyed innovators as contextual, differing from one field of endeavour to the next, and tended to be seen as a gatekeeper that made innovation possible. Interviewee 12 offered the example, “If you can't communicate your ideas, you can't write your ideas. You need writing skills; you need to be able to write proposals.” To innovators, a brilliant intellect without the necessary knowledge and skills would be insufficient to drive innovation. The content-specific knowledge and skills built
by formal education were seen as crucial to their innovation confidence and were characterized as foundational for the expectancies that would support the rest of their careers.

**Creative and problem-solving process skill development.** Both innovator samples credited the educational opportunities that they had learning about innovation processes including creative and problem-solving processes as building their future capacity by giving them a framework they could transfer across contexts. Interviewee 20 advocated for more teaching time devoted to the process of innovation and remarked: “I'd say that's the biggest barrier [is] a focus on products as opposed to processes.” Schools, they argued, can “provide something maybe even more important than the content. [They] provide the students an understanding of the process of how to succeed in a messy world.” (Int 7). The content was deemed important to innovation confidence, but survey respondents and interviewees also emphasized the need for schools to develop distinct student creative and problem-solving processes as a means of developing expectancies.

**Idea and design development training.** Both samples of innovators discussed the importance of education, schools, for teaching design thinking as well as tools and processes for idea development. Interviewees credited their education with providing them techniques that enabled them to cultivate their ideas including “structured brainstorming” (Int 1, 6, 17, 21), “problem setting” (Int 1, 6, 9, 13, 16, 22) and “design thinking” (Int 1, 5, 6, 8, 21, 25, 28, 30). Interviewee 16, described, for example, “a place called the problem lab where they don't focus on solutions at all. They just focus on deeply understanding problems. It's much better to start with the problem and then try to figure out the solution.” These and other techniques were emphasized as skills and techniques innovators could learn in schools to increase their expectancies and capacity.
**Systems and critical thinking.** Innovators in the survey and interview samples also identified formal education as a site for developing their systems and critical thinking. Participants credited systems thinking with enabling learners to isolate and critically examine the mechanics of a part of a system. As explained by interviewee 9, education interested in stoking innovation needs to “develop systems thinking, and work to ingrain critical thinking into the way that people approach every instance of their lives.” Interviewee 6 counselled the importance to innovating of “Any class that paired critical thinking with the real world.” Innovators identified that schools could nurture systems and critical thinking as an important expectancy aspect of preparing students to innovate.

Expectancy-related educational factors were found to occur in both formal and informal contexts. Content-specific skill and knowledge acquisition were acquired more frequently in formal settings. Mentorship, on the other hand, was found to more commonly occur in informal settings. The expectancy building properties of modelling innovation, an innovation culture, and stable access to opportunities were found in both informal and formal learning contexts.

**Educational Factors that Build Task Values**

Much like expectancies, education can also build task values as a means of supporting innovation education. Innovators in the surveys and interviews described two groupings of positive impacts that educational environments could have: boosting attainment task-value and fostering innovation’s intrinsic task-value for learners.

**Attainment Value: Promoting autonomy and taking the lead.** Educators can make learners’ innovation efforts more fulfilling through providing students the freedom and means to autonomously pursue their ideas. Surveyed innovators explicitly credited the teachers who provided them with the freedom to experiment with new ideas in formal education. They also
extolled the virtues of empowering learners to pursue their ideas and learn how to make important decisions for themselves in informal learning contexts. Interviewee 29 explained that “a learning environment where you can empower the learners to grab hold of their own destiny and give them some open-ended questions that they really care about” would recruit more interest. Innovators explained that informal opportunities for independent reading and work as well as opportunities to learn by doing made innovating seem more valuable as a source of freedom in the otherwise very structured process of schooling. Explaining how teachers could promote autonomy, Interviewee 18 suggested teachers could tell students, “You're going to find a way to innovate and you're going to come to me and tell me what your barriers are and I'm going to help you overcome those barriers.” Promoting autonomy was portrayed as a tool for building attainment value and thus recruiting engagement in early innovating, but also developing independent thinking skills that would later support innovating endeavours.

**Attainment Value: Connecting to real-world outcomes.** Innovators attributed their opportunities in school to wrestle with real-world issues as building up the perceived importance of future innovating. Surveyed innovators offered examples of activities schools could provide including volunteering, final projects with real-world relevance, and interactions with bona fide innovators who clearly articulate the importance of innovating as having strong potential for building the perceived value of innovating. Interviewees also described the importance of perceived connectivity to the wider world. Interviewee 22 advocated for “Giving them some real-world outcomes. Anything that connects to the real world is immediately going to spark a different kind of engagement.” Interviewee 29 gave another example: tasking students with “using twitter to engage with real world publics on real time conversations on very relevant issues.” She elaborated that “You see students going, ‘oh, this really matters! I'm not just writing
this for my professor.’” Schooling can boost the perceived importance, an attainment value, of innovating by making very clear the connection and impact innovating has on students’ lives and wider society.

**Intrinsic Values: Novelty in learning spaces.** Innovators described the importance of novelty, particularly shaking things up as a way of getting students engaged in innovating in their schooling as well as making the experience enjoyable. Surveyed innovators linked open-ended projects and the enjoyment of novel activities in class with the beginnings of recognizing intrinsic value in innovating. As described by innovators, teachers who made their activities engaging tended to focus on opportunities that helped students apply their skills. Interviewee 6 described an example of an enjoyable activity teaching him necessary content. His teacher designed a simulated scenario where he “participated in a model United Nations and had to negotiate” trade deals with his peers. He found it enjoyable because he was building the skills he would later use as a Canadian trade envoy. Innovators tended to describe the emphasis on novelty as a way of capturing and retaining student interest and these novel shakeups as outlets for expression catalyzing later interest in innovative endeavours.

**Intrinsic Value: Responding to student interests.** Innovators credited interest-responsive teaching with stoking their later innovative behaviour. Surveyed innovators praised teachers who inspired them to try new things and encouraged students to channel their passions into their assignments and learning. Interviewees commonly described the impact that teachers could have when they invited students’ own interests into the curriculum. Interviewee 24 reported that “The teachers I would vividly remember as being instrumental in me doing anything productive with my life have just been the ones who respond to what my interests are.” In another instance, interviewee 10 explained that one teacher among many told her to persist in
her then unorthodox style of art, stating “He told me ‘You should keep it up.’ I still think about that to this day. I’ll send him one of my installations.” Teachers who encouraged students to pursue their own interests helped make school and the process of innovating more intrinsically valuable.

**Intrinsic Value: Nurturing curiosity.** Innovators reported the importance of education nurturing curiosity as stoking an intrinsic value. Surveyed innovators described curiosity-supportive environments in schools as ones that required students to try new ideas, held an expectation of creative and analytical outputs in assignments, and ensured that opportunities to apply advanced skills took place within a structured environment. Interviewee 15 expanded on the above requirements “I would say develop the curiosity, provide some foundation, nurture it, and one of the best ways to nurture it is to provide opportunities to do it.” Surveyed and interviewed innovators cautioned that, unfortunately, formal schooling often punishes creative curiosity as non-conformity. Interviewee 29 explained, “Humans are by nature curious beings and that we do sometimes have the curiosity beaten out of us . . . If you want people to really truly foster and develop curiosity, then you have to be deliberate and purposeful about that.” From the responses of innovators, without nurturing the curiosity of students, innovation’s intrinsic value would seldom be developed by formal education.

Value-building factors were reported more frequently in formal education settings and included promoting autonomy, real world applicability, novel approaches, responding to student interests, and nurturing curiosity. The general trend within the reported examples was that the value-building factors were more noticeable in formal education settings because they tended to occur less frequently. Given that formal educational contexts were often compulsory and informal educational contexts were often attended by choice, it is indicative of the value that
innovators ascribed to their informal education experiences that they continued to attend them. The same value-building factors may well have been present in participants’ informal learning but were not highlighted by participants because they were part of an expected norm.

**Educational Factors that Mitigate Costs**

Innovators isolated specific educational methods of mitigating the costs of innovating in the classroom including a focus on developing processes and debriefing failure. It is notable that surveyed and interviewed innovators did not frequently report costs associated with informal education.

**Focus on developing the process and skills instead of immediate outcomes.**

Innovators credited teacher innovation cost-mitigating efforts as crucial to their continued engagement in innovating. Surveyed innovators described cost-mitigating efforts as formal educators choosing not to stifle innovation with an overemphasis on compliance and outcomes. Interviewees tended to advocate for not directly evaluating creativity at all, rather focusing on developing the process instead of the immediate outcome. Interviewee 20 advocated for “learning activities that provide opportunities for self-expression without evaluation attached.” She suggested providing “lots of opportunities to be creative without grades attached.”

Interviewees emphasized the need for managing the perceived risk that students would feel when learning innovation skills. Interviewee 24 offered, as a strategy for managing this risk, the idea of “not measuring success by the outcome but measuring success by the process and growth.” Formal education systems can manage the costs of learning to innovate by focusing on developing the process rather than evaluating outcomes, thereby making learning to innovate less risky.
Debriefing failure. Innovators credited being taught how to confront failure in their formal and informal education as a key to their resilience to the inevitable setbacks innovating entails. Surveyed innovators described powerful learning experiences moderated by teachers and mentors that helped them accept and learn from failures. Interviewees identified also noted the importance of resilience-building experiences, such as “getting comfortable learning about what didn't work and how to come back at it with future iterations” (Interviewee 7). According to innovator responses and exemplified by interviewee 19, this would look like “the chance for the students to fail in this task, and to have them realize that this is not failure but a natural part of the process.” Interviewee 20 explained that educators need to prioritize helping students to “deal with failure emotionally.” The responses point to a need for informal and formal education to not shy away from having students experience failure, but rather to focus on making certain that it is a constructive learning opportunity to enable them to be resilient when it occurs. The vast majority of cost-mitigating educational factors were reported in formal educational settings. Given that formal education features evaluation more prominently and with longer-term implications (e.g., grades), innovators’ experiences concentrated on formal schooling as the site where focusing on developing processes and debriefing failure were most necessary for mitigating the costs of innovative behaviour.

Comparing Formal and Informal Education

Surveyed and interviewed innovators when asked about the impacts of formal and informal education tended to view environments guided by curriculum including classrooms, postsecondary programs, enrolled scholarly courses, and sessions with a regionally mandated curriculum as formal. Other types of typically less-structured environments like clubs, mentoring, collaborative networks, and learning on the job were termed informal education.
Surveyed innovators were less positive about formal education than informal education as having a positive effect on their innovation development. Analysed responses from the survey revealed through MANOVA tests that innovators tended to rate informal (m= 5.98, SD= 1.12) over formal educational experiences (m= 5.22, SD=1.32) as positively impactful to their development as innovators constituting a significant difference with a medium effect size (p <0.001; df= 499; d= 0.62). Male innovators (m=5.58, SD= 1.03) tended to find formal schooling more useful than their female peers (m=5.02, SD= 1.11) resulting in a significant difference and a medium effect size (p <0.006; df= 499; d= 0.52). Formal education was described as having a positive impact on the development of innovators, but not as positively as informal education.

**Formal education has merits and builds the foundation.** Innovators indicated that formal education has a role in stoking innovation particularly in building confidence, teaching innovation processes, and the transmission of key disciplinary knowledge that serves as a foundation for innovating. 90% of interviewees and 54% of surveyed innovators echoed these sentiments in their responses, as exemplified by Interviewee 27: “Like Picasso ventures into abstraction, but he's classically trained. He needed to know shape and form and be able to do all the nuts and bolts before the innovation can happen instead of just starting off the bat.” In this way, innovators described formal education as laying the foundational skills, perspectives, and capacities that make the breakthroughs in informal education possible. As interviewee 26 explained, “informal environments augment the formal educational experience and can get students involved in problem-solving in a more realistic setting more closely mirroring the rest of their lives.”

