Connection between Entrepreneurial Skills and Intelligences of High-Tech Entrepreneurs

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Abstract

The uncertainties and risks of high-tech ventures are well known, and, despite the increasing number of start-up companies founded annually, few survive. This study examines the correlation between the entrepreneurial skills and multiple intelligences of entrepreneurs, as well as their influence on success in high-tech ventures. The theoretical foundation of the study is based on Salamzadeh and Kirby's (2017) venture-creation model and Gardner's (1983) multiple-intelligences theory. A convenience sample of three hundred entrepreneurs (281 men, 19 women) in different stages of their ventures was evaluated via an online Qualtrics questionnaire. The results indicate that the most successful entrepreneurs have the highest levels of logical intelligence but also the lowest levels of linguistic, intrapersonal, and interpersonal intelligences. Entrepreneurial skills were found to be related to all types of intelligences, as well as to success in entrepreneurial ventures. The study adds to the limited literature on the connection between personal characteristics and the success of entrepreneurial startup companies, and may contribute to improving entrepreneurship education programs. Future research is needed to examine other characteristics of both successful and unsuccessful entrepreneurs across a wider range of venture stages.

Keywords: entrepreneurial skills, high-tech, multiple intelligences, startup

1. Introduction

1.1 Problem Statement

This study will define and describe the entrepreneurial skills and multiple intelligences of successful entrepreneurs, and examine their contribution to entrepreneurial success. The past three decades have witnessed a continuous increase in the number of technological startups founded each year, yet few of these companies have survived. Uncertainty and risk in the field of entrepreneurship are high, and approximately 90% of startup ventures ultimately fail (Lin *et al.*, 2019). The premise of this study is that entrepreneurship expresses a value-based worldview and includes a set of skills and capabilities that may be improved by increasing awareness and participating in a designated course of training and experience. This study attempts to isolate the various characteristics of successful entrepreneurs. In this way, promising young businesspeople will be more readily identified, and investment in programs supporting future entrepreneurs will be encouraged. As part of more extensive research exploring the various skills and characteristics that are related to the success of high-tech entrepreneurs, this study looks at the connection between multiple intelligences and the success of creative ventures. This study presents the initial findings regarding these correlations and discusses possible implications for entrepreneurship education programs.

1.2 Background

"Entrepreneurship" has been defined and described as finding new and creative solutions for dealing with difficult challenges at all levels of society, by observing problems from different angles and using novel combinations of resources in both established and startup companies. Methods of coping with these challenges in both the national and international realms, have been explored and described (Karlsson *et al.*, 2021). Other definitions of entrepreneurship refer to the process of developing ideas into products and services, and launching ventures to promote these products and services in the marketplace (Bronstein, 2014). This process requires risk-taking, innovation, and creativity. The concept of entrepreneurship and its practical and financial implications are discussed in the literature (Galvão *et al.*, 2018). Entrepreneurship, in its wider sense, currently encompasses innovativeness,

creativity, realization of personal and national potential, and occasionally, the meeting of societal or environmental needs.

Recently, more studies have been taking a wider view of the factors contributing to the maturity, the success, or the failure of ventures by integrating different points of view (Zaheer *et al.*, 2019). One study on the success of ventures launched with the support of venture incubators shows that the two most important predictors of success are funding and prior experience of the entrepreneurs as independent actors (Messina & Hochsztain, 2015). Another study found that venture success was dependent on prior collaboration with venture capital firms, and type of exit (Wang *et al.*, 2022). The impact of multiple intelligences on entrepreneurship has also been the subject of recent research. This study explores the entrepreneurial skills and types of intelligences that characterize successful businesspeople; the ways these factors affect each other; and their impact on the success of the ventures themselves.

1.3 Related Literature and Scholarship

Over the years, research has studied the roles of innovativeness, excellence, risk taking, self-efficacy, self-confidence, locus of control, and the ability to work in a team. Many studies show that being proactive, taking risks, and innovativeness are key contributors to entrepreneurial success (Yasier *et al.*, 2018). The literature also confirms the impact of entrepreneurial intentions on the behavior of business students (Yasir *et al.*, 2018), on the success of their ventures (Duchek, 2018; Kim *et al.*, 2018), and on their social intelligence (Wu & Wu, 2019).

