MEASURING MODEL OF ENTREPRENEURIAL BEHAVIOR FROM BEHAVIORAL CHARACTERISTICS AND ENTREPRENEURIAL INTENTION

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1. INTRODUCTION

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

It cannot be guaranteed that this entrepreneurial behavior is decisive for the success of the entrepreneurs in the conduct of their enterprises, however, one can predict which characteristics of the entrepreneurial behavior are important in this process and which have relation with the intention to undertake (Carneiro et al., 2017), which can contribute to the enactment of more efficient and targeted programs for the formation of entrepreneurs.

The entrepreneurial individual, for Schaefer and Minello (2016), is the actor capable of innovating in the evolutionary process of the contemporary world, able to solve problems and absorb opportunities, considering this subject agent of change. The understanding of entrepreneurship through several researches has characterized it not only as a way of knowing, but also as a way of being (Schaefer & Minello, 2017).

In this sense, Salhi and Jemmali (2018) consider it important that university students are interested in entrepreneurship as an option not only for career but for life. Let them adopt entrepreneurship with their hearts and minds (Salhi & Jemmali, 2018). Lima et al. (2015) find that this entrepreneurial training contributes not only to the formation of companies, but also to the creation of jobs and innovation in organizations.

Faced with this, 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). If entrepreneurial behavior contributes to socioeconomic development, studying and analyzing the individual in order to promote and disseminate this behavior becomes a key factor in understanding this phenomenon. Therefore, in the present study the target population is undergraduate students of a higher education institution.

Moreover, when we talk about entrepreneurial behavior, especially intention, traditional methods of evaluation carry a degree of uncertainty and significant subjectivity with several uncontrollable independent variables (Carneiro, 2008). Facing this fragility, the fuzzy methods can be a tool that contributes to the understanding of the degree of pertinence regarding the entrepreneurial behavior (Mendonça et al., 2015). This is because these methods provide a simple way to arrive at a definitive conclusion based on vague, ambiguous and inaccurate information (Agarwal & Jain, 2013).

On this, the objective of this study was to develop a fuzzy model for measuring entrepreneurial behavior based on behavioral characteristics and entrepreneurial intent.

2. ENTREPRENEURIAL BEHAVIOR

Entrepreneurship has been increasingly present in Brazil and in the world (GEM, 2017). More than a way of knowing, entrepreneurship is a way of being (Schaefer, 2018). For the author, this behavioral aspect has developed over the decades, in the form of different epistemological currents that seek to understand and describe this human behavior. For Schaefer (2018), behavior can be considered a primordial characteristic of living beings, especially the human being.

The entrepreneur does not deviate from his objectives, he acts repeatedly or changes his

strategy in order to face challenges and overcome obstacles, even if personal sacrifice is necessary (Carreira et al., 2015). These individuals are not static social actors, as far as behavior is concerned, on the contrary, they are dynamic beings (Krüger, 2017).

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

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

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

From this reorganization, the characteristics were grouped into three categories of different personal characteristics (dimensions): Achievement (Search for opportunities and initiative, Take Calculated Risks, Persistence, Requirement of quality and efficiency, Commitment), Planning (Information search, Setting goals, Systematic planning and monitoring) and Power (Persuasion and contact networks, Independence and self-confidence).

These behavioral traits, for Engelman and Fracasso (2013), can contribute to the success of the enterprises, which makes their study and improvement essential. For Coan (2011), McClelland devoted himself to the study of the behavior of businessmen in society and their contributions to the economic development of nations, showing that entrepreneurs are responsible for their decisions and believe in their ability to achieve good results (Coan, 2011).

These characteristics, for Raupp and Beuren (2011), gain relevance. This is because, not all individuals have the skills to undertake them, so the importance of development programs and stimulus of entrepreneurial behavioral characteristics, such as that developed by McClelland and contributors (Raupp & Beuren, 2011).

For Souza (2015) the current challenge is to know how to promote entrepreneurial behavioral characteristics in individuals, so that they can act as protagonists of entrepreneurial activities. These characteristics are evolved in the view of Minello (2014), who understands the entrepreneur as "the individual who develops something innovative, has the initiative, the capacity to organize and reorganize social and economic mechanisms in order to transform resources and situations to practical advantage and accept the risk or the failure of their actions" (Minello, 2014, p. 74).

For Nassif et al. (2014), personal characteristics, including their innovative capacity and accumulated experience, as well as the constant improvement of the skills to create and manage businesses, are the key for entrepreneurs to achieve success. The development of entrepreneurial skills and characteristics is a mode of "self-enrichment" (Boutillier & Uzunidis, 2014). Entrepreneurial behavioral traits can help individuals cope with the challenges of undertaking (McClelland, 1978). For Minello (2014), the behavior of the entrepreneur, in the role of manager of his own business, is also evident in his ability to deal with adversity and adversity itself. In this sense understanding the relationship between behavior and entrepreneurial intention can help to improve such characteristics (Leiva et al., 2014).

