UNIVERSITIES' INFLUENCE ON STUDENT DECISIONS TO BECOME ENTREPRENEURS: THEORY AND EVIDENCE

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ABSTRACT

One definition of creativity (of a great many) is "widening the range of choice" (Ruttenberg & Maital, 2014). Increasingly, universities are informing students that they have a choice-they may choose to launch startups, after graduation, and to create their own business, as well as work for existing organizations. This has become a part of universities' so-called "third dimension" goal of social responsibility, in addition to the two traditional goals of teaching and research, partly because startups and small businesses help to create jobs and wealth. The purpose of this study is to provide both theory and evidence, on the key question, how can universities best foster entrepreneurship? The theory was proposed for the students' decision process to become an entrepreneur and adapted from the stage-gate innovation process. According to this model, students choose to open a series of startup "doors" or gates, from awareness through intention and skill-building to the post-graduation startup act itself. Basic Chi-square statistics were used to link entrepreneurial activities and studies with startup launches. Empirical evidence was provided drawn from a survey of graduates of Technion-Israel Institute of Technology, many of whom launched startups after graduating. The survey results from complementary studies of the antecedents of entrepreneurship intention, with evidence on the antecedents of actual startup behavior. Among the main findings were "Narrative" (story-telling) stage-gates foster awareness of the startup option, experiential stage-gates that simulate startup activities strengthen intention and skills; and since learning styles vary widely, offering a wide variety of entrepreneurship activities is probably optimal for today's science and technology students. In other words: different strokes for different folks. However, while influential and impactful, entrepreneurial activities of all kinds appear neither necessary nor sufficient for students to choose to launch startups; a significant proportion of graduates go on to launch startups without ever experiencing any type of entrepreneurial activity during their undergraduate studies. The high failure rates of startups suggest that students could benefit from more business skill-building courses and activities. This study seeks to fill the gap between studies of entrepreneurial intention (to launch a startup) and studies of those who actually launched startups. The most effective way universities can foster entrepreneurship among their students is to offer well-mentored experiential simulations of the startup process.

Keywords: Entrepreneurship, Universities, Startup, Education, Experiential, Skills, Stage-Gate.

INTRODUCTION

This study presents a stage-gate theory of how universities impact students' decisions to become entrepreneurs, and provides empirical evidence that tests the theory's validity, based on

a survey of graduates of Technion-Israel Institute of Technology. Technion was founded in 1912 and was shown to be instrumental in creating Israel's vibrant startup and high-tech industry ecosystem.[1]

Many universities worldwide are adding a third dimension to their dual traditional goals of research and teaching-social responsibility and service (Laredo, 2007). As governments impose austerity and slash spending, unmet social needs grow. Increasingly universities seek to help and fill the resulting gap and meet the social needs of their communities and nations. Partly as a result, interest is growing in ways for universities to foster entrepreneurship. In many universities, complex entrepreneurship ecosystems exist in which students become aware of the startup option, develop the intention to do so, acquire some vital skills, and ultimately, go on to become entrepreneurs. Two European Union programs alone seek to invest 80 billion euros (Horizon 2020) and 110 billion euros (European Structural and Investment Fund), respectively, in fostering innovation. The key question is, will universities supply empowered graduates whose entrepreneurial ambitions will drive such innovation and make those investments fruitful? As Centobelli et al. (2016a) observes, for Italy: *"…the number of graduates in engineering management that create a new firm at the end of their course, becoming entrepreneurs, is growing. This phenomenon now affects a majority of Italian universities and will require a more "entrepreneurship-oriented" university in the coming years."*

Vaquero-Garcia et al. (2016) found that *"Universities are currently experiencing significant changes in their mission, which have gone from carrying out traditional activities (like teaching and research) to promoting creative, innovative and enterprising capability that enables them to generate economic and social value through the transfer of knowledge."* In their international survey of universities, they conclude that *"universities with the greatest future projection are those which consider that the third mission [promoting enterprise] should be more and more present."*

Several studies have revealed the enormous impact that even a small science and technology university can have on the regional, national and world economies, through startup businesses launched by their graduates. To cite four such studies:

1. For many years, MIT's graduating class numbered only 1,000, and fairly recently, about 1,500. In 2016 MIT's entire undergraduate class numbered only 4,524. Yet Roberts and Eeseley (2011) found, in a survey of MIT graduates, that nearly 30,000 active businesses were launched, employing some three million; their revenues, some $2 trillion, would comprise the world's 11th largest economy, if aggregated.

2. Eeseley and Miller (2018) found similar, enormous impact on the part of Stanford University graduates; Stanford, of course, gave birth to Silicon Valley, one of the world's premier startup ecosystems. The above two studies' findings are echoed in the study of the impact of the graduates of the University of California (Berkeley) (2014) on San Francisco and the U.S. as a whole[2].

3. Technion-Israel Institute of Technology played a key role in the development and evolution of Israel's high tech industry, which drives 40% of Israel's economic growth and accounts for half of all exports (Frenkel and Maital, 2012a: 2012b). A survey of Technion alumni revealed that one in four Technion graduates launches at least one startup, and among women graduates, one in every seven.

[1] Frenkel. & Maital. (2012a, 2012b). For a study of Technion's entrepreneurship ecosystem, in comparison with other leading universities, see Bentur et al. (2017).

[2] "*2610 firms currently in operation, established by Berkeley founders, account for 542,433 employees report $317 in annual revenues*."

Elmuti et al. (2012) surveyed 170 entrepreneurs and prospective entrepreneurs in the United States and find *"causal linkages between entrepreneurial education….social competence… and basic entrepreneurial training skills…"*

These studies and others raised some important questions-How can universities influence students' choice to become entrepreneurs? Do students with entrepreneurial intentions engage in self-selection, choosing to apply and enroll at institutions known for successful, famous entrepreneurial alumni? Do universities in fact strongly influence entrepreneurial intensions and actions on the part on their students, and if so, how? These are the fascinating questions that is chosen to address.

