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The Entrepreneurial Intentions of Graduate Students in the Natural Sciences:
Evidence from Japan and Korea

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Abstract

The purpose of this study is to examine the influence of Japanese and Korean cultural background on the entrepreneurial intentions of graduate students majoring in natural science fields. We surveyed 298 graduate students from two Japanese and two Korean universities and used a variation of the Theory of Planned Behavior to analyze the effect of various factors on respondents' intentions to launch a startup in the future. We found that attitude had a positive impact on Japanese graduate students' entrepreneurial intentions, while attitude and the personality trait of innovation had a positive impact on Korean graduate students' entrepreneurial intentions. Our results suggest that university entrepreneurship education does

not influence graduate students' entrepreneurial intentions in either Japan or Korea, pointing to a need for more effective entrepreneurship education for graduate students in the natural sciences. Based on the results of this study, we propose measures that would make entrepreneurship education more effective in Japan and Korea by taking attitude, personality traits, and cultural factors into account.

Keywords

student startup, entrepreneurship, entrepreneurial intention, graduate students, Japan, Korea

Abstract in German

Das Ziel dieser Studie besteht darin, den Einfluss des japanischen und koreanischen kulturellen Hintergrunds auf die unternehmerischen Absichten von Graduierten in naturwissenschaftlichen Fächern zu untersuchen. Wir haben 298 Graduierten von zwei japanischen und zwei koreanischen Universitäten befragt und eine Variation der Theorie des geplanten Verhaltens verwendet, um den Einfluss verschiedener Faktoren auf die Absicht der Befragten, in Zukunft ein Start-up zu gründen, zu analysieren. Wir fanden heraus, dass die Einstellung einen positiven Einfluss auf die Gründungsabsichten der japanischen Graduierten hatte, während die Einstellung und das Persönlichkeitsmerkmal Innovation einen positiven Einfluss auf die Gründungsabsichten der koreanischen Graduierten hatten. Unsere Ergebnisse deuten darauf hin, dass die universitäre unternehmerische Ausbildung weder in Japan noch in Korea einen Einfluss auf die unternehmerischen Absichten von Graduierten hat, was auf die Notwendigkeit einer effektiveren Unternehmertumsausbildung für naturwissenschaftliche Graduierten hinweist. Basierend auf den Ergebnissen dieser Studie schlagen wir Maßnahmen vor, um die unternehmerische Ausbildung in Japan und Korea unter Einbeziehung von Einstellungen, Persönlichkeitsmerkmalen und kulturellen Faktoren effektiver zu gestalten.

Summary highlights

Contributions: This study contributes to the understanding of how cultural backgrounds in Japan and Korea influence the entrepreneurial intentions of graduate students in natural science fields. It examines the role of attitudes, personality traits, and entrepreneurship education in shaping entrepreneurial intentions and suggests practical improvements for entrepreneurship education in both countries.

Research questions/purpose: The purpose of the study is to analyze the impact of Japanese and Korean cultural backgrounds on the entrepreneurial intentions of graduate students in the natural sciences. It focuses on how various factors, including attitude, subjective norms, perceived behavioral control, personality traits, and entrepreneurship education, affect students' intentions to start a business.

Basic methods and information/data: The study surveyed 298 graduate students from two universities in Japan and two in Korea. Using a modified version of the Theory of Planned Behavior, it analyzed the influence of several factors on the students' intentions to launch a startup.

Results/findings: The findings show that attitude positively affects entrepreneurial intentions among Japanese students, while both attitude and the personality trait of innovativeness positively influence Korean students' entrepreneurial intentions. Notably, entrepreneurship education was not found to significantly influence the entrepreneurial intentions of students in either country.

Limitations (if any): The study's results are limited by the small number of universities included, which may affect the generalizability of the findings. Additionally, the study does not evaluate the impact of specific entrepreneurship education programs, limiting its ability to make definitive recommendations.

Theoretical implications and recommendations for future research: This study adds to the literature on entrepreneurial intentions by showing the influence of cultural and personality factors on students in Japan and Korea. Future research should broaden the scope to include more universities and countries, and also focus on specific entrepreneurship education interventions.

Practical implications for management and recommendations: Entrepreneurship education in Japan and Korea should be redesigned to be more effective, particularly by enhancing students' attitudes and fostering innovation. Practical, real-world experiences, such as virtual entrepreneurship simulations, could be introduced to make these programs more impactful.

Policy implications and recommendations (if any): The Japanese government should increase funding for entrepreneurship education, focusing on providing more practical and hands-on programs. Extending entrepreneurship education to students in natural sciences, not just business students, is critical for fostering innovation-based startups.

Suggestions for future research avenues: Future studies should explore entrepreneurial intentions across a wider range of countries and academic institutions, particularly within other Asian countries, to better understand the role of cultural and institutional factors in shaping entrepreneurship.

Author contributions

The study's conception, design, material preparation, and data collection were performed by Kensuke Inai, Takayuki Sakai, Kenji Kutsuna, and Hyung Jun Kim. Analysis was performed by Kensuke Inai, Takayuki Sakai, Yukichi Shimizu and Kenji Kutsuna. The first draft of the manuscript was written by Kensuke Inai and all authors commented on previous versions of the manuscript. All authors have read and approved the final manuscript.

Statements and Declarations

Ethical approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 WMA Declaration of Helsinki and its later amendments or comparable ethical standards.

Conflict of interest

The authors have no relevant financial or non-financial interests to disclose.

Data availability

Data will be available upon reasonable request from the corresponding author.

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1. Introduction

The role of universities has changed as the importance of knowledge utilization has increased compared with the days when the driving force of economic growth was physical capital and unskilled labor (Audretsch 2014). Today, universities are expected not only to teach and conduct research, but also to contribute to economic development through industry-government-academia collaborative activities in a networked society (Pronay et al. 2022; Sakai et al. 2022) and the creation of new firms and industries (Etzkowitz et al. 2000; Guerrero & Urbano 2012).

One of the primary roles of universities in educating students is to provide them with the knowledge and skills to become successful job seekers in society or independent entrepreneurs who are job creators (Guerrero et al. 2016; Audretsch 2014). With the changing role of universities in society, and the prospect that graduates at all levels of higher education will not be able to secure sufficient employment in the future, it is becoming more important to change the focus of university graduates from job searching to entrepreneurship as a basis for eventual job creation (Reuel Johnmark et al. 2016). For this reason, universities around the world are working to create environments that enhance the entrepreneurship skills of both students and faculty (Slaughter & Rhoades 2004; Guerrero et al. 2016; Wright et al. 2017).

One fundamental factor contributing to the formation of entrepreneurial intentions in students is entrepreneurship education, which Fayolle et al. (2006) define as "any pedagogical [program] or process of education for entrepreneurial attitudes and skills," a broad framework within which a variety of interventions and programs exist. Viewed broadly, entrepreneurial education aims to promote entrepreneurial attitudes, spirit, and culture, which can be applied in various areas of life (Martínez-Gregorio et al. 2021). Many studies have identified entrepreneurial intention (EI) as one of the most important predictors of entrepreneurial activity and behavior by students (Krueger et al. 2000; Autio et al. 2001; Yu et al. 2021). In recent years, there has been a rapid increase in research on entrepreneurship education and entrepreneurial intentions. Reviews and meta-analyses have been conducted to highlight and summarize evidence found regarding the effectiveness and impact of interventions (Aparicio 2019; Brüne & Lutz 2020; Ismail et al. 2024; Maheshwari et al. 2022; Xanthopoulou & Sahinidis 2024). Meta-analyses of entrepreneurship education and entrepreneurial intentions by Bae et al. (2014), Martin et al. (2013), and Martínez-Gregorio et al. (2021) found that entrepreneurship education contributes to the creation of entrepreneurial intentions. Individual educational factors reported to influence entrepreneurial intentions include study major (e.g., business versus science and engineering majors) and demographic factors such as nationality (Maheshwari et al. 2022).

