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## THE DETERMINANTS OF ENTREPRENEURIAL INTENTION OF SCIENTIST PHD STUDENTS: ANALYTICAL VS EMOTIONAL FORMATION OF THE INTENTION\*

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**Abstract.** We use the theory of planned behavior (TPB) to investigate the determinants of the entrepreneurial intention (EI) of two samples of PhD students in science in France (N=101) and Tunisia (N=308). We performed PLS-PM estimations of a structural path model. The survey design makes possible an explicit distinction between the direct and indirect measures of the Attitude, Norm and Control for the prediction of the EI. In a situation of “analytical” decision making process we would expect a strong connection between direct and indirect measures which not observed in the case of Attitude. In both countries the main direct explanatory variables of EI are the Perceived Behavioral Control (PBC) and the Attitude (ATT) whereas the Subjective Norm (SN) has no direct significant impact. We also observe a very strong relationship between the SN and the PBC and between PBC and ATT. It raises questions concerning the real causal relationship between these explanatory variables which could have important consequences in terms of entrepreneurship promotion strategies. In contrast with SN and PBC we observe that the indirect measures of ATT are not strongly connected to its direct measure. It may indicate in the case of SN and PBC that the evaluation process is analytic whereas it would be more “emotional” for ATT. We discuss the implications of that distinction. Our results indicate that the manipulation of believes related to PBC is certainly the most relevant strategy of behavioral change.

**Keywords:** entrepreneurial intention; Theory of Planned Behavior; academic entrepreneurship; science and technology policy; rational decision-making; PhD student entrepreneurship

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## 1. Introduction

In economies increasingly focused on knowledge and the strengthening of the linkages between governments, science and industry (Etzkowitz and Leydesdorff, 1995), researchers and doctoral students are integral intermediaries in the diffusion of academic knowledge towards the business world (Neumann and Tan, 2011; Autant-Bernard et al., 2007; Wright et al., 2008). The specific contribution of PhD students to this process can be a part of the traditional framework for being hired at the end of their degree. It can also be through the formal or informal relations they have maintained with companies during their research. They, therefore, carry a double contribution (Wallgren and Dahlgren, 2007; Thune, 2009; Mangematin and Robin, 2003). Their contribution to the dissemination of knowledge can also involve the creation of companies stemming from their research work that is commonly classified into the category ‘academic entrepreneurship’ (Shane, 2004; Cantu-Ortiz et al., 2017; Miranda et al., 2017a). The entrepreneurship of PhD students can serve the collective interest and at the same time mitigate the risks of unemployment and over-education (Horta et al., 2015). At least until the COVID19 epidemic, in most developed countries, the number of the doctoral graduates was structurally greater than the vacancies of academic researchers (Auriol et al., 2013a; Neumann and Tan, 2011). Young PhDs were obliged to seek jobs outside the academic sphere which, usually, was not their primary career intention. They had not only the problems of identifying and matching their skills with the needs of the available companies (Durette et al., 2016; Couston and Pignatelli, 2018; Mangematin, 2000) but also of cohering their career aspirations and the career opportunities offered to them outside the academic sphere (Agarwal and Ohyama, 2012). The consequence was a slower job placement for doctoral students than that of the lower-level graduates (Auriol et al., 2013b).

Consequently, PhD student entrepreneurship is seen as a vector of economic development leading to a more coherent use of the competencies of the PhDs, to higher job creation and finally resulting in higher levels of competitiveness and innovation in the market (Maalej, 2013, 2022; Doanh and Bernat, 2019; Barba-Sanchez et al., 2022). Given the high inertia of doctoral trajectories (Hayter and Parker, 2018; Mangematin, 2000), rapid demonstration of entrepreneurial intent can help doctoral students to guide the development of their knowledge and skills in order to limit the costs of a possible future reorientation of their career towards entrepreneurship (Lee et al., 2010). It accordingly increases the chances of success of their projects. Business creation can either be an open ‘option’ or become (or be from the beginning) the primary goal of their research. In both cases a deliberate strategy can be developed, one that assumes the existence of a minimum level of entrepreneurial intent that possibly results in an entrepreneurial behaviour.

Maalej and Cabagnols (2020) maintain that any entrepreneurial action is preceded by the intention to undertake. This intention expresses a person’s determination to start their own business. This determination can be accounted by individual skills of the entrepreneur, their social environment or even by cultural specificities (Maalej, 2013). Our work aims to identify, more precisely, *the factors that explain the intention of the PhD students to start a business*. We deal with this topic by using Ajzen’s theory of planned behavior (TPB) (Ajzen, 1991). It offers a strong methodological starting point on which many empirical studies have already been conducted in the field of entrepreneurship with numerous sub-populations. That large empirical literature makes possible the identification of the specific attribute of the PhDs.

Our work is characterized by a strict application of the standard methodological procedure described by Ajzen, only a few studies in entrepreneurship follow these steps. In particular, we performed an initial belief survey and

made a clear-cut distinction between direct and indirect measures of the determinants of the intention. Although we use the TPB methodology, the distinction between indirect and direct measures allows us to highlight results whose interpretation refers to the situated action (Sasseti et al., 2018; Suchman, 1987) and effectual theories (Sarasvathy, 2001). It leads to a specific discussion concerning the place of the “analytical” vs “emergent” “contextual” and maybe “emotional” nature of the decision-making processes behind the formation of the intention. The possible cultural sensitivity of our results is assessed with the help of a bi-cultural sample made of French and Tunisian PhD students.

## 2. Literature and Theoretical Background

This work is based on Ajzen's Theory of Planned Behavior (TPB) (Ajzen, 2012, 1991). Its explicit use in the field of entrepreneurship goes back to the work of Krueger & Carsrud, 1993). It is presented as a theoretical framework that federates a few entrepreneurial researches conducted during the 1970s and 1980s, such as the one of Shapero, 1975, Shapero & Sokol, 1982 et Bird, 1988). This theory is particularly applicable to the case of business start-up behaviors because they usually occur after a ‘rational’ decision-making phase of the project initiators who engage themselves in an ‘intentional’ and ‘prospective’ approach (Krueger and Carsrud, 1993). This model of behavioral prediction has shown its effectiveness in many areas of ‘planned’ decision-making both in the laboratory (by studying game strategy choices, for example) and in the field by studying voting behavior (Ajzen and Fishbein, 1980), the choice to breastfeed (Manstead et al., 1983), the use of abortion (Smetana and Adler, 1980), the birth of another child (Vinokur-Kaplan, 1978) or physical exercise (McAuley et al., 2001) and the use of university sports facilities (Sniehotta, 2009); drinking Alcohol (Ajzen et al., 2011). Starting from a traditional TPB approach our work will specifically focus on two questions relevant for entrepreneurship theory: firstly “how do we measure the factors that explain the intention? (“directly” and/or “indirectly”)” and, secondly, “what kind of structural model should we take into account?”.