Specifically, it seeks to add a key and heretofore somewhat missing piece to this puzzle. Many studies have researched intention to become entrepreneurs; Bae et al. (2014) for a meta-analysis of 73 such studies. But is that intention translated into action? If so, how? And for those graduates who do act, and launch startup, what in fact influenced their decision during their college studies? Actual startup actions (launch of startup) was studied, as revealed in a survey of graduates, and explore self-evaluated influences on those actions of a variety of entrepreneurship education modes, including courses, visiting speakers, simulations, contests, clubs, mentors, etc.

The structure of the paper as follows. Surveying and critical summarization of research on three related topics was done:

1. The various approaches for fostering entrepreneurship in universities.
2. The ecosystems of universities that comprise best-practice in producing entrepreneurs among their graduates and the key elements of a university entrepreneurship ecosystem.
3. The link between entrepreneurship activities in colleges, the awareness of a startup career option, the intention to launch a startup and the action itself to do so.

Next an outline was made of a stage-gate theory of the process through which university graduates transform startup awareness to the actual launch, after graduation. Then the research methods were described, and empirical results presented based on a survey of Technion graduates, including those who launched startups. It concludes by indicating some future directions this research could take.

UNIVERSITIES' IMPACT ON ENTREPRENEURSHIP: REVIEW OF THE LITERATURE

Entrepreneurial Skills

Launching a startup requires a wide range of skills. But what are those key skills, and how can universities best impart them to students who seek them? Centobelli et al. (2016a) provide a useful organizing framework. Seven key skills that entrepreneurs needed were denoted: Personal skills; Innovative skills; Financial skills; Organizational skills; Strategic skills; Relational skills (systemic grasp of the link between a startup and its surrounding ecosystem); and Reputational skills (building trust and mutual understanding). From this experience,

engineering universities fail badly in providing these so-called '*soft*' skills.[3] But there is evidence they are changing, albeit slowly.[4]

Many universities seek to motivate students to become entrepreneurs. But what does motivate entrepreneurs? Centobelli et al. (2016b) define *"three types of motivations driving people to fund a project"*: social, material and financial. Perhaps each motivation requires very different approaches in university settings, to stimulate and foster entrepreneurial drive.

Teaching Entrepreneurship

How can the effectiveness of a university entrepreneurship ecosystem best be measured? What are the most effective, proven methods for teaching entrepreneurship, in a manner that both inspires and enables students to launch startups after graduating? Indeed, there is controversy over whether entrepreneurship can be taught at all.

Management begins with measurement, it is said. Hence, a number of studies have sought to provide metrics or measurements for success of efforts to foster entrepreneurship; Walshok and Shapiro (2014) and Secundo and Elia (2014). Walshok and Shapiro (2014) argue that *"the primary metrics of success [in fostering entrepreneurship] remain patenting, licensing rates, and university spin-outs"* and that these tend to understate the *"many important contributions research-intensive universities make to their regional economies"*. Roberts and Eeseley (2011), and following their lead, Frenkel and Maital (2012a) surveyed graduates to find how many established companies, and/or managed companies; they estimate jobs created by those companies; and in some cases NASDAQ listings and market capitalization.

Lautenschläger & Haase (2011) offer seven strong arguments why entrepreneurship education should not focus on specific business skills, but rather on *"soft skills"* (e.g. managing and motivating people). Fiet (2001) stresses skill-building in entrepreneurial education: *"The most effective method is to establish a student-approved system for class meetings that requires students to practice specific skills"*. Boyles (2012) suggests how best to evaluate entrepreneurial education by a focused approach on KSA's (knowledge/skills/abilities) and entrepreneurial competencies. Similarly, Blank (Moules, 2015) focuses on a specific method or skill, that of lean startups: *".... In lean startup activity, students are taught how to keep testing their ideas in order to develop better businesses"*. He stresses the fact that not all students will be willing and able to learn and apply such skills:

"...while entrepreneurship and leadership skills can be taught, there are only certain people who will be able to apply them well. Problem is, universities and business schools have been treating entrepreneurship as a technical subject, such as accountancy, when it should be taught more like a creative subject, such as art, where practical exercises are as important as the theory".

Many researchers, like Blank, stress the vital importance of action learning, experiential learning and practical exercises. Rasmussen and Sorheim (2006) claim that *"entrepreneurship education focuses less on teaching individuals in a classroom setting and more on learning by doing activities in a group setting and a network context"*. Brush (2013) reports on the approach adopted by Babson College, consistently ranked #1 in undergraduate entrepreneurship education.

[3] See, for instance, the list of "future key skills" compiled by McKinsey: https://news.darden.virginia.edu/2017/09/21/10-critical-job-skills-of-the-future/

[4] See, for instance, Cerchione et al. (2016c): "From the sixties to the present day, the relative weight of technological skills (hardware skills) is reduced, compared to the organizational and managerial skills (software skills) that have become very important over the years for engineers…"

She notes that *"in order to learn entrepreneurship, one must do entrepreneurship. This definitely does not exclude theory. Effective doing…requires a set of practices firmly grounded in theory".* For example, Babson College has teams of entrepreneurship students form companies in their first year, assign roles (CEO, VP, etc.) produce a product (e.g. T-shirts or laundry bags) and weekly report to an instructor about their business activities, while applying their academic courses to the business itself, including accounting, finance, marketing, human resource management, economics, etc. Politis (2005) too stresses the key role played by experiential learning. The late Prof. Ted Grossman, a pioneering entrepreneur himself, innovated a Foundations of Management & Enterprise (FME) course at Babson College; in this course, freshmen (and women) formed companies, delegated roles, developed and produced a product, sold and marketed it, while applying the tools they learned during their first two semesters of studies, in accounting, marketing, economics, finance and management.