Field of university study may influence students' entrepreneurial intentions. Benedict et al. (2012), Cai & Winters (2017), and Breznitz & Zhang (2020) suggest that students with degrees in science, technology, engineering, and mathematics (STEM) fields are less likely to become entrepreneurs than those with degrees in non-STEM fields. On the other hand, STEM degree holders are key drivers of innovation (Atkinson & Mayo 2010); the high proportion of STEM degree holders in the high-tech sector

underscores the significant role they play in innovation and economic growth (Goldschlag & Miranda 2020). According to Åstebro et. al. (2012), new graduates in science and engineering produce many high-quality startups, suggesting that science and engineering students are a promising target for entrepreneurship education. However, much of the research on students' entrepreneurial intentions has focused on business majors and unspecified students (Zampetakis et al. 2011; Martin et al. 2013; Bae et al. 2014; Zhang et al. 2014; Hudea et al. 2021).

Graduate students in the natural sciences, who have received highly specialized education and training from university faculty, may start their own businesses using the results of their university research and the skills they acquired at university (Hayter 2016; Hasegawa & Sugawara 2017). According to Boh et al. (2016), with respect to student startups, Ph.D. and post-doctoral students focus on the broad aspects of idea generation, founding team formation, and fundraising, while business majors take on administrative, accounting, and fundraising roles that complement the technical skills of science and engineering graduate students and faculty. Thus, students are expected to make contributions that match the university education they receive. However, very few studies on entrepreneurship by students in the natural sciences have been conducted, and most of those that exist focus on undergraduate students (Maresch et al. 2016; Barba-Sanchez & Atienza-Sahuquillo 2018) rather than graduate students.

Demographic factors such as nationality may influence students' entrepreneurial intentions. Fayolle & Liñán (2014) suggest that entrepreneurship varies widely across countries and regions, as regulatory, normative, and cultural cognitive factors can directly and indirectly influence the perceptions individuals have about the desirability and feasibility of entrepreneurship. Bae et al. (2014) suggest that national culture may influence the formation of entrepreneurial behavior. Japan and Korea are geographically and culturally close, but with regard to entrepreneurship, according to a 2020 survey conducted by the Global Entrepreneurship Monitor (GEM), Total Entrepreneurial Activity Index (TEA) scores were 6.5 in Japan and 13.0 in South Korea, a two-fold difference. The positive relationship between entrepreneurial education and entrepreneurial intentions is stronger in countries that have high in-group collectivism than in countries with low in-group collectivism, and stronger in countries with low uncertainty avoidance than in countries with high uncertainty avoidance (Bae et al. 2014). As these studies show, national cultures affect entrepreneurship, yet little research has been conducted on entrepreneurship in Japan and South Korea (Kanama 2021; Hemmert et al. 2022).

In this study, we focus on the entrepreneurial intentions of Japanese and Korean master's and doctoral students majoring in natural science fields. The purpose of the study is to determine the impact of cultural background on the entrepreneurial intentions of graduate students majoring in the natural sciences. Graduate students in the natural sciences are an important group in terms of their contributions to a country's economic development in today's knowledge-based society. In order to explore differences in entrepreneurial intentions among graduate students majoring in natural science fields in Japan and Korea, we survey students' views on entrepreneurship and their entrepreneurial intentions after graduation and

analyze the results using the Theory of Planned Behavior (Ajzen 1987, 1991, 2001, 2002, 2011). As a practical contribution, we also propose ways to make entrepreneurship education more effective in Japan and Korea, taking into account cultural factors and the results of this study.

The paper is organized as follows. Section 2 describes the environment surrounding university entrepreneurship in Japan and Korea. In Section 3, we formulate hypotheses based on previous studies. Section 4 describes the questionnaire survey and the variables used in our analysis. Section 5 presents the results of the analysis and discussion. Finally, Section 6 summarizes and discusses the implications of this study.

2. The environment surrounding university entrepreneurship in Japan and Korea

Various studies have been conducted in Asia on entrepreneurial intentions and entrepreneurial education. Maheshwari et al. (2022) used a systematic review approach to analyze articles published between 2005 and June 2022 on the entrepreneurial intentions of university students. They found that most studies were conducted in Asia (52%), followed by 19% conducted in Europe, 12% each in the US and Africa, and the remaining 6% in multiple countries. Pretheeba & Venkatapathy (2018) investigated entrepreneurial intentions of graduate students in science, arts, and technology at Bharathiar University in India using the theory of planned behavior. They found that entrepreneurship education increases graduate students' entrepreneurial intentions regardless of student field of study. Saraih et al. (2018), in a study of entrepreneurial intentions among engineering students attending public higher education institutions in Malaysia—entrepreneurship is a compulsory subject in all Malaysian public universities—found that self-efficacy was significantly associated with entrepreneurial intentions. Law & Breznik (2017), investigating the impact of an entrepreneurship course on entrepreneurial intentions of engineering and non-engineering students in a Hong Kong university, found that attitude and self-efficacy were significant factors contributing to entrepreneurial intentions among engineering students while innovativeness, attitude and self-efficacy all contributed to entrepreneurial intentions among non-engineering students. Fan et al. (2024) surveyed the impact of entrepreneurship education on students' entrepreneurial intentions at 22 universities in China, finding that entrepreneurship education has a positive impact on students' entrepreneurial intentions. Ramadani et al. (2022) found that entrepreneurship education has a significant impact on entrepreneurial intentions among Bangladeshi university students. They note, however, that business students are required to take entrepreneurship education as part of their degree requirements, while engineering students are not. Swarupa & Goyal (2020) reviewed studies on the relationship between entrepreneurship education and entrepreneurial intentions from 30 countries around the world, including Asia. They found that there is a paucity of research on the kinds of entrepreneurship courses that are appropriate for engineering students, and that government approaches and policies in the area of employability skill development in higher education vary greatly across countries.

While various studies on entrepreneurial intentions and entrepreneurship education have been conducted in Asia, there are few studies that compare Japan and Korea or studies that focus on the entrepreneurial intentions of graduate students in the natural sciences in Japan and Korea. Hemmert et al. (2022) conducted a systematic review of entrepreneurship studies conducted between 2000 and 2020 on East Asia. They found that while the number of articles published annually on entrepreneurship in East Asia is growing rapidly, most of these studies are single-country studies focusing on China. Their review reveals that little research has been conducted on entrepreneurial culture and intentions in Japan and Korea, or on graduate students in the natural sciences.

In the 2021 Global University Entrepreneurial Spirit Students' Survey (GUESSS), conducted among undergraduate and graduate students in 58 countries, 32.8% of all respondents indicated that they wanted to become company founders within five years after graduation, while 10.8% were already entrepreneurs. The percentages for Japan and Korea were significantly lower, however: 9.0% of Japanese respondents and 11.7% of South Korean respondents wanted to become company founders within five years of graduation, while those that were already entrepreneurs accounted for only 1.5% in Japan and 4.3% in Korea. Although Korea ranks somewhat higher than Japan in student entrepreneurship, these numbers indicate that there is a need to improve the quality of entrepreneurship education in both countries. It has been noted that national culture influences how entrepreneurship education is viewed (Lee & Peterson 2000); this makes it important to understand the particular cultural environments of Japan and Korea, which both belong to the same East Asian cultural sphere.

Both Korea and Japan have developed national policies designed to foster and develop student start-ups. In Korea, the "Small-Medium Industry Start-up Support Law" and the "Law for Financial Assistance for the Development of New Technologies" were enacted in 1986 to promote the creation of university research-based start-ups. Other measures taken to support university research-based startups include the "Tech Incubator Program for Start-ups," enacted in 1991, and the "Special Act on Venture Firm Promotion," enacted in 1997 (revised in 1998). Following the financial crisis of the late 1990s, the Korean government began offering strong incentive packages to promote startups by entrepreneurs, which led to a boom in entrepreneurship (Hong et al. 2015).