Venture creation requires the ability to locate marketing opportunities while coping with a high degree of uncertainty. This means that venture developers must expand their spheres of contacts in order to gain access to necessary resources, a process best achieved via the development of social capital. Companies that succeed in doing so usually achieve better results than those who do not (Baum *et al.*, 2000). The research indicates that personal equity indirectly affects the success of startup companies by creating social capital. In addition to the organizational characteristics of the company, it is also necessary to examine the micro-characteristics of company employees. These variables include management traits, entrepreneurial skills, and the internal culture of the company (Bronstein, 2014). Many studies have shown that these variables contribute greatly to understanding the survival of organizations, and are the focus of organizational theories and the theory of human capital (Duman, 2018).

As with entrepreneurship, it is easier to identify intelligence than to define it. Different researchers provide their own definitions of the term. In the past, intelligence was associated with intellectual ability, as measured by standard IQ tests. In the early 1990s, the term was reconceptualized, and intelligence was defined as a combination of several distinct abilities. According to this approach, intellectual development is not a single process, but is influenced by one's cultural and social environment (Bordei, 2017). The theory of multiple intelligences is based on the assumption that each person has a dynamic individual set of intelligences that may be defined, described, and measured, and which change in accordance with one's personal development and human environment. Use of a specific intelligence may boost other intelligences; thus, each person has the opportunity to identify and raise all their intelligences, which provides a foundation for personal development (Gouws, 2007).

Studies examining Gardner's multiple intelligences found correlations between linguistic, spatial, and mathematical intelligences and academic success (Ahvan & Pour, 2016; Yavich & Rotnitsky, 2020). Malekian and Maleki (2012) found correlations between linguistic intelligence, movement-kinesthetic intelligence, and entrepreneurial drive among students. A link was also discovered between social intelligence and entrepreneurial skills (Wu & Wu, 2019). While most of the studies in this field explored the future entrepreneurial intentions of students, our study examines possible correlations between Gardner's intelligences and the prediction of success for entrepreneurs who are already involved in high-tech ventures.

1.4 Theoretical Framework

This study explores the relationship between Gardner's multiple intelligences and successful completion of a high-tech venture life cycle, according to the model presented by Salamzadeh and Kirby.

1.4.1 Theory of Multiple Intelligences

Gardner (1983): Gardner defines intelligence as the ability to solve problems and create products in a contextualized natural environment. Gardner contends that it is possible to improve and develop various intelligences that were acquired in certain environments by exposure, stimulation, and training, and that the higher the motivation, the higher the level of intelligence that will be reached. He divides human abilities into seven different types of intelligences; understanding and using a rich vocabulary and connecting words and expressions (linguistic intelligence); understanding the role of numbers in mathematical constructions (logical–mathematical intelligence); grasping and creating shapes, as well as manipulating and joining them in various ways (spatial intelligence); playing,

understanding, and creating music (musical intelligence); controlling one's body and its movements (kinesthetic intelligence); being sensitive to the moods, feelings, and intentions of others (interpersonal intelligence); and being aware of one's own feelings and behavior (intrapersonal intelligence). In the late 1990s Gardner later expanded his theory to include naturalist and existential intelligences and added mental searchlight and laser intelligences in 2004 (Gardner, 2011).

1.4.2 Model of New Venture Creation

Salamzadeh and Kirby (2017): Various models describing typical phases of organizational development were first proposed in the 1970s. This study utilizes Salamzadeh and Kirby's model of venture creation, which focuses on the initial development phases of the entrepreneurship process. Seven phases were defined, from the initial idea through the preliminary measures, to the exit or decision to establish the venture. The phases are defined as follows:

1. **Venture idea/opportunity**: a new idea that motivates the entrepreneur to start a new venture (startup).

2. **Entrepreneurial intention**: The creation of new ventures requires entrepreneurial intention and direction.

3. **Preparation**: Entrepreneurial intention is defined as the commitment to establish a new business.

4. **Networking**: Business networking is needed to launch a successful venture.

5. **Entry**: the attempt to market products or services.

6. **Value creation**: This is an inseparable part of preparing for a new venture. The more value created, the higher the venture's chances of success.

7. **Exit:** deciding on an exit strategy (merger and acquisition, first public stock issue, etc.). At the end of this stage and depending on the decision that is reached, either an organization is initiated or the venture is sold and the entrepreneur ceases to be involved in the process.