**Informal education provides rich opportunities.** Innovators credited informal education as being the primary source of opportunities to deeply engage with innovation.
Surveyed innovators frequently criticized formal schooling as actively stifling innovation, citing the need for compliance to avoid punishment, except on the rare occasion where an inspirational teacher was involved. Interviewee 3, for example, when asked where one learns to innovate, responded, “pretty much anywhere but a classroom.” Informal education, by comparison, was unanimously portrayed as a source of opportunities to develop innovation, with students tending to participate by choice and where they were not punished for exploring their ideas. Some of these opportunities were voluntary, such as enrolling in music lessons or going to space camp, while others were necessary reactions to their environments such as needing to become more time-efficient in order to have time to do their chores and still spend time with their friends.

**Discussion**

This study asked innovators to describe the educational factors that enabled them to develop into innovators. Their responses were considered and analyzed through the lens of Expectancy-Value-Cost theory and when applicable differentiated by their presence in formal or informal settings.

**Expectancies**

Educational factors associated with expectancies were the strongest and most frequently described in terms of what education could do to support young innovators according to both samples of innovators. Innovators tended to credit their innovating expectancies or confidence to endeavouring in an innovation culture that encouraged experimentation, as previously hypothesized by Bhaduri and Kumar (2011). Study results indicated that the learning activities most credited by innovators for building expectancies were noticeably “offbeat,” including robotic competitions, school musicals, and makerspaces. The effectiveness of such “offbeat”
learning environments is a key consideration in emerging literature investigating their promise (e.g., Jonsdottir & Macdonald, 2013; Kirsten & Du Preez, 2010; Maravilhas & Martins, 2019).

Innovators in both samples, and consistently across disciplines and formal and informal education settings, leaned heavily into the aegis of safe spaces as key to building innovation expectancies. Study participants described being motivated to innovate when risks were minimized, as has also been found in other studies in the recent literature (Chaiechi, 2014; Hendy & Barlow, 2012; Soleas, 2018a). A safe environment was key, but stable access to opportunities and resources was also credited in both formal and informal education settings as significant for building expectancies and therefore supporting innovation, in contrast to some previous studies which have identified the efficacy of sudden surges in resources (Carè, Trotta, Carè, & Rizzello, 2018; Chaiechi, 2014). Innovators in this study credited stability and consistency with making them more confident and therefore more likely to innovate as a result of the knowledge that they were safe to make mistakes. This security gave them the confidence to push boundaries which facilitated discovery and their future ability to find new solutions.

By far the strongest consensus among innovators was that their expectancies, specifically innovating confidence was increased due to the support that they experienced from mentors and peers, which complements the findings of recent innovation literature contributions that support from mentors and peers promotes innovation (e.g., Aarikka-Stenroos, Jaakkola, Harrison, & Mäkitalo-Keinonen, 2017; Oyemomi, Liu, Neaga, Chen, & Nakpodia, 2019; Pihlajamaa, 2017). Broadly speaking, mentors tended to make their mark in informal circumstances, whereas the most impactful peers tended to act in formal education, a distinction thus far not articulated in the innovation promotion literature. As an extension of mentorship, innovation development was facilitated by modelling innovative behaviour which built expectancies. The finding that
participants appreciated innovation being modelled hints at the importance of an active approach to innovation education featuring, for example, the showcasing of intelligent risk-taking (e.g., Kinney, Laux, & Newman, 2015), and demonstrating the virtues of following a process when innovating (e.g., Krathwohl, 2002; Li, Hsieh, & Rai, 2013; van Grinsven, Tillema, Grinsven, & Tillema, 2006).

Direct teaching of innovation-relevant knowledge and skills in formal education as credited for building expectancies by the innovators in this study represents a relatively unique finding given the focus in innovation education on activating previous knowledge and developing prodigies (e.g., Shavinina, 2012; Yun Dai, 2013). Extending the novelty of this finding was innovator prioritization of being taught different strands of innovation-relevant thinking more commonly associated with disciplinary learning, including systems thinking (e.g., Lee & Sohn, 2019), critical thinking (Olivares et al., 2013), creative processes (e.g., Fischer, Malycha, & Schafmann, 2019), and design thinking (e.g., Norman & Verganti, 2014). Innovators prioritized the learning of these various types of thinking in formal education with a particular emphasis on acquiring these skills in school as a means of building their innovation expectancies.

Values

While expectancies were especially impactful according to innovators, the ability of education to foster attainment and intrinsic values for innovating in learners was also well-articulated. Attainment values were found to be built in education via providing opportunities to pursue goals autonomously and reinforcing the connections between learning and the real world. Providing autonomy to pursue ideas was a key method that education, especially schooling utilized to build attainment value. This aligns well with previous findings in the literature,
especially social innovation studies (e.g., Radicic, Pugh, Hollanders, Wintjes, & Fairburn, 2016; Thorpe & Figge, 2018), that attainment was a key consideration that was acquired from the experiences that learners had prior to their gainful employment. Although not specifically identified in innovation promotion literature, other studies have highlighted that activities that are more closely connected with the world outside of schooling add to the perceived importance of the underlying content (e.g., Costa et al., 2015; Kandiko, 2013; Kruglanski et al., 1971; Sorice & Donlan, 2015).

Intrinsic task values for innovating were found to be built through providing engaging and novel experiences in learning spaces, responding to student interests, and nurturing curiosity. Despite a lack of research about novelty in innovation education, there is wide recognition that innovators enjoy activities that push boundaries as they capture and maintain their interest (Kirsten & Du Preez, 2010; Tan, 2007), all the while building the task values that will drive their future innovating. Innovators credited teachers who responded to their interests as helping them appreciate the value of innovating, paralleling the findings of research on the efficacy of leaders who consider the interest of their workers (e.g., Bolderdijk, Brouwer, & Cornelissen, 2018; Sergeeva & Zanello, 2018; Yidong & Xinxin, 2013). Innovators identified that having their curiosity nurtured built intrinsic task value as did the careful curation of activities that necessitated they think differently but within their field of interests (e.g., Cordero, Walsh, & Kirchhoff, 2005; Fischer et al., 2019; Minarcine & Shaw, 2016). It is worth noting that utility values (analogous to external extrinsic rewards) were not found to be relevant to innovation development in education, as demonstrated by their complete absence from innovator responses and their aversion to having early innovative works graded.
Costs

While participants rarely described experiencing or recommended cost mitigation in informal education contexts, formal education was identified as having specific opportunities to help students mitigate the costs of innovating. Innovators urged schooling to focus on student skill development and refining processes, rather than compliance and outcome metrics which were reported to exacerbate the costs of innovating. This stands in contrast to the findings in innovation literature which have focused on outcome metrics as the principal outputs of innovation promotion (Smith & Sandberg, 2018; Wendelken et al., 2014). A significantly smaller segment of innovation promotion literature has focused on developing the process and an increased capacity to innovate as the primary outputs of innovation promotion (Everard & Longhurst, 2018; Montani et al., 2014; Soleas, 2018b), which would align well with educational programs. Additionally, innovators positioned schooling as having an opportunity to develop students’ ability to confront failure as a way of mitigating costs. This finding adds to our understanding of innovation education, which has focused to this point on the importance of adding skills and creating a supportive environment in schools to build capacity (Noonan, 2013; Shavinina, 2013a). Conceptualizing failure and debriefing it as an opportunity is in alignment with literature in educational science (Elliot & Dweck, 2013; O’Rourke, Haimovitz, Ballweber, Dweck, & Popović, 2014), but represents a promising new direction for innovation education.

Informal versus formal education

Informal education has not been thoroughly studied in the context of innovation education, which has instead focused on formal education including classrooms and schools (e.g., Makri, Papanikolaou, Tsakiri, & Karkanis, 2009; Nold, 2017) and structured programs (Sandberg, 2013). The findings of this study point to informal education being at least as
impactful for innovators’ development as formal education. Among expectancies and costs, formal and informal education were found to have different roles. Formal education was found to primarily build skills and knowledge and to be the site where cost-mitigating was most necessary, whereas informal education was reported to be an effective outlet and safe space for the application of the knowledge and skills. The dearth of research elsewhere combined with the promise of informal education settings as identified by innovators in this study indicates the need for further study of its potential contributions to innovation education, especially as a principal method for exploring young innovators’ individual interests. This study points to the role of both informal and formal education in building the expectancies and values of innovating, whilst mitigating its costs, thereby motivating young innovators and supporting their development.

**Implications**

This study has implications for professional practice for teachers, innovators themselves, and for future research in innovation education and promotion. For teachers, this study suggests that the learning in classrooms can benefit from activities that push the boundaries of a traditional classroom, particularly hands-on and activities where students need to create something from initial ideas to a tangible, ideally real-world application. Additionally, this study suggests future innovators need their teachers to carefully curate the activities that are done in class to nurture and indulge student curiosity, in particular allowing them to pursue their “burning” questions whenever possible.

A signature finding of this study is the complete lack of innovator recognition of the role of utility value, analogous to external extrinsic rewards in broader motivation study (Flake et al., 2015). Innovators described the grading of evaluation of the outcomes of creativity or compliance with overly structured expectations as actively hindering future willingness to
innovate, making the evaluation of innovation outcomes, or punishing intelligent deviations from norms in learning environments as counter-productive. This study supports the notion that extrinsic rewards, such as grades, could be overemphasized in their efficacy and application. This study also provides insights into how innovators can better sustain their own motivation to innovate, by seeking informal learning environments where they can practice their skills in a safe environment with adequate peer support. Additionally, innovators can retain their motivation by self-advocating to be allowed to choose interesting topics and those they find important in their school tasks. They can also benefit greatly from the consistent habit of promptly debriefing their failures. This research also calls for aspiring innovators to take intelligent risks whenever they evaluate that it is safe to do so.

**Limitations and Trustworthiness in the Current Study**

This study has both methodological and generalizability limitations. Firstly, the comparison of informal and formal environments was driven by self-report closed-ended questions introducing the potential for desirability bias in favour of more enjoyable informal environments. Secondly, a delimitation was that some respondents for the survey were recruited anonymously, through social media, therefore a response rate for the whole sample could not be calculated. However, among the proportion recruited by email (n=94) the response rate was 45.4%. Lastly, this study was conducted with Canadian innovators spanning many, but not all disciplines leaving reasonable concerns with the generalizability to contexts, very different from Canada, as well as unconsidered disciplinary contexts.

Despite these limitations and delimitations, the use of a multidisciplinary mixed-methods approach that generated data from 500 surveys and 30 interviews with good representation across gender, levels of innovator, and disciplinary contexts suggest the trustworthiness of
findings. The inclusion of innovators from many faiths and cultural groups provided a diverse pool of perspectives for this study to consider. Additionally, the use of rigour-building methodological practices including member checking of interviewee responses yielding unanimous interviewee agreement with the aggregated thematic findings, and the use of stricter confidence intervals in the statistical analyses of the survey responses (99% instead of 95%) contributed to the trustworthiness of this study.