In response to growing interest among students, an increasing number of Korean universities and graduate schools are offering lectures related to entrepreneurship. The number of entrepreneurship education courses offered by Korean universities has increased sharply: in 2012, 189 Korean universities offered 1,050 entrepreneurship lectures to 159,456 students, while in 2014, 281 universities offered 4,751 entrepreneurship lectures to 217,734 students (Heo et. al., 2017). Entrepreneurship education is now included in the curricula of most Korean universities (Chang & Choi 2018). In order to differentiate their programs from those of existing business schools, universities have begun offering practical training programs for each stage of a business startup. Graduate schools of entrepreneurship now recognize the importance of alumni networks, partnerships with external institutions, coaching and mentoring,

community building, and consulting after graduation as means to secure funding and investment (Byun et al. 2018).

President Park Geun-hye (in office 2013–2017) declared that she would transform Korea into a "startup nation" under the paradigm of a "creative economy," and the creation of new business infrastructure, including university-based startups, gained momentum. The Korean government also implemented the Five Year University Entrepreneurship Education Plan (2013–2017). Park & Nam (2022) found that the government's business start-up support policies have had a positive impact on Korean students' entrepreneurial intentions.

In Japan, the enactment of policies on university startups has lagged behind that of Korea. The “Act on the Promotion of Technology Transfer from Universities to Private Business Operators” was enacted in 1998, the “Industrial Technology Enhancement Act” was enacted in 2000, the “Priority Plan for Creating New Markets and Jobs” was adopted in 2001, and Japan’s national universities were converted into independent corporate entities in 2004; all of these were aimed at creating more university-originated startups. The “Priority Plan for Creating New Markets and Jobs” included the “Plan for 1,000 University-originated Ventures,” which aimed to establish 1,000 new university-originated startups over the three-year period from 2002 to 2004. As a result, more than 1,000 startups were launched. But this burst of entrepreneurial activity also had the effect of revealing ways in which the government and various research institutions could better support university-originated startups and the challenges those startups faced.

The level of entrepreneurship in Japan is lower than that of other East Asian countries such as Taiwan and South Korea (Lubbadeh 2019), and the desire to launch startups remains low among Japanese compared to that in other countries (Iwasaki 2018). Kegel (2016), in research on startups in the United States and Japan, points out that entrepreneurship education is clearly lacking in Japan.

The Sixth Science, Technology and Innovation Basic Plan (MEXT 2021) calls for the creation of a new industrial base through the co-creation of value through collaboration among companies, universities, and public research institutions, and the generation of startups that contribute to solving social problems. However, only 1% of undergraduate and graduate students in Japan are taking entrepreneurship education courses. In addition, many universities do not provide budgets for entrepreneurship education, and practical entrepreneurship education programs are not available (MEXT 2021). These facts suggest that while the Japanese government attaches great importance to the creation of startups, it has not yet succeeded in increasing the intentions of Japanese students to start their own businesses.

Comparing the timing of enactment of various policies on university research-based startups in Japan and Korea, it can be seen that entrepreneurship-related policy development in Japan has lagged behind that in Korea, and that the environment surrounding entrepreneurship education and startups in Japan is less-developed than that in Korea. The research described below explores how this difference in cultural

background may account for differences in the entrepreneurial intentions of Japanese and Korean graduate students.

3. Literature Review and Hypotheses

3.1 Approaches to Entrepreneurial Intention Research

The idea that entrepreneurs possess unique psychological characteristics has a long history in research in the entrepreneurship domain (Gartner 1988). According to Yu et al. (2021), various models and theories have been developed in efforts to understand entrepreneurial intentions. Among these, Ajzen's Theory of Planned Behavior (Ajzen 1991) and Shapero's Entrepreneurial Event model (Shapero & Sokol 1982) have been shown to have strong predictive abilities. In particular, the Theory of Planned Behavior has been empirically shown to be effective in predicting dozens of different behaviors (Ajzen 1991; Krueger 2000); more than 2,000 empirical studies using it have been published over the last three decades (Tornikoski & Maalaoui 2019). In this study, we use the Theory of Planned Behavior.

According to the Theory of Planned Behavior, an individual's intention to engage in a particular behavior reflects his/her readiness to engage in the behavior and is a determinant of engaging in the behavior (Ajzen 1991). Intention, in turn, is influenced by three antecedents: attitude, subjective norms, and perceived behavioral control. Attitude includes beliefs about the primary outcome of the behavior in question and evaluation of that outcome. Subjective norms are the perceived normative beliefs and opinions of the reference group and the motivation to follow them. Perceived behavioral control is a concept related to the perceived ability to successfully engage in a certain behavior. Many studies have been conducted to predict and explain entrepreneurial intention and behavior based on the Theory of Planned Behavior, and it is believed to be an effective model for explaining entrepreneurial intentions (Souitaris et al. 2007; Liñán & Chen (2009); Díaz-Casero et al. 2012; Fayolle & Liñán 2014; García-Rodríguez et al. 2015; Nguyen et al. 2020; Yu et al. 2021; Maheshwari et al. 2022). Ajzen (2005), for example, modified the Theory of Planned Behavior by adding new personal, social, and environmental variables that can be indirect antecedents (mediators) of entrepreneurial behavior.

In the present study, we analyze and compare the intentions of Japanese and Korean students to launch startups using a model that adds personality traits and entrepreneurship education to the Theory of Planned Behavior factors of attitude, subjective norms, and perceived behavioral control.

3.2 Attitude (ATT)

Attitude is a person's judgment of whether a behavior is good or bad for him/her, and is considered to be a cognitive evaluation of various outcomes expected from the behavior. Attitude is considered to be proportional to "behavioral beliefs," which are the desirability of various outcomes that may result from the behavior, and to "evaluation of outcomes," which are evaluations of how important each consequence

is to a person (Ajzen, 2005). Outcomes include both intrinsic and extrinsic rewards. Some outcomes, such as economic benefits, independence or autonomy, personal rewards, and family security, have a positive impact on entrepreneurial intentions, while others, such as perceived risk associated with entrepreneurial activity, have a negative impact on entrepreneurial intentions (Yu et al. 2021). A number of studies using the Theory of Planned Behavior have found significant relationships between attitude and entrepreneurial intentions (Krueger et al. 2000; Armitage & Conner 2001; Autio et al. 2001; Kolvereid & Isaksen 2006; García-Rodríguez et al. 2015). In a study by Nguyen et al. (2020) on the entrepreneurial intentions of Vietnamese and Korean undergraduates, a significant relationship was found between attitudes and entrepreneurial intentions for Korean students, but not for Vietnamese students. Based on the research cited above, we hypothesize that entrepreneurial intentions are related to attitudes among graduate students in Japan and Korea, and derive Hypothesis 1-1.

H1-1 Attitude positively affects entrepreneurial intentions among Japanese and Korean graduate students.

3.3 Subjective Norms (SN)

Subjective norms are considered to be proportional to the “normative beliefs” that significant others (e.g., family, friends, and neighbors) have about a behavior, and “motivation to comply,” which is the strength of a person’s motivation to comply with others’ expectations (Ajzen 2005).

The influence of family, friends, and colleagues is also important when it comes to startup founding. Numerous studies have shown that parents' occupations have a significant impact on their children's career choices (Keller & Whiston 2008). It has been reported that when a parent is a company founder, the probability that the child will become a founder is 60% higher than when the parent is not a founder (Lindquist 2015). On the other hand, some reports have found no significant difference in entrepreneurial intention scores between students whose parents are founders and those whose parents are not founders (Fatoki 2014).