Hindle (2007) cites philosopher and mathematician Alfred North Whitehead (1953) in his support of action-based entrepreneurship education. Whitehead (1953) wrote, *"The careful shielding of a university from the activities of the world around is the best way to chill interest and to defeat progress. Celibacy does not suit a university. It must mate itself with action".* This appears to be especially true in entrepreneurship education.

Preparing a business plan is considered a key entrepreneurial skill. But Brush (2014) observes that *"in fact, at Babson College while we were the first school to offer a business plan competition in 1984, we stopped teaching the business plan in our curriculum five years ago and changed our business plan competition to the Babson Entrepreneurial Thought and Action (BETA) Challenge which focuses on accomplishment of major milestones in taking action towards creating and growth of a business."*

Entrepreneurship Ecosystems

Universities like MIT, Stanford, University of California at Berkeley and Technion all have complex entrepreneurship ecosystems, comprised of courses, interest groups, simulations, action learning, mentoring and other activities. Graham (2013: 2014) surveys *"emerging world leaders"* in creating such ecosystems and stresses three key issues:

1. *"Connecting with community efforts to build entrepreneurship and innovation engagement".*
2. Strengthening corporate engagement.
3. Strengthening the regional entrepreneurship skills base.

Yemini and Hadad (2010) analyze an *"engineer-entrepreneur"* program at an Israeli college and find it was impactful. Yoon and Lee's (2013) study of entrepreneurship education ecosystems in Korea emphasizes the key roles of networking with industry and alumni.

Awareness, Intention, Skill Building and Action

What is the link between university entrepreneurship education, entrepreneurial intention and entrepreneurial action following graduation? Bae et al. (2014) conducted a meta-analysis of 73 studies that examine the link between

a) Entrepreneurship education.

b) Entrepreneurial intentions (the intent to become an entrepreneur).

Small correlation between a) and b) was found, which, however, disappears when they control for *"pre-education entrepreneurial intensions"*, i.e. students who had entrepreneurial intension before enrolling in college. This strengthens the importance of the self-selection issue noted earlier. It is widely believed by entrepreneurs themselves that students who lack initial *"fire in the belly"* and risk affinity (*"natural characteristics"*) will not become entrepreneurs, no matter what they are taught.[5]

Entrepreneurial Success and Failure

The high failure rate of startup in every country suggests that measuring university success by the proportion and number of their graduates who launch startups is insufficient. It is perhaps also important to try to improve their odds of success, and to include the proportion who succeeded in any system of evaluation and measurement, and in addition to make students aware of the daunting odds against success, and ways to improve those odds, to enable evidence-based choice.

Creativity

The foundation of startup entrepreneurship is creative ideas. A vast body of research exists on creativity, compiled during the past 50 years. This research is summarized by Maital (2014) and Ruttenberg & Maital (2014). Longitudinal research by Land and Jarman (1992) shows a steep decline in measured creativity from age 5 through adulthood. It may well be that measures to foster entrepreneurship in universities are much too late, after many young people have their innate spark of creativity extinguished by rigid learn-by-rote schooling.

THEORY: A STAGE-GATE MODEL

Kuehn (2008) notes that *'intentions'* precede entrepreneurial behavior, and helps build the groundwork for effective intensions-based research. In their meta-analysis of entrepreneurship intentions among students, Bae et al. (2014) note two basic underlying theories that can help explain and interpret such intentions:

a) An economic theory, that of human capital (Becker, 1964).

b) A social psychological theory, that of self-efficacy (Bandura, 1977).

These two theories are complementary, not rivals. To the extent that entrepreneurship education creates human capital, i.e. the present value of the future stream of benefits accruing from investment in such education, it can be expected to foster startups. Specific human capital, i.e. skills that are useful specifically in innovation and entrepreneurship, should be positively correlated with entrepreneurial intentions. In addition, when entrepreneurship education enhances perceived self-efficacy (the belief in one's ability to perform successfully), (Bandura, 1977), it should also enhance students' intention to launch startup.

[5] E.g. Angel investor Zohar Gilon: *"I think that entrepreneurship cannot be taught….It is possible to be helped and add knowledge for people with natural characteristics, but someone without the basic characteristics of an entrepreneur cannot be taught them."* Globes [online], Israel business news - www.globesonline.com-January 23, 2014.

Two observations were added. First, the theory of subjective risk perception is known as prospect theory (Kahneman & Tversky, 1979) moderates self-efficacy. It is known that the odds of success in startup entrepreneurship are miniscule and daunting. A study of 10,185 Israei startups launched between 1999 and 2014 revealed that 43% shut down, 52% were *"running"* but *"living dead"*, and only 478 or about 5%, were successful, measured by revenue, profit and return on investment. (IVC, 2015). Only four of 100 startups succeeded, measured by annual sales, number of employees and return on investment; and only 4 of 500 were successful, growing and independent (i.e. not acquired).

However, these are large-sample odds. It is widely known that individual entrepreneurs believe firmly that their own personal perceived (subjective) odds of success are far higher. In general, students who intend to become entrepreneurs are not high-stake gamblers, tossing the dice, but those who believe in their ideas and their abilities to implement them.

The second observation: Psychologist Bruner (1991) has explained how people tend to understand and interpret reality, by creating narratives (or stories). From experience, students sometimes acquire the intention to become entrepreneurs after hearing stories about other entrepreneurs, and embrace those stories as role models, eventually crafting for themselves a similar story. In part of the empirical research described below, the impact (on intention and ultimately, action) of a guest-lecture General Studies course was analyzed, in which every week an entrepreneur told his or her story, with brutal honesty, to a varied group of students. This course was created and initiated by 2011 Nobel Laureate Prof. Dan Shechtman over 30 years ago, reflecting his passionate belief that entrepreneurship could, and would, change the world. Hearing stories about startup can perhaps prove effective in creating, and opening, that initial window of curiosity and awareness.