1.5 Research Objectives

While various aspects of entrepreneurship have been studied with regard to various populations of academic students, very little research exists on entrepreneurs in the actual business world. As part of a more extensive study, this research explores the relationship between Gardner's multiple intelligences and successful completion of a high-tech venture life cycle according to Salamzadeh and Kirby's model. This study defines successful entrepreneurs as those who have reached the final (exit) stage of the venture with a large number of employees. The study explores the following questions: (a) Are skills and intelligences related to the degree of entrepreneurial success? (b) Does a correlation exist between entrepreneurial skills and multiple intelligences? The study emphasizes the need for further research regarding the actual business world, which may inspire new curricula for entrepreneurship education programs.

2. Method

We used a quantitative approach in order to examine the entrepreneurial skills and intelligences of successful high-tech entrepreneurs. The purpose of the study was explained to each participant by email before providing a link to the questionnaire, and again in more detail at the beginning of the questionnaire itself.

2.1 Participants

Only individuals involved in high-tech ventures were included in the study. Potential participants received, via email, a link to a questionnaire. Three hundred Israeli high-tech entrepreneurs (281 men, 19 women), aged 24–75 (M = 46.35; SD = 10.89) agreed to complete the questionnaire. Information was provided and collected anonymously, and respondent confidentiality was strictly maintained. Participants had the option of providing an email address for receiving research results.

2.2 Sampling Procedures

A convenience sampling method was used to gather information from entrepreneurs in various venture stages. Notices were posted in a variety of high-tech forums, including entrepreneur groups on Facebook, and technological entrepreneurs received messages via LinkedIn. Owners of startup companies were sent personal invitations, and additional potential participants were located in research centers or notified by word of mouth. This sampling strategy was chosen due to the difficulty in reaching designated participants and the very low response rate reported in previous studies with similar populations. Novice entrepreneurs were approached via invitations sent to personal acquaintances, and snowball sampling was used as well.

2.3 Research Design

Data were collected by sending entrepreneurs an email message with a short description of the study, its purpose and eligibility, and a request to complete several online questionnaires. Contact details of the researcher team were included for full transparency and to avoid the message being mistaken for spam. A total of 3,856 email messages were sent to entrepreneur email addresses retrieved from a professional database, and an additional unknown number of email messages were distributed via social networks and by word-of-mouth. Of the email messages sent directly by the researchers, 1,688 messages were returned with an error message (could not be sent). The questionnaire was accessed by 748 individuals, but only 300 completed all 62 questions and were included in the quantitative analyses. The questionnaires were analyzed using Qualtrics software.

2.3.1 Multiple Intelligences Profiling Questionnaire III (MIPQ III)

The scale, which is based on Gardener's theory, was first developed in 2002 by Tirri and Komulainen. For the current study, the short 2013 version was used, which includes 28 statements (Tirri *et al.*, 2013). The scale explores seven multiple intelligences: linguistic, logical–mathematical, spatial, musical, movement–kinesthetic, social interpersonal, and intrapersonal. The questionnaire was administered in English. Respondents were asked to grade a series of statement on a 5-point Likert scale (strongly agree = 5; strongly disagree = 1). The internal consistency method showed high reliability, with the following values for Cronbach's alpha for each of the intelligences: linguistic, α = .71; logical mathematical, α = .75; spatial, α = .70; musical, α = .90; movement kinesthetic, α = .85; social interpersonal, α = .86; and intrapersonal, α = .77. The questionnaire generated seven scores, one for each of the intelligences.

2.3.2 Entrepreneurial Skills (ES) Scale

This questionnaire, which includes 34 statements, was developed by Yilmaz and Sünbül. The survey explores seven skills that are relevant for entrepreneurship: striving for excellence, innovativeness, risk taking, self-efficacy, self-confidence, teamwork, and locus of control (Yilmaz & Sünbül, 2009). Respondents were asked to grade the statements on a 5-point Likert scale (5 = very often; 1 = never). High reliability was found, using the internal consistency method, with a value of .80 for Cronbach's alpha.

2.3.3 Questionnaire for Information on the Venture

Respondents were asked to provide information about their professional background (their role in the venture, previous experience, participation in courses, mentor/entrepreneurship incubator) and about the venture status (field of activity, year of establishment, number of employees, stage in the model, funding sources).

2.3.4 Personal Information Questionnaire

Respondents were asked to provide personal information (age, gender, place of residence, birth order, education, parents' education, entrepreneurial experience), as well as the history and current status of their venture (area of activity, year since founding/entry, number of employees, etc.). The estimated time needed to complete the survey was 15 minutes.

3. Results

3.1 Recruitment

A total of 300 entrepreneurs from Israel agreed to complete the questionnaires. Consistent with statistics in the realm of high tech, most of the respondents (94%) were male and aged between 24 and 75 years (M = 46.35; SD = 10.89). Of the participants, 78% reported that they held an academic degree (90 bachelor's degrees, 109 master's degrees, and 36 doctoral degrees).