**Future Research**

Additional study of the efficacy of various informal and formal educational contexts would help discover the specific factors (e.g., developed safe spaces, innovation cultures, stability, and “offbeat” contexts) that facilitate the development of innovators and help replicate their successes, potentially leveraging more innovation from aspirants. Specifically, a future study could corroborate the self-report responses of participants with classroom observations. Although study designs that yield calculable response rates introduce the potential for selection bias, the response rate is a necessary tool for answering concerns about generalizability. Given that the task values findings of this study implicate overemphasis on evaluation for grades as stymieing innovation, research evaluating the formative assessment alternatives to assigning grades on aspirant capacity to innovate would be valuable. As a natural extension of this study, a future comparative case study could examine the qualities of various exemplary formal learning environments to evaluate the mechanisms by which they promote innovation. In a similar vein, experimental research is needed to ascertain the optimal methods for debriefing failure among innovators as an educational opportunity as well as the optimal way to evaluate innovation to promote growth.
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Chapter 7

Synthesis

This practitioner-oriented chapter synthesizes the findings reported in the previous chapters. My research reported in this dissertation sought to identify the factors that support innovation among Canadian innovators, with the ultimate goal of informing the design of learning environments that support innovation education. Three questions guided the research:

1. What are the expectancies, values, and costs of innovating as identified by Canadian innovators?
2. How do Canadian innovators balance the costs of innovating so that they can see innovation projects through to completion?
3. How do Canadian innovators perceive education can help students balance the expectancies, values, and costs of innovating?
Figure 6. The flow of data across my research

The Need for My Research

As first explained in my introductory chapter, education systems, formal and informal, are increasingly tasked by society with providing a critical thinking citizenry capable of confronting new challenges. Indeed, recent policy documents in Canada refer to the importance of innovation to our way of life with particular reference to how innovation is central to our knowledge economy (Council of Ministers of Education Canada (CMEC), 2019; Ontario Ministry of Education, 2014; OECD, 2017). Innovation scholarship paints a similar picture with some authors going so far as to argue that optimally supporting innovation will soon become a decisive factor in maintaining our very way of life (Catmull & Wallace, 2014; Council of Ministers of Education Canada (CMEC), 2019; Cramond & Fairweather, 2013; Emo, 2015; Jones, 2009). To this end, my research examined how to make innovation more likely by investigating the motivation dynamics of innovators. Leveraging this understanding has the potential to inform innovation education.
The literature review rationalizing this research illustrates there are profound gaps in the innovation literature in terms of interdisciplinary studies of innovation promotion, non-business studies of innovation promotion, and studies of innovation promotion within non-organizational contexts (Chapter 2, this dissertation). Deficits were especially notable in terms of the instrumentation available to assess and measure the motivation of innovators, as was also found in Soleas (2018a). Chapter 2 further elucidated that even though some studies did focus on innovators, they ignored examining individuals’ motivation in favour of measuring outcomes such as patents or profits (e.g., Bessonova & Gonchar, 2017; Wang, 2018). It is clear from the literature review that the measurement of innovation has been dominated by business thinking, vastly overshadowing the contributions of other disciplines that are also stakeholders in innovation. In order to identify motivating factors that could promote innovation in schools across disciplines, a new instrument was required.

Accordingly, in Chapter 3, I developed the Motivation to Innovate inventory (MTI) to assess the motivation factors experienced by innovators of various disciplinary backgrounds and gender expressions. The array of identified factors impacting the motivation to innovate were not only promotive; many were also hindering factors. My research required a flexible theoretical framework designed to consider both positive and negative valences of motivation: Expectancy-Value-Cost Theory (Barron & Hulleman, 2015; Flake et al., 2015).

As described in Chapter 3, the MTI (available in Appendix D) was developed and validated with international and Canadian samples of innovators. No significant differences in motivation constructs were found between these two interdisciplinary samples. Additionally, the exploratory and confirmatory psychometric properties of the instrument were all found to be better than the acceptable values established by Kline (2016) and Schreiber, Stage, King, Nora,
and Barlow (2006). The instrument validation reported in Chapter 3 found that the MTI instrument is psychometrically sound with a multidisciplinary, inclusion-oriented sample and holistically considers both promotive and hindering factors. The holistic approach of developing this instrument enabled my research to explore how to make innovation more likely by identifying the nature of different supports and barriers to innovating, as recommended by Chaiechi (2014), Manso (2017) and Soleas (2018).

Data collected with the MTI, supplemented with qualitative data, were analyzed and reported in Chapters 4, 5, and 6, addressing the extent and dynamics of the different motivational factors that innovators experience (Chapter 4), the strategies they use to mitigate the costs of their innovating (Chapter 5), and the motivational factors they experienced in schools that could help future innovators (Chapter 6). The following synthesis integrates the findings of my research from across all the manuscripts and distils them by motivation construct to illustrate the novel findings, their connections to literature, and how these findings are translatable to the promotion of innovation by decision-makers, especially teachers.

**Synthesis of Innovator Self-Concept Findings**

Across my research, innovator self-concept (the extent to which participants believed themselves to be innovators) did not differ between survey respondent groups by exceptionality, minority status, age group, parental level of education, gender, or discipline. However, innovator self-concept did differ based on education; individuals with graduate degrees reported the highest aggregate innovator self-concept (belief in self as innovator). Additionally, higher-level innovators (the level at which participants’ innovating was categorized in relation to the
Mini-I, Little-I, Pro-I, Big-I continuum)² reported a higher innovator self-concept than their peers categorized as lower-level innovators (Mini-I or Little-I). This difference lends support to the notion that academic credentials and achievement increase the extent to which a person self-conceptualizes as an innovator.

**Synthesis of Expectancy Findings**

In relation to expectancies (self-efficacy, confidence, and belief in one’s capacity to successfully innovate), there were no significant differences by reported exceptionality, minority status, age, parental level of education, or gender across my research. However, expectancies were found to behave differently than innovator self-concept; expectancy metrics among innovators differed by discipline, whereas innovator self-concept metrics did not. The disciplinary distinction hints that innovation confidence is accumulated differently in different areas of endeavour in a way that innovator self-concept is not.

Expectancies differed significantly between areas of endeavour in the aggregate, with arts and humanities innovators reporting the highest expectancies, followed by business, scholastics and education, social services, and lastly, science. Expectancies also differed by level of education and by the level of innovator; innovators with more education and those rated higher

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² As adapted from Kaufman and Beghetto's (2009) continuum of creativity, Mini-I innovation is preliminary-level innovation, Little-I is personally notable innovation, Pro-I is professional innovation, and Big-I is broadly recognized innovation
on the innovator level continuum (meaning their innovating had a more substantial impact) reported the highest confidence when innovating. Findings consistently corroborated these differences throughout my research; increased education and training were found consistently to predict higher expectancies. I explored these quantitative differences further through interviews, collecting and analyzing the experiences of innovators in order to provide narrative insight into the learning environments and experiences that built their confidence, and the particular supports from others that built their confidence to innovate.

Learning Environment

In describing their experiences of developing as innovators, 100% of interviewees (219 quotations) and 87% of survey respondents (458 quotations) credited formal and informal learning environments as a key source of confidence. Innovators described learning environments that required them to interact with colleagues as a catalyst for idea development and capacity. Learning environments have been a topic of interest in innovation promotion literature, (e.g., Jonsdottir & Macdonald, 2013; Koloniari, Vraimaki, & Fassoulis, 2018), however, my research showed that it was not just working with different peers, but having to work with them in different types of learning environments that spurred different types of ideas. From these interactions, they gained valuable skills and confidence that made them more likely to be successful and have innovation aspirations in the future. It was not only the people present in learning environments that innovators credited but also the types of learning spaces that they encountered that contributed to their future capability to innovate. A single, rich learning environment has been recognized as spurring ideas (Montani et al., 2014), but innovators in my sample reported that it was access to multiple, different learning environments, especially non-
traditional classroom learning structures, that helped them develop the skills and confidence to innovate.

Many innovators credited unorthodox formal and informal learning contexts as sparking thinking that would likely not have occurred without the “shake-up” that these places provided. Examples of these environments included innovation-supportive contexts like studio models, debates, robotics competitions, and seminar-style facilitations. Innovators reported that these contexts facilitated new ideas, enabled different perspectives, and helped “prime the pump” for future innovative behaviour because they were so different from typical learning structures. These findings from Chapters 4 and 5 suggest that educators should prioritize opportunities to have students work in groups on idea development projects as well as integrating the use of non-traditional classroom learning structures into their practice.

As shown in Chapters 4, 5, and 6, innovators benefited from learning environments where mistakes could happen without severe consequences. The findings of my research indicate that teachers can support developing innovators by helping them identify and take intelligent risks in a safe environment, thus nurturing this crucial capacity that is demonstrated by innovators. Teachers can resolve not to punish mistakes, but rather outline methods for making more effective choices in the future, thus treating mistakes and errors as learning opportunities. Similarly, teachers can evaluate aspiring innovators’ chosen alternative approaches to accomplish a goal as alternative options instead of immediately considering them as errors or mistakes.

In a similar vein, innovators described some formal and informal spaces as having a culture of innovation, as also posited by Gonzalez and de Melo (2018). Innovation cultures were built by enshrining the feeling of safety to take risks that would not be punished as well as
frequent, planned, opportunities to engage in the debate and translation of ideas. Innovators described this culture as teachers providing stable access to resources, spaces and opportunities and the integration of off-beat ideas into the learning life of classrooms. The opportunity to take risks with relative safety while learning was a key component of innovation-supportive learning environments that educators could replicate in their classrooms.

**Past innovating experiences facilitating future actions**

In describing their past innovating efforts, 100% of interviewees (165 quotes) and 79% of survey respondents (417 quotes) characterized their lived experiences in accomplishing early innovating goals as foundational catalysts for present innovator confidence. Innovators credited these kinds of early experiences as building the case for intelligent risk-taking, which helped them learn which risks they should take to maximize their opportunities. My findings in Chapters 4, 5, and 6 suggest that teachers can provide these early experiences through open-ended, problem-driven tasks in their classrooms as a method of proactively building the confidence of aspirants while they are students.

The idea that needs supportiveness is conducive to innovation is well-represented in the literature (Amabile, 1997; Chaiechi, 2014; Fischer et al., 2019). However, the safety they felt to make mistakes and learn from them was credited by innovators as contributing to their future ability to take intelligent risks, constituting a novel finding for the field. The finding that early opportunities to mobilize ideas led to more competent attempts later on has been found elsewhere (e.g., Shavinina, 2013). However, my research nuances this understanding by suggesting that these early opportunities taught innovators how to cautiously test boundaries to find the right balance between stability and safety versus edginess and advancing thinking. Innovators advised aspirants to stay disciplined in regulating their process in pursuit of their
goals, explaining that chasing every idea was a recipe for stretching oneself too thin. Therefore, teachers need to teach students how to evaluate ideas and then make informed decisions on how many and which they should pursue simultaneously. Teachers can make innovation (and other desirable skills) more likely by explicitly teaching students time management, prioritization, and how to approach problems deliberatively.

Innovators positioned these transferable skills as supplementary to the direct teaching of innovation knowledge in education. Innovators reported that formal education was effective in providing content-specific knowledge, but a curriculum integrating creative and problem-solving processes, design thinking, and idea refinement was typically missing. Innovators credited these infrequent moments as especially helpful to their development but found them only inserted sporadically into their learning. This would suggest that teachers have the opportunity to maximize student skills in these innovation-aligned processes by having problem-solving, design thinking, and idea refinement consistently and explicitly embedded in the assignments and class tasks that students would ordinarily complete in their learning.

**Supported and inspired by others**

In describing their experiences of developing as innovators, 100% of interviewees (232 quotes) and 83.8% of survey respondents (425 quotes) reported the support and inspiration of others as foundational to their innovating confidence. Developing innovators credited their family members, peers, and mentors—especially teachers—as building their confidence. Innovators reported that when their teachers modelled aspects of the innovating process that it humanized the process—making it seem achievable and within their ability to achieve. As well, teachers can model diverse approaches to innovation by describing and demonstrating their own
processes, by bringing in guest speakers, by using case studies, and by highlighting the successful work processes of other students.