The primary organizing framework for theorizing how students come to consider the startup option and for some is to come and embrace it, is the stage-gate model.

Stage-Gate Entrepreneurship

Innovative organizations all have robust idea-to-launch systems. One such system, proven successful, is known as Stage-Gate, implemented by such leading innovators as Procter & Gamble, 3M and Emerson Electric.

As described by its inventor and leading proponent, Cooper (2008), Stage-Gate comprises:

"... a series of stages–where the project team undertakes the work, obtains the needed information, and does the subsequent data integration and analysis, followed by gates where go/kill decisions are made to continue to invest in the project."

For science and technology students, the process of becoming a high-tech entrepreneur is similarly a series of gates, decision-points or *'doors'*, deciding a) whether, first, to enrol in a science and technology university, and next; b) once enrolled, to become aware of the option of eventually launching a startup, then; c) actually deciding to do so; d) acquiring the tools and knowledge needed to become an entrepreneur, and finally; e) launching a startup. In short: Preparation, Awareness, Intent, Action, and Success. This process can unfold over two decades or more.

Cooper (2008) notes that "*the innovation process is like a series of nested options, where each stage opens the door (or provides an option, not an obligation) to the next stage"*. This is also true of the decision to become an entrepreneur, as students advance from awareness, to intention, skill-building and action, exercising their option at each stage.

Universities that seek to foster entrepreneurship have ecosystems that impact all of these decisions. Essentially, the stage-gate process leading to a startup involves early preparation in high school, awareness of the entrepreneurship option, the intention to launch a startup and choose this option, learning tools that will be needed for doing so, and finally, actually launching a startup.

Startup Stage-Gates

A graphic portrayal of this stage-gate theory is shown in Figure 1.

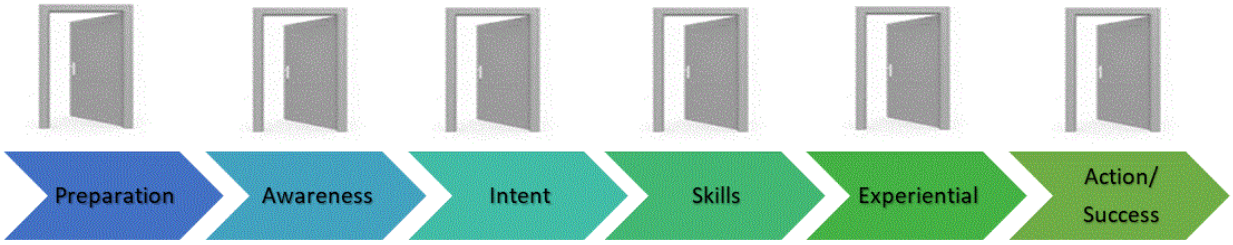

FIGURE 1
STAGE-GATE MODEL FOR UNIVERSITY ENTREPRENEURSHIP ECOSYSTEMS

Preparation

High school preparation has been an Achilles heel of Israeli entrepreneurship. Decreasing numbers of students have chosen high-level math studies that enable application to Technion and other science and engineering programs. Technion, the Ministry of Education and others have initiated programs to deal with this problem. Founding Singapore President Lee Kwan Yew famously told Singaporean mothers, shortly after his nation declared independence, to *"tell your children to study math in high school"*, so they can become engineers. The mothers did, their children listened–and Singapore enjoys great wealth today largely as a result.

Awareness

Students are made aware that they have the option of starting a business, in addition to taking a job as a wage-earner, by a variety of measures, including guest lectures by entrepreneurs. Of course, most Israeli students have read about, and heard about, leading entrepreneurs and billion-dollar exits. But on campus, this option is made real to them when they hear, see and sometimes meet leading entrepreneurs and hear their story, as in the Shechtman Entrepreneurship course described below (Appendix). In this and other venues, students begin to process the real possibility that they could become entrepreneurs.

Intent

Some students, after becoming aware of and familiar with the option of entrepreneurship, develop the intention to become one. Driving such intention are programs, in general, that involve simulations and action learning–3 day startups, hackathons, dream factory, etc. These programs, by making students aware of their abilities, passions, creativity and desires, can shape and strengthen the intent to become entrepreneurs, or conversely, dampen the desire, by

revealing the difficulties and very hard work and risks involved. At every stage, it is vital to inform students of the reality of entrepreneurship–long hours, sacrifices of family life, high risk of failure, and so on, so that the intention to launch a startup is based on reality and fact, rather than falsified idealized scenarios.

Role-modeling plays an important role in motivating entrepreneurship. Bruner (1991) has shown that "*we tend to understand reality and then shape our own reality by constructing narratives or stories"*. Students can shape their own narratives, toward entrepreneurship, by listening to the stories of real entrepreneurs and adapting their own narrative in those directions.

Skill Building

Acquisition of specific skills related to entrepreneurship: validation, business plan preparation, etc.

Experiential

Real-world simulations of the startup experience, includes three-day startups (intense compressed presentation and preparation, with mentors) and hackathons.

Action and Success

For those with the strong intent of becoming entrepreneurs, Technion supplies courses, mentoring and knowledge in general, that offers tools for improving the chances of success. For instance, the Biz-Tech competition, which is Israel-wide, enables 100 or more entrepreneurial teams to move forward with an idea, build a business plan, work on prototypes, and gain guidance from mentors, before pitching the idea to experts after the group is sorted down to the 10 most promising ideas. Some startup ideas in Biz-Tech do result in successful startups with VC funding. For those that do not, the experience in this year-long simulation is invaluable, and provides experience and tools that are later valuable when a new venture is born and built.

A strong caveat was added to the theory. Startup entrepreneurship is an art, not a science. While for some purposes it is helpful to model the process as a linear stage-gate one, in reality decision and intent to launch a business are not linear, and often involve non-linear steps forward, backward, and sideways, with considerable indecision.