3.2 Analytic Strategy

Bivariate Pearson correlations were computed for all research variables using IBM SPSS Statistics software, version 24. A power analysis was conducted using G*Power 3 software (Faul *et al.*, 2007), assuming that a = .05, N = 400, and that the medium effect size is 0.35 for analyses of correlations. The results of the analysis indicated a high power of 0.95. In the main analysis, a path method was used to examine associations between the latent factor of multiple intelligences, the observed factor of entrepreneurial skills, and entrepreneurial success in high-tech ventures. Success in high-tech ventures was examined by binary success (success = stage 7 with more than 100 employees) and by the continuous score of the number of employees. This was a mix of structural equation modeling (SEM) and path analysis, as it included both latent and observed factors. We first examined the measurement model that validated the latent factor of multiple intelligences, which was constructed from the multiple intelligences. In the measurement

model, the correlations between the multiple intelligence indicators were computed.

Several indices were employed to determine whether the hypothesized models fit the data. Good model fit is indicated by lower χ^2 goodness-of-fit values such as a comparative fit index (CFI) or normed-fit index (NFI) greater than .90; or a root mean square error of approximation (RMSEA) below .09 (Zhang *et al.*, 2007), with values less than .06 preferred (Hu & Bentler, 1999).

3.2.1 Group Differences in the Multiple Intelligences of Entrepreneurs

The first hypothesis predicted a significant difference between the entrepreneurial skills and intelligences of successful and less successful entrepreneurs. The hypothesis was tested by a multivariate analysis of variance (MANOVA) for multiple intelligences and a univariate analysis of variance (ANOVA) to examine the differences in entrepreneurial skills between both groups. The study examined a group of entrepreneurs and compared the characteristics of those who were successful in their ventures with those who were less successful. The findings demonstrated an overall difference between the groups regarding the variable of entrepreneurs' multiple intelligences, $F(7, 292) = 3.49$, $p = .001$. The dependent variables in Table 1 show group differences regarding the logical and linguistic intelligences, as well as the intrapersonal and interpersonal intelligences. Successful entrepreneurs reported lower levels of linguistic, intrapersonal, and interpersonal intelligences, and higher levels of logical intelligence than the group of less successful entrepreneurs.

Analysis of the measurement model, validating the latent factor of entrepreneurs' multiple intelligences and the relationship between the indicators, resulted in acceptable indices of fit, with $\chi^2(5) = 19.87$, $p = .003$, CFI = .96, NFI = .95, and RMSEA = .072 (CI 90% .033, .111). The latent factors of entrepreneurs' multiple intelligences were significantly represented by all three indicators (all at $p < .01$), except for logical intelligence (which was poorly loaded: -.03, $p = .900$) with standardized coefficients between .445 and .579. All indicators were correlated. The latent construct was represented by all indicators.

Next, we examined the theoretical path. The model provides excellent representation of the data, with $\chi^2(23) = 72.52$ $p < .001$, CFI = .91, NFI = .91, and RMSEA = .088 (CI 90% .067, .110). Figure 1 presents the standardized coefficients of the model. All specific intelligence factors were loaded significantly (between .443 and .710, the value of p is always less than .001). As depicted in Table 1, higher values of multiple intelligences were associated with fewer employees and with less success (these values are less dominant in the successful group of entrepreneurs). A higher value of entrepreneurial skills was related to a greater number of employees and greater success (and was more characteristic of successful entrepreneurs).

Table 1. Differences in intelligences between successful and less successful entrepreneurs (2022)

	Successful entrepreneurs (N = 22)	Less successful entrepreneurs (N = 278)	F(1, 298)	P
Linguistic	2.77 (.74)	3.17 (.76)	5.65*	.018
Logical	4.42 (.54)	4.07 (.73)	4.84*	.029
Spatial	3.67 (.69)	3.67 (.70)	.000	.990
Musical	3.02 (1.21)	3.27 (1.16)	.980	.323
Kinesthetic	3.75 (.94)	3.70 (.94)	2.435	.120
Intrapersonal	3.41 (.80)	3.96 (.76)	10.739*	.001
Interpersonal	3.24 (.77)	3.65 (.71)	6.578*	.011

* $p < .05$

3.2.2 Multiple Intelligences and Entrepreneurial Skills

The second hypothesis predicted a significant correlation between multiple intelligences and entrepreneurial skills. Pearson tests were conducted in order to explore this hypothesis. An analysis of the results supports the hypothesis. Entrepreneurial skills were found to be significantly and positively associated with all types of multiple intelligences, so greater entrepreneurial skills are associated with higher levels of all types of intelligences. The correlations are

presented in Table 2.