Whereas past literature has explored the value of like-minded peers as a support network (e.g., Bastian, Jetten, Thai, & Steffens, 2018; Curado, Muñoz-Pascual, & Galende, 2018), this research shows that skeptical colleagues also have a role in stoking innovation, by challenging ideas and necessitating reflection that hones ideas. Relationship-building was characterized as an active process; learners had to take responsibility for building their own support networks. Like-minded and skeptical peers both played a role in support networks. Aspiring innovators benefitted from like-minded peers enthusiastically supporting the work, but also from skeptics challenging ideas and providing feedback to spur idea development and refinement. Education has the opportunity and means to help aspirants build habits of collaboration and network-building skills that will help them succeed in pursuing their ideas. As a first step, innovators reported growing accustomed to working with others who have different perspectives or approaches to their own. This allows innovation learners to gain an appreciation for differences and crucial respect for perspectives other than their own. Teachers could facilitate this by encouraging or even requiring that student innovators work with students with different backgrounds and who approach problems differently.

**Synthesis of Values**

Across my research, quotations that addressed values were found less frequently than those that addressed expectancies. Previous literature on innovation tended to be highly focused on the utility-related values of innovating such as the monetary rewards, market share and patents (Cordero et al., 2005; Ederer & Manso, 2013; Manso, 2017). However, my research showed that innovators tended to hold a mosaic of values dominated by intrinsic and attainment
values rather than being driven primarily by one value sub-type. In general, the pattern tended to be that innovators reported intrinsic values as the most motivating, followed by attainment values and then utility values. This pattern held across disciplinary contexts, reported age, education level, parental level of education, exceptionality status, minority status, gender, and level of innovator. Participants tended to see value in innovating for more than one reason, suggesting that a singular, rewards-driven model would be less effective in innovation education than a more flexible multi-valued approach.

Innovators consistently described two groupings of positive impacts that schooling could have: 1) fostering innovation’s intrinsic task-value for learners (e.g., interest, curiosity, enjoyment); and 2) boosting attainment task-values (e.g., fulfilment, identity, importance). The third subgroup of task values, utility values (e.g., direct, or indirect rewards), were not reported to be particularly motivating or impactful in participants’ experiences of learning to innovate.

**Intrinsic Task Value**

Innovators reported finding multiple intrinsic task values—the perceived pleasure, interest, or satisfaction derived from an activity—in their endeavours. There were no significant differences in intrinsic task values among innovators by reported exceptionality, minority status, age, level of education, parental level of education, or gender. Intrinsic task values differed only by level of innovator (higher levels of innovators reported higher intrinsic task values) and by discipline (business sector respondents reported the highest intrinsic task value, followed by the arts and humanities, education, sciences, and lastly, social services). Innovators tended to find innovating generally interesting but were specifically driven by the thrill of the process, including mobilizing ideas, solving puzzles, and combining elements in new ways. The intrinsic task values explored in my research manifested in two broad categories: namely as innovation
satisfying a compulsion or the interest generated from aspiring innovators being able to engage in a task they are passionate about more deeply.

**Satisfying a compulsion.** In describing their perceived values of innovating, 73.33% of interviewees (91 quotes) and 63.3% of survey respondents (337 quotes) described the value of innovating as satisfying a compulsion. When describing their schooling, innovators described as learning opportunities in which they could pursue their own ideas as especially engaging. For example, aspiring innovators being able to choose their topic on assignments (e.g., a biology enthusiast allowed to write about their clean water initiative for a social justice essay). Given the responses of innovators, a crucial component of supporting innovation development within formal education is for teachers to nurture students’ intrinsic curiosity. Similarly, innovators described curiosity-supportive environments in schools as ones that encouraged students to try new ideas, held an expectation of creative and analytical outputs in assignments, and ensured that opportunities to apply advanced skills took place within a structured environment. Teachers can plan to use these curiosity-supportive environments to promote student innovation.

**Student engagement and interest.** In describing their experiences developing as innovators, 100% of interviewees (245 quotes) and 96.4% of survey respondents (1261 quotes) referenced enjoyment of innovating, specifically identifying the enjoyment as resulting from bringing an idea to fruition, confronting challenges, and combining elements. Innovators credited teachers who encouraged students to pursue and implement their novel ideas. Teachers could adapt their assignments to provide students with a chance to mobilize their ideas. These educators helped make school and the process of innovating more interesting by allowing innovators to bring their ideas to fruition, thereby helping to maintain the motivation that would lead to the young innovators’ later career successes. Innovators also described their enjoyment
of confronting challenges. As described by innovators, teachers in both elementary and secondary school contexts could make their activities engaging by providing students opportunities to apply their skills and to be challenged enough that the projects were immersive.

Participants extended this to include the gratifying experience of combining elements into a new creation. Innovators especially enjoyed bringing previously divergent ideas together in one project. Educators could play into this powerful motivator by providing students with the opportunity to synthesize and integrate concepts from multiple classes towards the end of terms, strands, or units, thus building connections between learning areas.

**Attainment Task Value**

Compared to intrinsic task values, attainment task values appeared in fewer of the interviews and surveys, but still quite commonly. Attainment task values (i.e., the perceived importance of a task or the identity fulfillment and pride experienced from completing a task) did not differ by reported exceptionality or minority status, age, level of education, parental level of education or gender. These values differed only by level of innovator—with higher levels of innovators reporting higher attainment value—and by discipline, with arts and humanities sector respondents reporting the highest attainment value, followed by business, education, science, and lastly, social services. Although innovation was frequently found to be motivating because it was interesting, a similarly powerful class of motivators were the attainment task value motivators, which included the fulfillment of identity and the perceived importance of innovating—as in the pursuit of social justice and other dimensions of making the world better.

**Innovation fuels identity and autonomy.** In describing their experiences of developing as innovators, 83.3% of interviewees (130 quotes) and 92.6% of survey respondents (496 quotes) referenced the fuelling of their identity and autonomy in their endeavours as benefits of
innovating. Findings suggest educators could make learners’ innovation efforts more fulfilling through providing students with the freedom and means to autonomously pursue their ideas. Promoting autonomy was portrayed as a tool for building attainment value and thus recruiting engagement in early innovating, but also developing independent thinking skills that would later support innovating endeavours. Teachers could invest their energy into designing classrooms and unit planning that affords the independent study opportunities that promote these fulfilling experiences.

**Making a difference and perceived importance.** In describing their experiences developing as innovators, 60% of interviewees (69 quotes) and 60.4% of survey respondents (338 quotes) reported feeling an intense fulfilment when making a difference as a result of their innovating. Similarly, 80% of interviewees (116 quotes) and 63.8% of survey respondents (375 quotes) recognized the importance of innovation as being necessary for societal progress and challenging status quos. These two entangled motivators were found relatively commonly, but not universally. These findings suggest that teachers can build the value of innovating by highlighting the potential positive impact of the innovations and providing opportunities in school to wrestle with real-world issues. These approaches could build up the perceived importance of future innovating. Schooling can boost the perceived importance (attainment value) of innovating by making very clear the connection and impact innovating can have on students’ lives and broader society.

**Utility Task Value**

Utility task values, the most external of values (i.e., perceived usefulness or the possibility of obtaining material rewards for completing the task), the most previously studied task value, did not differ by reported exceptionality, minority status, age, level of education,
parental level of education, or gender. These values differed only by level of innovator, favouring higher innovators and by discipline, with arts and humanities participants reporting the highest utility, followed by business, scholastics, and education, applied, health, and basic science and lastly social services participants. Utility value quotations tended to appear less frequently than those addressing either intrinsic or attainment values.

**What does innovating get me?** In describing their experiences of developing as innovators, 56.7% of interviewees (38 quotes) and 62.2% of survey respondents (331 quotes) reported direct rewards (money, material prizes and awards) as motivators. They also described indirect benefits (health benefits, recognition), 46.7% of interviewees (32 quotes) and 61.6% of survey respondents (325 quotes) as motivators. Lastly, 43.3% of interviewees (41 quotes) and 67.8% of survey respondents (367 quotes) described how they valued innovation because it helped in their job. A smaller proportion of innovators recognized utility task value as more motivating than internal motivators like interest, importance, or personal fulfilment. Moreover, utility values were exceedingly rare among respondents as being principal drivers for innovating, although they did frequently occur as supporting considerations, corroborated by utilitarian values being peripheral considerations when mentioned in the interviews.

External rewards tended to behave as cost mitigation factors rather than motivators, as they did not seem to drive motivation significantly on their own but rather only mattered in their absence. As a complementary means of maximizing the value of innovating, innovators counselled aspirants to holistically consider if their innovation is going to return an investment (usefulness) that makes the endeavour worthwhile. In the same vein, innovators did not report that schooling played a particular role in enhancing the utility value of innovation, positioning utility value as outside the purview of schooling. Innovators in the interdisciplinary sample for
all three studies placed tertiary emphasis on the motivation induced by the prospect of monetary
gain or other more externally regulated motivators, which could hint at the overstatement of
influence that financial factors and external, extrinsic motivators could have on stoking
innovation.

**Synthesis of Costs**

As explored in Chapter 2 in detail, and given the primacy of business-aligned literature in
innovation (Carr et al., 2016; Norris, 2011; S. Roth, Schneckenberg, & Tsai, 2015; Soleas,
2018b), it is unsurprising that innovator perceived costs, beyond the financial considerations,
have been understudied as a factor in the motivation to innovate of an individual. Whereas it
might be obvious to work swiftly to increase the confidence and illustrate the values that might
be obtained from the act of innovating, the mitigation of the perceived costs has received far less
attention from decision-makers and academics alike. The mitigation of these costs, as seen by
innovators, constitutes a relatively untapped avenue for making innovation more likely, in
comparison to the previously explored and exploited avenues focussing on maximizing
expectancies and values. In my view, this made the cost mitigation findings among the most
interesting and useful for educators and other decision-makers who wish to make innovating
more likely for all kinds of learners.

Across my research, perceived costs (i.e., the drawbacks, consequences, or risks of
innovating) did not differ between groups by parental education, gender, or level of education.
Costs were found to differ based on level of innovator, with higher levels of innovators
consistently reporting lower costs than their lower-level peers. Perceived costs also varied based
on disciplinary subjects, with business respondents reporting the highest costs, followed by
applied, health, and basic science, social services, arts and humanities, and scholastics and academia reporting the lowest perceived costs.

Additionally, innovation’s costs were felt more by visible minorities and those who reported an exceptionality, despite having similar levels of expectancies and values as individuals who did not identify as having an exceptionality or being visible minorities. These findings suggest that the costs of innovation could disproportionately impact the drive to innovate of marginalized individuals as alluded to by Nager, Hart, Ezell, and Atkinson (2016). As equity-seeking groups have similar levels of expectancies and task values as their non-marginalized peers, mitigation of the disproportionately perceived costs could address the social disparity of motivation dynamics.

Participants identified a variety of perceived costs of innovating, including losing out on alternatives (investing time pursuing this opportunity, precludes being able to capitalize on another opportunity), additional efforts and exertions, risks when rocking the boat, significant financial costs, and fear of both failure and success. These described costs were consistent across areas of endeavour, age, and life histories, indicating that promotional and educational efforts should consider the potential universality of the need to mitigate these costs. The findings of this study point to the mitigation of the costs of innovating as being every bit as productive (and in many circumstances more important than), as the maximizing of expectancies and values in aspiring innovators for the promotion of innovation skill development. Innovators from both samples offered various means to mitigate these potential costs, including: (a) knowing what you are getting into; and (b) recognizing and being willing to make the hard choices. Innovators isolated specific educational methods of mitigating the costs of innovating in the classroom, including a focus on developing processes and debriefing failure. It is notable that surveyed and
interviewed innovators did not frequently report costs associated with innovating in informal education contexts.

