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BIS/BAS sensitivity and entrepreneurship: the role of gender

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Abstract

Recent literature has identified the potential importance of the behavioural inhibition system (BIS) and the behavioural approach system (BAS) for entrepreneurship. Using a sample of Dutch university (N = 246) students I analyze the relationship between BIS/BAS sensitivity and entrepreneurial intention. Additionally, I examine gender as a possible mediator in this relationship as males and females tend to differ in their respective BIS/BAS sensitivity. Results indicate that BAS Drive is positively associated and BIS is negatively correlated with entrepreneurial intention. BAS Fun Seeking and BAS Reward Responsiveness are not significantly associated with entrepreneurial intentions. The results do not support the mediating role of gender. Overall, the results suggest the importance of BIS/BAS as a novel theoretical construct to predict entrepreneurial intentions. This paper adds to the emerging body of literature that looks at entrepreneurship through the lens of BIS/BAS and it substantiates evidence of its importance for this field of study in economics.

Keywords: Entrepreneurial intentions, behavioural inhibition system, behavioural approach system, entrepreneurship, gender

Table of Contents

Abstract	2
1. Introduction	5
2. Theory	8
2.1 Literature review	8
2.1.1 Education.....	8
2.1.2 Parental influence, role modeling and peer effects.....	8
2.1.4 Genetics.....	9
2.1.5 Personality traits	9
2.2 Theoretical framework	10
2.2.1 Entrepreneurial intention	10
2.2.2 BIS/BAS system.....	11
2.2.3 BAS Fun Seeking	12
2.2.4 BAS Reward Responsiveness.....	12
2.2.5 BAS Drive	12
2.2.6 BIS.....	13
2.2.7 Gender and entrepreneurial intention	13
3. Data	14
3.1 Participants	14
3.2 Procedure	15
3.3 Measures	16
3.3.1 BIS/BAS subscales.....	16
3.3.2 Entrepreneurial intentions	16
3.3.3 Control variables	16
4. Method	17
4.1 Correlations	17
4.2 Relationship between BIS/BAS sensitivity and entrepreneurial intention	18
4.3 Mediating effect of gender	19
5. Results	21
5.1 Goodness of fit	21
5.2 Results direct effect BIS/BAS sensitivity on entrepreneurial intentions	21
5.3 Robustness check	23

5.4 Results effect of BIS/BAS sensitivity on entrepreneurial intention, mediated by gender	23
6. Discussion and Conclusion.....	26
6.1 Discussion results	26
6.2 Limitations, relevance and future research.....	28
6.3 Conclusion.....	30
Appendix A.....	31
Appendix B	33
Appendix C	34
Bibliography	38

1. Introduction

Entrepreneurship has become one of the most studied topics in economics over the past years. There are several reasons for this interest in entrepreneurs and entrepreneurship. In the US 1.5 million jobs were created by small businesses in 2022, which accounted for 64% of the total new jobs created (SBA, 2022). Also, 46.4% of US employees worked for a small business in 2022 (SBA, 2022). These figures illustrate the importance of entrepreneurship for the economy and job creation. Furthermore, research has also shown that entrepreneurship is positively associated with economic growth and economic recovery after recessions (Baumol & Strom, 2007; P. D. Koellinger & Roy Thurik, 2012). As the research and statistics show entrepreneurship is of great importance to welfare and overall performance of the economy. Therefore, one of the fundamental questions in this field of research is why people become entrepreneurs and what characteristics are specific to entrepreneurs. Research on this topic has led to the discussion of whether entrepreneurs are born or made (Krueger, 2017).

The large body of literature on this topic has found many factors of importance, but there is still a lot of unexplored territory that is in need of more research. One area of research examines the potential link between behavioural inhibition and entrepreneurship. The concept of behavioural inhibition might explain some of the differences between individuals that determine the likelihood of becoming an entrepreneur (Lerner, 2016). Underlying this concept are two psychological systems, called the behavioural inhibition system (BIS) and the behavioural approach system (BAS) (Carver & White, 1994; Gray, 1970). The BAS can be divided into three subsystems: Drive (BAS-D), Reward Responsiveness (BAS-RR) and Fun Seeking (BAS-FS) (Carver & White, 1994).