HYPOTHESES

The three main hypotheses are:

Hypothesis 1: Entrepreneurship activities that have a strong experiential/action learning element are more impactful on students' ultimate startup actions than conventional courses or skill-building-focused events.

Hypothesis 2: An entrepreneurship event in which entrepreneurs recount to students their own personal stories, with strong truthfulness, including failures, mistakes, crises, mishaps and disasters, can be impactful on entrepreneurial intensions and actions.

Hypothesis 3: The stage-gate model of student entrepreneurial awareness, intensions and actions implies that an effective university entrepreneurship ecosystem needs a variety of activities, which focus on all the various stage-gates, from awareness through skill building and actions. Students have widely varying learning styles. A successful impactful university entrepreneurship ecosystem should include a wide variety of learning modes -- "different strokes for different folks".

METHODS

The entrepreneurial students who do launch startups have in principle gone through the stage-gate decision process before becoming entrepreneurs. It was sought to explore how the various resources available at Technion–courses, guest lectures, simulations, contests, mentoring, etc, influenced the actual decision to launch a startup. An on-line questionnaire was sent to some 10,000 Technion graduates asking them to describe how, and whether, and how, they were influenced by a variety of Technion entrepreneurship resources.

Through the questionnaire, it was determined which of the respondents actually launched a startup, and if so, which of the various Technion programs fostering entrepreneurship influenced them, and if they did, in what manner. This study thus adds an additional dimension to other studies that focus predominantly on entrepreneurial intent.

Sample

The sample consisted of Technion graduate students who belong to the Technion Alumni Organization. The survey was sent to a total of 10,826 alumni/ae for whom the Technion Alumni Organization had email address. Many of these emails were not updated since the years that they studied at the Technion. Some 444 alumni's answered the questionnaire. The participating individuals were on average 39.91 (standard deviation [SD]=9.94) years old. 83% were male. 50% of the survey respondents (222) participated in entrepreneurial activities during their studies at the Technion. 44% of them (98) participated in Prof. Schechtman's entrepreneurship course.

13 Likert-scale items (with scores ranging from 1-*"Did not have influence"* to 5-*"Had great influence")*, were used to measure the attitudes toward the degree to which the participation in the Technion's entrepreneurial activities contributed to their own entrepreneurial behaviour (Table 1: Questionnaire Influence Items).

Table 1
INFLUENCE OF ENTREPRENEURIAL ACTIVITIES (SCORED 1 TO 5)

Reinforce belief in yourself and your abilities
Develop an idea/invention that has horizon application
Explore options to implement an idea or an invention that you developed
Establishment of start-up company
Networking helped you advance in entrepreneurial direction
Patent application
Patent submission
Commercialize an idea/technology
Your professional path
Understand the additional tools, you need to acquire in order to promote your entrepreneurial ideas
Understand of the business environment
Understand how to promote your idea towards application
Develop an entrepreneurial mindset

In addition, the respondents were asked to specify their professional path since their graduation, which allowed us to track those who established companies.

RESULTS

Some 300 respondents filled out the career path part of the questionnaire. Of these, 62 (21%) said they had launched a startup. This is close to the percentage of alumni who launched startups, 25%, found in an earlier study (Frenkel and Maital, 2012a). About one-half of the respondents (160) stated they had engaged in some form of entrepreneurial activity at Technion.

Figure 2 shows visually the path followed by those who did, and who did not, launch startup, where the size of rectangles reflects the respective number of respondents. Entrepreneurial activity was split into: Biztech (a year-long competition); 3-Day Startup (an intense 3-day simulation of the startup process); *"Shechtman"* (the one-semester general studies course initiated by Prof. Dan Shechtman in 1987/8, in which guest entrepreneurs tell their stories); and *"other activities"* (Figure 2).

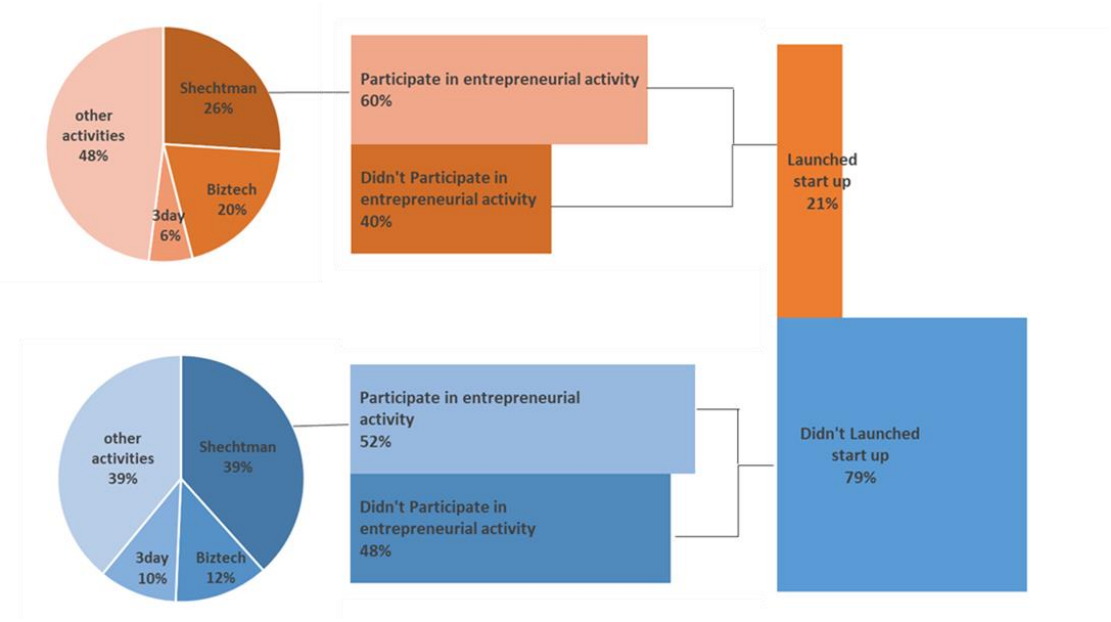

FIGURE 2
GRAPHIC PORTRAYAL OF RESPONSES FOR RESPONDENTS WHO PROVIDED CAREER INFORMATION N=300

Chi-square test was performed to determine the significant impact of Technion entrepreneurial activities, on the decision to eventually launch a startup (Table 2). Rows represented those who participated in no entrepreneurial activity (0), one entrepreneurial activity (=1) and two or more entrepreneurial activities (=2), and columns represented those who launched a startup (0=no, 1=yes).