**Loss of Alternatives and Additional Efforts**

In describing their experiences of developing as innovators, 96.67% of interviewees (122 quotes) and 85.6% of survey respondents (440 quotes) reported perceiving a loss of alternative options they could have pursued instead. Similarly, 93.33% of interviewees (107 quotes) and 87.4% of survey respondents (473 quotes) expressed perceiving additional efforts and exertions of innovating. Innovators were very aware that innovating could inflict short term pain for long term gain. Indeed, a common thread throughout my research was the comfort and assurance from innovators knowing what they were getting into when innovating. Similarly, innovators counselled aspirants to be open to making hard choices; for example, balancing a willingness to persist in difficulty versus dispassionately letting go of an idea. Teachers can help aspiring innovators persist in difficulty by pre-briefing and de-briefing students before and after they engage in an innovation activity to help them better prepare themselves mentally for their next challenge. Teachers can step-by-step teach and model the savvy navigation of these choices as a way to conserve creative energy and address the risk aversion highlighted first by Manimala, Jose, and Thomas (2006), Pihie (2007), and Shane, Locke, and Collins, (2003).

**Fear of Failure and Success**

Similarly, innovation was found to inspire a fear of failure, but also of success. Across my research, 76.67% of interviewees (54 quotes) and 82.2% of survey respondents (494 quotes) reported fearing the potential outcomes of their innovating. Innovators credited learning about how to confront failure in their formal and informal education as key to their resilience, helping them cope with the inevitable setbacks of innovating. Teachers can facilitate this learning by
articulating their thinking and explicit modelling. They can demonstrate how innovators are able to persist in innovative endeavours by proactively mitigating costs and anticipating the setbacks that they might encounter. Respondents pointed to a need for informal and formal education to not shy away from having students experience failure, but rather to focus on making it a constructive learning opportunity that enables them to be resilient when it occurs.

In these environments, innovators credited the cost-mitigating efforts of teachers as crucial to their continued engagement in innovating. Interviewees tended to advocate for not directly evaluating creativity at all, but rather focusing on developing the process instead of the immediate outcome. Formal and informal education systems can, therefore, manage the costs of learning to innovate by focusing on developing the process rather than evaluating outcomes, thereby making learning to innovate less risky. Teachers can also avoid the pitfalls that stifle innovation, such as an overemphasis on compliance and outcomes.

**Formal and Informal Education**

Across my research, it became clear that innovators differentiated formal and informal education but had clear ideas for the roles of both. Innovators reported that formal education has a role in stoking innovation, particularly in building confidence, teaching innovation processes, and the transmission of key foundational disciplinary knowledge. My research suggests that teachers can provide learners with the opportunities to practice skills in a safe environment, model the behaviours that underpin innovation, and also teach the specific disciplinary skills in their chosen discipline. Almost all interviewees and a majority of survey respondents echoed the need for formal training or education to build the foundation of skills, perspectives, and capacity that makes the breakthroughs in informal education possible. However, participants criticized
many aspects of their formal schooling as actively stifling innovation, citing the need for compliance to avoid punishment.

My research pointed to the importance of informal education, which innovators credited to a much larger extent than formal education for their success. This represents a valuable contribution to the literature at large as it challenges a common focus on formal training, education, and credentials (e.g., Ghosh & Rajaram, 2015; Noonan, 2013; Pihie, 2007; Shavinina, 2013), having left the innovation learning that takes place in informal settings somewhat understudied. In my research, informal education, by comparison, was unanimously portrayed as a source of opportunities to develop innovation. In informal education, students tended to participate by choice and were not punished for exploring their ideas. Although potentially outside the scope of teachers in school, informal education’s effects on promoting innovation can be fostered through the recommendations and encouragement of teachers. Teachers can encourage their students to participate in extracurricular activities and to join positive interest groups that enable opportunities to innovate.

Trustworthiness and Strengths

My research integrated two systematic literature reviews on approaches and environments conducive to innovation; thirty interdisciplinary consultations across think-alouds, focus groups, and content experts; and data collection from Canadian innovators involving thirty interviews and 500 survey responses. The connection of my work to the innovation promotion literature, in particular, the literature on promoting creativity and innovation in the organizational and individual context lends credibility to the transfer of the strategies and thematic findings of my work to inform action in these contexts. As a first step, this research rigorously developed an instrument that utilized an Expectancy-Value-Cost conceptualization of the motivations to
innovate, which accounted for both promotive and hindering factors. Understanding both promotive and hindering factors enabled the recommendation of strategies that educators can use in a two-pronged approach to support innovation development. The balanced consideration of motivating and de-motivating factors has strong potential to be helpful to those who seek to make innovation more likely. The survey research revealed that respondents at the Pro-I and Big-I level tended to report higher innovator self-concept, expectancies, and intrinsic-, attainment-, and utility-task values, while also reporting lower costs than their peers at the Mini-I or Little-I level. These promotive and mitigating strategies are useful guides for teachers and others who seek to support innovators (e.g., leaders in professional and business contexts) and of course, for innovators themselves.

Additionally, the use of qualitative and quantitative methods integrated to comprehensively answer the research questions adds to the trustworthiness of the study. The foundation of a systematic review was key to situating the study for the successful pursuit of an understudied area in innovation and innovation promotion literature. The instrument was rigorously developed using appropriate and replicable methodologies commonly utilized in the field and then iteratively improved by cycles of consultations with experts. The samples of survey responses gathered were found to meet the necessary statistical assumptions for the analyses performed and the interviews were ample for the thematic analyses that yielded the themes and subthemes that led to my research’s conclusions.

**Limitations and Future Directions**

This research had limitations stemming from the qualitative methods used. First, one researcher did all the coding and thematic analyses leading to an establishment of a codebook. Sections were also coded by a critical colleague to check for intercoder reliability, but not all.
Although there were no differences between the themes identified, this did introduce the potential for the findings being interpreted with a skew towards the worldview of one researcher. These generated themes were critically reviewed by the dissertation committee for trustworthiness and logic. Invitations to interviewees were done on a stratified, but purposeful selection to gain fair representation from different disciplines. This could introduce a self-selection bias as I chose who was invited to participate in the interview.

The choice to purposefully recruit interviewees from a range of disciplines rather than by a first-come-first-served basis introduced a degree of non-randomness to the interview sample which must be considered a delimitation in the study. This is the case as well with the choice to evaluate innovators based upon their achievement to create an innovator level construct. My choice to use Expectancy-Value-Cost constructs as the primary themes in the dissertation, although a helpful organizer of the findings, naturally steered the analyses in their direction and must, therefore, be considered a delimitation.

This research had three main limitations emerging from the quantitative data. As with many motivation studies, this research relied on self-assessment and self-reported data as proxies to investigate a latent construct: the motivation to innovate. Future research could benefit from corroborating these self-report data with observations in context. Although identical factor structures were found in the international and Canadian samples with very good internal consistency, factor loadings and fit indices, it is essential to recognize that the survey instrument is a functional work-in-progress. Researchers deploying it in different contexts will help provide further evidence of its psychometric properties and potential validity in an increasing number of contexts.
Although my research illustrates many perceived strategies for making innovation more likely through building expectancies and values and mitigating costs, the findings are based on participant reporting and not verified through direct observation. This opens up the possibility of a desirability bias, however, the responses were anonymous in the survey which would diminish this possibility in the quantitative data. Lastly, although yielding a large and diverse sample, recruitment through social media precluded the ability to calculate a survey response rate and definitively determine the representativeness of the survey sample, in particular, the quantitative data. Therefore, the findings of this study should be generalized judiciously with the knowledge that the sample was self-reporting and not situated in any one disciplinary context.

Future Research

This research has revealed distinct avenues for future research ranging from the aforementioned further instrument validation, corroboration with classroom observations, and specific study of identified strategies for innovation promotion. These findings build on understandings first made in the innovation education and innovation management literatures.

**Cost mitigation as a program of study.** Among the most novel contributions of this research are the revelations about the understudied perceived holistic costs of innovating and how these barriers can be addressed to make innovation more likely. More studies are needed about the costs identified by innovators, as well as the factors that mitigate the costs of innovating. Intervention studies that utilize a pre-post design could be especially useful in evaluating several of the identified cost mitigating strategies deployed by innovators as well as cost-reducing factors of environments. The finding that innovators who reported having exceptionalities or being visible minorities perceived higher costs of innovating demands more
study to identify the specific mechanisms and what interventions could alleviate this social injustice.

**Potential intervention studies in educational settings.** Future research should evaluate the elucidated strategies identified by innovators through interventions in educational settings to demonstrate their potential efficacy in increasing expectancies and values of aspiring innovators or in mitigating costs. Additional study of the efficacy of various informal and formal educational contexts would help discover the specific factors (e.g., developed safe spaces, innovation cultures, stability, and “off-beat” contexts) that facilitate the development of innovators and help replicate their successes, potentially leveraging more innovation from aspirants.

As a natural extension of this research, a future comparative case study could examine the qualities of various exemplary formal learning environments to evaluate the mechanisms by which they promote innovation. In a similar vein, experimental research is needed to ascertain the optimal methods for debriefing failure among innovators as an educational opportunity as well as the optimal way to evaluate innovation to promote growth. Collaboration was found to increase expectancies (e.g., confidence and efficacy) and values (e.g., enjoyable partnerships and identity building), as well as mitigate perceived costs (e.g., increased perception of safety). A quasi-experimental comparison of the innovator perceptions of costs between independent work conditions and groups configured in a variety of collaborative structures would illustrate the extent to which collaborations help promote innovation behaviours.

The findings of this research highlight the reported positive innovation capacity impact of letting students select their assignments based on interest and fulfilment and how this allowance resulted in higher engagement in projects as well as building an appetite for later innovation. An
experimental design would be useful for teachers and decision-makers as they make choices about what strategies to use in their efforts to nurture and support innovation and young innovators. It would also be illuminating to examine whether these strategies work across cultural groups and learning contexts as they do across disciplines. Given that the task values findings of this study implicate overemphasis on evaluation for grades as stymieing innovation, research evaluating the formative assessment alternatives to evaluating for grades on the aspirant capacity to innovate would be informative.

Conclusion

Innovators’ perceptions of the costs of innovating and corresponding countermeasures used to mitigate such costs naturally fit within the EVC framework (Barron & Hulleman, 2015). This study is among the first to ask innovators what they identify as the costs of innovating and how they have overcome them. This research contributes to the literature on motivating innovation as it was among the first research to (a) consider both promotive and hindering factors as a means of giving a more thorough picture of the dynamics at play in supporting innovation, (b) be fuelled by rigorously developed interview and survey protocols made freely available under creative commons usage, (c) integrate narrative insight from innovators themselves, and (d) be interdisciplinary in participant scope providing insights that sometimes challenged and extended the established innovation promotion literature. In my view, my research connects findings of past innovation promotion efforts across disciplines and creates a rationale for adapting strategies from many and sometimes unexpected contexts.

The findings of this research point to an underrepresentation of the impact of expectancies and costs in the innovation literature coupled with a corresponding literature overemphasis on reward-derived value. They also illustrate a need for a conversation about
interdisciplinary innovation, which would ameliorate the clustering of the existing literature that currently exists in disciplines as also found by Nager et al. (2016) and Soleas (2018b). My research’s holistic view of motivation to innovate at the individual level enables a more thorough consideration of the countermeasures successful innovators can use to balance the costs of innovation. These behaviours direct attention to approaches that decision-makers should integrate into programs designed to promote innovation across disciplines and learning contexts. Although studies have highlighted the role of rewards in supporting innovation, there is a dearth of data about interest, fulfilment, and particularly cost, given that this research vividly shows their importance among respondents and interviewees, particularly during their school-age years. The truly effective supports should prompt teachers to encourage aspiring innovators to pursue things that they are passionate about, which typically are at least partially controllable by leaders and teachers, while the factors which can be controlled mostly relate to mitigating costs (Manso, 2017; Soleas, 2018b). These efforts could be made during the education of aspiring innovators, with special consideration given to providing the necessary early opportunities to build attainment and intrinsic task values and by encouraging the pursuit of fulfilling and individually and communally exciting endeavours in schools.