For Gomes (2004), McClelland provided contributions to the discussions on the subject,

showing that men tend to repeat benchmarks, which in many cases influence the motivation to undertake. From the study of McClelland's characteristics, the more the value system of a society positively distinguishes the entrepreneurial activity, the greater the number of people who tend to choose to undertake (Gomes, 2004).

Vilas Boas (2015) also supports McClelland's study, stating that the instrument developed by him is still one of the main mechanisms for identifying characteristics of entrepreneurial behavior, used with great international scope and replicability. Matias (2010) corroborates this view by arguing that McClelland's criticism of McClelland's continued broader and more rigorous empirical research on behavioral characteristics in developing countries is being adopted by international organizations such as the United Nations in a number of countries.

Therefore, when one intends to study entrepreneurial behavior it is essential to analyze the work of David McClelland (Brancher et al., 2012).

2.2 ENTREPRENEURIAL INTENT

When investigating entrepreneurial behavior, Hisrich et al., (2014) highlight the role that intention or predisposition plays in the entrepreneurial activity, searching for the motivating factors that influence the behavior of the individual. For the subject to be an entrepreneur he must, in general, have the intention of being (Liñán & Chen, 2006). For the authors, the lack of interest in being an entrepreneur does not rule out this possibility, but it decreases in comparison to who has this predisposition.

Entrepreneurial intent is defined as the "self-acknowledged conviction by a person that he intends to create an enterprise and consciously plans to do so at some point in the future" (Thompson, 2009, p. 677). For the author it is a conscious and planned decision that drives the actions needed to launch a business. Individual entrepreneurial intent is a key construct in research into new business formation (Thompson, 2009).

Carvalho and Gonzales (2006) consider that the concretization of the idea of creating an enterprise, like a company, is preceded by the intention, which in turn can be planned. For these authors, in some cases the intention is formed instants before the idea is realized, in other cases, the intention may never coincide with the performance of the behavior. Therefore, it is assumed that the analysis of the entrepreneurial intention serves to predict the behavior of the individual as to the relation to undertake, but one must be cautious about the second case mentioned (Davidsson, 1995).

Krueger et al. (2000) point out that the decision to become entrepreneur is voluntary and conscious, being, as already mentioned, a planned decision, therefore predictable and understood by models of intention. Years later, a longitudinal study by Kautonen et al. (2015) also confirmed that entrepreneurial intent can predict action to take.

Thus, the question of what influences entrepreneurial intent may be relevant to policy makers, educators, and researchers. So much so that Fayolle and Liñán (2014) consider entrepreneurial intention a vibrant field in entrepreneurship research. According to Almeida (2013), this possibility of predicting behavioral action has led to numerous theoretical models developing, offering a "coherent, parsimonious, generalizable and robust theoretical framework to understand and predict this behavior" (Almeida, 2013, p. 121).

The frame of the theoretical foundation on entrepreneurial intention can be attributed to Ajzen's (1991) Theory of Planned Behavior (TPB). Souza (2015) explains that TPB comprises three independent variables that precede the formation of intention, through which it is possible to predict behavior. For the author, the first variable, attitude, allows to determine the favorable moment for a given behavior; to the second variable, subjective norms, refers to the very perception that an individual has about the community that surrounds him and that determines

his behavior; the third variable reflects the degree of perception of control that the individual has, which leads him to determine the behavior (Souza, 2015).

TPB was promoted by the authors Liñán and Chen (2006, 2009). The authors proposed a model of psychometric measurement of the entrepreneurial intention adapted from TPB (Ajzen, 1991), the Entrepreneurial Intention Questionnaire (QIE). Entrepreneurial intent is based on TPB (Ajzen, 1991), which for Schlaegel and Koenig (2014) and Krueger and Carsrud (1993), provides a solid theoretical basis. The QIE de Liñán and Chen (2006) was developed and validated years later (Liñán & Chen, 2009). This instrument was developed to verify the degree of entrepreneurial intention of students of higher education, being constituted by a set of assertions that represent the dimensions of entrepreneurial intention, perception of behavior, subjective norms and personal attitudes.

Liñán and Chen (2009) postulate that the future behavior of a person is preceded by intention: the stronger a person's intention to engage in a specific behavior, the more likely it is that the actual behavior will be realized. In addition, the intention to perform a given 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). Behavior attitude refers to the individual's assessment of their own behavior, whether positive or negative (Oliveira et al., 2016). The evaluation is the most affective component of the attitude, determining the motivation and strength of the intention of the behavior. In this sense, the favorable attitude is associated with a greater intention to act (Moriano et al., 2007).

