e-ISSN: 2316-2058

Iberoamerican Journal of Entrepreneurship and Small Business

ENTREPRENEURIAL BEHAVIOR FROM BEHAVIORAL CHARACTERISTICS AND ENTREPRENEURIAL INTENT

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Abstract

Study objective: this study aimed to develop a diffuse model to measure entrepreneurial behavior based on behavioral characteristics and entrepreneurial intention.

Methodology/approach: The research is applied, quantitative, descriptive and exploratory. To satisfy the problem raised, already validated data collection instruments were used. The sample consisted of 2,519 respondents. For the construction of the measurement model, fuzzy modeling was used.

Main results: Traditional methods of evaluating entrepreneurial behavior carry a degree of uncertainty and subjectivity with different uncontrollable independent variables. Given this fragility, fuzzy modeling proved to be a tool that contributes to the understanding of this behavior.

Theoretical/methodological contributions: the research contributes to presenting a differentiated model for measuring entrepreneurial behavior. Also, suggestions for future studies emerged from the results.

Relevance/originality: The diffuse model developed was more detailed and reliable compared to the method traditionally used. The originality of the study lies in the development of a fuzzy model to measure entrepreneurial behavior.

Keywords: Entrepreneurial behavior. Entrepreneurial intent. Fuzzy model.

Received on: 07/04/2019 / Approved on: 11/06/2020
Responsible editor: Profa. Dra. Vânia Maria Nassif
Translator: Diego Jahn
Evaluation process: Double Blind Review
Doi: https://doi.org/10.14211/regepe.v9i4.1544

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1 INTRODUCTION

The development of entrepreneurial behavior has been discussed in political, economic, and scientific agendas and debates in several countries, including Brazil, given the proven influence that this aspect has on a nation's economic and social development. Rocha and Freitas (2014) emphasize that one of the ways to develop entrepreneurial behavior is through entrepreneurship education.

It cannot be guaranteed that this entrepreneurial behavior will be decisive for the success of entrepreneurs in conducting their enterprises, however, it can still predict which characteristics of entrepreneurial behavior are important in this process, and which are related to the intention to undertake (Carneiro et al., 2017), and which can contribute to the development of more efficient programs focused on entrepreneurs training.

According to Schaefer and Minello (2016), the entrepreneur is capable of innovating in this contemporary and dynamic world, capable of solving problems and absorbing opportunities. Thus, this individual is considered as an agent of change. Entrepreneurship has been characterized through several researches, as an area of knowledge, as well as a way of being (Schaefer & Minello, 2017).

In this context, Salhi and Jemmali (2018) consider it important that university students are interested in entrepreneurship, as an option not only for their career, but for their lives**.** According to the authors, the students should “adopt entrepreneurship with their hearts and minds” (Salhi & Jemmali, 2018). Lima et al. (2015) state that entrepreneurial training contributes not only to the formation of companies, but also to the creation of jobs, and innovation in organizations.

In this sense, it is evident that one of the university's roles is to promote development through teaching, research, and extension, benefiting society as a whole (Etzkowitz, 2013). Considering that, entrepreneurial behavior contributes to socioeconomic development, thus, studying and analyzing the entrepreneurs in order to promote and disseminate their behavior becomes a key factor in understanding this phenomenon.

In addition, when talking about entrepreneurial intention, traditional evaluation methods have a significant degree of uncertainty and subjectivity with several independent and uncontrollable variables (Carneiro, 2008). In light of these

weaknesses, fuzzy methods may be a tool that can contribute to the understanding of the relevance of entrepreneurial behavior (Mendonça et al., 2015).

In this context, this study aims to develop a model for measuring entrepreneurial behavior from behavioral characteristics and entrepreneurial intent.

2 ENTREPRENEURIAL BEHAVIOR

Entrepreneurship is increasingly present in Brazil and worldwide (GEM, 2017). According to the author, this behavioral aspect has been developed over the decades under different epistemological currents that seek to understand and describe this human behavior. Schaefer states (2018) that behavior can be considered a primordial characteristic of living beings, especially in humans.

The entrepreneurs do not give up on their goals because they are persistent and when it is necessary, they modify their strategies to face challenges and overcome obstacles, even when personal sacrifice is required (Carreira et al., 2015). These individuals are dynamic social actors (Krüger, 2017).

In this scenario, entrepreneurial behavior can be described by different behavioral characteristics. David C. McClelland (1972) is one of the scholars on the behavior, who investigated the motivation to undertake associated with the need for achievement. McClelland used behavioral science theories to conduct empirical studies on motivation to undertake (Krüger et al., 2017).

As described by Matias and Martins (2012), McClelland perceived entrepreneurs as differentiated individuals and investigated their main external characteristics, so that it was possible to create programs that stimulated their development. McClelland's (1972) theory stands out for its easy approach and it is considered one of the most important and complex theories among behavioral theories of human psychological motivation (Ching & Kitahara, 2015).

McClelland's studies began to gain importance since the 1980s, when the United States Agency for International Development (USAID), Management Systems International (MSI), and McBeer and Company, a McClelland consulting firm started a project for more comprehensive studies about entrepreneurial behavior characteristics (Krüger et al., 2017).

The characteristics were grouped from this reorganization into three categories of different personal characteristics (dimensions): achievement (seeking for opportunities and initiative, calculated risks, persistence, demand for quality and

efficiency, commitment); planning (information seeking, goal setting, systematic monitoring, and planning), and power (persuasion and networking, independence and self-confidence) (MSI, 1990).

Engelman and Failure (2013) state these behavioral characteristics can contribute to the success of the enterprises, so, it is essential to study and improve them. According to Coan (2011), McClelland dedicated himself to the study of the behavior of entrepreneurs and their contributions to the economic development of nations, showing that entrepreneurs are responsible for their own decisions and that they believe in their ability to achieve good results (Coan, 2011).

Raupp and Beuren (2011) mention that these characteristics have gained relevance over the years, since not all individuals have the skills to undertake. Hence, the importance of programs to encourage the development of entrepreneurial behavior characteristics, such as the one developed by McClelland and his colleagues (Raupp & Beuren, 2011).