While it is clear that subjective norms are powerful predictors of entrepreneurial intentions, there is not unanimous agreement on the question of whether or not a direct relationship exists. While some studies have found significant relationships between subjective norms and intentions (Kolvereid 1996; Tkachev & Kolvereid 1999; Kolvereid & Isaksen 2006), others have found no significant relationship (Krueger et al. 2000; Autio et al. 2001; Liñán & Chen (2009); García-Rodríguez et al. 2015). Maresch et al. (2016) found a negative relationship between subjective norms and entrepreneurial intentions among science and engineering students. Nguyen et al. (2020), on the other hand, found a significant positive relationship between subjective norms and entrepreneurial intentions among Korean undergraduates. Based on the above studies, we hypothesize that entrepreneurial intention is linked to subjective norm among graduate students in Japan and Korea, and derive Hypothesis 1-2.

H1-2 Subjective norms positively affect entrepreneurial intentions among Japanese and Korean graduate students.

3.4 Perceived Behavioral Control (PBC)

Perceived behavioral control refers to a person's belief and confidence that he/she can successfully perform a behavior. When it comes to startup founding, perceived behavioral control can be directly measured by asking the extent to which a person believes he/she is capable of founding a startup (Ajzen, 2005). Krueger et al. (2000) argue that entrepreneurial self-efficacy—that is, a person's belief in his/her own entrepreneurial competence—significantly influences entrepreneurial behavior. Although some studies have failed to show a significant relationship between perceived behavioral control and entrepreneurial intentions (Kolvereid & Isaksen 2006), many others have found significant relationships (Krueger et al. 2000; Armitage & Conner 2001; Autio et al. 2001; Liñán & Chen 2009; García-Rodríguez et al. 2015; Nguyen et al. 2020). In their study of Korean university undergraduates, Nguyen et al. (2020) found perceived behavioral control to be positive related to entrepreneurial intentions. Based on the above studies, we consider entrepreneurial intention to be linked to perceived behavioral control in both Japanese and Korean graduate students, and derive hypothesis 1-3.

H1-3 Perceived behavioral control positively affects entrepreneurial intentions among Japanese and Korean graduate students.

3.5 Personality traits

The idea that company founders possess unique personality traits is a topic of interest in entrepreneurship research (Gartner 1988; Littunen 2000). Numerous studies have been conducted on personality traits associated with entrepreneurial intentions, one of which is innovativeness (Mueller 2001; Zampetakis et al. 2011; Ozaralli & Rivenburgh 2016; Martins et al. 2023). Innovation involves transforming ideas and knowledge into new value through creative thinking. Startup founders need to be able to think creatively, generate novel and practical ideas, create new markets, and recognize opportunities to propose new products and services (Chen 2007). Gürol & Atsan (2006) show that entrepreneurs have a higher level of innovativeness than managers and regular company employees. Innovation also requires a strong conviction to turn innovative ideas into things of concrete value. Given that launching a startup is a complex process and that a high percentage of startups fail, strong and positive belief in oneself is necessary for carrying out entrepreneurial activities. Such positive emotions as optimism, hope, and resilience have been reported to be important for leaders of high-tech ventures (Peterson et al. 2009; Ucbasaran et al. 2010). Martins et al. (2023), in a study of Pakistani master's students, found that innovativeness has a partially mediating effect on the relationship between self-efficacy and entrepreneurial intention.

Kanama (2021) found that barriers to entrepreneurship among Japanese undergraduate and graduate students include a lack of entrepreneurial ability and experience and a lack of confidence in one's own abilities. He also suggests that barriers to entrepreneurial intentions in Japan do not stem from regulatory or legal obstacles, but depend on factors such as culture and perceptions about entrepreneurship. In an attitude survey conducted by the Japanese Cabinet Office on males and females between the ages of 13 and 29 (Cabinet Office 2019), 45.1% of Japanese respondents agreed with the statement "I am satisfied with myself," and 62.2% agreed with the statement "I feel I have strong points." On the other hand, the percentages of South Korean respondents who agreed with the same statements were 73.5% and 74.2%, respectively. This suggests that Japanese youth have lower self-esteem than Korean youth. Further, according to an international survey of university students conducted by Harada et al. (2014) on the topic of social self-control, Korean students value assertiveness more highly than Japanese students do. Thus, it can be said that Japanese youth have lower self-esteem than their Korean counterparts and that Japan has a cultural climate in which self-restraint is more highly valued than assertiveness.

Taken together, these studies suggest that, in terms of personality traits, Korean students are more likely to engage in innovative activities than Japanese students. Based on this, we derive Hypothesis 2.

H2 The effect of the personality trait of innovativeness on entrepreneurial intention is weaker for Japanese graduate students than for Korean graduate students.

3.6 Entrepreneurship Education

As the transition to a knowledge-based economy progresses, universities are required to significantly enhance their unique capabilities, such as providing entrepreneurship education and commercializing knowledge through industry-academia collaboration (Wong 2007). Türker & Selçuk (2009) show that entrepreneurship education programs are more effective when they are properly designed, taking into account students' motivations and goals. Yemini & Haddad (2010) suggest that entrepreneurship education for students in the natural sciences fosters entrepreneurship in students and positively impacts self-esteem. This suggests that university entrepreneurship education is related to students' entrepreneurial intentions (Ozaralli & Rivenburgh 2016; Maresch et al. 2016). Barba-Sanchez & Atienza-Sahuquillo (2018), in a study of Spanish engineering students, found that entrepreneurship education positively influences entrepreneurial intentions. Aga (2023), in a study of undergraduate students at an Ethiopian university, found that entrepreneurship education had a positive and significant effect on entrepreneurial intention and perceived behavioral control, and suggests further that perceived behavioral control has a partially mediating effect on the relationship between entrepreneurship education and entrepreneurial intention. Nguyen et al.'s (2020) study of undergraduates at a Korean university found that entrepreneurship education positively influences entrepreneurial intention through the mediating effect of perceived behavioral control. At the same time, it has been shown that large differences exist in the

availability and content of entrepreneurship education among different countries (Lee et al. 2005; Pittaway & Cope 2007; Giacomini et al. 2011).

Regarding startups, it has been suggested that student startups in particular face a variety of challenges, including limited expertise and business training, lack of market credibility, and limited access to funding and talent (Bailetti 2011; Borges et al. 2008; Zahari & Azizan 2018). A qualitative analysis by Longva et al. (2021) found that student startups take advantage of entrepreneurship classes, on-campus collaborative activities, and university infrastructure, including meeting places, to acquire scarce resources.

On the positive side, student startups have access to laboratory equipment, research laboratories, scientific publications, and research infrastructure, according to their major specialization. Students also have the opportunity to interact with university-based scientists and researchers, and they can take advantage of acceleration programs and incubation providers to nurture their entrepreneurial ideas, improve their business plans, and access resources before launching a new business (Boh et al. 2016; Beyhan & Findik 2018; Breznitz & Zhang 2019; Blank 2021).

As mentioned above, the development of policies regarding university startups in Japan has lagged behind that of Korea, and entrepreneurship education and the development of a startup-supporting environment are also weaker in Japan than in Korea. These factors may influence the entrepreneurial intentions of Japanese versus Korean graduate students. Overall, previous studies suggest that the entrepreneurial intentions of Japanese graduate students are less affected by university entrepreneurship education than those of Korean graduate students. From this, we derive Hypothesis 3.

H3 The effect of the university entrepreneurship education on entrepreneurial intention is weaker for Japanese graduate students than for Korean graduate students.

4. Analysis Method

4.1 Survey

(Insert Figure 1)

Figure 1 shows a conceptual diagram of the hypotheses presented in the previous section. To summarize, we hypothesize that entrepreneurial intention is driven by three factors of the Theory of Planned Behavior (TPB)—attitude (ATT), subjective norms (SN), and perceived behavioral control (PBC)—plus personality traits and entrepreneurship education (EE).