The subjective norms refer to the social pressure exerted to perform - or not - a behavior and reflects the effect of social values on the individual (Morales et al., 1994). The subjective norm is the most social component of the model, in that it incorporates the influence of significant people to the subject in the decision to develop their professional career through entrepreneurship (Oliveira et al., 2016). Figure 1 shows the entrepreneurial intention model of Liñán and Chen (2009).

Figure 1 - Entrepreneurial intent model
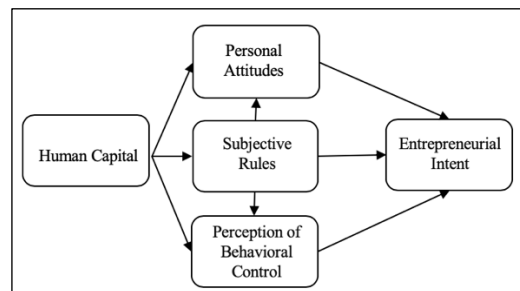
Source: Adapted from Liñán and Chen (2009, p. 597).

Personal attitudes relate to the degree to which the individual holds a positive or negative personal assessment of being an entrepreneur. This dimension encompasses assertions that include the affective, such as "I like, it is attractive to me", as well as evaluation considerations, such as "it has advantages for me" (Liñán & Chen, 2009, p. 596).

For these authors, subjective norms measure the perceived social pressure to carry out entrepreneurial behaviors or not. This dimension refers to the perception that the people considered as a reference for the individual will or will not approve the decision to become an entrepreneur (Liñán & Chen, 2009). The perception of behavioral control is defined as the understanding of ease or difficulty of becoming an entrepreneur. In Brazil the QIE was validated from the studies of Couto, Mariano and Mayer (2010) and Hecke (2011). In this sense, for the present study the entrepreneurial intention construct based on TPB (Ajzen, 1991) was adopted, through the QIE (Liñán & Chen, 2009).

3. RESEARCH METHODS

The study is classified as applied, quantitative, descriptive and exploratory (Hair Jr. et al., 2009; Sampieri et al., 2013). The research was carried out at the Federal University of Santa Maria, located in the south of Brazil. Currently the institution has 132 undergraduate courses and a population about 26 thousand regularly enrolled students (UFSM, 2018). For this population a minimum sample of 750 respondents was calculated, taking into account the number of variables of the data collection instruments (Hair Jr. et al., 2009).

For the collection of data, two previously validated instruments were used. The first one refers to the entrepreneurial behavioral characteristics (CCEs) developed by McClelland (Mansfield et al., 1987) in order to raise the entrepreneurial behavioral characteristics of the students. This questionnaire is based on the ten CCE's of McClelland (MSI, 1990), and the maximum score is 25 points for each of the characteristics. When the total is equal to or greater than 15 points the individual has the characteristic, in the end, it is understood that if the subject behaves as an entrepreneur (Mansfield et al., 1987).

In order to analyze the entrepreneurial intention, QIE was adopted (Liñán & Chen, 2009). The QIE is composed of 20 assertions, separated into 4 blocks, according to the respective dimension: personal attitudes, subjective norms, perception of behavioral control and entrepreneurial intention. The total value of each dimension is the sum of the respective assertions.

The application of the instruments took place in the university researched throughout 2018. The applications were classroom-based, in the different undergraduate courses of the institution, in which undergraduate students were invited to participate. The applications occurred sequentially, from a previous schedule, in order to avoid that the same student answered the questionnaires twice. The data collected were consolidated in spreadsheet, after tabulation were checked and then analyzed.

After consolidating the collected data, a conference was held to verify possible typing errors. For the treatment and analysis of the data collected, statistical tests were performed using the SPSS software, at which time the data were analyzed based on the models proposed by McClelland (Mansfield et al., 1987) and Liñán and Chen (2009).

For each of the instruments were calculated minimum, maximum, average and the standard deviation of each characteristic and dimension. Then, to estimate the reliability, the internal consistency of the instruments was measured by Cronbach's Alpha Coefficient (Sampieri et al., 2013). In order to analyze the association between the entrepreneurial behavioral characteristics and the dimensions of the entrepreneurial intention, Pearson's Correlation Coefficient was used, which according to Collis and Hussey (2005), refers to a parametric technique that indicates the measure of strength of association between two variables.

From the calculation of the indicators (characteristics and intention), the premises for the construction of the fuzzy model were elaborated. After presenting the research design, the research subjects, the collection instruments, the data analysis procedures for this thesis, detailing the respective particularities, the following presents the analysis and discussion of the results.

4. FINDINGS

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

4.1 DESCRIPTIVE STATISTICS

For the analysis, 2.519 valid instruments were considered. The analysis of the data began with the calculation of the minimum, maximum, mean, standard deviation and variance of each characteristic of the CCE's and the dimensions of the QIE, of the constructs studied. Table 1 shows the descriptive statistics for the constructs studied.