If leaders and teachers are truly interested in making innovating more likely, they should first look to mitigate the perceived costs of aspirants in their innovating. This cost mitigation could begin in schools to stoke the motivation earlier than entry into the workforce. Of note, innovators of all disciplines, ages, and genders reported that stability and safety made innovation more likely, as identified by Chaiechi (2014) and Soleas (2018b). The importance of stability and safety flies in the face of the societal zeitgeist, which has in the past gravitated to the notion that disruption, genius, and necessity are significant drivers of innovation (e.g., Bendell & Thomas,
Collaboration, a safe learning environment that can be created in schools, as well as opportunities to pursue interests and fulfilment are needs-supportive elements of a safe, stable environment that participants and the literature report as making innovation more likely, which could include assignment choice and needs-supportive teaching that builds student autonomy, competence, and relatedness (e.g., Ryan & Deci, 2017). The creation of such environments should be a high priority of educational efforts to stoke innovation across contexts.

My research points to an opportunity to better allocate resources towards innovation promotion efforts that have, in the past, overemphasized the notion of prodigies, with too much emphasis on economic considerations and not nearly enough emphasis on leveraging the capacity of potential innovators. This research provides empirical evidence for a wider, more inclusive, and representative view of innovation by investigating the motivations of all innovators rather than focussing on prodigies or those who become famous for their innovating achievement. The findings of my research support the idea that when the expectancies and values are increased, and the perceived costs of innovating are mitigated then innovation would naturally be made more likely for many people. By asking innovators from a variety of fields about their motivations, my research provides a snapshot of the factors at play for an interdisciplinary sample of innovators and a novel contribution to the field that shines a light on fulfilling the promise of innovation education to help aspirants rise to the challenges and opportunities that face humanity.

References


Ghosh, N. B., & Rajaram, G. (2015). Developing Emotional Intelligence for Entrepreneurs: The Role of Entrepreneurship Development Programs [dagger]. *South Asian Journal of Management, 22*(4), 85. Retrieved from http://uwo.summon.serialssolutions.com/2.0.0/link/0/eLvHCXMwY2AwNtIz0EUrE8xNjRKBSSkFVEebGYFO_bY0TAOd5W6SlAbqn6GdmQS7whUa27BCElxyp-QngwbN9Q3NzY3B56Mb2hcU6oKukQJnt8Lu1EiE3rWQAszShqBN6KyGZumboJxrHh4JK6qBmQu8Vw50jpKuqYmRBUaBDC5U3QQYGmB7daDrrmFnOMF6sK1VBYmJIRm


Appendix A - Research Ethics Board Approval

January 31, 2018

Mr. Eleftherios Soleas
Ph.D. Candidate
Faculty of Education
Queen’s University
Duncan McArthur Hall
511 Union Street West
Kingston, ON, K7M 5R7

GREB Ref #: GEDUC-885-18; TRAQ # 6022733
Title: “GEDUC-885-18 Promoting Student Innovating: Examining the Motivations that Help Overcome the Perceived Costs of Innovating”

Dear Mr. Soleas:

The General Research Ethics Board (GREB), by means of a delegated board review, has cleared your proposal entitled “GEDUC-885-18 Promoting Student Innovating: Examining the Motivations that Help Overcome the Perceived Costs of Innovating” for ethical compliance with the Tri-Council Guidelines (TCPS 2 (2014)) and Queen’s ethics policies. In accordance with the Tri-Council Guidelines (Article 6.14) and Standard Operating Procedures (405.001), your project has been cleared for one year. You are reminded of your obligation to submit an annual renewal form prior to the annual renewal due date (access this form at http://www.queensu.ca/trac/simon.html; click on “Events”; under “Create New Event” click on “General Research Ethics Board Annual Renewal/Closure Form for Cleared Studies”). Please note that when your research project is completed, you need to submit an Annual Renewal/Closure Form in Romeo/trac indicating that the project is ‘completed’ so that the file can be closed. This should be submitted at the time of completion; there is no need to wait until the annual renewal due date.

You are reminded of your obligation to advise the GREB of any adverse event(s) that occur during this one year period (access this form at http://www.queensu.ca/trac/simon.html; click on “Events”; under “Create New Event” click on “General Research Ethics Board Adverse Event Form”). An adverse event includes, but is not limited to, a complaint, a change or unexpected event that alters the level of risk for the researcher or participants or situation that requires a substantial change in approach to a participant(s). You are also advised that all adverse events must be reported to the GREB within 48 hours.

You are also reminded that all changes that might affect human participants must be cleared by the GREB. For example, you must report changes to the level of risk, applicant characteristics, and implementation of new procedures. To submit an amendment form, access the application by at http://www.queensu.ca/trac/simon.html; click on “Events”; under “Create New Event” click on “General Research Ethics Board Request for the Amendment of Approved Studies”. Once submitted, these changes will automatically be sent to the Ethics Coordinator, Mr. Gail Irving, at the Office of Research Services for further review and clearance by the GREB or GREB Chair.

On behalf of the General Research Ethics Board, I wish you continued success in your research.

Sincerely,

[Signature]

Joan Stevenson, Ph.D.
Interim Chair
General Research Ethics Board

cc: Dr. Benjamin Bolden, Supervisor
Dr. Richard Reeve, Chair, Unit REB
Mrs. Erin Remie, Dept. Admin.
## Appendix B- Interview Participant Codex

<table>
<thead>
<tr>
<th>#</th>
<th>Interviewee</th>
<th>Inclusion Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pseudonym</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Thomas</td>
<td>Inventor/entrepreneur/start-up founder and executive</td>
</tr>
<tr>
<td>2</td>
<td>Geordi</td>
<td>Graduate engineer/ maker-space advocate</td>
</tr>
<tr>
<td>3</td>
<td>Justina</td>
<td>Award-winning arts educator and conservation advocate</td>
</tr>
<tr>
<td>4</td>
<td>Seamus</td>
<td>Award-winning musician/comedian/lyricist</td>
</tr>
<tr>
<td>5</td>
<td>Tamara</td>
<td>National best-selling author/literacy advocate</td>
</tr>
<tr>
<td>6</td>
<td>Hal</td>
<td>Federal government policymaker</td>
</tr>
<tr>
<td>7</td>
<td>Erwin</td>
<td>Award-winning physicist noted for his teaching</td>
</tr>
<tr>
<td>8</td>
<td>Darius</td>
<td>Award-winning executive chef- fusion cuisines</td>
</tr>
<tr>
<td>9</td>
<td>Sidney</td>
<td>Entrepreneur/renowned venture capitalist</td>
</tr>
<tr>
<td>10</td>
<td>Anastasia</td>
<td>Award-winning mixed media artist and illustrator</td>
</tr>
<tr>
<td>11</td>
<td>Gwen</td>
<td>Not-for-profit executive, community leader and community organizer</td>
</tr>
<tr>
<td>12</td>
<td>Catherine</td>
<td>Community care agency founder and social entrepreneur</td>
</tr>
<tr>
<td>13</td>
<td>Charles</td>
<td>Not-for-profit executive and hospital CEO</td>
</tr>
<tr>
<td>14</td>
<td>Frederick</td>
<td>Award-winning biology- tissue engineering researcher and entrepreneur</td>
</tr>
<tr>
<td>15</td>
<td>Marcus</td>
<td>Founder of national innovator network</td>
</tr>
<tr>
<td>16</td>
<td>Frank</td>
<td>Serial entrepreneur and inventor</td>
</tr>
<tr>
<td>17</td>
<td>Farah</td>
<td>Surgeon/regenerative medicine researcher</td>
</tr>
<tr>
<td>18</td>
<td>Oliver</td>
<td>Award-winning academic and health quality improvement scholar</td>
</tr>
<tr>
<td>19</td>
<td>Nathaniel</td>
<td>Noted Canadian positivist, life coach, and guru</td>
</tr>
<tr>
<td>20</td>
<td>Miranda</td>
<td>Award-winning author, media creator, and creativity consultant</td>
</tr>
<tr>
<td>No.</td>
<td>Name</td>
<td>Description</td>
</tr>
<tr>
<td>-----</td>
<td>---------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>21</td>
<td>Barry</td>
<td>Startup entrepreneur specializing in sustainable transportation</td>
</tr>
<tr>
<td>22</td>
<td>Linda</td>
<td>Notable member of Black Lives Matter Canada and community organizer</td>
</tr>
<tr>
<td>23</td>
<td>Yvonne</td>
<td>Award-winning indigenous activist</td>
</tr>
<tr>
<td>24</td>
<td>Atticus</td>
<td>Video blogger, philosopher, and digital media designer- recipient of</td>
</tr>
<tr>
<td></td>
<td></td>
<td>numerous Canadian emerging artist awards</td>
</tr>
<tr>
<td>25</td>
<td>Jonathan</td>
<td>President of a crown corporation and consumer protection agency scientist</td>
</tr>
<tr>
<td>26</td>
<td>Sandy</td>
<td>Nobel prize laureate in science</td>
</tr>
<tr>
<td>27</td>
<td>Okla</td>
<td>National award-winning humanities thinker</td>
</tr>
<tr>
<td>28</td>
<td>Claire</td>
<td>Award-winning higher education professor</td>
</tr>
<tr>
<td>29</td>
<td>Jenson</td>
<td>Renowned leader in a national paradigm shift in health science education</td>
</tr>
<tr>
<td>30</td>
<td>Honoria</td>
<td>Award-winning academic and university administrator</td>
</tr>
</tbody>
</table>
Appendix C- Interview Protocol

Conceptualizing Innovation

1. Why is innovating important?
2. How would you define innovation? What does it look like?
3. In what ways would you or someone who knows you describe your current occupation or activities as being innovative?

Expectancies, Values, and Costs of Innovating

4. What are some barriers to innovating?
5. What are some supports for innovating?
6. To what extent do you enjoy working on innovative-type projects? Please elaborate.
7. To what extent do you find innovation fulfilling? How does it make you feel? Please elaborate.
8. How useful is learning how to innovate for what you want to do? Please elaborate.
9. What are the costs of innovating to someone in your position? What do these costs look like?

Experience of Innovating

10. How do you balance the costs of innovating so that you see through projects that you start?
11. What events or experiences do you think contributed to your ability to innovate?
   a) Anything from school? Education?
   b) What kinds of teaching approaches do you think help people go on to innovate?
   c) What kinds of learning environments do you think help people go on to innovate?
12. If you were teaching high school students and wanted to nurture their ability to innovate, how would you help them? What would you put in place?
13. Compared to doing things as they have been done in the past, is innovating worthwhile to you?
   What makes you feel this way?
   a. What can help make innovating worthwhile to someone in your position?
14. Compared to doing things as they have been done in the past, is innovating worthwhile to your employers or colleagues? What makes you feel this way?
   a. What can help make innovating worthwhile to them?
15. Any final thoughts or statements you’d like to share?
Appendix D- Survey Instrument with Response Breakdown

Defining innovation: Innovation has many definitions. For the purposes of this study, innovation involves the novel execution of ideas to create products or processes of value. Products, processes, and values are different across subjects and contexts and can be economic, social, or intellectual among many other types.