To test our hypotheses, we conducted a questionnaire survey titled “Survey of university-affiliated persons regarding participation in startups” at two universities in Japan—Tokushima University (a

regional university) and Kobe University (a research university)—and two universities in Korea—ChungNam National University (CNU) (a regional university) and Korea Advanced Institute of Science and Technology (KAIST) (a research university). The questionnaire consisted of 49 items in total: 4 questions on entrepreneurial intentions, 5 questions on attitude, 3 questions on subjective norms, 5 questions on perceived behavioral control, 12 questions on the personality trait of innovativeness, 5 questions on entrepreneurship education, plus 15 questions asking for respondent information. The research studies used to develop the questionnaire items were: Thompson et al. (2009) for entrepreneurial intentions; Rasheed (2003) for attitude; Kolvereid (1996) for subjective norms; Lucas et al. (2009) and Schjoedt & Craig (2017) for perceived behavioral control; Littunen (2000) for the personality trait of innovativeness; and Fayolle & Gailly (2015) and Kim & Park (2019) for entrepreneurial education. Except for the questions asking for specific respondent information, respondent were asked to provide their answers based on a 7-point Likert scale. The questionnaire can be found in the Appendix.

The language used in the survey was Japanese for Tokushima University and Kobe University, and Korean for CNU and KAIST. The survey was conducted between April 2019 and February 2020 using a web-based questionnaire. A total number of 298 graduate students responded to the questionnaire survey: 50 from Tokushima University, 67 from Kobe University, 88 from CNU, and 93 from KAIST. All four universities are national universities. Descriptive statistics of the questionnaire respondents are shown in Table 1.

(Insert Table 1)

Common method variance (CMV) is a concern when self-report questionnaires are used to collect data from the same participants at one time. To avoid CMV, we assured respondents of the anonymity and confidentiality of the study (Podsakoff et al. 2003). We also took great care to systematically examine the item structure to ensure that ambiguous, vague, and unfamiliar terms were not included and that the questionnaire as a whole and individual items were as concise as possible (Chang et al. 2020). To test for potential CMV we used Harman's one-factor test on all variables of this study (Podsakoff & Organ, 1986). We conducted an exploratory factor analysis (generalized least squares method, no rotation) on all observed variables, with an extraction condition of an eigenvalue greater than 1.00, and six factors were extracted. The proportion of the variance of all the observed variables explained by these six factors was 65.7%. The proportion of the variance of all the observed variables explained by the first factor, which had the largest eigenvalue, was 35.0%. Based on this result, We conclude that CMV did not affect our findings.

4.2 Preliminary analysis

Analyses were conducted using SPSS version 25. Before testing the hypotheses, we conducted a reliability and validity test on the responses of the Japanese and Korean graduate students who comprised the sample. Due to sample size issues for the Japanese and Korean samples, preliminary analysis was conducted using the entire (Japanese plus Korean) sample. Factor analysis was conducted on the 34 questionnaire items that were considered relevant to the hypotheses, i.e., the questionnaire items related to the components of the model shown in Figure 1: entrepreneurship education, attitude, entrepreneurial intention, perceived behavioral control, subjective norms, and personality traits. The analysis was conducted using the generalized least squares method, promax rotation, and an eigenvalue of 1 or greater, and six factors were derived. Table 2 shows the factor loadings, Cronbach's alpha, composite reliability (CR), and average variance extracted (AVE). For all items, CR was greater than 0.8, and factor loadings ranged from 0.494 to 0.958. Thus, the required criteria of CR greater than 0.6 (Leung et al, 2008) and factor loadings from about 0.5 to about 0.95 (Bagozzi & Yi 1988) were satisfied. The convergent and discriminant validity of the psychological factors were both tested. For convergent validity, the AVE exceeded the required criterion of $AVE \geq 0.5$ for all factors (Fornell & Larcker 1981). It has been reported that discriminant validity is confirmed when the square root of the AVE is higher than the correlations between factors. As shown in Table 3, in our results the square root of AVE is higher than all inter-factor correlations.

(Insert Table 2)

(Insert Table 3)

4.3 Main analysis

Multiple regression analysis is a method of exploring the influence of explanatory variables (causes) on an objective variable (outcome). Using data from our survey of attitudes toward entrepreneurship among graduate students in Japan and Korea, we used multiple regression analysis to analyze the effects of each of the explanatory variables in our hypotheses.

Our objective variable was “entrepreneurial intentions” (EI), which we define as a graduate student’s intention to create a startup.

Of our explanatory variables, “attitude,” “subjective norms,” and “perceived behavioral control” are taken from the Theory of Planned Behavior. In addition, we added the explanatory variables of “personality traits” (specifically, innovativeness) and “entrepreneurship education.”

The control variables we used were “gender (female=0, male=1),” “age,” “program (master's=0, doctoral=1),” “university attributes (regional university=0, research university=1),” and “work experience (no=0, yes=1).”

Three regression models were run. Model 1 included three explanatory variables: “attitude,” “subjective norms,” and “perceived behavioral control.” For Model 2, “personality traits” was added as a fourth explanatory variable. For Model 3, “entrepreneurship education” was added as a fifth explanatory variable.

5. Results and Discussion

Table 4 presents the results of the multiple regression analysis. The values in each cell in Table 4 are the standard partial regression coefficients (β). These enable us to gauge the influence of each explanatory variable on the objective variable “entrepreneurial intentions.” An asterisk (*) indicates that a coefficient is statistically significant at the 5% level; a double asterisk (**) indicates that a coefficient is statistically significant at the 1% level.

(Insert Table 4)

The F value indicates the overall significance of the regression model; the P value obtained with the F test was less than 0.001. The adjusted R^2 for the regression model including all explanatory variables is 0.340 for Japan and Korea combined, 0.402 for Japan, and 0.383 for Korea. These values are comparable to or higher than those in similar studies (Krueger et al. 2000; Autio et al. 2001; Kolvereid & Isaksen 2006). A meta-analytic review conducted by Armitage & Conner (2001) found that the Theory of Planned Behavior explained 27% and 39% of variance in behavior and intention, respectively, which is similar to the 34% of variance explained by our model.

The Variance Inflation Factor (VIF) was used to check for multicollinearity. A VIF greater than 10 indicates multicollinearity problems, but in the present study, the VIF was less than 2.42 for all variables, indicating an absence of multicollinearity issues. The Durbin-Watson statistic (DW) is an index that indicates autocorrelation between error terms (difference between measured and theoretical values). In the present study, DW ranged from 1.5 to 2.5 for all models, indicating that there was no autocorrelation.

5.1 Effect of the explanatory variables

Attitude is a judgment of whether a behavior is good or bad for oneself; it is a cognitive evaluation of the various outcomes expected from a behavior. Our results show that attitude has a positive effect on entrepreneurial intentions in the Japanese student sample, the Korean student sample, and the combined Japanese + Korean students sample. For all three samples, the null hypothesis is rejected at the 1% level. This is consistent with other studies using the Theory of Planned Behavior, which also show a significant positive relationship between attitude and entrepreneurial intentions (e.g., Krueger et al. 2000; Armitage & Conner 2001; Autio et al. 2001; Kolvereid & Isaksen 2006; García-Rodríguez et al. 2015). Comparing the coefficients for the Japanese and Korean student samples, we find that attitude has a larger impact on

entrepreneurial intentions for Japanese graduate students than for Korean graduate students. In our models, no other explanatory variables had a significant effect on the entrepreneurial intentions of Japanese graduate students.

Subjective norms represent the pressure that social cognition exerts on entrepreneurial intentions. Our results do not show any significant effect of subjective norms on entrepreneurial intentions in any of our three samples. Many other studies similarly find no significant relationship between subjective norms and entrepreneurial intentions (e.g., Krueger et al. 2000; Autio et al. 2001; Liñán & Chen 2009; García-Rodríguez et al. 2015).