### 2.1. Direct vs. indirect measures: Analytical vs emotional rational decision-making

In the light of a set of experimental tests, the TPB postulates that in the case of planned behaviors, intention to act is the most immediate determinant of behavior. The effect of other explanatory factors on behavior is systematically mediated by intention. Ajzen's work shows that the intention would be directly determined by three main variables that are themselves the consequence of the individuals' beliefs about different issues (see Figure 1 below in which the black arrows represent the causal structure of the model of Ajzen):

- The attitude consists in the *globally favorable note or unfavorable evaluation of an individual* with respect to the realization of a behavior (here the behavior of creation of company) or not. That global evaluation will be referred as the “*direct measure*” of the intention.  
In a rational decision-making perspective, the attitude of the individual towards entrepreneurship is supposed to be the result of a set of conscious subjective beliefs about the favorable / unfavorable consequences of business creation. The inventory of these beliefs is made during a preliminary semi-directive interview with a small sample. Thereafter, these “behavior beliefs” are used as question items during a second stage of large-scale surveying. For each belief, two questions are asked. The first question measures the intensity of the belief, the second one measures the expected impact of the belief in the formation of the global attitude. When these weighted behavioral beliefs are combined they form an “*indirect measure*” of the attitude.
- The subjective norm reflects *the overall perception by the individual of the most salient social pressures regarding the realization a behavior* or not. That overall perception will be later referred as the “*direct measure*” of the subjective norm. In a rational decision-making perspective, the “direct measure” of the subjective norm is supposed to be the result of the opinion that the subject has regarding the opinions of the various members of his social network. ‘Normative beliefs’ represent the beliefs of the individual about the favorable / unfavorable expectations of specific social network regarding the behavior of business creation. The ‘motivation to comply’ measures the importance that the individual associates with the opinion of the

social network. Thus, the subjective norm is considered in the TPB as the consequence of the normative beliefs of the individual about each member of his/her surroundings considered weighted by the motivation to conform to each of them. Combined these normative beliefs form the “*indirect measure*” of the subjective norm.

- Perceived behavioral control refers to the *overall perception of the ease or difficulty that the individual expects to encounter in the achievement of the behavior* being studied. It will be referred as the “*direct measure*” of the perceived behavioral control.

TPB presupposes that perceived control results from the combination of two elements: on the one hand, the intensity of the obstacles and facilitating elements that the subject predicts to encounter in the realization of the behavior (the ‘control beliefs’) and on the other hand, the level of control he / she believes to have on each of them (‘evaluation of obstacles and facilitator’). Combined the control beliefs give an “*indirect measure*” of the perceived behavioral control.

The direct measures represent the global perception of the individual concerning the situation whereas the indirect measures reflect the intensity of the rational arguments that are supposed to back his global evaluation. As such, we will consider that the indirect measures reflect an “analytical” evaluation whereas the direct measure reflect a more global “emergent”, “contextual and maybe “emotional” evaluation (Colombetti, 2010). In an usual rational decision-making process, we could expect a strong causality running from the indirect measures to the direct measures: Global evaluations are the result of taking into account all relevant elements in the judgement from the evaluator’s point of view. On the contrary, a low correlation between the direct and indirect measures would be the sign of an evaluation process that is not directly related to the explicit criteria of judgement but to more holistic mechanisms such those described by the theory of situated action and effectuation (Saravathy, 2008, 2001; Sasseti et al., 2018). In these theories the evaluation of the situation and the behaviour are not only guided by plans but emerge during the action in relation to the context. Feelings and “emotions” may strongly contribute to the judgement (Colombetti, 2010). It doesn’t mean that the decision-making process is not “rational” but that it is not grounded on an analytical and summative decontextualized evaluation process. In a behavioral change perspective, the identification of the evaluation process behind the decision-making process of the PhDs is important since it could lead to quite different strategies either devoted to change beliefs (in an analytical perspective) or devoted to change “emotions” with the help of “contextualization” and “enaction” tools.

## 2.2. Choice of a causal structure

The causal structure of the TPB model has generated many theoretical debates as indicated in the review article by Liska (Liska, 1984): anteriority of the intention before the behavior, the causal independence of attitude, norm, control and the anteriority of attitude, control and norm with respect to intention etc... In the field of entrepreneurship, the hypothesis of causal independence is probably not verified as indicated by different studies (Alonso-Galicia et al., 2015; Liñán et al., 2011; Liñán and Chen, 2009; Miranda et al., 2017b; Obschonka et al., 2012; Trivedi, 2017; Doanh and Bernat, 2019; Barba-Sanchez et al., 2022). Accordingly, we introduced three relationships that are represented by gray arrows in Figure 1. The relationship that goes from the subjective norm to the behavioral control is justified by the fact that the perceived social support intervenes potentially as a factor of performance since the social network of project promoters is often considered as a key factor of success (Fernández-Pérez et al., 2014; Liñán and Chen, 2009; Maes et al., 2014; Sun et al., 2017; Trivedi, 2017). The relationship between the social norm and the attitude can be explained by a phenomenon of internalization of the social norm in the perspective of the theories of dissonance which is a function of the motivation to conform to individuals as it has already been suggested in several studies (Giger, 2008; Liñán and Chen, 2009; Maes et al., 2014; Miniard and Cohen, 1981; Ryan, 1982; Sun et al., 2017; Trivedi, 2017). Be out of a strict TPB framework, the relationship between perceived behavioral control and attitude has already been explored in studies of attitudes toward computer use and learning to read (Gardner et al., 1993; Morgan and Fuchs, 2007; Vaknin-Nusbaum et al., 2018). These works reveal a causal relationship that seems to go from control to attitude

rather than vice versa. In entrepreneurship, Obschonka et al. (2012) statistically highlight a correlation between these two constructs without considering a causal relationship whereas Sun et al. (2017) explicitly test it and obtain a low but positive and slightly significant path coefficient<sup>†</sup>. Barba-Sanchez et al. (2022) show that attitude mediates the relationship between perceived behavioral control and the university students 'entrepreneurial intention. Therefore, in this article, we will assume a relationship that goes from perceived behavioral control to attitude.