According to Souza (2015), the current challenge is to know how to develop entrepreneurial behavior characteristics in individuals, so that they can act as protagonists of entrepreneurial activities. Minello (2014) mentions that these characteristics can be developed. The author states that entrepreneurs are “individuals who develop something innovative, people who have the initiative and ability to organize and reorganize social and economic mechanisms to transform resources and situations into a practical advantage, accepting the risk or failure of their actions” (Minello, 2014, p. 74).

As stated by Nassif et al. (2014), personal characteristics, innovative ability, experience, and the constant improvement of business creation and management skills are fundamental to entrepreneurs' success. Developing entrepreneurial skills and characteristics is a way of “self-enrichment” (Boutillier & Uzunidis, 2014).

Entrepreneurial behavior characteristics can help individuals to cope with entrepreneurial challenges (McClelland, 1978). Minello (2014) says that when entrepreneurs are the managers of their own business, their behavior reflect on their ability to deal with adversity. In this regard, understanding the relationship between behavior and entrepreneurial intention can help to improve such characteristics (Leiva et al., 2014).

According to Gomes (2004), McClelland provided contributions to this topic, by showing that people tend to follow reference models, which in many cases, influences

the motivation to undertake. The author mentions that according to McClelland's studies, the more a society's value system is positively distinguished from entrepreneurial activity, the greater the number of people who choose to undertake (Gomes, 2004).

Vilas Boas (2015) also supports McClelland's study, stating that his instrument is still one of the main mechanisms for identifying characteristics of entrepreneurial behavior, which is widely used and internationally replicable. Matias (2010) corroborates with this view, by arguing that regardless of the criticism that McClelland has received, his theory remains as one of the broadest and most rigorous empirical research on behavioral characteristics for developing countries, besides of been adopted by international bodies, such as the United Nations in several countries.

Hence, when studying entrepreneurial behavior, it is essential to analyze David McClelland's theory. (Brancher et al., 2012). However, although there are other scales for measuring entrepreneurial behavior, such as Schmidt et al. (2018), this study opted for the instrument developed by McClelland (Mansfield et al., 1987), considering that it is used worldwide, and it was also used by the authors in a longitudinal research at UFSM (UFSM Project N. 042930).

2.1 ENTREPRENEURIAL INTENTION

In investigating entrepreneurial behavior, Hisrich et al. (2014) highlight the role that intention or predisposition plays in entrepreneurial activity, seeking the motivating factors that influence the individual's behavior. In order to be an entrepreneur, the individual must want to be one (Liñán & Chen, 2006). As the authors mention, the lack of interest in being an entrepreneur does not rule out this possibility, but the chance is lower.

Entrepreneurial intention is defined as "people's self-acknowledged conviction that they intend to start a business and consciously plans to do so at some point in the future" (Thompson, 2009, p. 677). As stated by the author, it is a conscious and planned decision that drives the actions necessary to set up a new business.

Carvalho and Gonzales (2006) consider that turning an idea into an enterprise is always preceded by intention, which in turn can be planned. These authors say that in some cases, the intention is formed just before the behavior, but in others, this may never happen. Therefore, it is assumed that the entrepreneurial intention analysis serves to predict entrepreneurial behavior, but caution should be exercised regarding

the second case mentioned (Davidsson, 1995).

Krueger et al. (2000) point out that the decision to become an entrepreneur is voluntary, conscious, and planned, therefore predictable and understood by intention models. A longitudinal study by Kautonen et al. (2015) years later also confirmed that entrepreneurial intention can predict actions to be taken.

Thus, factors influencing entrepreneurial intent may be relevant to policy makers, educators, and researchers. Fayolle and Liñán (2014) also consider entrepreneurial intention a promising field in entrepreneurship research. According to Almeida (2013), this possibility of predicting behavioral actions has led to several theoretical models under development, offering a "coherent, parsimonious, generalizable, and robust theoretical framework for understanding and predicting this behavior"

The theoretical framework about entrepreneurial intention can be attributed to Ajzen and his Theory of Planned Behavior (TPB) (1991). Souza (2015) explains that TPB comprises three independent variables that precede the formation of intention, through which, it is possible to predict the behavior. As stated by the author, attitude is the first variable and it allows to determine the favorable moment for a given behavior; the second one, subjective norms refers to the individuals' perceptions of the surrounding community that influence their behaviors; finally, the third is the perceived behavioral control, which is the individuals' perception of their behaviors, as well as the extent of this behavior that is within their control, which leads them to determine their entrepreneurial intentions (Souza, 2015).

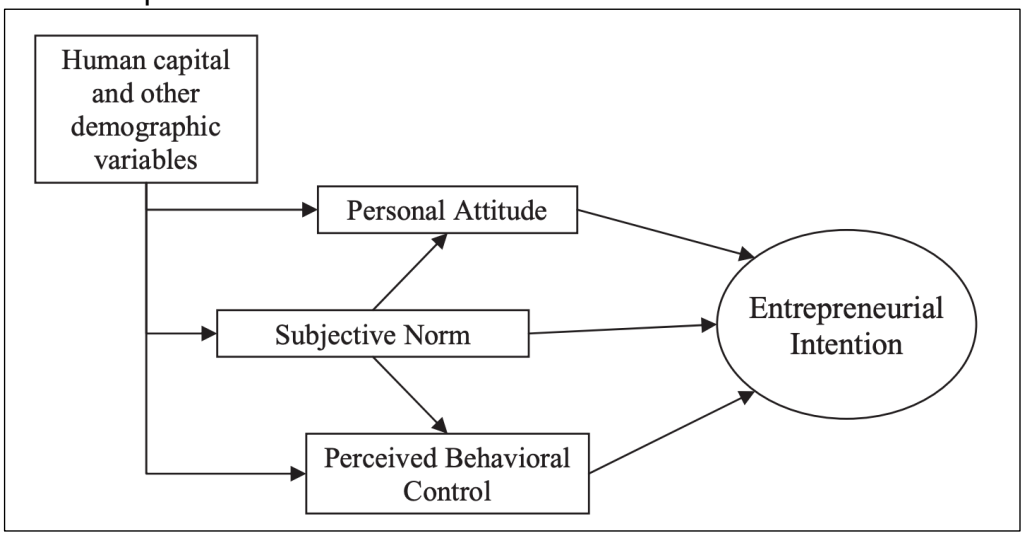
TPB was promoted by Liñán and Chen (2006). The authors proposed a model of psychometric measurement of entrepreneurial intention adapted from TPB (Ajzen, 1991), named as the Entrepreneurial Intention Questionnaire (EIQ). Entrepreneurial intention is based on TPB (Ajzen, 1991), which for Schlaegel and Koenig (2014) and Krueger and Carsrud (1993) provides a solid theoretical basis.