Table 1 - Descriptive statistics

Inst.	Characteristics/ Dimensions	Min.	Max.	Mean	Standard Deviation	Variance
CCE's	Search for opportunities and initiative	6,00	25,00	19,2946	2,85564	8,155
	Persistence	6,00	25,00	16,3335	2,60825	6,803
	Commitment	6,00	25,00	18,8757	2,83545	8,040
	Requirement of quality and efficiency	5,00	25,00	17,8051	3,17489	10,080
	Ride Calculated Risks	5,00	25,00	16,4903	3,14689	9,903
	Setting goals	5,00	25,00	17,1501	3,25799	10,614
	Information search	5,00	25,00	17,9194	2,98837	8,930
	Systematic planning and monitoring	5,00	25,00	17,7233	2,92236	8,540
	Persuasion and contact networks	5,00	25,00	16,3100	2,94717	8,686
	Independence and self-confidence	5,00	25,00	16,9420	2,92177	8,537
QIE	Personal Attitudes	5,00	25,00	18,5931	4,68558	21,955
	Subjective Norms	3,00	15,00	12,3740	2,38556	5,691
	Control Perception Behavior.	6,00	30,00	17,0159	5,57519	31,083
	Entrepreneurial Intent	6,00	30,00	18,1342	6,91945	47,879

Source: Authors (2019).

From Table 1 it is verified that each dimension of the QIE has its own maximum limit, this is due to the quantity of items that varies from one dimension to another. The Personal Attitudes dimension presents five items, achieved maximum score of 25; Subjective Norms has three items and reached a maximum score of 15 points; Perception of Control and Entrepreneurial Intent have both six items, reaching 30 points. In the case of behavioral characteristics, the maximum limit is 25 points, which was reached in all characteristics.

Variance is a measure of variability that uses all data, it is useful to compare the variability of two or more variables. Meanwhile the standard deviation is defined as the positive square root of the variance, that is, it is a little easier to interpret than the variance, since it is measured in the same units of the data. The coefficient of variation is a measure of relative variability: it measures the standard deviation in relation to the mean (Dennis et al., 2013).

The highest standard deviation and variance occurs in the dimensions of Control Perception and Entrepreneurial Intent, which have the highest number of items, six, which means that a distinction is made between the answers. The lowest standard deviation and variance occurs in the Subjective Norms dimension, which contemplates only three items and demonstrates uniqueness in the responses.

It is identified that all characteristics obtained minimum scores below the 15-point limit, which for McClelland are non-existent (Mansfield et al., 1987), this means that one or a few students do not have these entrepreneurial behavioral characteristics. The ten CCE's of the students, based on the mean, were scored above 15 points, indicating the existence of the behavioral characteristics (Mansfield et al., 1987), as shown in Table 1.

Among the ten behavioral characteristics, the characteristic search for opportunities and initiative that obtained the highest average 19,3, which refers to the individual's proactivity in the face of adverse situations and the search for opportunities to create or expand a goal (MSI, 1990). On the other hand, persistence and persuasion and contact networks obtained the lowest scores (16,3). Persistence is a behavioral characteristic that denotes how the individual acts in the face of a significant obstacle; acts repeatedly or changes strategy in order to face a challenge or overcome an obstacle (MSI, 1990).

This characteristic is also related to the accomplishment of personal sacrifices or the conception of an extraordinary effort to complete a task or activity (MSI, 1990). On the other hand, the persuasion and contact networks characteristic is about discussing strategies in advance to influence and persuade others, the use of key people to achieve proposed 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 or not the individual has entrepreneurial behavior. This score follows the prerogative of McClelland, when the total is equal to or greater than 15 points the individual is considered an entrepreneur (Mansfield et al., 1987). For the 2.519 respondents, from the group average, a score of 17,5 was obtained, which means that the researched students, in general, are entrepreneurs regarding the behavioral aspects.

Analyzing individually, 92% (2.323) of the students surveyed can effectively be considered entrepreneurs (McClelland, 1987), since they obtained final scores equal or superior to 15 points, and 8% (196) had an individual final result lower than 15 points or cannot be considered as having entrepreneurial behavior. For McClelland (1987) the successful entrepreneurial subject must have or need to develop these ten entrepreneurial behavioral traits.

The characteristics are segmented into three dimensions: achievement, planning and power. The respective averages of these dimensions were: Realization (17,8), Planning (17,6) and Power (16,6). It is noticed that the Realization dimension presents the highest score (17,8), for the scholar this is because people are motivated by need for achievement, which drives them to success (McClelland, 1972). For the author, the specific need for achievement is present and generates a differentiated motivational structure in the entrepreneur (McClelland, 1972). Power is in the last position (16,6), the difference between both is considerable, more than one point. The Power dimension is understood as "a concern with the control of the means to influence a person", it is perceived that for the students studied this concern is not significant (McClelland, 1972, p. 211).