Table 2
CHI-SQUARE ANALYSIS OF THE IMPACT OF TECHNION ENTREPRENEURIAL ACTIVITIES ON THE EVENTUAL DECISION TO LAUNCH A STARTUP

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Present	N	Present	N	Present
Q2 participate * Start-up1	301	67.80%	143	32.20%	444	100.00%

Q2_participate * Start-up1 Crosstabulation

	Count	Start-up1		
		0	1	Total
Q2_participate	0	113	25	138
	1	107	23	130
	2	19	14	33
Total		239	62	301

Chi-Square Test

	Value	df	Asymptotic Significance (2-Sided)
Person Chi-Square	10.803	2	0.005
Likelihood Ratio	9.249	2	0.01
Linear-by-Linear Association	5.123	1	0.024
N of Valid Cases	301		

The results showed that *"entrepreneurial activities"* do impact the decision to launch a startup, according to the perceptions of the respondents.

It was chosen to examine visually the relative impact of a variety of entrepreneurial activities, as evaluated by the students, on a Likert scale of 1 (no impact) to 5 (very strong impact). Three impactful activities were focused: The *"Shechtman course"* (a one-semester General Studies entrepreneurship course initiated by Nobel Laureate Dan Shechtman in 1987/8, featuring guest lectures by leading entrepreneurs and intended to increase awareness of entrepreneurial opportunities, and to some extent, to foster intension); Biztech, a national contest organized by Technion, in which teams work for a year to build a business plan, and 10 of the initial 100 teams are chosen for final presentations); this contest uses extensive mentoring and is in fact a dry-wet simulation, as some of the startups continue and raise money, while some do not, but the entrepreneurs gain valuable experience for their next effort; and the experiential *"Hackathon"* and 3 three-day startup, in which students' teams simulate launching startups in highly compressed time scales (one to three days total). The results are shown in Table 3 and in Figure 3.

It can be seen visually from Figure 3 that as expected, overall the three entrepreneurial activities have a far lower impact for those who did not do startup, than for those who did (this is almost a tautology, given the nature of the question). However, Figure 3 reveals as well that the experiential activities have major impact more on mindset, awareness and skills, than on narrower technical aspects such as patenting. This suggests that student entrepreneurial activities that *"open windows"*, i.e. make students aware of the possibilities to launch startups, and create the perception that a startup is indeed a career option, are important initial stage-gates; while the

more experiential activities translate awareness into intention, by showing students what the abstract notion of *"entrepreneur"* truly means in reality.