The EIQ by Liñán and Chen (2006) was developed and validated years later (Liñán & Chen, 2009). This instrument was created to verify the entrepreneurial intention of university students, and it consists of a set of statements that represent the dimensions of entrepreneurial intention, perceived behavior, subjective norms, and personal attitudes.

Liñán and Chen (2009) mention that a person's future behavior is preceded by intention: the stronger the intention to engage in a specific behavior, the greater the

chance that the behavior will happen. Moreover, the intention to perform a particular behavior is the result of three cognitive antecedents: (i) attitude towards behavior; (ii) subjective norms; and (iii) perceived behavioral control. (Krueger & Carsrud, 1993; Schlaegel & Koenig, 2014). Figure 1 shows the entrepreneurial intention model by Liñán and Chen (2009).

Figure 1 – Entrepreneurial Intention Model



Source: Adapted from Liñán and Chen (2009, p. 597).

Behavioral attitude refers to the individual's assessment of their behavior, whether positive or negative (Oliveira et al., 2016). Assessment is the most affective component of attitude, determining the motivation and strength of the behavioral intention. Hence, a favorable attitude is associated with a greater intention to act (Moriano et al., 2007). Personal attitudes are related to the degree to which the individual holds a positive or negative valuation of being an entrepreneur. This dimension encompasses assertions that include the affective side, such as “I like it”, as well as evaluation considerations, such as “it has advantages for me” (Liñán & Chen, 2009, p. 596).

Subjective norms refer to the social pressure to perform a behavior or not, and it reflects the effect of social values on the individual. (Morales et al., 1994). The subjective norm is the most social component of the model, as it incorporates the influence of significant people for the individuals in the decision to develop their professional career through entrepreneurship (Oliveira et al., 2016). According to the authors, subjective norms measure the perceived social pressure to perform an entrepreneurial behavior or not. This dimension refers to the perception that people

considered as a reference for the individuals would think about them becoming entrepreneurs (Liñán & Chen, 2009).

Perceived behavioral control is defined as an understanding of the ease or difficulty of becoming an entrepreneur (Liñán & Chen, 2009). This antecedent reflects the degree of perceived control that the individual has, which leads him to determine the behavior (Souza, 2015). For Ajzen and Fishbein (2000) the greater the perception of behavioral control, the stronger the individual intention to perform the behavior in question.

In Brazil, the EIQ was validated from the studies by Couto, Mariano, and Mayer (2010) and Hecke (2011). Hence, for the present study, the construct of entrepreneurship intention based on TPB (Ajzen, 1991), through the EIQ (Liñán & Chen, 2009).

3. METHODOLOGICAL PROCEDURES

The study is classified as applied, quantitative, descriptive, and exploratory. (Hair Jr. et al., 2009; Sampieri et al., 2013). The research was conducted at the Federal University of Santa Maria, located in southern Brazil. Currently, there are 132 undergraduate programs and approximately 26,000 students enrolled at the university. A minimum sample of 750 respondents was calculated for this population, taking into account the number of variables of the data collection instruments (Hair Jr. et al., 2009).

Two previously validated instruments were used for the data collection. The first refers to the entrepreneurial behavior characteristics (EBCs) developed by McClelland (Mansfield et al., 1987) to measure the entrepreneurial behavior characteristics of the students. This questionnaire is based on the ten EBC's by McClelland (MSI, 1990), and the maximum score is 25 points for each of the characteristics. When the total is 15 points or more means that the individual has that specific characteristic. In the end, it is understood that if the individual has an equivalent average, he is considered as an entrepreneur (Mansfield et al., 1987).

The EIQ was adopted to analyze the entrepreneurial intention (Liñán & Chen, 2009). The EIQ consists of 20 assertions that are separated into 4 blocks, according to their respective dimensions: personal attitudes, subjective norms, perceived behavioral control, and entrepreneurial intention. The total value of each dimension is the sum of its assertions.

The application of the instruments occurred at UFSM during 2018. The data collection was made in person in the different undergraduate programs of the institution, in which students from different semesters and majors were invited to participate. The applications occurred sequentially, from a previous schedule to prevent the same student from answering the questionnaires twice. The collected data were consolidated in an electronic spreadsheet, and then the tabulation was analyzed for further analysis.

The collected data was revised to verify possible typing errors after been consolidated. Statistical tests were performed for the data handling and analysis, using the SPSS software; at this time, the data were analyzed based on the models proposed by McClelland (Mansfield et al., 1987) and Liñán and Chen (2009).

The minimum, maximum, mean, and standard deviation of each characteristic and dimension were calculated for the instruments. The internal consistency of the instruments was measured by Cronbach's alpha coefficient to estimate the reliability of the responses (Sampieri et al., 2013). Pearson's Correlation Coefficient was used to analyze the relationship between entrepreneurial behavior characteristics and the dimensions of entrepreneurial intention, which, according to Collis and Hussey (2005), refers to a parametric technique that measures the strength of the relationship between two variables.