1. In what sector do you work? (Please describe in detail) [Text response]

2. What is your current role? (Please describe in detail) [Text response]

Likert-type items

Please think about your role/occupation and sector/field and use this to guide your responses to the following questions.

Please indicate your relative agreement with the following statements

Innovator Identity Scale

<table>
<thead>
<tr>
<th>Scale</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Slightly Disagree</th>
<th>Neither Disagree nor Agree</th>
<th>Slightly Agree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISC1- I enjoy trying out new ideas.</td>
<td>3</td>
<td>5</td>
<td>11</td>
<td>32</td>
<td>42</td>
<td>130</td>
<td>277</td>
</tr>
<tr>
<td>ISC2- I prefer to see other people using new ideas before I will consider using them.</td>
<td>39</td>
<td>71</td>
<td>119</td>
<td>99</td>
<td>55</td>
<td>90</td>
<td>27</td>
</tr>
<tr>
<td>ISC3- I prefer to be among the first to implement a new idea.</td>
<td>3</td>
<td>6</td>
<td>28</td>
<td>144</td>
<td>120</td>
<td>111</td>
<td>88</td>
</tr>
<tr>
<td>ISC4- I am often involved in projects that require innovation.</td>
<td>6</td>
<td>16</td>
<td>26</td>
<td>49</td>
<td>110</td>
<td>156</td>
<td>137</td>
</tr>
<tr>
<td>ISC5- I seek out projects that require innovation.</td>
<td>3</td>
<td>10</td>
<td>19</td>
<td>68</td>
<td>104</td>
<td>165</td>
<td>131</td>
</tr>
<tr>
<td>ISC6- The projects that I initiate would typically require innovation to be successful.</td>
<td>7</td>
<td>11</td>
<td>30</td>
<td>104</td>
<td>130</td>
<td>131</td>
<td>87</td>
</tr>
<tr>
<td>ISC7- To be successful in my field, I need to be innovative.</td>
<td>8</td>
<td>27</td>
<td>30</td>
<td>44</td>
<td>107</td>
<td>152</td>
<td>132</td>
</tr>
<tr>
<td>ISC8- In general, my peers think of me as an innovator.</td>
<td>3</td>
<td>23</td>
<td>25</td>
<td>120</td>
<td>114</td>
<td>151</td>
<td>64</td>
</tr>
</tbody>
</table>
### Expectancies Scale—*Do you believe that you are capable of innovating in your specific area?*

<table>
<thead>
<tr>
<th></th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Slightly Disagree</th>
<th>Neither Disagree nor Agree</th>
<th>Slightly Agree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>EX1-I am skilled at solving problems in novel circumstances.</td>
<td>5</td>
<td>13</td>
<td>46</td>
<td>107</td>
<td>140</td>
<td>96</td>
<td>93</td>
</tr>
<tr>
<td>EX2-I am knowledgeable about how to innovate in my field.</td>
<td>2</td>
<td>7</td>
<td>22</td>
<td>134</td>
<td>131</td>
<td>121</td>
<td>83</td>
</tr>
<tr>
<td>EX3-My capacity to innovate has improved over time.</td>
<td>10</td>
<td>25</td>
<td>35</td>
<td>122</td>
<td>125</td>
<td>111</td>
<td>72</td>
</tr>
<tr>
<td>EX4-I am confident that I can innovate in my field.</td>
<td>5</td>
<td>12</td>
<td>23</td>
<td>108</td>
<td>170</td>
<td>113</td>
<td>69</td>
</tr>
<tr>
<td>EX5-I struggle with innovating because I do not know enough about the process to feel comfortable.</td>
<td>18</td>
<td>37</td>
<td>64</td>
<td>60</td>
<td>103</td>
<td>135</td>
<td>83</td>
</tr>
</tbody>
</table>

### Intrinsic Task Value Scale (5 Items)- *Do you find innovating enjoyable, fulfilling, or rewarding? Please elaborate.*

<table>
<thead>
<tr>
<th></th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Slightly Disagree</th>
<th>Neither Disagree nor Agree</th>
<th>Slightly Agree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>IV1-In general, I find the process of innovating personally rewarding.</td>
<td>21</td>
<td>34</td>
<td>46</td>
<td>121</td>
<td>117</td>
<td>76</td>
<td>85</td>
</tr>
<tr>
<td>IV2-I take pride in innovating.</td>
<td>12</td>
<td>27</td>
<td>65</td>
<td>122</td>
<td>104</td>
<td>76</td>
<td>94</td>
</tr>
<tr>
<td>IV3-I like to innovate during my day-to-day work.</td>
<td>1</td>
<td>10</td>
<td>16</td>
<td>177</td>
<td>117</td>
<td>45</td>
<td>134</td>
</tr>
<tr>
<td>IV4-I enjoy being in an environment that fosters innovation.</td>
<td>3</td>
<td>5</td>
<td>8</td>
<td>196</td>
<td>59</td>
<td>23</td>
<td>206</td>
</tr>
<tr>
<td>IV5-I get bored when my work becomes routine.</td>
<td>7</td>
<td>16</td>
<td>26</td>
<td>122</td>
<td>80</td>
<td>51</td>
<td>198</td>
</tr>
</tbody>
</table>

### Attainment Task Value Scale (5 items)- *Is innovation important to your identity or self?*

<table>
<thead>
<tr>
<th></th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Slightly Disagree</th>
<th>Neither Disagree nor Agree</th>
<th>Slightly Agree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>AV1-Innovation is foundational to me feeling effective in my work.</td>
<td>6</td>
<td>19</td>
<td>25</td>
<td>174</td>
<td>116</td>
<td>64</td>
<td>96</td>
</tr>
<tr>
<td>AV2-Being innovative is important to how I am perceived by my peers.</td>
<td>5</td>
<td>38</td>
<td>47</td>
<td>139</td>
<td>108</td>
<td>84</td>
<td>79</td>
</tr>
</tbody>
</table>
AV3-I am proud of my accomplishments even if I do not consider them innovative. | 146 | 207 | 87 | 4 | 16 | 39 | 1 |
AV4-Being innovative is important to my identity. | 11 | 44 | 44 | 146 | 100 | 76 | 79 |
AV5-Innovation is important to my own sense of self. | 16 | 41 | 32 | 138 | 94 | 91 | 88 |
AV6-When I struggle to innovate, I feel like I am letting myself down. | 34 | 79 | 68 | 77 | 88 | 77 | 77 |

**Utility Task Value Scale** (5 items)- *Is innovation useful or relevant to you? Does it connect you to things that you want?*

<table>
<thead>
<tr>
<th>UV1-If I am not innovating, I am likely to be less effective.</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Slightly Disagree</th>
<th>Neither Disagree nor Agree</th>
<th>Slightly Agree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td>64</td>
<td>77</td>
<td>122</td>
<td>93</td>
<td>83</td>
<td>50</td>
<td></td>
</tr>
</tbody>
</table>

| UV2-Innovation is critical to the work that I do day-to-day. | 20 | 43 | 58 | 118 | 111 | 75 | 75 |

| UV3-Innovation connects me to things that I want. | 7 | 23 | 29 | 118 | 139 | 94 | 90 |

| UV4-External pressures drive my innovating more than my own desire. | 47 | 89 | 81 | 90 | 84 | 83 | 26 |

| UV5-Innovation helps me stay a step ahead of the competition. | 9 | 12 | 18 | 155 | 147 | 71 | 88 |

| UV6-To be successful, I must innovate. | 12 | 23 | 35 | 136 | 123 | 109 | 63 |

| UV7-My ability to innovative can help me achieve my goals. | 3 | 7 | 9 | 200 | 113 | 132 | 36 |

| UV8-My ability to innovate has improved my quality of life. | 6 | 18 | 26 | 160 | 100 | 102 | 88 |

| UV9- Innovating is central to how I will make my living or be successful in my career/job. | 11 | 23 | 33 | 140 | 136 | 97 | 60 |

257
**Cost Scale** (8 items)- *What are the drawbacks, or costs you pay to innovate?*

<table>
<thead>
<tr>
<th>CST</th>
<th>Description</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Slightly Disagree</th>
<th>Neither Disagree nor Agree</th>
<th>Slightly Agree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>CST1</td>
<td>Innovative behaviour is usually worthwhile, despite the effort required.</td>
<td>125</td>
<td>230</td>
<td>99</td>
<td>27</td>
<td>14</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>CST2</td>
<td>Trying to innovate places a lot of pressure on me.</td>
<td>21</td>
<td>59</td>
<td>57</td>
<td>92</td>
<td>115</td>
<td>106</td>
<td>50</td>
</tr>
<tr>
<td>CST3</td>
<td>Innovation uses a lot of time that might be better spent elsewhere.</td>
<td>52</td>
<td>115</td>
<td>118</td>
<td>74</td>
<td>62</td>
<td>60</td>
<td>19</td>
</tr>
<tr>
<td>CST4</td>
<td>Innovation is frequently less valuable than sticking to what works.</td>
<td>56</td>
<td>132</td>
<td>127</td>
<td>72</td>
<td>54</td>
<td>34</td>
<td>25</td>
</tr>
<tr>
<td>CST5</td>
<td>I am afraid to try out novel ideas because of the implications if I fail.</td>
<td>84</td>
<td>137</td>
<td>92</td>
<td>52</td>
<td>78</td>
<td>39</td>
<td>18</td>
</tr>
<tr>
<td>CST6</td>
<td>Sometimes being innovative requires too much time and effort.</td>
<td>35</td>
<td>75</td>
<td>59</td>
<td>65</td>
<td>134</td>
<td>98</td>
<td>34</td>
</tr>
<tr>
<td>CST7</td>
<td>Innovation can be difficult for me because it involves challenging the status quo.</td>
<td>69</td>
<td>91</td>
<td>88</td>
<td>61</td>
<td>113</td>
<td>61</td>
<td>17</td>
</tr>
<tr>
<td>CST8</td>
<td>There is a strong chance that innovation could harm other people.</td>
<td>78</td>
<td>117</td>
<td>80</td>
<td>81</td>
<td>74</td>
<td>46</td>
<td>24</td>
</tr>
</tbody>
</table>

**Open-Ended Questions**- Prompt: Think of a time that you were involved in an innovative process

1. What has been helpful to you when involved in the process of innovation?
2. What barriers, if any, have you experienced when involved in the process of innovation?
3. What FORMAL education experiences, if any, impacted your ability to innovate?
4. What INFORMAL education experiences, if any, impacted your ability to innovate?
5. Think of a time when you were involved in an innovative activity.
a. What were the things that you did that would be considered innovative? (Please describe in detail)

b. What were your motivations?

c. How did that experience make you feel?

Demographic Questions

6. With what gender do you identify?

<table>
<thead>
<tr>
<th>Gender</th>
<th>Number of Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Man</td>
<td>243</td>
</tr>
<tr>
<td>Woman</td>
<td>210</td>
</tr>
<tr>
<td>I do not identify within the gender binary</td>
<td>3</td>
</tr>
<tr>
<td>I prefer not to disclose information related to</td>
<td>44</td>
</tr>
<tr>
<td>my gender</td>
<td></td>
</tr>
</tbody>
</table>

7. Please list your degrees/diplomas and associated field. (e.g. Bachelor of Science in biology)

<table>
<thead>
<tr>
<th>Level of Education</th>
<th>Number of Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>PhD</td>
<td>35</td>
</tr>
<tr>
<td>Master’s</td>
<td>103</td>
</tr>
<tr>
<td>Bachelor’s or Equivalent</td>
<td>183</td>
</tr>
<tr>
<td>College or Technical diploma or equivalent</td>
<td>99</td>
</tr>
<tr>
<td>High School</td>
<td>54</td>
</tr>
<tr>
<td>Did not graduate</td>
<td>19</td>
</tr>
<tr>
<td>Prefer not to disclose</td>
<td>7</td>
</tr>
</tbody>
</table>

8. Parent(s)/Guardian(s) education:

<table>
<thead>
<tr>
<th>Parental Education</th>
<th>Number of Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neither of my parent(s)/guardian(s) completed</td>
<td>134</td>
</tr>
<tr>
<td>postsecondary education</td>
<td></td>
</tr>
<tr>
<td>One of my parent(s)/guardian(s) completed</td>
<td>130</td>
</tr>
<tr>
<td>postsecondary education</td>
<td></td>
</tr>
<tr>
<td>Both of my parent(s)/guardian(s) completed</td>
<td>182</td>
</tr>
<tr>
<td>postsecondary education</td>
<td></td>
</tr>
<tr>
<td>Prefer not to disclose</td>
<td>54</td>
</tr>
</tbody>
</table>
9. In what year were you born?