To estimate reliability, internal consistency was measured by Cronbach's Alpha (Sampieri et al., 2013). Cronbach's Alpha for the CCE's instrument for the ten items obtained $\alpha = 0,879$.

As for the instrument of entrepreneurial intention, observed that the dimension of subjective norms obtained the lowest score and personal attitudes obtained higher scores, however, it should be emphasized that in the QIE the dimensions do not present the same number of items. Thus, the quotient of the total score of the dimension was calculated taking into account the quantity of items of each dimension. The scores were: 3.7 for personal attitudes; 4.1 for subjective norms; 2.8 for perception of behavioral control; and 3.0 for entrepreneurial intent.

The more favorable the Attitudes, Subjective Norms and Control Perception, the greater the individual's intention to exert such behavior. It is inferred that the highest score resulted in the Subjective Norms dimension, this means that, according to the individual's perception, the community around him determines his behavior (SOUZA, 2015). This dimension represents the perceived social pressure to carry out the behavior in question (AJZEN, 1991). Liñán and Chen (2009) indicate that subjective norms are the first filter to enterprising intentions.

In this study Subjective Norms obtained higher values than the other dimensions, that is to say that the respondents believe that their decisions will be approved or not, and that these decisions concern the social pressure exerted to carry out - or not - a behavior, reflecting the effect of social values on the individual (Morales et al., 1994). The subjective norm is the most social component of the QIE, insofar as it incorporates the influence of significant individuals on the decision to develop the professional career through entrepreneurship (Oliveira et al., 2016).

The lowest score was obtained in Behavioral Control Perception, which for Ajzen (2002)

is defined as the perception of the ease or difficulty of becoming an entrepreneur. Regarding this dimension of perceived behavioral control, individuals' manifest behaviors that they feel are able to control and dominate (Bandura, 1982). It is observed that the students studied present an intention to undertake. Entrepreneurial intention is considered as the effort that the individual exerts or intends to exert to carry out an entrepreneurial activity (Ajzen, 1991). For Ajzen (1991) entrepreneurship is predicted by intentions that are derived from attitudes.

For the authors Schlaegel and Koenig (2014) and Krueger and Carsrud (1993), the future behavior of a person is preceded by intention, the stronger a person's intention to engage in a specific behavior, the more likely the actual behavior will be realized. It is inferred that the students intend to undertake, but this dimension was only superior to the Perception of Behavioral Control, that is, it can be improved.

For the QIE, Cronbach's alpha totaled 0,788 for the four items, which means that such responses are reliable. The Pearson Correlation matrix was then performed between the means of the behavioral characteristics and the entrepreneurial intention of the students (Table 2).

Table 2 - Correlation of CCE's and entrepreneurial intention

		QIE			
		Attit. Pers.	Sub. Norm.	Cont. Per.	Ent. Int.
CCE's	Search for opportunities and initiative	,241**	,150**	,214**	,216**
	Persistence	,094**	,007*	,081**	,090**
	Commitment	,144**	,116**	,127**	,108**
	Requirement of quality and efficiency	,103**	,048*	,106**	,101**
	Ride Calculated Risks	,143**	,057**	,178**	,145**
	Setting goals	,197**	,088**	,181**	,194**
	Information search	,151**	,073**	,161**	,156**
	Systematic planning and monitoring	,154**	,098**	,137**	,139**
	Persuasion and contact networks	,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).

It is verified that the correlations (Table 2) between the entrepreneurial behavioral characteristics and the dimensions of the entrepreneurial intention were positive associations of intensity weak and weak, and that there is a direct relationship between them (Hair Jr. et al., 2009; Lopes, 2016). The strongest correlation occurred between the Search for Opportunities and Initiative characteristics and the Personal Attitudes (0,24), Entrepreneurial Intent (0,22) and Control Perception (0,21) dimensions.

The correlation between the behavioral characteristics and the Subjective Norms dimension showed positive associations with the lowest values in relation to the other dimensions (Personal Attitude, Control Perception and Entrepreneurial Intent). In this way, it can be affirmed that there is no social pressure exerted on the students to become or not entrepreneurs, coming from the social circle in which they live, similar to that obtained by Moraes et al. (2016). Interestingly, it is observed that the social circle does not pressure these students to be entrepreneurs (Pearson's Correlation), but in the QIE (Liñán; Chen, 2009) social values, social pressure and influence of people that surround these students are showed significant.