After calculating the indicators (characteristics and intention), the assumptions for the construction of the fuzzy model were elaborated. In this study, the fuzzy modeling was built on the MATLAB® R2018b software with the toolbox. The adoption of fuzzy modeling is due to the possibility of measuring the relevance of entrepreneurial behavior (Mendonça et al., 2015) and entrepreneurial intention. This modeling provides a simple way to obtain a definitive conclusion based on vague, ambiguous, and inaccurate information (Agarwal & Jain, 2013), which also justifies its adoption.

After presenting the research design, the research subjects, the collection instruments, the data analysis procedures, detailing their respective particularities; now, it is presented the analysis and discussion of the results.

4. ANALYSIS AND DISCUSSION OF RESULTS

Data analysis is divided into two parts. First, the descriptive statistics of the collected instruments. Second, the fuzzy model is elaborated from the analysis of the studied constructs.

4.1 DESCRIPTIVE STATISTICS

In order to perform the analysis, 2,519 valid instruments were considered. Data analysis began with the calculation of the minimum, maximum, mean, standard deviation, and variance of each characteristic of the EBCs and the dimensions of the EIQ of the studied constructs. Table 1 shows the descriptive statistics of such constructs.

Table 1 - Descriptive Statistics

Q	Dimensions/Characteristics	Minimum	Maximum	Mean	Standard Deviation	Variance
EBC's	Seeking for opportunities and initiative	6,00	25,00	19,29	2,85564	8,155
	Persistence	6,00	25,00	16,33	2,60825	6,803
	Commitment	6,00	25,00	18,87	2,83545	8,040
	Demand for efficiency and quality	5,00	25,00	17,80	3,17489	10,080
	Taking calculated risks	5,00	25,00	16,49	3,14689	9,903
	Goal setting	5,00	25,00	17,15	3,25799	10,614
	Information seeking	5,00	25,00	17,92	2,98837	8,930
	Systematic planning and monitoring	5,00	25,00	17,72	2,92236	8,540
	Persuasion and networking	5,00	25,00	16,31	2,94717	8,686
	Independence and self-confidence	5,00	25,00	16,94	2,92177	8,537
EIQ	Personal Attitudes	5,00	25,00	18,59	4,68558	21,955
	Subjective Norms	3,00	15,00	12,37	2,38556	5,691
	Perceived Behavioral Control	6,00	30,00	17,01	5,57519	31,083
	Entrepreneurial Intention	6,00	30,00	18,13	6,91945	47,879

Source: Authors (2019).

Table 1 shows that each of the EIQ dimensions has a maximum limit, and this is due to the items that vary from one dimension to another. The Personal Attitudes dimension has five items and achieved a maximum score of 25; Subjective Norms has three with a maximum score of 15 points; Control Perception and Entrepreneurial Intention with six items, reaching 30 points. Regarding behavioral characteristics, the maximum limit is 25 points, which was achieved in all characteristics.

Variance is a measure of variability that uses all data to compare the variability of two or more variables. Standard deviation is the positive square root of the variance, and it is easier to interpret than variance, since it is measured in the same units of data. (Dennis et al., 2013).

The highest standard deviation and variance occur in the Perceived Behavior Control and Entrepreneurial Intention dimensions, which have the largest number of items, which means that there is a distinction between the answers. The smallest

standard deviation and variance occurs in the Subjective Norms dimension, which includes only three items and demonstrates uniqueness in the answers.

It is identified that all characteristics obtained minimum scores below the limit of 15 points, which means for McClelland that they are non-existent (Mansfield et al., 1987). This means that one or more of the students do not have these entrepreneurial behavior characteristics**.** The ten CCEs of the students were scored above 15 points based on the average, indicating the existence of behavioral characteristics (Mansfield et al., 1987), as shown in Table 1.

The seek for opportunities and initiatives is highlighted among the ten behavioral characteristics that obtained the highest average with 19.3, which refers to the individual's proactivity towards adverse situations and the seek for opportunities to create, or reset a goal (MSI, 1990).

On the other hand, the characteristics of persistence and persuasion and networking obtained the lowest scores (16.3). Persistence is a behavioral characteristic that reflects how the individual acts towards significant obstacles; if the subject is persistent or changes the strategies in order to face challenges, or overcome obstacles (MSI, 1990).

This characteristic is also related to self-sacrifices or the conception of an extraordinary effort to complete a task (MSI, 1990).

The characteristic of persuasion and networking are related to planning strategies in advance in order to influence and persuade others, besides the use of key elements to achieve goals and how the subject acts to develop and maintain relationships (networking) (MSI, 1990).

In addition to the individual score for each characteristic, it is possible to measure the final score that indicates whether the individual has entrepreneurial behavior or not. This score follows McClelland's prerogative that when the total is equal to or greater than 15 points, the individual is considered an entrepreneur (Mansfield et al., 1987). A score of 17.5 was obtained from the group average for the 2,519 respondents, which means that in general, the students surveyed are entrepreneurs in terms of behavioral aspects.

Analyzing individually, 92% (2,323) of students can be considered entrepreneurs (McClelland, 1987), as they obtained final scores equal to or greater than 15 points; and 8% (196) had an individual final result below 15 points, so they cannot be considered as having entrepreneurial behavior. McClelland (1987) states