Perceived behavioral control (PBC) refers to a person's confidence that he/she can launch a successful startup. The coefficients for PBC are significant in Model 1 for the Japanese graduate student sample and the combined Japanese + Korean students sample, but not significant in Models 2 and 3, which take personality traits into account. The coefficients are not significant for Korean graduate students in any model. We therefore conclude that perceived behavioral control does not significantly affect the entrepreneurial intentions of graduate students in either Japan and Korea. Other studies have found perceived behavioral control to significantly influence entrepreneurial intentions (e.g., Krueger et al. 2000; Armitage & Conner 2001; Autio et al. 2001; Liñán & Chen (2009); García-Rodríguez et al. 2015; Nguyen et al. 2020). We attribute the differences across models in our analysis to the confounding effects of personality traits, as described below.

Various personality traits have been studied in relation to entrepreneurial intentions, but in this study we focused on *the personality trait of innovativeness*. Our results show a positive effect of innovativeness on entrepreneurial intentions for the Korean graduate student sample and the combined Japanese + Korean students sample, but no significant effect for the Japanese graduate student sample. This difference may be explained by studies showing that Japanese youth have lower self-esteem than Korean youth (Cabinet Office 2019) and that Japan has a cultural climate in which self-restraint is more highly valued than assertiveness (Harada et al. 2014). In the above-mentioned study of Japanese undergraduate and graduate students by Kanama (2021), Japanese students cited a lack of confidence in their own abilities as a factor that hinders entrepreneurship in Japan. In Model 1, for both the Japanese and the combined Japan + Korea sample, perceived behavioral control shows a positive impact on entrepreneurial intentions, but when the personality trait of innovativeness is taken into account, the effect of perceived behavioral control on entrepreneurial intentions disappears. This may be due to confounding effects.

Entrepreneurship education did not significantly affect entrepreneurial intentions in any of the graduate student samples, suggesting that entrepreneurship education at Japanese and Korean universities is lacking in effectiveness.

5.2 Control variables

As seen in Table 4, among the control variables of gender, age, course of study, university attribute, and work experience, the only significant coefficients were for the university attribute of “research university” in Korea. This result was influenced by the fact that we only obtained data from graduate students at two universities in Korea, of which one (KAIST) was a research university and the other (CNU) was a regional university. To check for robustness, we analyzed KAIST and CNU separately; the results are presented in Table 5.

(Insert Table 5)

The results for our analysis of the two Korean universities are consistent with the results for Korea in Table 4: the null hypotheses are rejected at the 1% level of significance. On the other hand, course of study (doctoral program) has a negative impact on entrepreneurial intentions at CNU; the null hypothesis is rejected at the 1% level of significance. This suggests, consistent with Küttima et al. (2014), that being in a master's or doctoral program is negatively related to entrepreneurial intentions, in contrast to the positive relationship seen for undergraduate students. This may be due to the fact that many doctoral students enter doctoral programs because they aspire to become university faculty members or researchers in a company, rather than entrepreneurs.

5.3 Discussion of Results

(Insert Table 6)

Table 6 summarizes shows the hypothesis test results for Japan and Korea. In both the analysis of the two country samples and the analysis of the combined Japan + Korea sample, attitude has a significant positive impact on entrepreneurial intention. Personality trait (innovativeness) has a positive impact on entrepreneurial intention for the Korean graduate student sample and the combined Japan + Korea sample, but no significant difference was found for the Japanese graduate student sample. Therefore, hypotheses H1-1 and H2 were supported, while the other hypotheses were not.

Our finding that entrepreneurship education has no significant effect on the entrepreneurial intentions of either Japanese or Korean graduate students strongly suggests that current entrepreneurship education in Japan and Korea needs to be re-examined. Only one percent of Japanese undergraduate and graduate students take entrepreneurship courses, which reflects the fact that few Japanese universities have practical entrepreneurship education programs (MEXT, 2021). Shinato et al. (2013) show that Japanese university education, in accordance with the traditional educational and social climate in Japan, is designed to prepare students to enter large corporations; this hinders the development of entrepreneurship. In Korea, on the other hand, entrepreneurship education is now part of most university curricula (Chang

& Choi 2018). In the future, further development of entrepreneurship education in Korea, with practicing entrepreneurs teaching or assisting in classes, may strengthen the effect of entrepreneurship education on students' entrepreneurial intentions. As Türker & Selçuk (2009) suggest, entrepreneurship education is more effective when curricula and programs are designed to take students' motivations and goals into account. What, then, would more effective entrepreneurship education look like in Japan and Korea?

The results of this study show that attitudes positively influence entrepreneurial intentions for both Japanese and Korean graduate students. Arranz et al. (2017) found that attitude toward entrepreneurship has a positive effect on entrepreneurial intentions, and that university education, including extracurricular activities, has a positive effect on attitudes toward entrepreneurship. They suggest that programs should be developed that stimulate the search for opportunities and the acquisition of action skills in order to encourage entrepreneurship. We concur, and suggest additionally that entrepreneurship education programs that allow graduate students to virtually experience entrepreneurship would be effective in terms of increasing entrepreneurial activity. We also found that the regression coefficients were larger for Japanese students, suggesting that the influence of attitude is stronger in Japan, and that entrepreneurship education programs of this sort would be particularly effective in Japan.

As for the practical implications of our findings, we suggest that (a) the Japanese government should invest more in entrepreneurship education programs, as suggested by Ramadani et al. (2022) and Swarupa & Goyal (2020); (b) entrepreneurship education should be offered not only to business school students but also to students in the natural sciences, as suggested by Åstebro et al. (2012) and Law & Breznik (2017); and (c) entrepreneurship programs should be very practical, delivered at least in part by persons with actual entrepreneurial experience, as suggested by Arranz et al. (2017) and Byun et al. (2018).

We also found that the personality trait of innovativeness had a significant effect on the entrepreneurial intentions of Korean graduate students, but not Japanese graduate students. This suggests that providing entrepreneurship education to students who are innovative by nature, especially in Korea, and offering courses in the area of creativity and innovation would lead to an increase in the number of entrepreneurs. Brüne & Lutz (2020) found that entrepreneurship education has a greater positive impact on the self-efficacy and entrepreneurial aspirations of younger students than older students, while Barth & Muehlfeld (2021) suggest that early entrepreneurship intervention increases entrepreneurial self-efficacy among college students. Thus, it is conceivable that education for innovation may be more effective with younger college students than with students in graduate programs.

Entrepreneurship education, which Fayolle et al. (2006) define as "any pedagogical [program] or process of education for entrepreneurial attitudes and skills," is a fundamental factor contributing to the formation of student entrepreneurship. Martínez-Gregorio et al. (2021), adopting a broader point of view, argue that entrepreneurial education aims to promote entrepreneurial attitudes, spirit, and culture that can be applied in various aspects of life. Oe (2004) defines entrepreneurship education in a broad sense as

fostering an entrepreneurial mindset and in a narrow sense as fostering company founders.

Entrepreneurship education at universities tends to be focused on fostering the former rather than being aimed at students who aspire to become company founders (although in recent years Korean university entrepreneurship education has begun to move in the latter direction). If the aim of government policy is to increase the amount of entrepreneurial activity, it would seem to make sense for entrepreneurship education to focus more on fostering company founders than on fostering a more general “entrepreneurial mindset.”

Regarding cultural differences between Japan and Korea, previous research studies suggesting that Japanese youth have lower self-esteem than their Korean counterparts (Cabinet Office 2019) and that Japan’s cultural climate values and rewards self-restraint rather than assertiveness (Harada et al. 2014) were supported by the results of the present study. Our study suggests that barriers to increased entrepreneurship in Japan depend on factors such as culture and perceptions. This may be related to our finding that even when Japanese graduate students are “innovative,” this is not linked to entrepreneurial intentions.