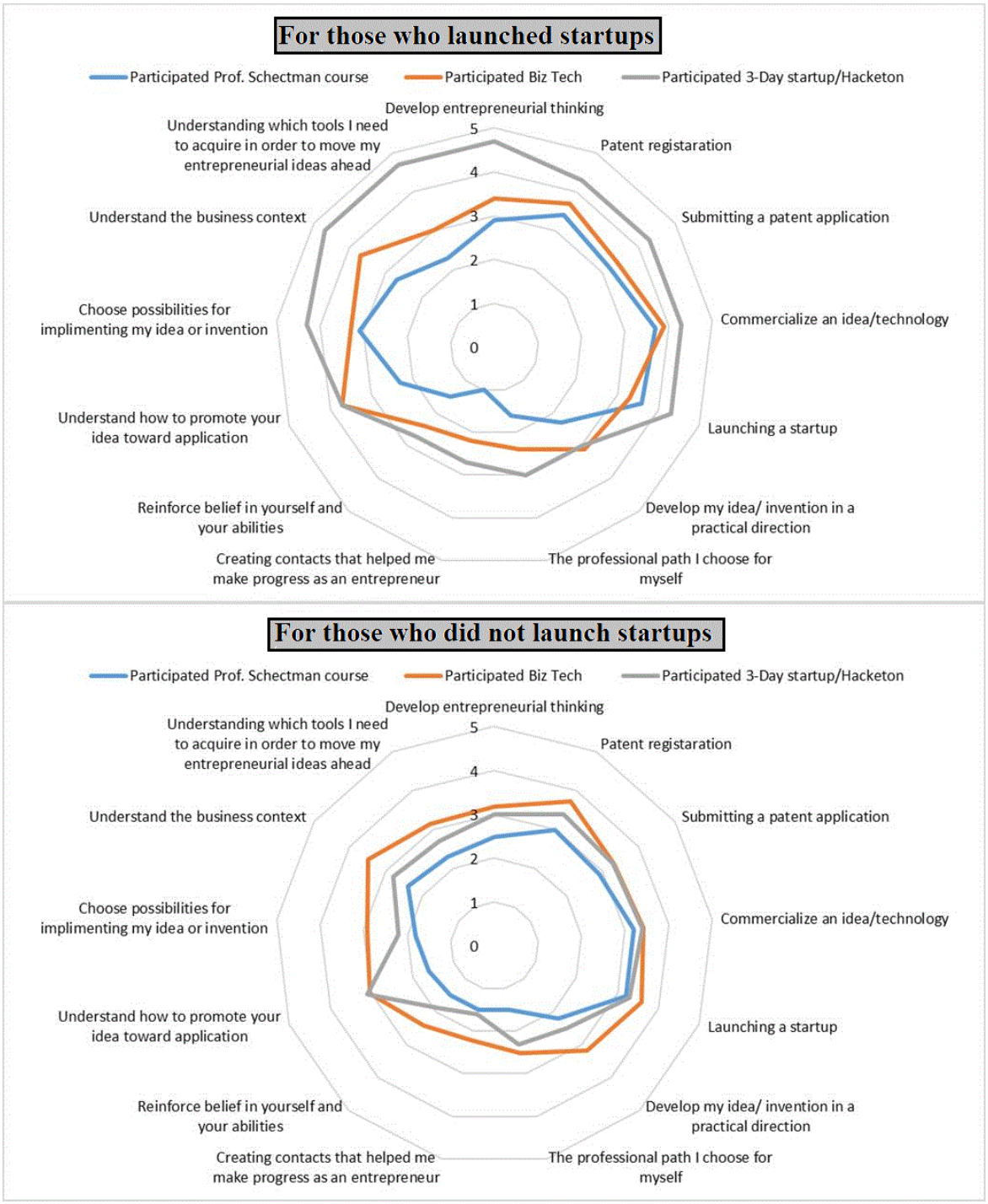

FIGURE 3
SELF-EVALUATED IMPACT OF ENTREPRENEURIAL ACTIVITIES ON THE DECISION TO LAUNCH A STARTUP; FOR THOSE WHO EVENTUALLY LAUNCHED STARTUPS VS. THOSE WHO DIDN'T

Table 3
AVERAGE SCORE AND STANDARD DEVIATION FOR EACH OF THREE CORE TECHNION ENTREPRENEURIAL ACTIVITIES (ON THE 1-5 LIKERT SCALE)–FOR ALL RESPONDENTS

	Participated Prof. Schectman course			Participated Biz Tech			Participated 3-Day startup/Hacketon		
	N	Average	STD.	N	Average	STD.	N	Average	STD.
1. Develop entrepreneurial thinking	91	2.6	1.19	34	3.1	1.42	71	3.2	1.45
2. Understanding which tools I need to acquire in order to move my entrepreneurial ideas ahead	91	2.3	1.16	34	3.0	1.38	66	3.0	1.51
3. Understand the business context	91	2.4	1.24	34	3.4	1.35	67	3.0	1.50
4. Choose possibilities for implementing my idea or invention	91	2.0	1.23	34	2.9	1.40	55	2.5	1.57
5. Understand how to promote your idea toward application	90	1.7	1.09	34	3.1	1.36	70	3.2	1.30
6. Reinforce belief in yourself and your abilities	91	1.5	0.91	34	2.2	1.44	43	2.0	1.53
7. Creating contacts that helped me make progress as an entrepreneur	53	1.5	0.97	34	2.0	1.30	36	1.7	1.23
8. The professional path I choose for myself	53	1.6	0.99	34	2.3	1.41	48	2.4	1.57
9. Develop my idea/ invention in a practical direction	92	2.2	1.32	34	3.0	1.38	56	2.5	1.50
10.Launching a startup	91	3.3	1.30	34	3.4	1.48	76	3.5	1.26
11.Commercialize an idea/technology	91	3.3	1.18	34	3.4	1.42	78	3.5	1.22
12.Submitting a patent application	90	2.9	1.35	34	3.2	1.32	76	3.5	1.37
13.Patent registration	91	3.0	1.33	34	3.6	1.42	74	3.5	1.25

Table 4
IMPACT OF ENTREPRENEURIAL ACTIVITIES FOR THOSE WHO LAUNCHED STARTUPS VS. THOSE WHO DID NOT: AVERAGE IMPACT SCORES FOR 3 ENTREPRENEURIAL ACTIVITIES

	Participated Prof. Shechtman course		Participated Biz Tech		Participated 3-Day startup/Hacketon	
	Launched startup	Did not Launched startup	Launched startup	Did not Launched startup	Launched startup	Did not Launched startup
1. Develop entrepreneurial thinking	2.9	2.5	3.4	3.19	4.7	3
2. Understanding which tools I need to acquire in order to move my entrepreneurial ideas ahead	2.3	2.3	3	3.15	4.7	2.7
3. Understand the business context	2.7	2.4	3.7	3.5	4.7	2.8

4. Choose possibilities for implementing my idea or invention	3.1	1.8	3.3	2.92	4.3	2.2
5. Understand how to promote your idea toward application	2.3	1.6	3.7	3.04	3.7	3.1
6. Reinforce belief in yourself and your abilities	1.5	1.5	2.4	2.42	2.7	1.9
7. Creating contacts that helped me make progress as an entrepreneur	1	1.5	2.2	2.2	2.7	1.6
8. The professional path I choose for myself	1.6	1.5	2.4	2.52	3	2.3
9. Develop my idea/ invention in a practical direction	2.3	2.2	3.1	3.19	3	2.5
10. Launching a startup	3.6	3.2	3.3	3.58	4.3	3.3
11. Commercialize an idea/technology	3.7	3.2	3.9	3.42	4.3	3.4
12. Submitting a patent application	3.2	2.9	3.4	3.31	4.3	3.3
13. Patent registration	3.4	3	3.7	3.73	4.3	3.4

Statistical significance of the differences in the mean Likert scores was tested, for each of the three entrepreneurial activities listed in Table 4, and for each of the 13 impact items in the questionnaire, for those who later launched a startup vs. those who did not. It was found that:

1. For the Shechtman course, the mean difference for items 4 and 5 was significant, $p<0.05$; that is, the General Studies course that brought entrepreneurs weekly, for a semester, to tell their stories, spurred participants to consider ways to implement their ideas and helped them understand how to implement them. Regarding the stage-gate model, this helped students advance from the raw idea stage to considering how to make it happen.
2. For Biz-Tech, the year-long mentored contest, the main differential impact (between those who launched startups and those who did not) was in item 5; spending a year working on a business plan clearly helped clarify how to implement an idea.
3. For the intense 3 Day Startup and Hackathon, items 1, 2, 3, and 4 showed significant differential impact-participants learned about the tools they would need, the business context, and the various possibilities for implementation, as well as how to think like an entrepreneur, for later startup entrepreneurs vs. those who did not launch a startup.