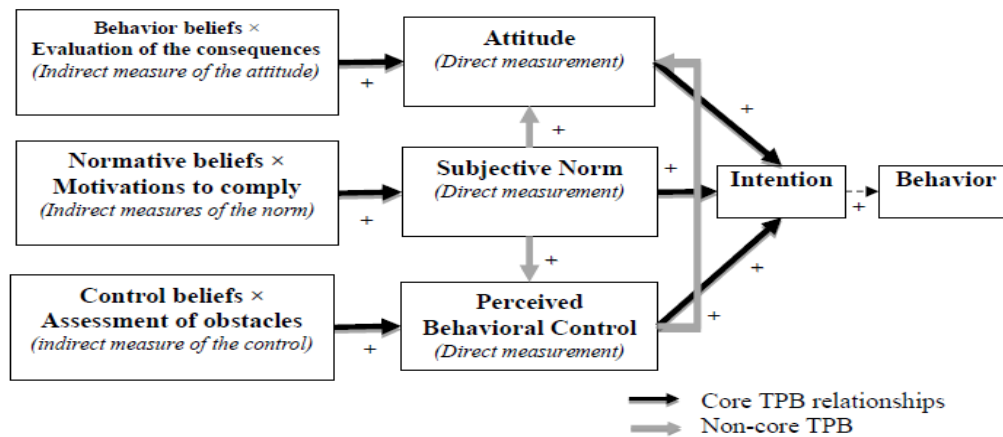


Figure 1. Schematic representation of the theory of planned behavior (TPB) (Ajzen, 1988)

### 3. Methodological choices, Survey and data

As indicated by Liñán and Fayolle (2015) in their review of literature since the founding article of Krueger & Carsrud, 1993, the TPB model and its adaptations represent a very important part of the research dedicated to the study of the explanatory factors of entrepreneurial behavior. The method has been applied to many subpopulations (students, engineering students, researchers, and in some part to the general population) and in contexts of intercultural comparisons. Most of these studies validate the existence of one or more significant effects associated with attitude, subjective norm, or perceived control over intent (Iakovleva et al., 2011; Kautonen et al., 2015). Nevertheless, the magnitude of the estimated effects of these three variables varies greatly from one study to another depending on the samples and their exact methodologies which compromise any generalization as to the exact value of the parameters obtained (J.Boissin et al., 2009; J.-P. Boissin et al., 2009; Emin, 2004).

To circumvent the biases due to our methodological choices we decided to make a “strict” implementation of the TPB approach of Ajzen in the way we built the survey and organized data collection. Firstly, we conducted a pre-investigation that aimed at collecting the salient believes. Secondly, after identification of the salient believe we performed an internet survey in which a clear distinction was made between indirect and direct measures.

In addition as it is pointed out by Antonioli et al. (2016), most of the existing works in the field of academic entrepreneurship deal with “academic researchers” in general. They do not focus exclusively on doctoral students who are likely to have marked specificities compared to other academic subjects given their unconventional position between “student” and “researcher”. That heterogeneity in the samples may blur the results. Therefore, we have decided to focus exclusively on a sample of PhDs in both stages of pre-investigation and large-scale final survey diffusion.

<sup>†</sup> They conducted a SEM path analysis.

### **3.1. Pre-investigation and the Construction of the Belief Survey**

In order to obtain the relevant basic material for constructing the questionnaire (i.e., the population's strong beliefs about the behavior studied), 17 doctoral students in science (7 men and 10 women) from the Universities of Clermont-Ferrand (N = 4), Saint-Etienne (N = 4), Sfax (N = 5) and Tunis (N = 4) were surveyed in one-to-one interviews. Questions about the pros and cons expected by the subject particularly when he or she actually achieves the proposed behavior were asked in order to probe into the behavioral beliefs (e.g., 'What benefits would you see in starting a business?'). As such probing into normative beliefs, the questions focused on identifying those who may be supportive or unfavorable to the subject performing the same behavior (e.g., 'Who would approve of starting a business?'). Finally, at the level of control beliefs, it was a question of identifying the personal and external factors that, according to the subject, facilitated or complicated the actual performance of the behavior (e.g., 'What personal factors could encourage you to start a business?')

To make the questionnaire more representative, only a subset of the beliefs of each type was retained. According to (Ajzen and Fishbein 1980), it is necessary to choose as many beliefs as necessary to arrive at a representative percentage of the subjects consulted. A minimum of 75% seems reasonable.

In the case of behavioral beliefs, to reach 75% of doctoral students consulted, 4 beliefs were included in the questionnaire. Normative beliefs were retained in their entirety, given the fact that they were few (3). Regarding the control beliefs, there are four in the structure of the questionnaire.

In conjunction with the questions about the beliefs (indirect measures), we have, according to the recommendations of Ajzen and Fishbein, developed questions dealing with the other variables (direct measures): attitude, subjective norm, perceived control and intention.

### **3.2. Sample of the Final Investigation**

Based on the beliefs index developed in the pre-survey phase, we conducted an online survey of students enrolled in PhDs in science at four different universities. For France, these are University Clermont-Auvergne in Clermont-Ferrand and Jean-Monnet in Saint-Etienne. For Tunisia, the universities of Sfax and Tunis were targeted. The sampling frames were created from the e-mail lists of the students enrolled in the PhD in these universities at the time of the launch of the survey in mid-October 2016. Apart from Saint-Etienne, after the first sending process, we sent 3 reminders 10 days apart to each of those who had not explicitly asked not to be relaunched. The final response rate is 27% in France and 37% in Tunisia. It indicates a certain interest of the students for this subject.

In order to avoid a possible selection bias linked to the reluctance of some PhDs when it comes to entrepreneurship, the survey was described as a "Survey about the professional insertion of doctoral students". The questionnaire was also structured around the notion of employability. Entrepreneurship was presented as a possible alternative among others in order not to discourage the respondents who were not interested in entrepreneurship.

The questionnaire had to be completely filled in so that the answers could be used in this study which represents 15% of the original French sample and 16% of the Tunisian one (the response rates were respectively 27% and 37%). In the end, 409 observations will be used: 101 in France and 308 in Tunisia. The analyze will then be conducted by bringing together on one side the two French universities and on the other the two Tunisian ones in order to highlight any national specificities and stabilize the results.

The main differences between the French and Tunisian samples come from the distribution of men and women (79% of women in Tunisia against 53% of men in France); age structure (27.31 in France vs. 29.07 in Tunisia);

the average duration of the doctoral registration (2.31 in France vs. 2.9 in Tunisia). The evaluation that PhD students make of the applied nature of their thesis does not differ significantly between countries (5.01 in France and 5.31 in Tunisia on a 10 point scale). The high overrepresentation of women in the Tunisian stems from a large structural imbalance between men and women in the Tunisian higher education sectors which are even more marked in the scientific field<sup>‡</sup>. The French and Tunisian sample also strongly differ in terms of field of research. 71% of the French sample is composed of PhD students that are carrying researches in the field of ‘Mathematics, physics, chemistry and computer sciences’ whereas the Tunisian sample is constituted 61% of PhD students enrolled in ‘Biology and life sciences’.