Up till now, research on entrepreneurial intentions has mostly had a social-cognitive perspective, which focuses on the dynamic interplay between an individual's internal mental processes and external social influences (e.g., Hmieleski & Baron, 2009; Liguori et al., 2018). Recently, researchers have started to examine more bio-behaviourally rooted drivers of entrepreneurial intent, such as interpersonal differences in BIS/BAS sensitivity. Only two small empirical studies have been done that investigated the relationship between the BIS/BAS model and entrepreneurship (Geenen et al., 2016; Lerner et al., 2018). Despite BIS/BAS sensitivity being related to many concepts underlying the decision to become an

entrepreneur, there have been few studies looking into this connection. This research aims to add to this existing literature and contribute to this new field of study by empirically examining the relationship between BIS/BAS sensitivity and entrepreneurial intentions using a sample of Dutch university students. The BIS/BAS model underlies impulsive behaviour, risk propensity and clinical constructs like ADHD (Corr et al., 2016). This research could form the basis for and substantiate further research on behavioural constructs like ADHD, which are related to entrepreneurship (Wiklund et al., 2017).

Data from the Chamber of Commerce (KVK) shows that in 2023 in the Netherlands the share of women in entrepreneurship was 37.3%. Furthermore research has shown that this disparity is not caused by a higher failure rate of businesses started by women, but more due to other factors such as, the lower propensity of women to start a business than men, less availability of female role models or limited access to entrepreneurial resources for women (Klyver & Grant, 2010; P. Koellinger et al., 2013). Research on the reason why women are less likely to start a business is therefore important to close the gender gap. This research aims to investigate whether the effect of BIS/BAS sensitivity on entrepreneurial intentions is mediated by gender. If this is the case, gender could explain some of the discrepancy in entrepreneurial intentions and partly explain why there is less female business ownership.

The aim of this research is to examine the relationship between the BIS/BAS model and entrepreneurial intention and gender as a potential mediator, thus the research question is:

What is the role of the interpersonal differences in BIS/BAS sensitivity and gender for entrepreneurial intentions?

To investigate this I used a sample of 246 Dutch university students, who filled in a questionnaire measuring their BIS/BAS sensitivities and entrepreneurial intention. Additionally, I collected data on the age and gender of the participants. The direct relationship between BIS/BAS sensitivity and entrepreneurial intention was analysed using a logistic regression model. The results showed that BAS-D is positively and significantly associated with entrepreneurial intention. Furthermore, BIS was also negatively and significantly correlated with entrepreneurial intention. There was no evidence for a significant correlation between BAS-FS and BAS-RR and entrepreneurial intention. To examine gender as a possible mediator I employed both a logistic regression model and a linear probability model. None of the

interaction terms in both types of model were significant, indicating there is no evidence for the potential mediating effect of gender in the relationship between BIS/BAS and entrepreneurial intention. Furthermore, BAS-D was the only significant predictor of entrepreneurial intention in the models including the interaction terms.

This research adds to the existing literature in several ways. First, the results substantiate the small but emerging body of literature on the potential importance of the BIS/BAS framework for entrepreneurship literature. Second, it is the first study that investigates gender as a possible mediator in the relationship between BIS/BAS sensitivity and entrepreneurial intention. It thus also adds to the existing literature on gender differences in entrepreneurship. Third, the results substantiate the claim that the BAS scale should be divided into three sub-dimensions as they differentially affect entrepreneurial intentions, indicating the effect of the sub-dimensions should be examined separately.

In terms of policy implications, the results stress the importance of BIS/BAS sensitivity for the identification of potential entrepreneurs. Policy makers should consider using the BIS/BAS framework when developing policies aimed at promoting entrepreneurship.

The rest of this paper will be structured as follows. Section 2 will discuss the literature that already exists on the question whether entrepreneurs are born or made and it will provide the theoretical framework of this research. Section 3 will describe the sample, the procedure and measures used in this research. Section 4 will discuss the methods that are used to analyse the research question and justification for the choice of modelling. Section 5 gives an overview of the most important results related to the hypotheses. Section 6 discusses the results and their implications, the limitations of the research, the contribution to the literature, recommendations for future research and ends with some concluding remarks.