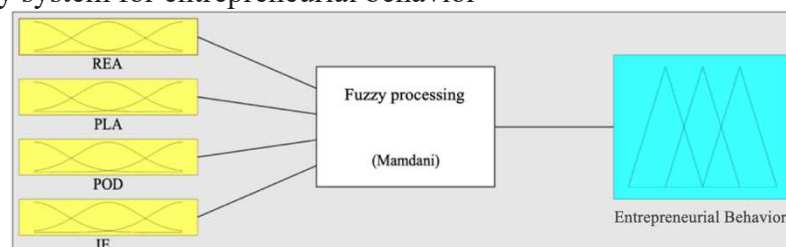## 4.2 FUZZY MODEL FOR ENTREPRENEURIAL BEHAVIOR

In order to elaborate the premises for the development of the fuzzy model, it was chosen the extraction of numerical data (Marçal & Susin, 2006), therefore, it was based on Pearson's correlation for the creation of premises in diffuse logic. In this study, a fuzzy model was developed to measure entrepreneurial behavior through entrepreneurial behavioral

characteristics and entrepreneurial intent. The construction of the model originates from the inference system and considers: input, processing and output (Chen, 1985).

The measurement is based on a model in which factors, variables and fuzzy weights are defined. From the sum of the alternatives of responses to the weighted factors and the resulting sets, we obtain the diffuse or nebulous result for each step of the test (Sigette, 2017). The result is a fuzzy set which, when compared to maximizing sets, defuzzified by the centroid method and normalized, assume results between 0 and 1 (Chen, 1985), comparable with a reference graph (Sigette, 2017).

The developed model follows a set of linguistic variables, pertinence functions, fuzzification method and defuzzification, which are the component elements of fuzzy logic. In order to reach the research objective, a fuzzy system was initially developed to measure entrepreneurial behavior. Figure 2 presents the system for analyzing entrepreneurial behavior through the entrepreneurial behavioral characteristics of McClelland (MSI, 1990) and entrepreneurial intent (Liñán & Chen, 2009).

Figure 2 - Fuzzy system for entrepreneurial behavior

Source: Authors (2019) from MATLAB.

In this study the fuzzy modeling was built in the software MATLAB® R2018b together with the toolbox toolbox. In the system (Figure 2) the entrepreneurial behavioral characteristics were grouped in three dimensions: Realization (REA), Planning (PLA) and Power (POD) and followed what was predicted by McClelland's theory (MSI, 1990). Entrepreneurial Intent (IE) was established by TCP de Liñán and Chen (2009). The system took into consideration the validation of the structural model for entrepreneurial behavior.

In Figure 2 it is observed that the system starts with the input data referring to the four REA, PLA, POD and IE dimensions, that is, based on the responses of the research subjects in the instruments (Mansfield et al., 1987; Liñán and Chen, 2009). From these data the processing takes place, finally, in the exit it is demonstrated if the subject presents or not an entrepreneurial behavior.

The input parameter of the system corresponds to a scale ranging from 5 to 25 points. If the individual presents a score lower than 15, he does not present an entrepreneurial behavior. Already, if it has a score equal to or higher than 15, it is considered a subject with entrepreneurial behavior. This finding is based on Mansfield et al. (1987) for the entrepreneurial behavioral characteristics, extended to the entrepreneurial intention that went through adjustment in the final score to correspond with the scale of 25 maximum points of Mansfield et al. (1987), since this dimension had a maximum score of 30 points. By means of rule of three this score was adjusted, satisfying the need of 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 (REA, PLA, POD and IE) and consequently entrepreneurial behavior. Traditionally we adopt the mean for analysis, that is, the sum of all items divided by the total quantity of items. The result obtained by the average is questionable, since the individual may have obtained a very high score in one dimension and low in the others, but in the end result in entrepreneurial behavior due to adoption of mean or vice versa.

Given this situation of uncertainty, the system developed to analyze the entrepreneurial behavior takes into account the weighted range called nebulous. The focus of this research is in this situation of uncertainty, which corresponds to a subjective result considering that they are four dimensions and instead of the average a fuzzy processing system is used to calculate the entrepreneurial behavior.

The research subject, based on the answers to the assertions in the instruments, obtains as a result if it presents an entrepreneurial behavior, does not present an entrepreneurial behavior or perhaps presents an entrepreneurial behavior, considering for this the nebulous interval, by which it is combined with the other behavioral dimensions. In this sense, the system uses the nebulous interval as perhaps and considers the result of the other dimensions to arrive at a final result, considered as more reliable than the traditionally adopted average.

This is due to the fact that in this modeling, fuzzy inference occurs, which is a process of input evaluation with the objective of obtaining conclusions through the previously defined rules and inputs, using the fuzzy set theory (De Lima, 2017). For De Lima (2017) the existing models of inference are Mamdani and Sugeno. The choice of these methods of inference must take into account the type of problem to be solved, obtaining a better processing. In this study we chose Mamdani.

The fuzzy modeling uses a fuzzy algorithm in which each rule is a fuzzy conditional proposition and different fuzzy relations in U x V x W can be derived from it (Andrade & Jacques, 2008). These assumptions, also called antecedents, are associated with the inputs of the fuzzy controller, while the consequences, which are also known as actions, are associated with the outputs of the controllers (De Lima, 2017).