6. Conclusion

6.1 Implications of this study

This study focuses on the entrepreneurial intentions of master's and doctoral students majoring in the natural sciences in Japan and Korea, and how entrepreneurial intentions are impacted by national cultural background. Our study has theoretical, practical, and policy implications.

In terms of theoretical contribution, as a comparison between Japanese and Korean graduate students, the study deepens understanding of the influence of national culture on entrepreneurial intentions. Many previous studies have examined the impact of entrepreneurship education and cultural background on the entrepreneurial intentions of young people (e.g., Souitaris et al. 2007; Díaz-Casero et al. 2012; García-Rodríguez et al. 2015; Nguyen et al. 2020), but few studies have explored factors that influence the entrepreneurial intentions of graduate students in Japan and Korea, two countries which are geographically close, and culturally similar but with clear differences.

In terms of practical contribution, our results strongly suggest that university entrepreneurship education does not influence graduate students' entrepreneurial intentions in either Japan and Korea. This points to the need for more effective entrepreneurship education for graduate students in both countries. Our finding confirming that attitude positively influences entrepreneurial intentions for both Japanese and Korean graduate students suggests that programs that encourage students to search for opportunities and practice action skills, such as courses involving virtual entrepreneurship, would be effective in increasing entrepreneurial intentions. This would be especially true in Japan, where such programs are rare. Our

finding that the personality trait of innovativeness positively influences entrepreneurial intentions for Korean graduate students suggests that offering entrepreneurship education and courses that enhance innovativeness to graduate students who are innovative by nature would lead to an increase in the number of entrepreneurs in Korea. For Japanese students, on the other hand, we found no relationship between innovativeness and entrepreneurial intentions. We attribute this to the fact that in Japan there is a cultural preference for the security of working in a large company versus the perceived risk of being an entrepreneur; this leads Japanese who are innovative by nature to practice innovation within large companies rather than by starting their own companies.

Finally, as a policy contribution, our study highlights the need for greater investment in entrepreneurship education by the Japanese government. In Korea, new business startups have gained momentum since President Park Geun-hye (in office 2013–2017) declared that she would transform Korea into a startup nation under the creative economy paradigm. In Japan, however, it was not until 2022 that the Kishida Cabinet announced a national startup creation effort and pledged to strengthen support for startup founding and growth. Entrepreneurship education remains underdeveloped in Japan, where only 27% of universities provide entrepreneurship education, and only 1% of undergraduate and graduate students take entrepreneurship courses. In addition, few Japanese universities provide budgets for entrepreneurship education, and it has been pointed out that practical entrepreneurship education programs are lacking (MEXT 2021). In order to raise Japan's Total Entrepreneurial Activity Index (TEA), which is half that of Korea, it will be necessary to increase the government budget for entrepreneurship education, to make entrepreneurship education less general and more practical and hands-on, and to provide entrepreneurship education opportunities not only to business students but also to students in the natural sciences and other fields (Åstebro et al., 2012; Law & Breznik 2017).

6.2 Limitations of this study

First of all, this study did not examine the effectiveness of a specific entrepreneurship education program by comparing pre- and post-enrollment, or enrolled and non-enrolled groups. Therefore, the recommendations we have made above are to some extent speculative, rather than definitive statements about what kind of educational programs would be more effective in Japan and Korea.

Second, we investigated students at only four universities: two research universities and two regional universities, two in Japan and two in Korea. This weakens the generalizability of our findings, as each of the universities in our sample has its own particular professional and entrepreneurship programs. Future studies, we hope, will build on this research by obtaining and analyzing data from a broader range of universities, and distinguish among research subjects by attributes such as study major and work experience.

Finally, there is a possibility that non-response bias (NRB) affected the survey results, as not all participants responded. Armstrong & Overton (1977) and Rogelberg & Stanton (2007) have proposed

methods for evaluating differences between respondents and non-respondents. While we took several measures to minimize NRB, including careful management of the questionnaire design and number of questions, we cannot say with 100% certainty that NRB was eliminated. Therefore, caution should be exercised when interpreting the survey results.

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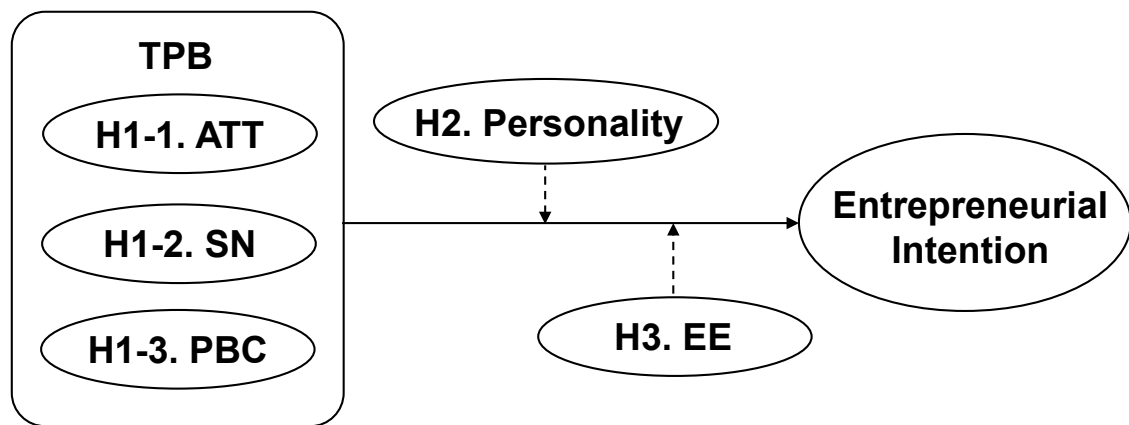


Figure 1: Conceptual diagram of the hypotheses

Table 1: Descriptive Statistics

		Japan (N=117)		Korea (N=181)	
		Frequency	Percent (%)	Frequency	Percent (%)
Gender	Male	104	88.9%	143	79.0%
	female	13	11.1%	38	21.0%
Program	Master's	113	96.6%	100	55.2%
	Doctoral	4	3.4%	81	44.8%
University Attributes	Korea Advanced Institute of Science and Technology (KAIST)			93	51.4%
	Chungnam National University (CNU)			88	48.6%
	Kobe University (KU)	67	57.3%		
	Tokushima University (TU)	50	42.7%		
Work Experience	Yes	76	65.0%	81	44.8%
	No	41	35.0%	100	55.2%
		Mean	SD	Mean	SD
Age		23.58	1.62	27.17	3.55

Table 2: Reliability Assessments

	Item	Loading	α	CR	AVE
Personality (Per)	Per1	0.741	0.931	0.927	0.520
	Per2	0.686			
	Per3	0.621			
	Per4	0.623			
	Per5	0.680			
	Per6	0.731			
	Per7	0.864			
	Per8	0.951			
	Per9	0.833			
	Per10	0.666			
	Per11	0.642			
	Per12	0.494			
Entrepreneurial Intention (EI)	EI1	0.810	0.953	0.927	0.762
	EI2	0.915			
	EI3	0.918			
	EI4	0.843			
Attitude (ATT)	EA1	0.786	0.891	0.892	0.624
	EA2	0.796			
	EA3	0.859			
	EA4	0.825			
	EA5	0.672			
Perceived Behaviour Control (PBC)	PBC1	0.759	0.874	0.851	0.535
	PBC2	0.645			
	PBC3	0.793			
	PBC4	0.672			
	PBC5	0.776			
Entrepreneurship Education (EE)	EDU1	0.690	0.850	0.858	0.549
	EDU2	0.689			
	EDU3	0.834			
	EDU4	0.796			
	EDU5	0.683			
Subjective Norms (SN)	SN1	0.564	0.831	0.842	0.651
	SN2	0.846			
	SN3	0.958			

α : Cronbach's alpha coefficient, CR: composite reliability,
AVE: average variance extracted