Regarding the professional projections of doctoral students (Table 1), it should be noted that the French are more likely to think of being salaried than researchers while the opposite is the case in Tunisia. Business creation comes last in the professional perspectives of the French as well as the Tunisian. The gap between the least attractive alternative and entrepreneurship does not seem to be more pronounced in the face of entrepreneurship in France ( $5.09-3.70 = -1.39$ ) compared to Tunisia ( $5.39-4.07 = -1.32$ ). The intentions of starting a business just after the doctorate and ‘later’ are on the other hand much less strong in France than in Tunisia. It indicates a less attractive on the event of the creation of company in France compared to Tunisia.

**Table 1.** The professional perspectives of the PhD students

Variables measured with a 7-points Likert scale (1 : not all agree ; 7 : totally agree)	FR	TN	t-value FR-TN
After the PhD, the future profession I imagine is ...			
... researcher	5.09 (1.88)	5.39 (1.93)	-1.35
... salaried	5.31 (1.51)	4.77 (1.94)	2.52
... business creator	3.72 (1.83)	4.07 (1.92)	-1.61
I intend to create a business:			
... just after my PhD	2.62 (1.73)	3.90 (1.96)	-5.62
... later after or during my professional life	4.25 (1.88)	5.20 (1.64)	-4.77

### 3.3. Measurements and Descriptive Analysis of the TPB Variables

The final survey was conducted exclusively online. The order of the questions was fixed but the response items were presented in random orders.

#### 3.3.1. Measure of the entrepreneurial intent (I)

Entrepreneurial intent is the dependent variable of the model. It is measured by using three items. Two items at 7 levels {very unlikely, very likely}: ‘I intend to start a business just after obtaining my Ph.D.’ and ‘After the thesis, the professional future I imagine is a business creator’. A three-level item {never, sometimes, often}: ‘I’ve already thought about starting a business’: three-level item. Table 2 summarizes the results obtained on the two samples. On average, Tunisian doctoral students seem to be more inclined to consider the creation of companies at the end of the thesis, as indicated by the very significant difference observed for the item ‘intention\_ct’.

<sup>‡</sup> In 2014-2015, the proportion of women enrolled in doctorates in Tunisia was 67% for all sectors, it reaches 73% at the University of Sfax (Bureau des études, de la planification et de la programmation, 2016).

**Table 2.** Measure of entrepreneurial intention

		Scale	FR*	TN*	p-value FR-TN**
I: Intention					
Future	I have already think of setting up a business	0-3	0.82 (0.75)	0.80 (0.73)	0.81754
Future_crea	After my PhD, I think of creating a business in my professional life	1-7	3.72 (1.83)	4.07 (1.92)	0.09927
Intention	I intend to create a business just after setting my PhD	1-7	2.62 (1.73)	3.90 (1.96)	0.0000

\* in brackets are reported the standard deviations

\*\* p-values from the comparison test of the French and Tunisian averages under the hypothesis of heteroscedasticity

### 3.3.2. Direct measures of attitude, subjective norms and behavioral control

The direct measures of Attitude, Subjective Norm and Behavioral Control were conducted by using a single question giving rise to a measured response on unipolar scales ranging from 1 to 7. The scores were not displayed on the scales.

Table 3 shows that the levels of Subjective Norm and Attitude of French and Tunisian PhD students do not differ significantly at the 5% level. On the other hand, the perceived behavioral control of Tunisians (4.92) is much higher than that of French (3.95). It indicates that the Tunisian doctoral students generally feel more able to create than French PhD ones.

**Table 3.** Direct measures of attitude, subjective norm and behavioral control

			Scale	FR*	TN*	p-value FR-TN**
Ad	Attitude	‘My attitude concerning the creation of a company is ... ‘	1-7	4.267 (1.6964)	4.627 (1.7885)	0.07010
Nd	Subjective Norm	‘My entourage would approve that I create a company ...’	1-7	4.792 (1.3514)	4.623 (1.5716)	0.29768
Cd	Behavioral control	‘I feel able to create a business ...’	1-7	3.951 (1.8296)	4.929 (1.5964)	0.00000

\* in brackets are reported the standard deviations

\*\* p-values from the comparison test of the French and Tunisian averages under the hypothesis of heteroscedasticity

### 3.3.3. Indirect measurements

Indirect measurements were made using 7-point Likert scales ranging from 1 to 7. The scores were not displayed on the scales so as not to encourage the effects of ‘social desirability’ in the responses. In accordance with the procedure suggested by Ajzen and Fishbein and for each indirect measure (i) the subjects were first asked about the level of their beliefs (Bi) and then asked to evaluate the importance they attached to each of them (Ei). The final score associated with each item i (Si) is calculated as the level of the belief considered multiplied by its evaluation. To carry out this calculation, we have retained the formula  $S_i = (B_i \times E_i)^{0.5}$

With the help of a PLS-regression theses score will be combined to produce 3 latent variables:

- Ai: ‘indirect measure of attitude’.
- Ni : ‘indirect measure of subjective norm’
- Ci: ‘indirect measure of perceived behavioral control’

#### Indirect measure of attitude (Ai)

Four statements were used that evoke possible consequences of business start-up behavior: ‘being independent’ (indep), ‘being your own boss’ (boss), ‘having a good salary’ (wage), and ‘creating jobs’ (Job). The subjects first had to indicate their beliefs about the proposed consequences on a scale from ‘totally disagree’ to ‘totally agree’ (e.g., ‘If I started a business, it would be a good way for me ...’to be independent’?). They then had to indicate the value they gave to each of these consequences (e.g., ‘Personally, what value do you give to the fact ... of being independent’?). Table 4 shows that the scores (Si) of the indirect measures of attitude differ sharply between the two samples: Tunisian doctoral students have a significantly more favorable view on entrepreneurship.

#### Indirect measurement of subjective norm Ni

In the first place, the doctoral students indicate their normative beliefs. In other words, for each referent that is envisaged (family, friends or colleagues and thesis director), they evaluate the probability (on a 7-point Likert scale from ‘very improbable’ to ‘very likely’) that the referent approves the behavior studied. Secondly, on a 7-point Likert scale ranging from ‘very weak’ to ‘very strong’, they evaluate the importance given to the opinion of each referent. Table 4 reports higher scores (Si) for the Tunisian sample mainly regarding the family and the thesis director.

#### Indirect measurement of perceived behavioral control Ci

Behavioral beliefs are evaluated on four factors from the prompt ‘After I get my doctorate, if I want to start a business ... I will find the necessary funding; I will have a network of relationships; I will have the necessary knowledge in economic and / or legal matters; I will meet a favorable socio-economic context ‘. The importance associated with each factor is assessed by using the prompt: ‘To start a business, how much importance would you give to finding the necessary funding, having a sufficient relationship network, having the necessary knowledge in the socio-economic context). Table 4 shows that the scores (Si) associated with the indirect measures of behavioral control are significantly lower in France than in Tunisia (except for the financing aspect).