2. Theory

In this section I will give a brief overview of the literature on the question whether entrepreneurs are born or made. This involves examining whether some individuals are 'born' entrepreneurs, due to certain genetics or personality traits, or whether entrepreneurs can be 'made', implying entrepreneurship can be taught and induced by external factors. In the second part I will describe the theoretical framework of the paper with regards to BIS/BAS, entrepreneurial intention and gender.

2.1 Literature review

Many factors may influence the decision to become an entrepreneur. This might be due to external factors such as the environment, education or parental influence. There are also internal factors that may influence this decision including personality, genetics, gender and other individual differences such as differences in BIS/BAS sensitivity, which is the focus of this research. There is still no conclusive answer on the question whether entrepreneurs are born or made. It is, however, clear that it is a complex process that involves both internal and external factors (Frese, 2009). In this research entrepreneurship will be defined as the independent ownership of a business (Stewart Jr. & Roth, 2001).

2.1.1 Education

One of the factors that is positively associated with entrepreneurial intentions is entrepreneurial knowledge and inspiration provided by educational institutions (Turker & Selcuk, 2009). Other research has shown that entrepreneurship education has a positive effect on the overall desirability, feasibility and attitude towards entrepreneurship (Fayolle et al., 2006; Souitaris et al., 2007). However, later research on the effect of entrepreneurship education on entrepreneurial intentions showed that there is no significant effect or even a negative effect (Fairlie et al., 2015; Oosterbeek et al., 2010). Other research does show a positive effect on entrepreneurial skills and argues that the education indirectly has a positive effect on selection of more motivated and well-equipped individuals that want to become entrepreneurs (von Graevenitz et al., 2010).

2.1.2 Parental influence, role modeling and peer effects

Another important external factor the literature puts forward is parental influence and role modeling. Having entrepreneurial parents is one of the biggest predictors of children also becoming entrepreneurs (Lindquist et al., 2015). This effect works through parental role

modeling and can compensate for a lack of knowledge and experience (Bosma et al., 2012). Another factor that is an important predictor of entrepreneurial activities is prior work experience in a family member's firm (Fairlie & Robb, 2007). Another study found that when the parent are owners of a successful business, the effect of having entrepreneurial parents on entrepreneurial intention is stronger (Dunn & Holtz-Eakin, 2000). A Danish study examined peer effect as an environmental factor that could influence entrepreneurial intention. The study found that having entrepreneurial colleagues is positively associated with the propensity to become an entrepreneur (Nanda & Sørensen, 2010).

2.1.4 Genetics

Over the last decade a new area of research has looked into a potential link between genetic variants and entrepreneurship. Although it has been established that human traits are heritable, there has been no big breakthrough yet that identified which genes are responsible for transferring these traits (Rietveld et al., 2021; van der Loos et al., 2011). Research, however, does show that approximately 40% of the variation in entrepreneurship is explained by genetic factors, while controlling for many confounding factors. Genetic factors do play an important role in the development of entrepreneurial intention, but it can not be concluded that entrepreneurial intention is genetically determined. The results did indicate that the environment or "nurturing" does not play a significant role (Nicolaou et al., 2008). Further research discovered differences in genetic factors between male and female has an effect on the propensity to become an entrepreneur (Nicolaou & Shane, 2010). The effect of the environment, however, does play a more important role for males than females, due to the mediating effect of extraversion (Zhang et al., 2009).

2.1.5 Personality traits

After the critique of Gartner (1988), who argued that studying the role of personality traits for entrepreneurs is not relevant, because he believed a behavioural approach is better suited to understand entrepreneurship, the focus of entrepreneurship research shifted more towards how organizations are created. This changed from the year 2000 onwards when there was a renewed interest in the role of personality for entrepreneurship, which could be studied using new insights and better data sources (Pekkala Kerr et al., 2017).