Table 3: Discriminant validity

Constructs	(1)	(2)	(3)	(4)	(5)	(6)
(1) Entrepreneurial Intention	0.873					
(2) Attitude	0.520	0.790				
(3) Subjective Norms	0.237	0.453	0.807			
(4) Perceived Behavioral Control	0.363	0.433	0.304	0.731		
(5) Personality	0.464	0.469	0.388	0.547	0.721	
(6) Entrepreneurship Education	0.220	0.203	0.171	0.418	0.243	0.741

Bold values are the square root of relevant AVE

Table 4: Multiple Regression Analysis Results

	Japan + Korea			Japan			Korea		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Attitude	0.454**	0.398**	0.397**	0.546**	0.522**	0.521**	0.436**	0.354**	0.349**
Subjective Norms	-0.007	-0.047	-0.050	-0.143	-0.146	-0.140	0.148	0.047	0.052
Perceived Behavioral Control	0.186**	0.063	0.039	0.220*	0.148	0.156	0.047	-0.119	-0.142
Personality Traits		0.268**	0.266**		0.130	0.126		0.425**	0.413**
Entrepreneurship Education			0.064			-0.042			0.046
Gender (Male)	0.004	0.001	0.002	0.062	0.063	0.066	0.047	0.063	0.062
Age	0.080	0.112	0.109	0.142	0.157	0.158	-0.042	-0.044	-0.041
Program (Doctoral)	-0.063	-0.057	-0.057	0.002	0.006	0.005	-0.117	-0.111	-0.108
University Attributes (Research University)	0.119*	0.073	0.076	-0.018	-0.040	-0.045	0.230**	0.182**	0.176**
Work Experience (Yes)	-0.066	-0.074	-0.067	0.062	0.047	0.051	-0.132*	-0.098	-0.090
R ²	0.318	0.358	0.362	0.445	0.452	0.454	0.306	0.416	0.417
Adjusted R ²	0.299	0.338	0.340	0.404	0.406	0.402	0.273	0.385	0.383
F value	16.816**	17.878**	16.269**	10.824**	9.822**	8.814**	9.465**	13.532**	12.165**

(* : p<0.05, ** : p<0.01)

Table 5: Multiple Regression Analysis Results (Korea)

	Korea					
	KAIST			CNU		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Attitude	0.392**	0.356**	0.356**	0.530**	0.403**	0.380**
Subjective Norms	0.102	-0.002	0.000	0.188	0.104	0.107
Perceived Behavioral Control	0.182	-0.080	-0.084	-0.044	-0.103	-0.143
Personality Traits		0.453**	0.450**		0.358**	0.344**
Entrepreneurship Education			0.009			0.098
Gender (Male)	0.104	0.146	0.146	-0.007	-0.019	-0.027
Age	-0.162	-0.134	-0.135	0.035	-0.028	-0.017
Program (Doctral)	0.092	0.078	0.079	-0.304**	-0.260**	-0.255**
Work Experience (Yes)	-0.208*	-0.090	-0.089	-0.032	-0.043	-0.022
R ²	0.298	0.384	0.384	0.417	0.497	0.503
Adjusted R ²	0.240	0.326	0.318	0.366	0.446	0.445
F value	5.151**	6.557**	5.760**	8.176**	9.751**	8.754**

(* : p<0.05, ** : p<0.01)

Table 6: Summary of hypothesis test results

Hypotheses	Results
H1-1	○
H1-2	×
H1-3	×
H2	○
H3	×

Appendix

Survey questionnaire: "Survey of university-affiliated persons regarding participation in startups"

Respondent Information

Gender ① male ② female

Major ① Humanities ② Social Studies ③ Economics/Management ④ Natural Sciences
⑤ Engineering ⑥ Other

Level ① Master's course student ② Doctoral student ③ Researcher ④ Lecturer
⑤ Research professor ⑥ Full-time professor (or above)

Training Period ① Master's course 1st year ② Master's course 2nd year (or above)
③ Doctoral course 1st year ④ Doctoral course 2nd year
⑤ Doctoral course 3rd year (or above) ⑥ Doctoral course completed
⑦ Doctorate degree

A. Opinion about Entrepreneurship

A1. <Startup Education Environment> I think

[1: strongly disagree 2: disagree 3: somewhat disagree
4: neutral 5: somewhat agree 6: agree 7: strongly agree]

- (1) The environment at the university helped me to find business opportunities.
- (2) The university has improved my creativity and ability to innovate.
- (3) The university environment provided the tasks necessary for me to develop planning skills.
- (4) I learned problem analysis in university, improving my ability to calculate and take risks.
- (5) The university environment provided important things for my personal and professional growth.

A2. <Attitude toward Startups> Starting a business for me is

← 1 2 3 4 5 6 7 →

- | | |
|-----------------|---------------|
| (1) Positive | Negative |
| (2) Helpful | Harmful |
| (3) Worthwhile | Worthless |
| (4) Good for me | Bad for me |
| (5) Rewarding | Disappointing |

A3. <Startup Intention> I think

[1: strongly disagree 2: disagree 3: somewhat disagree
4: neutral 5: somewhat agree 6: agree 7: strongly agree]

- (1) I have a goal to found a startup.
- (2) I have decided to start a company in the future.
- (3) I will start my own business in the next few years.
- (4) I will make a lot of efforts to start a business.

A4. <Startup Self-efficacy> Confidence. I have...

[1: very little confidence 2: little confidence 3: some confidence
4: neutral 5: pretty much confidence 6: strong confidence 7: complete confidence]

- (1) I think I have the ability to deal effectively with practical matters.
- (2) When writing my business plans, I am quite sure that they will be executed.
- (3) I can usually deal with the typical problems of life.
- (4) I can learn something if I make up my mind to do so.
- (5) I can go through any situation in my life.

A5. If you decide to start a new company, who will be in favor of your decision?

← 1: completely negative 2 3 4 5 6 7: completely positive →

- (1) family (parents, brother/sister, etc.)
- (2) friends
- (3) my colleagues

A6. Is there anyone around you who started a business?

1: No, 2: Yes

- (1) I have a startup founder in my family (parents, brothers / sisters).
- (2) One of my friends is a startup founder.
- (3) A close neighbor is a startup founder.
- (4) There is a startup founder among my schoolmates.

A7. <Personal trait> what do you think about the following?

[1: very unlikely 2: unlikely 3: somewhat unlikely
4: neutral 5: somewhat likely 6: likely 7: very likely]

- (1) I usually like new challenges.
- (2) I always try to work in a new way.
- (3) I actively accept new ideas.
- (4) I like imaginative ideas.
- (5) I try to find new opportunities before others.
- (6) I keep trying new ideas to surpass others.

- (7) I tend to go ahead even when expectations are high.
- (8) I take risks for new opportunities.
- (9) I tend to take on challenges, even if there is a risk of failure.
- (10) I always actively plan and establish new things.
- (11) I proactively plan and execute rather than waiting for work to be given to me.
- (12) I actively pioneer and overcome rather than blame others or the environment around me.

A8. <Founder experience> Have you ever started up a new business?

- (1) I have experienced it.
- (2) I have experienced but not currently.
- (3) I'm interested and preparing.
- (4) I have no interest and no intention to try.

B. Respondent information

B1. Have you ever had a paying job? (including part-time jobs)

- ① no ② yes ⇒ length of time (years)

B2. What is your major?

B3. Do you have any intellectual property rights, such as patents?

- ① no ② yes ⇒ number of intellectual properties ()

B4. How many of the above-mentioned IP rights (patents) have been successfully used by spin-off or licensing agreement?

Number of successful commercialized patents ()

B5. In what percentage range is your household income?

(Top _____% of 100% of households)

- ① less than 10%
- ② 10% ~ less than 30%
- ③ 30% ~ less than 50%
- ④ 50% ~ less than 70%
- ⑤ 70% or more

B6. In which year were you born? (ex) 1981 ()