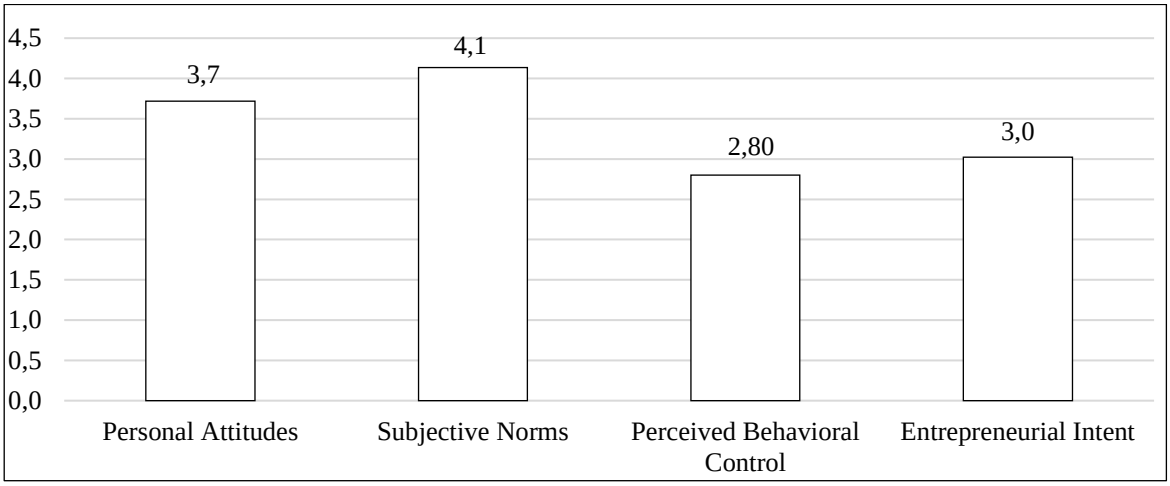
that a successful entrepreneur must have or need to develop these ten entrepreneurial behavior characteristics.

The characteristics are divided into three dimensions: achievement, planning, and power. The respective averages of these dimensions were as follows: Achievement (17.8), Planning (17.6), and Power (16.6). It is noticed that the Achievement dimension has the highest score (17.8). As stated by McClelland (1972), this is because people are motivated by the need for achievement, which leads them to the path of success. According to the author, this specific need for achievement is present and generates a different motivational structure in the entrepreneur (McClelland, 1972). Power is in the last position (16.6) and the difference between them is more than one point, which is considerable. The Power dimension is understood as “a concern regarding the control of the means to influence a person”, and it is clear that this concern is not significant for the students surveyed, (McClelland, 1972, p. 211).

In order to estimate reliability, the internal consistency was measured by Cronbach's Alpha (Sampieri et al., 2013). Cronbach's Alpha for the instrument of the ten behavioral characteristics obtained $\alpha = 0.879$, which reveals that the answers can be considered reliable.

It was observed that regarding the instruments of entrepreneurial intention, the dimension of subjective norms obtained the lowest score, and personal attitudes obtained the highest one (Table 1). However, it should be noted that in the EIQ, the dimensions do not have the same number of items. Therefore, Figure 2 was created, to show the quotient of the total score of each dimension.

Figure 2 - Quotients for the dimensions of EIQ



Source: Authors (2019).

The more favorable the Attitudes, Subjective Norms, and Perceived Behavior Control, the greater the individual's intention to perform such behavior. Figure 2 shows that the highest score was the Subjective Norms, that is, according to the individual's perception, the community around him influences his behavior (Souza, 2015). This dimension represents the perceived social pressure to perform a behavior (Ajzen, 1991). In addition, Liñán and Chen (2009) indicate that subjective norms are the first filter for entrepreneurial intentions.

In this study, the Subjective Norms obtained greater values than the other dimensions, that is, the respondents believe that their decisions could be approved or not and that these decisions are related to the social pressure exerted to perform a certain behavior, reflecting the influence of social values on the individual (Morales et al., 1994). The subjective norm is the component with the most social aspects in the EIQ, since it covers the influence that significant people have on invididuals' decision-making to either develop their professional careers through entrepreneurship or not (Oliveira et al., 2016).

The lowest score was obtained in the Perceived Behavioral Control, which for Ajzen (2002) is defined as the perception of the ease or difficulty of becoming an entrepreneur. Regarding this dimension, individuals tend to manifest behaviors in which, they feel more comfortable doing it or if they have more knowledge in the area (greater dominance) (Bandura, 1982). It is observed that the students surveyed want to perform entrepreneurial activities. Entrepreneurial intention is considered as the effort that the individual exerts or intends to exert in order to perform an entrepreneurial

activity (Ajzen, 1991). According to Ajzen (1991), entrepreneurship is predicted by intentions derived from attitudes.

As stated by Schlaegel and Koenig (2014), and Krueger and Carsrud (1993), a person's future behavior is preceded by intention. The stronger a person's intention to engage in a specific behavior, the more likely it is to happen. It is inferred that students intend to undertake, but this dimension was only higher than the Perceived Behavioral Control, that is, it can be improved.

In the EIQ, Cronbach's Alpha totaled 0.788 for the four items, which means that such responses are reliable. Pearson's Correlation matrix was performed between the averages of the behavioral characteristics and the entrepreneurial intention of the students (Table 2).

Table 2 – Correlation of behavioral characteristics and entrepreneurial intention

		EIQ			
		Pers. Attitude	**Sub. Norms**	**Per. Cont.**	**Emp. Int**
EBC's	Seeking for opportunities and initiative	,241**	,150**	,214**	,216**
	Persistence	,094**	,007*	,081**	,090**
	Commitment	,144**	,116**	,127**	,108**
	Demand for efficiency and quality	,103**	,048*	,106**	,101**
	Taking calculated risks	,143**	,057**	,178**	,145**
	Goal setting	,197**	,088**	,181**	,194**
	Information seeking	,151**	,073**	,161**	,156**
	Systematic planning and monitoring	,154**	,098**	,137**	,139**
	Persuasion and networking	,170**	,088**	,211**	,184**
	Independence and self-confidence	,166**	,088**	,256**	,196**

** The correlation is significant at the 0.01 level (bilateral).
* The correlation is significant at the 0.05 level (bilateral).
Source: Authors (2019).

The correlations (Table 2) between entrepreneurial behavior characteristics and the dimensions of entrepreneurial intention were positively associated, but with weak intensity (Hair Jr. et al., 2009; Lopes, 2016). The strongest correlation was between the characteristics of the Seeking for Opportunities and Initiative and Personal Attitudes (0.24), Entrepreneurial Intention (0.22), and Perceived Behavior Control (0.21).