10. Do you self-identify as having a learning exceptionality (disability)?

<table>
<thead>
<tr>
<th>Learning Exceptionality</th>
<th>Number of Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>56</td>
</tr>
<tr>
<td>No</td>
<td>398</td>
</tr>
<tr>
<td>Prefer not to disclose</td>
<td>46</td>
</tr>
</tbody>
</table>

11. Do you identify as being a part of a visible minority?

<table>
<thead>
<tr>
<th>Visible Minority</th>
<th>Number of Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>95</td>
</tr>
<tr>
<td>No</td>
<td>366</td>
</tr>
<tr>
<td>Prefer not to disclose</td>
<td>39</td>
</tr>
</tbody>
</table>
Appendix E- Detailed Statistical Results

MANOVAs organized by demographic factors

*All tests performed at 99% confidence making the target $p$-value for significance less than 0.01.

Given the implications of my research for teaching, and its calls for changed practice I reduced alpha to 0.01 to increase confidence in the recommendations.

MANOVA #1 Area of Endeavour (Discipline)

Multivariate Test

There were statistically significant differences in the motivations to innovate based on their areas of endeavour, $F (24, 1711) = 3.969$, $p < 0.001$; Wilk's $\Lambda = 0.829$; partial $\eta^2 = 0.046$.

Non-Significant Results

There were no statistically significant differences in innovator self-concept based on their areas of endeavour ($p=0.51$).

Expectancies

There were statistically significant differences in expectancies based on their areas of endeavour, $F (4,495) = 3.859$, $p = 0.004$; partial $\eta^2 = 0.050$.

Bonferroni-post-hoc tests revealed that the lone significant difference by discipline was between innovators in the sciences ($M= 5.62$, $SD= 0.93$) and arts and humanities innovators ($M=6.10$, $SD= 0.70$) with sciences reporting much lower expectancy ($p= 0.004$). Social service innovators reported the lowest expectancies of all disciplines. There were no expectancy differences between any of the other disciplinary backgrounds (all $p$-values $>0.01$).
Intrinsic Task Value

There were statistically significant differences in intrinsic task value based on their areas of endeavour, $F(4, 495) = 7.559, p < 0.001$; partial $\eta^2 = 0.058$.

Bonferroni-post-hoc tests revealed that the lone significant intrinsic task differences by discipline were between innovators in the social services ($M = 5.59$, $SD = 0.98$) and scholastics ($M = 6.01$, $SD = 0.69$, $p < 0.001$), business ($M = 6.11$, $0.70$, $p =< 0.001$), and arts and humanities ($M = 6.20$, $SD = 0.65$, $p < 0.001$). Social service innovators reported the lowest intrinsic task values of all disciplines. There were no significant intrinsic task value differences in the post-hoc tests for sciences, nor between any other disciplines (all $p$-values $> 0.01$).

Attainment Task Value

There were statistically significant differences in attainment task value based on their areas of endeavour, $F(4, 495) = 6.375, p < 0.001$; partial $\eta^2 = 0.049$.

Bonferroni-post-hoc tests revealed that the lone significant attainment task value difference by discipline was between innovators in the social services ($M = 4.53$, $SD = 1.48$) and arts and humanities ($M = 5.41$, $SD = 1.10$, $p < 0.001$). Social service innovators reported the lowest attainment value of all disciplines. There were no significant attainment task value differences in the post-hoc tests between any other disciplines (all $p$-values $> 0.01$).

Utility Task Value

There were statistically significant differences in utility task value based on their areas of endeavour, $F(4, 495) = 6.078, p < 0.001$; partial $\eta^2 = 0.047$.

Bonferroni-post-hoc tests revealed that the significant utility task value differences by discipline was between innovators in the social services ($M = 4.74$, $SD = 1.11$) and arts and
humanities (M=5.38, SD=0.85, p <0.001) and business sector innovators (M=5.35, SD= 1.09, p<0.001). Social service innovators reported the lowest utility task values of all disciplines. There were no significant utility task value differences in the post-hoc test between any other disciplines (all p-values>0.01).

Costs

There were statistically significant differences in costs based on their areas of endeavour, F (4,495) = 4.420, p <0.001; partial η2= 0.034.

Bonferroni-post-hoc tests revealed that the lone significant cost difference by discipline were between innovators in the business sector (M= 4.01, SD= 0.92) and those in scholastics and academia (M= 3.35, SD= 0.94, p<0.001). Business sector innovators reported the highest perceived cost values of all disciplines. There were no significant cost differences in the post-hoc test between any other disciplines (all p-values>0.01).

MANOVA #2 Parental Level of Education

Multivariate Test

There were no statistically significant differences in the motivations to innovate based on parental level of education (all p-values>0.01).

MANOVA #3 Exceptionality

Multivariate Test

There were statistically significant differences in the motivations to innovate based on their reported exceptionality status, F (6, 447) = 9.69, p <0.001; Wilk's Λ = 0.971; partial η2= 0.029.

Non-significant results
There were no significant differences by reported exceptionality status in Innovator Self-Concept, Expectancies, Intrinsic Task Value, Attainment Task Value, or Utility Task Value (all \( p \)-values > 0.01).

**Costs**

There were statistically significant differences in perceived cost based on whether they reported an exceptionality of any kind, \( F (4, 447) = 4.420, p < 0.001 \); partial \( \eta^2 = 0.034 \). Innovators who reported having an exceptionality (\( M = 4.13, SD = 0.73 \)) reported significantly greater perceived costs than their non-exceptionality reporting peers (\( M = 3.59, SD = 1.02 \)). As there were only two groups, no post-hoc tests were necessary.

**MANOVA #4 Minority Status**

**Multivariate Test**

There were statistically significant differences in the motivations to innovate based on their reported racialized minority status, \( F (6, 444) = 7.084, p < 0.001 \); Wilk's \( \Lambda = 0.933 \); partial \( \eta^2 = 0.087 \).

**Non-Significant results**

There were no significant differences in innovator self-concept, expectancies, or any task value based on level of education (all \( p \)-values > 0.01)

**Costs**

There were statistically significant differences in perceived cost based on whether they reported an exceptionality of any kind, \( F (4, 447) = 32.166, p < 0.0001 \); partial \( \eta^2 = 0.067 \). Innovators who reported being racialized (\( M = 4.32, SD = 1.07 \)) reported significantly greater perceived costs than
their non-racialized peers (M=3.50, SD= 0.91). As there were only two groups, no post-hoc tests were necessary.

**MANOVA #5 Age Group**

**Multivariate Test**

There were no significant differences in the motivations to innovate based on the age group of the innovator (all \( p \)-values>0.01).

**MANOVA #6 Gender**

**Multivariate Test**

There were no statistically significant differences in the motivations to innovate based on gender (all \( p \)-values>0.01).

**MANOVA #7 Innovator Level**

**Multivariate Test**

There were statistically significant differences in the motivations to innovate based on their areas of endeavour, \( F (6,493) = 5.91, \ p < 0.001; \) Wilk's \( \Lambda = 0.933; \) partial \( \eta^2 = 0.067. \)

**Innovator Self-Concept**

There were statistically significant differences in innovator self-concept based on identified level of innovator, \( F (3, 496) = 25.30, \ p < .0001; \) partial \( \eta^2 = 0.048. \) Innovators identified as being higher-level innovators (Big-I or Pro-I; \( M= 5.68, \ SD=0.81) \) reported significantly higher innovator self-concept than their peers who were lower-level innovators (little-I or mini-I; \( M= 5.21, \ SD= 0.91). \) As there were only two groups, no post-hoc tests were necessary.

**Expectancies**

There were statistically significant differences in expectancies based on identified level of innovator, \( F (3, 496) = 12.84, \ p < .0001; \) partial \( \eta^2 = 0.035. \) Innovators identified as being higher-
level innovators (Big-I or Pro-I; M= 5.93, SD=0.75) reported significantly higher expectancies than their peers who were lower-level innovators (little-I or mini-I; M= 5.66, SD= 0.85). As there were only two groupings Big-I and Pro-I representing high-level innovators and little-I and mini-I representing everyday innovators, no post-hoc tests were necessary.

**Intrinsic Task Value**

There were statistically significant differences in intrinsic task values based on identified level of innovator, F (3, 496) = 20.76, p <.0001; partial η2= 0.040. Innovators identified as being higher-level innovators (Big-I or Pro-I; M= 6.13, SD=0.73) reported significantly higher intrinsic task values than their peers who were lower-level innovators (little-I or mini-I; M= 5.78, SD= 0.92). As there were only two groups, no post-hoc tests were necessary.

**Attainment Task Value**

There were statistically significant differences in attainment task values based on identified level of innovator, F (3, 496) = 22.30, p <0.0001; partial η2= 0.043. Innovators identified as being higher-level innovators (Big-I or Pro-I; M= 5.21, SD=1.01) reported significantly higher expectancies than their peers who were lower-level innovators (little-I or mini-I; M= 4.64, SD= 1.13). As there were only two groups, no post-hoc tests were necessary.

**Utility Task Value**

There were statistically significant differences in utility task values based on identified level of innovator, F (3, 496) = 16.55, p <0.0001; partial η2= 0.032. Innovators identified as being higher-level innovators (Big-I or Pro-I; M= 5.34, SD=0.90) reported significantly higher utility task values than their peers who were lower-level innovators (little-I or mini-I; M= 4.95, SD= 1.17). As there were only two groups, no post-hoc tests were necessary.
Costs

There were statistically significant differences in costs based on identified level of innovator, $F(3, 496) = 8.897, p < 0.001$; partial $\eta^2 = 0.023$. Innovators identified as being higher-level innovators (Big-I or Pro-I; $M= 3.88$, $SD=0.45$) reported significantly lower costs than their peers who were lower-level innovators (little-I or mini-I; $M= 3.66$, $SD= 0.57$). As there were only two groups, no post-hoc tests were necessary.

**MANOVA #8 Level of Education**

**Multivariate Test**

There were statistically significant differences in the motivations to innovate based on innovator level of education areas of endeavour, $F(36,1979) = 4.45, p <0.001$; Wilk's $\Lambda = 0.871$; partial $\eta^2 = 0.033$.

**Non-Significant results**

There were no significant differences in expectancies, any task value, or perceived costs based on level of education ($p>0.01$)

**Innovator Self-concept**

There were statistically significant differences in innovator self-concept based on level of education, $F(6, 455) = 4.938, p <0.001$; partial $\eta^2 = 0.061$. Innovators who held graduate degrees ($M= 5.88$, $SD=0.75$) reported significantly higher innovator self-concept than their peers who had not attended post-secondary education ($M= 4.79$, $SD= 1.14$) as differentiated by Bonferroni post-hoc tests ($p$-values<0.001). Among the other levels of education, there were no significant differences in the post-hoc-tests ($p>0.01$).