Most researchers have utilized the Big-five factor model of personality (FFM) as a framework to analyze personality traits. The FFM is a widely accepted and well-researched psychological model that aims to describe and explain the major dimensions of human personality. The FFM consists of five broad personality dimensions, each representing a distinct aspect of an individual's personality. These traits are Openness to Experience, Conscientiousness, Extraversion, Agreeableness, and Neuroticism (McCrae & Costa, 1987). In a very influential meta-analysis Zhao and Seibert (2006), examine if there are differences in the five traits between managers and entrepreneurs. They find that entrepreneurs are more conscientious and more open to experience and they score lower on agreeableness and neuroticism. They found no significant difference in extraversion. Additionally, several others traits than the Big-five traits have been found to be significantly correlated with entrepreneurship and these include locus of control, innovativeness, need for achievement and self-efficacy (Chen et al., 1998; Lüthje & Franke, 2003; Stewart Jr. & Roth, 2007; Utsch & Rauch, 2000).

The first one to propose that risk propensity plays an important role in the decision to become an entrepreneur was Knight (1921). More recent research on this topic, however, is contradictory. Some studies that compared entrepreneurs to managers, concluded that entrepreneurs have lower risk aversion than managers, while other studies have shown that actually managers have lower risk aversion than entrepreneurs (Miner & Raju, 2004; Stewart Jr. & Roth, 2001). An explanation the literature puts forward, is that entrepreneurs are a heterogeneous group. Entrepreneurs that are necessity driven are more risk averse than entrepreneurs that are opportunity driven (Block et al., 2015). Similarly, entrepreneurs that focus on business growth tend to be less risk averse than entrepreneurs that focus on providing for their family (Miner & Raju, 2004; Stewart Jr. & Roth, 2001).

2.2 Theoretical framework

2.2.1 Entrepreneurial intention

Consistent with the seminal paper on entrepreneurial intentions by Bird (1988), entrepreneurial intention will be defined as the expression of the intent to become self-employed. Entrepreneurial intention is the first crucial step in the process of becoming an entrepreneur and starting a new venture (Bird, 1988; Lee et al., 2011). The theory of entrepreneurial intention is based on the behavioural model of planned behaviour (Ajzen, 1985). This theory states that an individual's intention to engage in a particular behavior is

influenced by three main factors. The first one is *attitude* which refers to the individual's positive or negative evaluation of the behaviour based on the person's belief about the likely outcomes and consequences. The second one are *subjective norms* which refer to the perceived social pressure or influence from others that impact their decision to perform the behaviour. The third one is *perceived behavioural control* which captures the individual's beliefs about the ease or difficulty of performing the behaviour. The stronger the intention to engage in a specific behaviour, the greater the probability an individual will perform that behaviour. Literature on the subject of entrepreneurial intention mainly examines two factors: desirability of starting your own business (related with attitude and subjective norms) and feasibility of becoming self-employed (related to perceived behavioural control) (Krueger et al., 2000). Research has shown the moderating effect of self-efficacy and the propensity to act in this relationship (Ajzen, 1991; Krueger & Brazeal, 1994; Lee et al., 2011). Research on entrepreneurial intention has identified many individual predictors as previously discussed in the literature review.

2.2.2 BIS/BAS system

The behavioural inhibition system (BIS) and the behavioural approach system (BAS) are two psychological mechanisms that underlie individual differences in avoidance and approach behaviour (Carver & White, 1994; Gray, 1970). Individuals differ in their sensitivity to either system and the more sensitive a person is to BIS or BAS, the more likely the system is to be activated in response to certain stimuli, such as reward and punishment, in the environment (Reinforcement Sensitivity Theory) (Carver & White, 1994; Corr et al., 2016; Gray, 1970).

BIS is the aversive motivational system that is responsible for inhibiting behaviour in response to signals of punishment and threats that may lead to negative outcomes (Carver & White, 1994; Gray, 1982). BIS is related to anxiety, neuroticism, psychopathy and other negative feelings (Fowles, 1988; Kimbrel et al., 2012; Newman et al., 2005). Some scholars argue that BIS, should be divided into two sub-dimensions, although others argue it is a unitary scale (Carver & White, 1994; Heym et al., 2008; Poythress et al., 2008).