The correlation between behavioral characteristics and the Subjective Norms dimension had positive associations with lower values in relation to the other dimensions (Personal Attitude, Perceived Behavior Control, and Entrepreneurial Intention). Therefore, it can be said that there is no social pressure exerted on students to become entrepreneurs, which is contrary to the results obtained by Moraes et al. (2016). Interestingly, it is observed that the social circle does not pressure these

students to become entrepreneurs (Pearson's correlation), but in the EIQ (Liñán; Chen, 2009), the social values, social pressure, and influence of the people that surround these students are significant.

In the university context, Esfandiar, Sharifi-Tehrani, Pratt, and Altinay (2019) contribute by stating that desirability is the main determinant of the intention of the entrepreneurial objective. Also, autonomy, competence, and relationship have an indirect impact on entrepreneurial intention through the background: attitude, subjective norm and perceived behavioral control (Al-Jubari; Hassan & Liñán, 2019). Interestingly, it is observed that in the present research the social circle does not pressure these students to be entrepreneurs (Pearson's correlation), while in the QIE (Liñán; Chen, 2009) the social values, social pressure, and influence of the people that surround these students are significant.

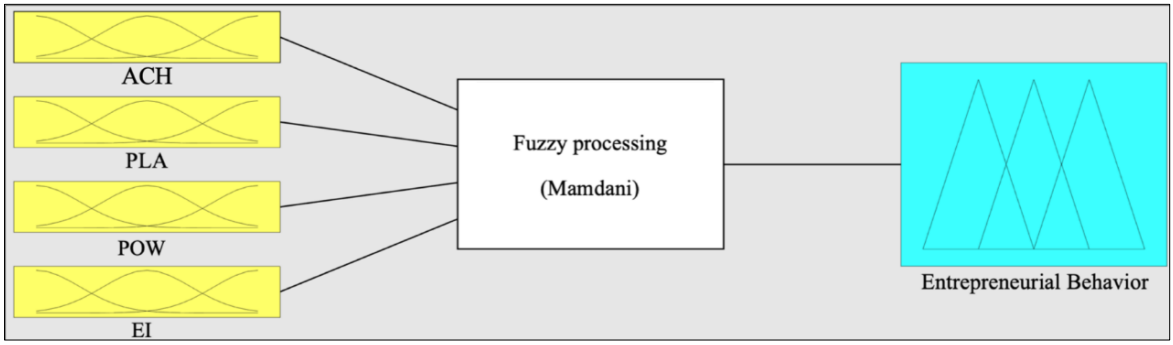
4.2 FUZZY MODEL FOR ENTREPRENEURIAL BEHAVIOR

In order to elaborate the premises for the development of the fuzzy model, it was decided to extract numerical data (Marçal & Susin, 2006), to this end, it was used Pearson's correlation. In this study, a fuzzy model was developed to measure entrepreneurial behavior through entrepreneurial behavior characteristics and entrepreneurial intention. The construction of the model originates from the inference system and considers input, processing, and output (Chen, 1985).

The measurement is based on a fuzzy model in which factors, variables, and diffuse weights are defined. The fuzzy result was obtained for each stage of the test from the sum of the responses to the weighted factors, and the resulting sets. (Sigette, 2017). The result is a fuzzy set that when compared to the maximization of sets that are defuzzified by the centroid and normalized method, assumes results between 0 and 1 (Chen, 1985), which is comparable with a reference graph (Sigette, 2017).

The developed model follows a set of linguistic variables, pertinence functions, fuzzification and defuzzification method, which are the elements of fuzzy logic. In order to achieve the research objective, a fuzzy system was developed to measure entrepreneurial behavior. Figure 3 shows the entrepreneurial behavior analysis system through entrepreneurial behavior characteristics by McClelland (MSI, 1990) and entrepreneurial intention (Liñán & Chen, 2009).

Figure 3 - Fuzzy System for Entrepreneurial Behavior



Source: Adapted from MATLAB (2019).

In the system (Figure 3), the entrepreneurial behavior characteristics were grouped into three dimensions: Achievement (ACH), Planning (PLA), and Power (POW) and followed McClelland's theory (MSI, 1990). Entrepreneurial Intention (EI) was established by the TPB by Liñán and Chen (2009). The system took into account the validation of the structural model for entrepreneurial behavior.

It is observed in Figure 3 that the system starts with the input data referring to the four dimensions: ACH, PLA, POW, and EI, that is, based on the questionnaire responses (Mansfield et al., 1987; Liñán and Chen, 2009). Processing takes place from this data, and the output shows whether the subject exhibits an entrepreneurial behavior or not.

The system input parameter corresponds to a scale ranging from 5 to 25 points. If the individuals score less than 15, it means that they do not have entrepreneurial behavior. However, if they score equal to or greater than 15, they have entrepreneurial behavior. This finding is based on Mansfield et al. (1987) for entrepreneurial behavior characteristics, which in turn are extended to the entrepreneurial intention that was adjusted in the final score to correspond with the 25 maximum points by Mansfield et al. (1987), since this dimension had a maximum score of 30 points**.** This score was adjusted using the rule of three, satisfying the need for the model.

The complexity of the study is found between scores 14 and 16, considering that the individual may or may not have the respective dimension (ACH, PLA, POW, and EI) and consequently, the entrepreneurial behavior. The mean for analysis was adopted by the sum of all items divided by the total number of items. The result obtained by the mean is questionable, since the individual may have obtained a very

high score in one dimension and low one in the others, but in overall, it results in entrepreneurial behavior due to the adoption of a mean.

Given this situation of uncertainty, the system developed to analyze entrepreneurial behavior takes into account the weighted fuzzy range. This research focuses on this situation of uncertainty, which corresponds to a subjective result, considering that there are four dimensions and instead of the average, a fuzzy processing system is used to calculate the entrepreneurial behavior.

Based on the responses of the instruments, the students surveyed can obtain as results: if they have entrepreneurial behavior, if they do not have it, or if they maybe have it, considering for this, the fuzzy interval that is combined with the others behavioral dimensions. In this context, the system uses the fuzzy interval as “maybe” and considers the result of the other dimensions to obtain a final result, which is considered more reliable than the average that is traditionally used.