Examples of programmed assumptions (rules) for the fuzzy model of measurement of entrepreneurial behavior are: If achievement is low and planning is low and power is low and entrepreneurial is low then it does not present Entrepreneurial Behavior; e, If realization is nebulous and planning is nebulous and power is nebulous and entrepreneurial it tries nebulous then perhaps it presents Entrepreneurial Behavior. These assumptions were elaborated from the dimensions of entrepreneurial behavioral characteristics and entrepreneurial intention.

For the construction of this fuzzy model for the measurement of the entrepreneurial behavior, the Mamdani inference method was used, with defuzzification by means of the Centroid method. The choice by this method was based on the fuzzy implication functions and on the composition operators for the fuzzy output definition of the controller (Sugeno, 1985). The control action is obtained through the definition of a set of instructions (rules or premises) of fuzzy control, from which a fuzzy algorithm is developed.

The implementation of each premise is done through the definition of operators for the processing of the antecedent of the premise and the implication function that will define its consequent (Andrade & Jacques, 2008). The action of the fuzzy controller is defined by the aggregation of the n rules R_i that compose the algorithm, which can be implemented by different operators. This aggregation results in the fuzzy set, which defines the output of the controller. The effective output of the controller is then obtained by means of a defuzzification process applied to the set (Andrade & Jacques, 2008).

Thus, the equations for calculating the premises $\boldsymbol{\mu(x)}$ were computed by correlating the numerical intervals and the linguistic terms for the different possibilities for entrepreneurial behavior, detailed below (Table 3).
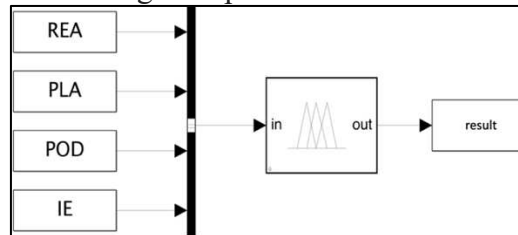
Table 3 - Equations for entrepreneurial behavior

Low entrepreneurial behavior	Nebulous entrepreneurial behavior	High entrepreneurial behavior
If $0 < \mu(x) \leq 14{,}9$ then $\mu(x)$=no	If $14 \leq \mu(x) \leq 16$ then $\mu(x)$=maybe	If $15 \leq \mu(x) \leq 25$ then $\mu(x)$=yes
Not entrepreneurial	Perhaps entrepreneurial	Entrepreneurial

Source: Authors (2019).

The equations presented take into account the dimensions of Realization, Planning, Power and Entrepreneurial Intent and are the linguistic variables of the fuzzy model for measuring entrepreneurial behavior. The terms low, perhaps, and high are associated with these behavioral dimensions and correspond to the modeling inputs.

From the configuration of the fuzzy system, the input and output parameters, the established premises, the formulated and inserted equations and the algorithm created the fuzzy model is ready to be tested. Figure 3 presents the final fuzzy model for measuring entrepreneurial behavior.

Figure 3 - Fuzzy model for measuring entrepreneurial behavior

Source: Authors (2019).

Initially the configuration in the MATLAB Fuzzy Toolbox of the indicators and premises for each dimension of the entrepreneurial behavior was later saved in an .fis file. Then the fuzzy system already configured (.fis) with the Simulink tool was tested. Finally, a program was created to analyze the input data, answers of UFSM undergraduate students, the data of these research subjects were executed in the fuzzy model to measure entrepreneurial behavior.

After construction of the measurement model the data of 2.519 respondents were inserted into MATLAB. The measurement model was tested. After construction of the measurement model the data of 2.519 respondents were inserted into MATLAB. The measurement model was tested. The results were: 2.093 (83%) students are entrepreneurs, 330 (13%) are not entrepreneurs and 96 (4%) are entrepreneurs.

The percentage of entrepreneurial respondents who were considered to be entrepreneurs in the descriptive statistics (Mansfield et al., 1987) was 92%, now the percentage fell by almost 10% (83%). As for non-entrepreneurs, by means of descriptive statistics, they represented 8%, now this percentage has risen to 13,1%. In addition, through the Fuzzy Model, students classified as 14-16 (points) were considered maybe entrepreneurs (4%, 96 students), which in the descriptive statistics could not be verified.

From this finding, one can observe the advantage of using fuzzy logic, which has been shown to be more detailed and can be taken as more reliable than traditional methods. The fuzzy model used linguistic variables and the understanding in the modeling of the premises which facilitated the understanding of the results, differently from the traditionally adopted average. Contribute Machado et al. (2007), in which the most characteristic of fuzzy logic is to represent in an innovative way the handling of imprecise information. It is proved that the Fuzzy Model provides a method of translating verbal, vague, imprecise and qualitative expressions, common in human behavior in numerical values.