**Table 4.** Indirect measures of attitude (Ai), subjective norm (Ni) and perceived behavioral control (Ci)

		S <sub>i</sub> =(Belief <sub>i</sub> × Evaluation <sub>i</sub> ) <sup>0.5</sup>		
		FR*	TN*	p-value FR-TN**
Indirect measures of Attitude (Ai) : “If I started a business it would be a good way of ...”				
S_indep	... being independent	5.129 (1.2594)	5.537 (1.3847)	0.00656
S_boss	... being my own boss	5.035 (1.2797)	5.561 (1.3273)	0.00049
S_wage	... earing a good salary	4.352 (1.3166)	5.759 (1.0974)	0.00000
S_job	... creating jobs	4.967 (1.3317)	5.866 (1.2537)	0.00000
Indirect measures of subjective norm (Ni) : “Who think that you should start a business ...”				
S_family	... my family	4,258 (1,4824)	4,847 (1,5003)	0,00070
S_friends	... my friends or colleagues	4,368 (1,3986)	4,64 (1,4408)	0,09432
S_dr	... my PhD supervisor	3,877 (1,4773)	4,418 (1,683)	0,00233
Indirect measures of behavioral control (Ci) : “After obtaining my PhD, if I want to start a business ...”				
S_finance	... I will find the necessary finance	4,537 (1,1843)	4,358 (1,6745)	0,23940
S_net	... I will have an adequate social net work	4,463 (1,2247)	4,911 (1,4958)	0,00294
S_knowledge	... I have developed the necessary knowledge	4,009 (1,2325)	5,072 (1,5289)	0,00000
S_context	... the socio-economic context will be favorable	4,15 (1,2485)	4,795 (1,582)	0,00004

\* we report the mean of each variable and in parenthesis the standard deviation

\*\* p-values resulting from a test of comparison between the French and Tunisian means (taking account of a possible heteroscedasticity)

#### 4. Final Model, Estimation Method and QUALITY ASSESSEMENT

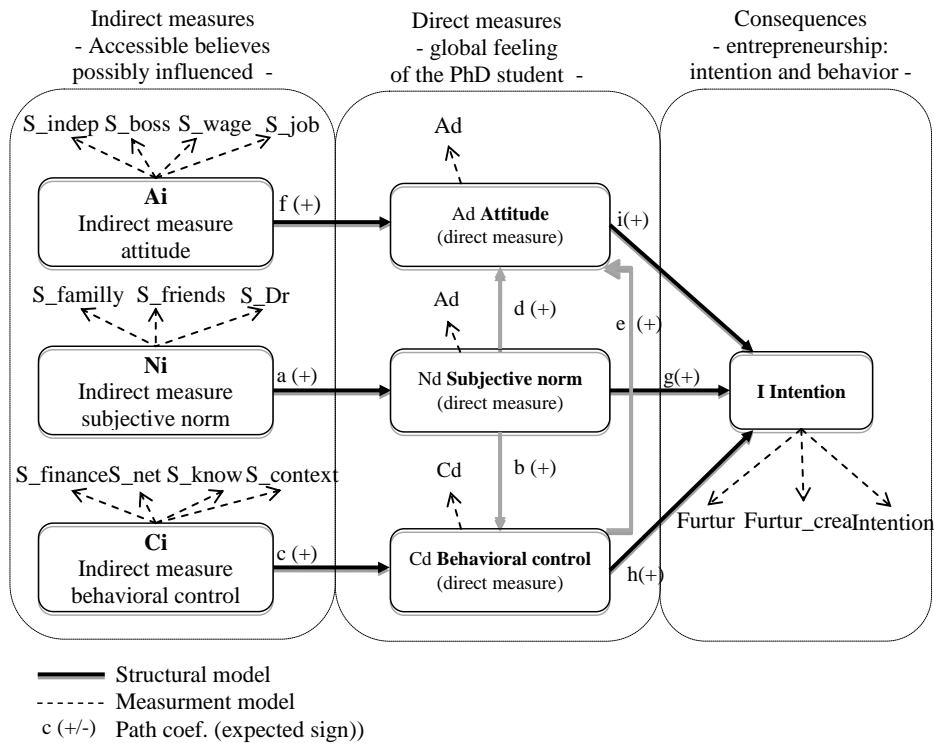
**Figure 2.** Measurement model and structural model

Figure 2 schematically represents the model that we estimated. The estimation of the measurement model and the structural model were made by using a PLS regression carried out with the R PLS-PM package (Sanchez, 2013). This method has the advantage of being ‘robust’ in the presence of small samples and when the variables are not multi-normal. The analysis of the results will enable us to test the magnitude of the ‘direct’ effects associated with the TPB variables (coefficients g, h, i) in addition to the indirect effects when the effect of one variable passes through another to calculate the ‘total’ effect of each variable. Significance tests were performed by bootstrap. We will also test the existence of differences between France and Tunisia.

We work on to estimate the value of the linear coefficients [a ... i] (path coefficient) which link the different variables of interest of the TPB to each other. Note that latent variables associated with indirect measures are all considered exogenous. We also note that direct measurements are only made with one measure. This means the latent variables Ad, Nd, Cd are confused with their measures. Therefore, the loadings of their manifest variables will be equal to 1.

The structural model can also be written as follows:

$$Nd = a. Ni + \varepsilon_N$$

$$Cd = b. Nd + c. Ci + \varepsilon_C$$

$$Ad = d. Nd + e. Cd + f. Ai + \varepsilon_A$$

$$I = g. Nd + h. Cd + i. Ad + \varepsilon_I$$

Where the  $\varepsilon_i$  represent the prediction errors related to the existence of omitted variables in the model.

#### 4.1. Quality assessment

##### Unidimensionality and convergence

All the measurement variables are considered reflective of the latent variables they are associated to. In other words, we will assume that their level is the consequence of the latent variables they measure. If these manifest variables measure the same latent underlying variable, a high level of correlation between them should be observed (unidimensional criterion evaluated by Cronbach's Alpha). Moreover, the level of association of the manifest variables with the latent variable with which they are associated should be greater than with the other latent variables (criterion of specificity evaluated by cross-loadings).