This is because, in this modeling, there is a fuzzy inference, which is a process of evaluating inputs to obtain conclusions through defined rules and inputs, using the theory of fuzzy sets (De Lima, 2017).

The interference system addressed in this work is the Mamdani (Nguyen & Walker, 1976). There is another interference system known as Takagi Sugeno (Tanscheit & Scharf, 1988), which differs from Mamdani in the consequent part, which is a function (generally linear) of the antecedent variables: if x1 is A1, and x2 is A2, then z = f (x_1, x_2). Usually, the function f is a polynomial and the inference system is referenced according to the degree of this polynomial (Bothe, 1997), which motivates the use of Mamdani.

Fuzzy modeling uses a fuzzy algorithm that each rule is a fuzzy conditional proposition and different fuzzy relationships in U x V x W can be derived from it (Andrade & Jacques, 2008). These premises (antecedents) are associated with the inputs of the fuzzy controller, while the consequences (actions) are associated with the outputs of the controllers (De Lima, 2017).

Examples of programmed assumptions (rules) for the fuzzy model are as follow: if achievement, planning, power, and entrepreneur are low, then the subject does not have Entrepreneurial Behavior; and, if the achievement, planning, power, and entrepreneur are nebulous, then maybe the subject has Entrepreneurial Behavior. These premises were elaborated from the dimensions of entrepreneurial behavior

characteristics and entrepreneurial intention, and denote the model's reliability, since the programming depends on the programmed premises.

In order to build this fuzzy model for measuring entrepreneurial behavior, the inference method by Mamdani was used with the defuzzification being performed by the Centroid method. The choice for this method was based on the fuzzy implication functions, and on the composition operators for the definition of the fuzzy output of the controller (Sugeno, 1985). The control action is obtained, by defining a set of fuzzy control instructions (rules or premises) from which, a fuzzy algorithm is developed.

The implementation of the premises is done through the definition of operators to process the antecedent of the premise, and the implication function that will define its consequence (Andrade & Jacques, 2008). The action of the fuzzy controller is defined by the aggregation of the number of Ri rules that make up the algorithm, which can be implemented by different operators. This aggregation results in the fuzzy set that defines the controller output. The effective output of the controller is obtained through a defuzzification process applied to the set (Andrade & Jacques, 2008).

Hence, the equations for calculating the premises $\boldsymbol{\mu}$ $(\boldsymbol{x})$ were calculated, by correlating the numerical intervals and the linguistic terms for the different possibilities of entrepreneurial behavior, which are detailed below (Table 3).

Table 3 - Equations for entrepreneurial behavior

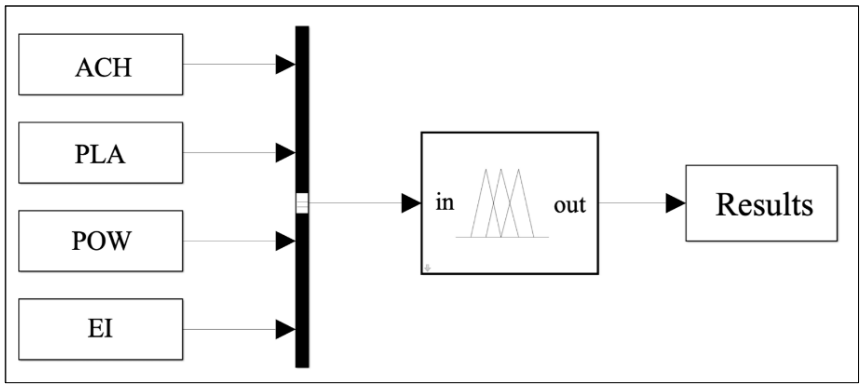
Low entrepreneurial behavior	Nebulous entrepreneurial behavior	High Entrepreneurial Behavior
If 0 <μ (x) ≤ 14,9 then μ (x)=no	If 14 ≤ μ (x) ≤ 16 then μ (x)= maybe	If 15 ≤ μ (x) ≤ 25 then μ (x)= yes
Non-entrepreneur	Maybe entrepreneur	Entrepreneur

Source: Authors (2019).

These equations take into account the dimensions of Achievement, Planning, Power, and Entrepreneurial Intention, and they are the linguistic variables of the fuzzy model for measuring entrepreneurial behavior, which reinforce the reliability of the model, since the results (outputs) are consistent with this programming. The terms, “low”, “maybe”, and “high” are associated with these behavioral dimensions and correspond to the modeling inputs.

The input and output parameters, the assumptions established, the equations formulated and inserted, and the algorithm created by the fuzzy model are ready to be tested, from the configuration of the fuzzy system. Figure 4 presents the final fuzzy model to measure entrepreneurial behavior.

Figure 4 - Fuzzy model for measuring entrepreneurial behavior



Source: Authors (2019).

Initially, the indicators and premises for each dimension of entrepreneurial behavior were configured in the Fuzzy Toolbox – MATLAB and subsequently, they were saved in a .fis file. Thereafter, the fuzzy system (already configured (.fis)) was tested with the Simulink tool. Finally, a program was created to analyze the input data and the responses of undergraduate students at UFSM. The data of these students were inserted into the fuzzy model to measure their behavior.

After building the measurement model, data from 2,519 respondents were entered into MATLAB. The measurement model was tested and the results were that 2,093 (83%) students are entrepreneurs, 330 (13%) are not entrepreneurs, and 96 (4%) maybe are entrepreneurs.

The percentage of students who were considered entrepreneurs in descriptive statistics (Mansfield et al., 1987) was 92%, but through the fuzzy method, the percentage has dropped by almost 10% (83%). Non-entrepreneurs represented 8% through descriptive statistics, but through the fuzzy method, this percentage rose to 13.1%. Moreover, through the Fuzzy Model, students classified with 14-16 (points) were considered as being maybe entrepreneurs (4%, 96 students), which in descriptive statistics could not be verified.