DISCUSSION

Hypothesis 1

The results largely confirm that experiential activities are most impactful. The sole caveat is that such activities are intense, intensive and in one case (*"Biztech"*) extend over almost an entire year, while a conventional course, for example, covers an hour or two for 14 weeks.

Hypothesis 2

The Shechtman course, as hypothesized, did play a role of an initial stage-gate (awareness), through the frank and truthful stories of entrepreneurs.

Hypotheses 3

The variety of responses and relatively high standard deviations of *'impact'* scores, do confirm that an effective university entrepreneurship ecosystem embodies a wide range of activities, reflecting large variations in student learning styles and interests.

Overall, with reference to the three hypotheses, it was found that there is general support for the stage-gate theory. *"Narrative"* activities ignite interest and awareness, experiential activities go on to spark intention and skill-building goals. Expectedly, experiential activities were strongly cited by those who went on to launch startups, as *hypothesis 2* suggested. Experiential events such as Biztech, Hackatthon, 3 Day startup, etc., in which students experience in a compressed time frame the translation of ideas to business plans, were influential; the *'narrative'* model, in which students simply heard the stories of entrepreneurs, was also impactful, mainly in building awareness; the stage-gate model, in which students' progress from curiosity to awareness through intention and decision, appeared valid; and the wide variety of entrepreneurial activities appeared suitable for the wide variety of learning styles of students.

The fairly high standard deviations of *'impact'* scores, shown in Table 3, do suggested that there is a wide variation among students in the way they learn and the way they absorb entrepreneurial narratives, skills and experiences.

The wide array of Technion entrepreneurial activities may appear to some as somewhat chaotic and disorganized. But in fact this decentralized model, in which a great many initiatives spring up and are tried, may in fact be optimal, and indeed, by a global study of best-practices among universities, it was found that universities distinguished for a high level of startup entrepreneurship among their alumni/ae do have similar *"chaotic"* ecosystems (such as MIT, Stanford, and others). By nature startup entrepreneurship is highly individualistic (though startups are often launched by small teams or two or three). Universities that seek to best achieve the "*third dimension*" of fostering startup may do well to treat the relevant activities as a kind of buffet-offer a wide selection of activities to students, *"market"* them effectively, make students aware of their options, and then, turn them loose.

In Table 5, selected comments by respondents were presented that amplify on their responses to the Likert scale questions. These comments reinforce the insight that there are very large differences across students, in the impact of various entrepreneurship-fostering activities.

Table 5
SELECTED COMMENTS BY RESPONDENTS

"*Shechtman*" Course
"[the course] showed me the inspiration for opening a startup, the faith and belief of the entrepreneur in his/her product, that brought the success I seek"
"I heard lectures by Uziah Galil and Stef Wertheimer and others (famed Israeli entrepreneurs), and I understand that is what I wanted to become".
"realizing the options"
"wonderful lectures that taught me a lot, success stories and failure stories that remain with me to this day"
"opened my mind to developing an idea, from idea to more advanced stages"
"a general view of the world of entrepreneurship"
Biz-Tech
"*We won first place in Biztech 2007, following that we launched Polytouch Medical, sold to Covidian in 2011 and now I lead Via Surgical Ltd."*

"Great impact-from it I went on to an Intel Global Challenge competition and won first place".
"Experience and deep understanding of the long process of launching a company"
Three-Day Startup/Hackathon
"Contributed a lot to understanding the business context, and finding and presenting to investors and entrepreneurs"
"This is the first thing that really 'stuck' me on the idea of technological entrepreneurship"
"This activity showed me how accessible the world of entrepreneurship is, it's not just a distant dream"
"My proposed idea was chosen and our team worked on it during the workshop. At present, the idea is in the process of being launched as a startup".

IMPLICATIONS AND FUTURE DIRECTIONS FOR RESEARCH

The stage gate theory can perhaps add a new dimension to the efforts to measure the impact of university entrepreneurship programs. Luehrman (1998) has shown that the financial theory of options can be applied to a wide variety of investments that are *'staged'*. The Black-Scholes equation that measures the value of financial options can be adapted, Luehrman (1998) showed, to measure the value of staged investments. Perhaps, too, it can ultimately measure the value of university entrepreneurship education, as it creates real options through impacting awareness, intensions, skills, and ultimately actions. The five parameters needed to implement the Black-Scholes option valuation formula can possibly be translated to the context of entrepreneurial options.

It is believed that this research has revealed a possible lacuna in university entrepreneurship activities. The experiential activities are indeed powerful. But perhaps much more can and should be done, to improve the odds of launching a successful startup. Earlier, the daunting odds against launching a successful startup were cited. For Israel, 1999-2007, of some 5,400 active startup, only 139 can be defined as fully successful (2.5%), based on revenue, growth and return on investment[6]. Given these odds, which students are largely aware of, it is rather incredible that so many choose to leave well-paying jobs and launch startups despite them. Can universities do more to help students acquire crucial management tools that increase the chances of success? It is believed they can. A key implication, and corollary, is this: The most effective way universities can foster entrepreneurship among their students is to offer well-mentored experiential simulations of the startup process

The most effective experiential ways to impart startup skills, at universities, for those with *"fire in their belly"*, could be a fruitful subject for future research.

[6] Source: IVC Research Center, 2015. "*Israeli Startup Success Report 1999-2014*". IVC Research Center: Tel Aviv. 5 pages.

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