In table 5 for France and Tunisia, we check that:

- Manifest variables are relatively homogeneous as indicated by Cronbach's alpha ( $\alpha$ ) greater than 0.7 except in two cases where it is 0.697 and 0.698.
- The Dillon-Goldstein rho and the Cronbach alpha measure the convergence of the manifest variables but considering the weight of each variable in the construction of the latent variables obtained by PLS (the loadings). This indicator is therefore more reliable than Cronbach's alpha for PLS (Chin, 1998; Vinzi et al., 2010). The rho's are all well above 0.7 indicating that the relationship between latent and manifest variables are good.
- The analysis of Eigen value from the matrix of correlations between manifest variables gives a final indication of the reliability of the measurements: the first Eigen value (VP1) are all much greater than 1. The second ones (VP2) are all less than 1. This difference in value informs us of the importance of the ‘polarization’ of the manifest variables which all point in the same direction.

**Table 5.** Verification of the unidimensionality of the manifest variables on the whole sample

Latent variables	FR+TN N= 409				FR N= 101				TN N= 308			
	$\alpha$	rho	VP1	VP2o	$\alpha$	rho	VP1	VP2	$\alpha$	rho	VP1	VP2
Normei	0.738	0.851	1.97	0.599	0.830	0.898	2.24	0.494	0.698	0.833	1.87	0.646
Normed	1.000	1.000	1.00	0.000	1.000	1.000	1.00	0.000	1.000	1.000	1.00	0.000
Controlei	0.887	0.922	2.99	0.488	0.876	0.915	2.92	0.476	0.895	0.927	3.05	0.438
Controlled	1.000	1.000	1.00	0.000	1.000	1.000	1.00	0.000	1.000	1.000	1.00	0.000
Attitudei	0.829	0.886	2.64	0.637	0.784	0.861	2.43	0.686	0.831	0.888	2.66	0.641
Attituded	1.000	1.000	1.00	0.000	1.000	1.000	1.00	0.000	1.000	1.000	1.00	0.000
Intention	0.734	0.850	1.96	0.626	0.856	0.913	2.33	0.439	0.697	0.832	1.87	0.667

As part of a PLS estimation, the convergent validity of the measurements is based on the examination of the correlations (or loadings) between the manifest variables and the latent variables associated with them. An informal rule used by researchers is to consider that the correlation coefficient must be greater than 0.7 implying that there is more than  $0.7^2 \approx 50\%$  of shared variance between the manifest variable and the latent variable (Fernandes, 2012; Hair et al., 2016). Referring to Table 6 below, it is verified that the 'loadings' of the variables manifested with the latent variables that they reflect are greater than or equal to 0.7 in all cases (shaded boxes). The correlations of the manifest variables with the latent variables to which they are not associated (the 'cross-loadings') are on the other hand always lower than those obtained for their latent variables of membership. It can, therefore, be concluded that the manifest variables used in this study are sufficiently correlated to their latent variables of attachment and are specifically related to them.

**Table 6.** Loadings and cross-loadings on the full sample (France and Tunisia simultaneously)

		Normei	Normed	Controlei	Controlled	Attitudei	Attituded	Intention
Normei								
	S_family	0.885	0.551	0.335	0.508	0.370	0.362	0.451
	S_friends	0.816	0.379	0.274	0.364	0.288	0.248	0.342
	S_dr	0.711	0.317	0.383	0.369	0.285	0.279	0.307
Normed								
	MDN	0.536	1.000	0.279	0.429	0.303	0.416	0.398
Controlei								
	S_finance	0.307	0.223	0.780	0.325	0.198	0.286	0.339
	S_net	0.383	0.297	0.888	0.470	0.309	0.343	0.400
	S_knowledge	0.326	0.206	0.882	0.458	0.279	0.320	0.406
	S_context	0.366	0.238	0.903	0.428	0.277	0.284	0.355
Controlled								
	MDC	0.524	0.429	0.492	1.000	0.473	0.635	0.651
Attitudei								
	S_indep	0.273	0.261	0.204	0.355	0.815	0.321	0.258
	S_boss	0.252	0.260	0.153	0.326	0.829	0.275	0.291
	S_wage	0.364	0.221	0.317	0.442	0.814	0.306	0.309
	S_job	0.386	0.244	0.331	0.407	0.793	0.312	0.309
Attituded								
	MDA	0.373	0.416	0.358	0.635	0.375	1.000	0.619
Intention								
	Intention	0.492	0.386	0.481	0.610	0.388	0.511	0.799
	Future_crea	0.336	0.248	0.323	0.506	0.231	0.484	0.826
	Future_	0.274	0.314	0.222	0.441	0.228	0.498	0.796

Nb: We also verify that for each country individually the convergence rule was satisfied.

The measurement model seems generally correct. The unidimensionality, the convergence of the measurements and their specificity are verified on the two samples considered jointly and separately. It should be noted, however, that the quality of the measures seems better for the French sample than for the Tunisian one.

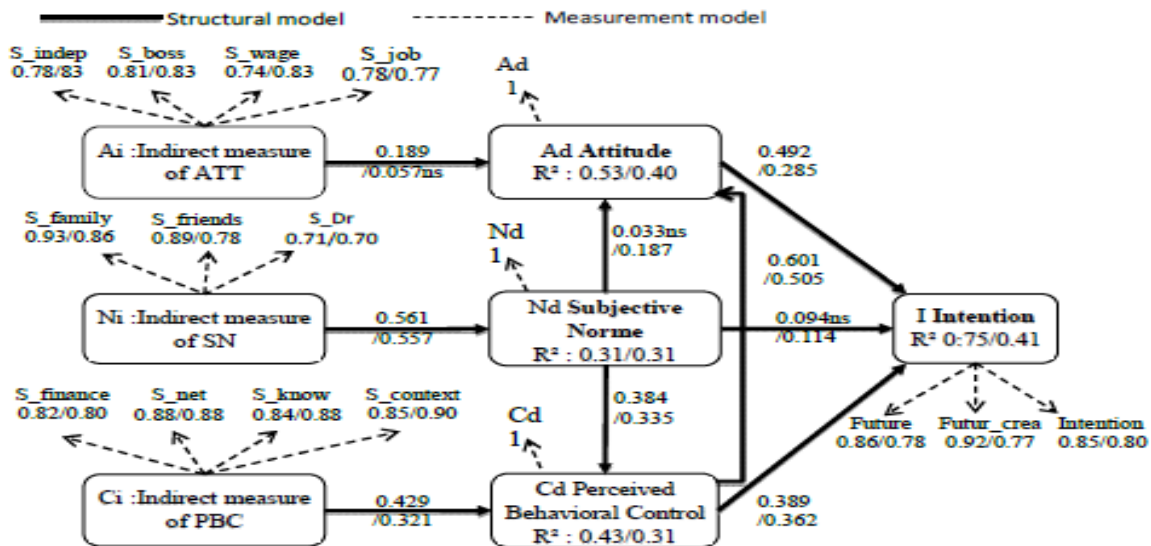
### Predictive power of the structural model and global quality

As it is reported in Table 7, the overall predictive power seems much higher in France than in Tunisia (GOF = 0.59 in France against 0.49 in Tunisia). It should be noted that the intention is particularly well predicted in France with a  $R^2$  of 75% against 41% in Tunisia. In both cases the predictive powers are correct. This, nevertheless, raises the question of the possible heterogeneity of the Tunisian sample composed of 2 cities: Sfax and Tunis. It would also seem that in the Tunisian context of profound institutional and economic change, it would be difficult to obtain a reliable predictive model of intention (Maâlej, 2013).