It can be noted the advantage of using fuzzy logic based on this finding, since it proved to be more detailed and reliable than traditional methods. The fuzzy model used the understanding in modeling the premises and linguistic variables, which in turn facilitated the understanding of the results. Machado et al. (2007) state that the most outstanding characteristic of fuzzy logic is that it represents in an innovative way, the handling of inaccurate information. It is proven that the Fuzzy Model provides a method

of translating verbal, vague, imprecise, and qualitative expressions that are common in human behavior into numerical values.

Table 4 shows some results of the simulations using the developed fuzzy model (Simulink in MATLAB), and the traditional analysis methodology of the three students surveyed.

Table 4 - Comparison of scores

Student	ACH	PLA	POW	EI	Traditional average score	Scoring by the fuzzy model
316	18,0	13,3	14,5	14,2	15,00	8,66
380	16,0	15,7	15	5	12,92	19,28
20	16,8	15,7	14,5	13,3	15,08	14,17

Source: Authors (2019).

The research subject number 316 (Table 4) obtained an average score of 15 points when compared to descriptive statistics, which classifies him as having an entrepreneurial behavior (McClelland, 1987). However, as observed through fuzzy modeling, the individual has three dimensions below the 15 points limit (PLA, POW, and EI), which classifies him, as a non-entrepreneur. In this way, it is observed that the fuzzy model correctly proceeded to the configured assumptions, as well as fuzzification and defuzzification, and in fact, student 316 does not have entrepreneurial behavior. It is concluded that the developed fuzzy model is more complete when compared to traditional measurement methods.

When verifying the scores obtained by student 380 in descriptive statistics, he obtained a final average below 15 points, which would classify him as a non-entrepreneur (Table 4). However, on the other hand, with the fuzzy model, in which it presents three dimensions above the stipulated limit (ACH, PLA, and POW), the individual is considered as an entrepreneur. Again, the model developed proved to be more reliable compared to the traditional analysis.

Student number 20 based on the developed model, obtained the option as being “maybe entrepreneur” as the answer. This is because two dimensions are considered high, above 15 points (ACH and PLA), and two dimensions are considered low (POW and EI), below 15 points. Once again, the model for measuring entrepreneurial behavior proceeded correctly for the configured premises.

Comparing with descriptive statistics (Table 4), student 20 obtained an average higher than the limit of 15 points. This result indicates that from the traditional analysis, this individual would be considered as an entrepreneur, however, in the fuzzy model

he does not have entrepreneurial behavior. The model developed considers both fuzzification and defuzzification, which indicates a more authentic result compared to the traditional analysis.

It should be noted that the fuzzy model was presented to measure entrepreneurial behavior, considering entrepreneurial behavior characteristics and entrepreneurial intention. The model developed was adequate to perform the proposed measurement.

5. FINAL CONSIDERATIONS

The present study aimed to develop a model to measure entrepreneurial behavior from behavioral characteristics and entrepreneurial intention. This objective was achieved through the structuring and development of a specific model to measure entrepreneurial behavior through fuzzy logic.

In order to develop a model the entrepreneurial behavior measurement model, initially, we sought to identify the characteristics and entrepreneurial behavior dimensions and to verify the dimensions of the entrepreneurial intention of the respondents. This was contemplated through the responses of undergraduate students at UFSM in the instrument of entrepreneurial behavior characteristics by Mansfield et al. (1987), and in the entrepreneurial intention questionnaire by Liñán and Chen (2009).

Regarding the identification of entrepreneurial behavior characteristics and dimensions, it is concluded that most of the students have entrepreneurial behavior (Mansfield et al., 1987). This behavior was measured through descriptive statistics.

The characteristic of seeking for opportunities and initiative based on the average, achieved the highest score, revealing that these students are proactive and seek for opportunities. On the other hand, they are not persistent about what they want for their future and do not consider themselves as influencers. Regarding the entrepreneurial intention, the respective scores were observed through the EIQ (Liñán & Chen, 2009). The Subjective Norms dimension obtained the highest score among the students in descriptive statistics.

Pearson's Correlation matrix was performed between behavioral and entrepreneurial intentions. Positive associations of weak intensity were found, which indicates a direct relationship between them. The fuzzy model was developed from that. The construction of the model was performed in the MATLAB software, using the

Mamdani method with the defuzzification by the Centroide method

The fuzzy measurement model was tested and proved to be valid for measuring entrepreneurial behavior. The advantage of using fuzzy logic can be seen from the results, which were more detailed if compared to the traditional method (statistical) for measuring entrepreneurial behavior. Therefore, it is understood that this model can be more reliable**.** The fuzzy model used the understanding in modeling the premises and linguistic variables, which facilitated the understanding of the results**,** unlike the average that is traditionally used.

It is understood that the results of this research lead to the development of actions that encourage entrepreneurial behavior in higher education institutions. It is possible to identify the percentage of undergraduate students who have or not entrepreneurial behavior, from the analysis of the entrepreneurial characteristics and intentions. These findings are essential to the development of more skilled people for the labor market.

When addressing entrepreneurial behavior, it is inevitable to consider the behavior characteristics and entrepreneurial intentions to deepen this analysis. In this context, this study sought to contribute to an existing gap in the traditional methods of analysis of these constructs. The results of the measurement model developed to contribute to expand the frontier of knowledge about entrepreneurial behavior, in addition to providing subsidies for researchers in the area.

Regarding the limitations, the study was restricted to the development of a fuzzy model to measure entrepreneurial behavior based on two instruments already validated (Mansfield et al., 1987; Liñán & Chen, 2009). It is suggested that future studies expand the constructs addressed in this model and that they compare the model with and without the entrepreneurial intention. Besides that, it is recommended to consider other validated scales on entrepreneurial behavior and to take into account other dimensions such as culture and cognition.

The research was limited to only a public institution of higher education, contemplating only undergraduate students with a cross-section and with analysis of the sample as a whole, without segregating by undergraduate course or semester.

As a suggestion for future research, comparative studies between the sample and other institutions of higher or basic education are recommended to find relevant information on the topic. In addition to longitudinal monitoring of the entrepreneurial behavior evolution of the students surveyed.

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