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

Table 4 - Comparison of scores

Student	REA	PLA	POD	IE	Traditional score by average	Fuzzy model score
316	18,0	13,3	14,5	14,2	15,00	8,6627
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: Author (2019).

Compared with descriptive statistics (Table 4), the research subject nº 316 obtained an average score of 15 points, which classifies him as having entrepreneurial behavior (McClelland, 1987). However, as observed through fuzzy modeling, he presents three dimensions below the 15-point limit (PLA, POD and IE), which classifies it as non-entrepreneurial. Thus, it is observed that the fuzzy model correctly proceeded to the configured premises, as well as the fuzzification and defuzzification, and in fact the student nº 316 does not present any entrepreneurial behavior. The fuzzy model developed, it is concluded, is more complete compared to traditional methods of measurement.

When verifying the scores obtained by the student nº 380 in the descriptive statistics, the same obtained a final average below 15 points, which would classify him as non-entrepreneur (Table 4), but when he comes across the fuzzy model, in which it presents three dimensions above of the stipulated limit (REA, PLA and POD), it is considered as an entrepreneur. Once again, the developed model proved to be more reliable compared to the traditional analysis methodology.

From the developed model the student nº 20 obtained as answer the position of perhaps entrepreneur. This is because two dimensions are considered high, above 15 points (REA and PLA); and two dimensions are considered as low (POD and IE), below 15 points. Again, the model for measuring entrepreneurial behavior proceeded correctly to the configured premises.

Comparing with descriptive statistics (Table 4), student nº 20 obtained an average higher than the 15-point limit, from the traditional analysis would be considered an entrepreneur, however, through the fuzzy model does not present entrepreneurial behavior. The model considers fuzzification beyond defuzzification, which indicates a more authentic result compared to traditional analysis.

It should be noted that a fuzzy model was presented to measure the entrepreneurial behavior contemplating entrepreneurial behavioral characteristics and entrepreneurial intention. The developed model was adequate to carry out the proposed measurement.

5. CONCLUSION

The present study aimed to develop a model for measuring entrepreneurial behavior based on behavioral characteristics and entrepreneurial intent. It was verified that this objective was reached through the structuring and development of a specific model to measure the entrepreneurial behavior through fuzzy logic.

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

As to the identification of entrepreneurial behavioral characteristics and dimensions, it is concluded that students, for the most part, have entrepreneurial behavior (Mansfield et al., 1987). This behavior was measured by descriptive statistics. From the average, the characteristic search for opportunities and initiative has earned the highest score, revealing that these students are proactive and looking for opportunities. However, on the other hand, the respondents are not persistent about what they want and also do not consider themselves influencers. Regarding the entrepreneurial intent, the respective scores were observed through the EIS (Liñán & Chen, 2009). In the descriptive statistics, the Subjective Norms dimension obtained higher score among the undergraduate students surveyed.

The Pearson Correlation matrix was then performed between the behavioral and entrepreneurial intentions. It was found positive associations of intensity weak and weak, which

indicates a direct relationship between them. From this the fuzzy model was developed. The construction of the model was performed in MATLAB software, using the Mamdani method with defuzzification by the Centroid method.

The fuzzy measurement model was tested and proved to be valid for the measurement of entrepreneurial behavior. From the results, one can observe the advantage of using fuzzy logic, which was more detailed compared to the traditional methods of measuring entrepreneurial behavior, so it is understood that this developed model can be more reliable. The fuzzy model used linguistic variables and the understanding in the modeling of the premises which facilitated the understanding of the results, differently from the traditionally adopted average.

It is understood that the results of this research direct to the development of actions that stimulate the entrepreneurial behavior in the different institutions of higher education. From the analysis of entrepreneurial characteristics and intentions of undergraduate students, it is possible to identify the percentage of students who present entrepreneurial behavior, as well as those who do not. These findings are essential to finding ways to provide the market with more prepared and complete people.

When addressing entrepreneurial behavior for the deepening of analysis it is inevitable to consider behavioral and entrepreneurial intentions, this study sought to contribute to a gap in the traditional methods of analysis of these constructs. The results of the developed measurement model contribute to broadening the frontier of knowledge about entrepreneurial behavior, besides providing subsidies for researchers in the area.

As for the limitations, the study was restricted to the development of a fuzzy model for measuring entrepreneurial behavior based on two already validated instruments (Mansfield et al., 1987; Liñán & Chen, 2009). It is suggested that future studies amplify the constructs addressed in this fuzzy model and consider other dimensions such as culture and cognition.

The research was limited to a public higher education institution, with only undergraduate students, with a cross-sectional view. As a suggestion for future research, studies in other institutions of higher education or basic are recommended in order to compare, deepen and new findings. In addition to considering a longitudinal follow-up of the entrepreneurial behavioral evolution of the individuals surveyed.

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