**Table 7.**  $R^2$  of the equations of the structural model and goodness of fit of the full model (GOF)

	Equation	$R^2$		
		FR+TN	FR	TN
Norm :	$Nd = a \cdot Ni + \varepsilon_N$	0.287	0.315	0.311
Control :	$Cd = b \cdot Nd + c \cdot Ci + \varepsilon_C$	0.334	0.431	0.314
Attitude :	$Ad = d \cdot Nd + e \cdot Cd + f \cdot Ai + \varepsilon_A$	0.433	0.536	0.408
Intention :	$I = g \cdot Nd + h \cdot Cd + i \cdot Ad + \varepsilon_I$	0.501	0.750	0.417
Goodness Of Fit (GOF):		0.5147	0.5982	0.4938

### 4.2. Analysis of the estimated path coefficients



Presentation of the results: coefficient for France / coefficient for Tunisia

All the path coefficients are significant at 5% except those marked "ns" for "non-significant at 5%"

Goodness of fit of the full model : 0.59/0.49 (see Henseler & Sarstedt, M., 2013)

**Figure 3.** Results of the structural PLS estimations when the French and Tunisian samples are used separately (France / Tunisia)

### Analytical vs “emotional” evaluations

The intensity of the connection between the indirect and direct measures provides an indication of the strength of the connection between the analytical evaluations made by the PhDs and their corresponding overall evaluations of attitude, norm and control. The higher that connection is, the higher may be the impact of a manipulation of their beliefs on their intention.

Concerning subjective norm and perceived behavioral control, the connection between the indirect and direct measures is significant and relatively strong in France and in Tunisia (the path coefficients are between .32 and .56) (See Figure 3). Firstly, it indicates that the global evaluation made by the PhDs concerning these two items is more clearly related to an analytical process than to an “emotional” one. Secondly it means that the manipulation of the main accessible believes should have an impact on their global perception of behavioral control and their subjective evaluation of the social norms.

On the contrary, we observe that the connection between the indirect and direct measures of attitude is not significant in Tunisia and significant and quite low in France. Two explanations can be suggested. Firstly, it may result from the omission of relevant believes that have not been elicited during the preliminary interviews. Secondly, we think that it may indicate that the attitudes concerning entrepreneurship are not primarily driven by an analytical evaluation process but by a more “emotional” evaluation that can neither be easily described in term of salient believes nor reduced to a summation of believes about the possible outcomes of the behavior. Such a result raises questions concerning the proper strategies that could influence such direct “emotional” evaluations.

### Core TPB path coefficients

Following the literature about the intercultural dimensions of entrepreneurship, we expected that some of the core TPB coefficients<sup>§</sup> may exhibit significant differences between France and Tunisia (Franco et al., 2010; Léger-Jarniou, 2008; Thurik and Dejardin, 2012; Trivedi, 2017). However, we notice that two out of three TPB's core path coefficients are similar in France and Tunisia:

- The lowest coefficient in both countries is obtained for the path ‘Subjective Norm → Intention’: it is not significant for France and very low in Tunisia (0.11). In most of the existing researches (Doanh and Bernat, 2019; Barba-Sanchez et al., 2022) conducted in the field of entrepreneurship that coefficient is lower than the other and often not significant.
- The path perceived behavioral control → Intention is positive and significant and very close in France (0.39) and Tunisia (0.36).

The only statistically significant difference (at 5%) that we obtain between France and Tunisia is associated to the path coefficient that goes from Attitude to Intention. We observe that the French path coefficient is significantly higher than the Tunisian one (with a 10% p-value threshold). In fact, it is the highest of the three TPB's core path coefficients for the French sample. Several entrepreneurial studies report similar highest coefficients for that Attitude → Intention path (Alonso-Galicia et al., 2015; Ambad and Damit, 2016; Barba-Sánchez and Atienza-Sahuquillo, 2017; Goethner et al., 2012; Hesse and Brünjes, 2018; Liñán et al., 2011; Liñán and Chen, 2009; Miranda et al., 2017b; Yurtkoru et al., 2014)\*\*.

In Tunisia, the attitude → intention path coefficient is lower than in France. Firstly, it may be explained by a problem of measure since we also observe that the R-square associated to the Attitude equation is 13% lower in

<sup>§</sup> Core TPB path coefficients : Norm→Intention; Control→Intention; Attitude→ Intention

\*\* Some studies report lower but still positive and significant coefficients (Delanoë and Brulhart, 2011; Devonish et al., 2010; Obschonka et al., 2015, 2012).

Tunisia than in France. It indicates a lower predictive power of the Tunisian dataset compared to the French one. Secondly it could be explained by the fact that French culture encourages people to behave according to their attitude and realize themselves, while in the Tunisian culture several other factors come into play such as for example the destiny and self-confidence that are less pregnant in the French culture.

### Likelihood of the hypothesis of causal independence

One key question was the existence of ‘lateral’ relationships between the TPB explanatory variables of the intention that is referred to as ‘the hypothesis of causal independence’ (Liska, 1984).

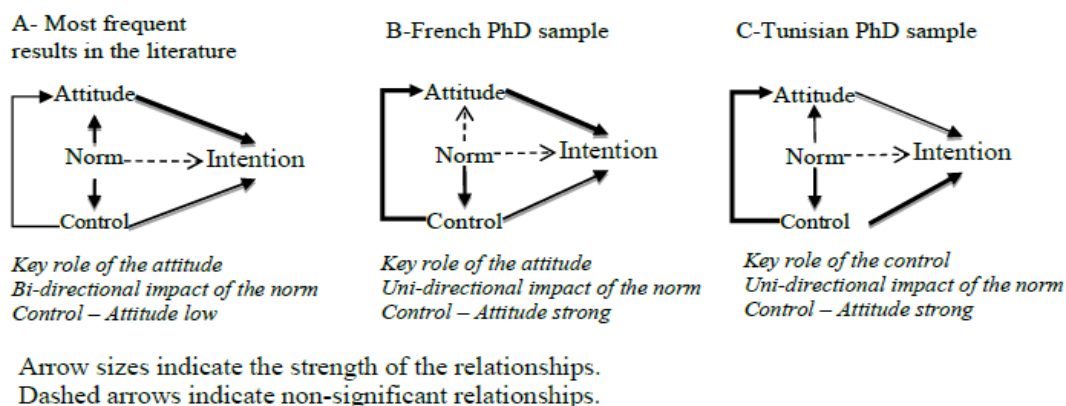
### Norm: a larger impact on control than on attitude