Table 2. Correlations between entrepreneurial stages, entrepreneurial skills, and intelligences (2022)

	Model Stage	Linguistic	Logical	Spatial	Musical	Kinesthetic	Intra-personal	Inter-personal	Skills
Model Stage									
Linguistic	0.02								
Logical	0.03	-0.10							
Spatial	-0.03	0.30***	0.36***						
Musical	-0.01	0.33***	-0.03	0.29***					
Kinesthetic	-0.00	0.21***	0.32***	0.48***	0.24***				
Intra-personal	-0.06	0.32***	0.04	0.18**	0.25***	0.31***			
Inter-personal	-0.12	0.48***	0.10	0.30**	0.15*	0.16**	0.32***		
Skills	0.03	0.23***	0.32***	0.36**	0.20***	0.38***	0.36***	0.36***	

*$p < .05$. **$p < .01$. ***$p < .001$

3.2.3 Research Model—Predicted Correlations between Multiple Intelligences, Entrepreneurial Skills, and Entrepreneurial Success

The structural model used to examine the research model included predictor variables: multiple intelligences and entrepreneurial skills were the independent variables, while dichotomous entrepreneurial success and the number of employees were the dependent variables. Moreover, the model included the measurement errors of the outcome variables. The model's goodness of fit indices indicated good fit of the sample data, with $\chi^2(23) = 125.05$, $p < .001$, CFI = .83, NFI = .80, and RMSEA = .12 (CI 90% .098, .139). Figure 3 presents the model's coefficients. Notably, all the factors of the multiple intelligences were significantly loaded on the latent variable (with values ranging from .2345 to .609 that were all significant and $p < .001$). Evidently, higher levels of multiple intelligences are associated with a lower number of employees and with less success. In contrast, higher levels of entrepreneurial skills are associated with more employees and with greater success.
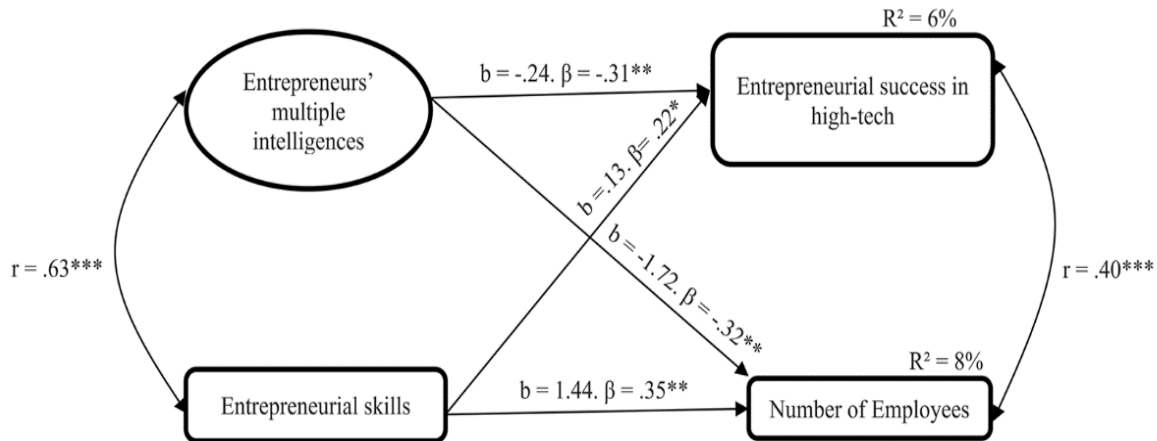
Figure 1. Research model—correlation between multiple intelligences, entrepreneurial skills, and entrepreneurial success,⸸ 2022.

Note. The multiple intelligences variable appears in a circle because it is a latent factor.
*p < .05. **p < .01. ***p < .001

⸸ All pathways in the model are significant, and the values are gross (b) and standardized (ß). The values are included above the one-way arrows and next to the two-way arrows (r). The percentage of explained variances (R^2) appears above the dependent variables in the model.