The previous researches that examined the paths Norm → Attitude and Norm → Control reported positive significant coefficients for both but no significant differences between each other<sup>††</sup> (Alonso-Galicia et al., 2015; Liñán et al., 2011; Liñán and Chen, 2009; Maes et al., 2014; Obschonka et al., 2012; Sun et al., 2017; Trivedi, 2017). In the case of doctoral students, our results show that in France and in Tunisia the Subjective Norm tends to have a stronger impact on Control than on Attitude (respectively in France 0.38\*/0.03ns, in Tunisia 0.33\*/0.18\*). This is consistent with several studies that highlight the importance of the relational capital of PhD students in the achievement of their doctoral and entrepreneurial projects (Benmore, 2016; Bienkowska et al., 2016; Bienkowska and Klofsten, 2012).

### Control and Attitude: a strong connection

The explicit hypothesis of a link from Control to Attitude in the field of entrepreneurship has been studied by (Sun et al., 2017). They report a slightly positive and significant coefficient. In our case, we observe a strong and very significant connection between these two variables: it is the highest estimated path coefficient for the French sample and the second highest one for the Tunisian sample. In line with the experimental researches conducted in the field of education sciences (Gardner et al., 1993; Morgan and Fuchs, 2007; Vaknin-Nusbaum et al., 2018), it indicates that the perceived behavioral control may also be a major explanatory variable of the attitude of PhD student toward entrepreneurship.

### Synthesis of the results in comparison with the previous literature



**Figure 4.** Synthesis of the structural relationships (arrows proportional to the intensity of the relationships)

<sup>††</sup> The studies based on PLS models report coefficients between .25 and .4 (Alonso-Galicia et al., 2015; Liñán et al., 2011; Liñán and Chen, 2009; Obschonka et al., 2012).

Figure 4 box A represents the usual results reported in most of the previous studies about the TPB determinants of the entrepreneurial intention. Boxes B and C summarize the results obtained with our two samples of PhD students. Roughly speaking, we observe the same kind of structural relationship in France and Tunisia:

- The subjective norm positively impacts the perceived behavioral control
- The perceived behavioral control results in more positive attitude
- Attitude and perceived behavioral control directly determine the intention whereas the impact of the subjective norm is only indirect.

## 5. Conclusions and Discussion

### 5.1. Analytical vs emotional decision-making

From a theoretical point of view these results indicate that the distinction between “direct” and “indirect” measures may contribute to a better understanding of the evaluation process that is carried out by the decision maker. In the case of PhDs, we observe that the subjective norm and the perceived behavioral control are certainly the consequence of an analytical process of evaluation whereas it may not be the case for the attitude. Additional investigations are necessary to assert that finding and to understand how not-analytical evaluations (“emotional”) can be incorporated in a rational decision-making framework. In a dynamic perspective it may lead to a distinction between two kinds of process: the process of the beliefs formation relevant for analytical evaluations and the process of “emotional experiencing” when the evaluation is not analytic. Both would be relevant for the prediction of the intention as it is the case in our survey. Indeed, we observe in France and Tunisia a strong impact of the direct measure of the attitude on the entrepreneurial intention whereas that indirect measure is not strongly connected (indirect measures). On the basis of a situated action perspective developed by Suchman (1987), Maâlej and Cabagnols (2020) attempt such a kind of combination between the TPB and the more context dependent and emotional perspective.

### 5.2. Lateral connections between Control and Attitude

We observe a very strong connection between the direct measures of control and attitude. When people consider that they have enough ability and control to run a business, their attitude towards this goal improves, causing a positive effect on entrepreneurial intention (Zhao et al., 2015; Barba-Sanchez et al., 2022). From the point of view of the entrepreneurship theory, the possible existence of relationships between attitude, norm and control is very important since it could explain why the probability to start a business is growing over time and reaches a peak between 40 years-45 years before declining both at the macroeconomic and individual levels (Lévesque and Minniti, 2011; Azoulay et al., 2018). We may think that the accumulation of knowledge during the career leads to an increase of the perceived behavioral control which results in a more favorable attitude and an evolution of the intention and of the probability of entrepreneurial triggering during the first part of the career whereas in its second part the opportunity cost may become too high and reduce the attitude in a proportion that exceeds the positive impact of knowledge accumulation (Amit et al., 1995). This hypothesis of causality has yet to be confirmed. Does it result from measurement problems? What is the direction of the causalities? To clarify such matters, it would be necessary to carry out longitudinal cohort monitoring and, in the best case, to carry out experiments in which each component of the TPB model would be controlled to elucidate the causalities and a possible phenomenon of reinforcement of the entrepreneurial intention through time.

### 5.3. Strategies of behavioral change for PhDs

In practical terms, the TPB approach leads to the identification of the major determinants of the intention and of the salient beliefs that are associated to them. The manipulation of these beliefs is thus considered as a way of influencing decision making in a chosen direction. Concerning PhD entrepreneurship, our results indicate that the main direct determinants of the entrepreneurial intention of PhDs are their perceived behavioral control and attitude whereas the impact of the subjective norm is mainly indirect (via its impact on the perceived behavioral

control). Consequently, the perceived behavioral control and the subjective norm may be first two candidates for manipulation. However, we have shown that the salient beliefs associated to the attitude are not strongly correlated to the overall attitude of PhDs whereas the connection between salient beliefs of control (indirect measures) and the direct measure of the perceived behavioral control is much stronger. Consequently, it seems more reliable to envisage strategies of influence that are based on the manipulation of the beliefs of control than of the attitude. In addition, our results and the existing literature indicate that the perceived behavioral control may also have a very strong impact on the attitude which in turn should reinforce the intention. If the manipulation of the salient beliefs associated to the perceived behavioral control is difficult a second and easier strategy may be the use of the PhD supervisor advices. Indeed, we observe a significant connection between the normative belief concerning the PhD supervisor and the global evaluation of the subjective norm.

#### 5.4. Opening

That research raises points out that the traditional TPB can still be relevant for further researches in as much as that methodology is strictly applied. It seems important to perform a systematic assessment of the salient beliefs in a pre-survey and to establish a clear distinction between direct and indirect measures of attitude, norm and control. Such simple methodological steps could open fruitful analysis concerning the analytic vs emotional background evaluations involved in the decision-making process that underly the entrepreneurial decision.

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