4. Discussion

This study examines the correlation between entrepreneurial skills and multiple intelligences in successful real-life high-tech ventures. We defined "successful entrepreneurs" as those with one or more ventures reaching the exit phase, or businesses with over 100 employees. The research hypotheses were partially confirmed. Our first hypothesis, that different intelligences yield varying levels of success in high-tech ventures, was shown to be accurate. We found that successful entrepreneurs demonstrated significantly higher levels of logical intelligence but lower levels of linguistic intelligence, as well as high levels of intrapersonal and interpersonal intelligence. No significant relationships were found regarding spatial, musical, or kinesthetic intelligence. The existing literature does not include studies that tested the exact combination of intelligences and skills as in the current study with an identical population of entrepreneurs. Similar studies have examined multiple intelligences and specific entrepreneurial skills in more accessible populations (such as students with entrepreneurial ambitions) and have found contradictory findings. Malekian and Maleki (2012) found a correlation between multiple intelligences and entrepreneurship among students, but, when examining the separate intelligences, they found a significant positive relationship between linguistic, kinesthetic, and interpersonal intelligences and entrepreneurship. Conversely, they found no such relationship with spatial, musical, intrapersonal, or logical intelligences. The second hypothesis was confirmed: Greater entrepreneurial skills were associated with higher levels of all types of intelligence. This result is consistent with other studies, including the study by Wu and Wu (2019), who found a positive correlation between social intelligence and entrepreneurial skills in college students.

Most studies on technological entrepreneurship have included various populations of academic students in areas perceived to be tied to technological fields, such as the exact sciences and business administration. This study, however, explores entrepreneurs who are currently active in high-tech ventures. It adds to the existing body of knowledge through its investigation of the cognitive factors leading to successful high-tech entrepreneurship.

5. Recommendations

The phenomenon of venture creation is evident in many areas of life, including entrepreneurship programs currently offered by many universities. Therefore, cutting-edge findings on intelligences and personality traits as they relate to venture creation is vital to universities as they hone and improve incubator curricula. Future studies may rely on the findings in the current study for the development of a tool that will predict the chances of novice entrepreneurs succeeding in high-tech start-ups (Guo, 2021).

Our findings emphasize the importance of cultivating these skills and developing intelligences in entrepreneurial programs. For instance, the inclusion of logical thinking and entrepreneurial abilities may contribute to greater success in future ventures. However, the need remains to fully investigate the effectiveness of programs that encourage entrepreneurship in aiding the success of high-tech entrepreneurial ventures.

Due to the difficulty in finding inactive entrepreneurs, most of the individuals who responded to the online questionnaires were in advanced stages of their ventures (stages 4 and up according to Salamzadeh and Kirby's model) or had not succeeded in previous ventures but were already involved in a new one. Therefore, the generalizability of the research findings is somewhat limited, as it is based on a heterogeneous sample with relatively little variance. Future studies will need to sample a larger group of unsuccessful entrepreneurs who did not pursue other ventures. The large number of questions and the relatively lengthy time needed to fill out the questionnaire also reduced the number of individuals willing to participate in the study. Reducing the number of questions should solve this issue. In addition, the data collected are based on self-assessment reports. While self-reported data are recognized as reliable and common in this field of research, future studies may achieve more reliable results if based on a variety of data-collection methods and not only self-reports.

This study adds to the existing body of knowledge and suggests avenues for further improving entrepreneurial skills programs. The findings show that, in order to improve the efficacy of academic programs in this field, creators of future programs must focus of strengthening logical intelligence, in addition to improving entrepreneurial skills. Another possible application is to assist in the development of screening tools for admitting students to university entrepreneurship programs. Future research is needed to examine other characteristics of successful entrepreneurs across a wider range of venture stages, as well as to explore those characteristics which may encourage failure. In addition, it should be noted that all study participants were Israelis. Since entrepreneurial skills and intelligence may be influenced by national culture (Lounsbury *et al.*, 2019), it will be necessary to conduct further studies in different cultural contexts.

6. Conclusion

Entrepreneurship is a major part of today's reality, and entrepreneurial skills are needed in varied fields. The main recommendation that emerges from the findings is for entrepreneurship development curricula to place greater emphasis on two main areas: developing, encouraging, and implementing entrepreneurial skills, and strengthening logical and mathematical thinking. By encouraging striving for excellence, innovativeness, risk taking, self-efficacy, self-confidence, teamwork, and by focusing on the cultivation of innovative and entrepreneurial solutions, these programs will be better able to prepare emerging entrepreneurs. Further studies are needed to examine how personality traits and different intelligences may be related to the degree of success of high-tech entrepreneurs at the most advanced levels of their ventures.

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