BAS is the appetitive motivation system which responds to stimuli of reward and non-punishment in the environment (Carver & White, 1994; Fowles, 1988). BAS is associated with novelty, impulsivity, substance abuse, seeking out rewards and goal-directed efforts (Carver & White, 1994; Cloninger, 1987; Franken et al., 2006; Nigg, 2000). BAS is often divided into

three sub-dimensions: BAS-fun seeking (BAS-FS, BAS-reward responsiveness (BAS-RR) and BAS-drive (BAS-D) (Carver & White, 1994).

2.2.3 BAS Fun Seeking

BAS-FS describes the eagerness of individuals to seek out new rewards and to spontaneously act upon a potentially rewarding opportunity (Carver & White, 1994). Schumpeter (1934), one of the founders of the field of entrepreneurship, describes entrepreneurs as individuals that identify new opportunities and act upon these opportunities. Openness is found to be one of the traits that is associated with entrepreneurship (Zhao et al., 2010). Since, starting a business entails identifying a new opportunity and acting upon this, it is expected that people that are motivated to seek out these opportunities are more likely to become entrepreneurs.

Hypothesis 1: The relationship between BAS-FS and entrepreneurial intentions is positive.

2.2.4 BAS Reward Responsiveness

BAS-RR measures how strongly people react when they receive or anticipate a reward (Carver & White, 1994). Literature has shown that the potential of a financial reward is one of the main drivers of an individual's decision to become entrepreneurs (Kuratko et al., 1997). Since entrepreneurship has the potential of substantial financial rewards, it is expected that people that react strongly to reward are more drawn to becoming entrepreneurs.

Hypothesis 2: The relationship between BAS-RR and entrepreneurial intentions is positive

2.2.5 BAS Drive

BAS-D captures the individual difference in motivation to persistently try to achieve desired goals (Carver & White, 1994). Perseverance is one of the most important factors linked with being an entrepreneur (Markman & Baron, 2003). Additionally, other research found that motivation and hard work are also important determinants of entrepreneurship (Baum & Locke, 2004). In general, we tend to think that entrepreneurs face many difficult challenges and therefore people who are more persevere are more likely to be drawn to entrepreneurship.

Hypothesis 3: The relationship between BAS-D and entrepreneurial intentions is positive.

2.2.6 BIS

BIS is responsible for detection of risks, conflict, and negative emotions. When it detects these anxiety-related signals, like punishment or novelty, it inhibits behaviour that may cause negative outcomes and prevent punishment (Carver & White, 1994). BIS sensitivity is associated with psychopathy, social anxiety and neuroticism (Kimbrel et al, 2012; Newman et al., 2005; Nigg, 2000), which are also related to entrepreneurship (Hmieleski & Lerner, 2016). Since the risks of failing when starting a business is very high and thus also the likelihood of wasting money and time, it is expected that individuals who are more BIS sensitive are less likely to become entrepreneurs.

Hypothesis 4: The relationship between BIS and entrepreneurial intention is negative.

2.2.7 Gender and entrepreneurial intention

Lastly, I want to investigate whether gender mediates the relationship between BIS/BAS sensitivity and entrepreneurial intentions. Previous research has shown that men and women differ in their emotions, as for instance men tend to report higher levels of anger than women and women experience more fear and sadness than men (Fischer et al., 2004). As already mentioned two basic motivational systems can explain emotion and behaviour, namely BIS and BAS (Gray, 1970). Combining these two findings other research found gender differences in BIS/BAS. For instance, women tend to score higher on BIS than men (Carver & White, 1994). Furthermore, women tend to score higher on BAS-RR (Carver & White, 1994). Although the finding that women score higher on BIS is accepted in the literature, evidence on gender differences in BAS is mixed and some studies find no systematic differences in BAS sensitivity between men and women (Ma-Kellams & Wu, 2020; Wright et al., 2009). As women tend to score higher on the BIS scale, it is expected the effect of BIS on entrepreneurial intention to be stronger for women than for men.

Hypothesis 5: The interaction term between gender and BIS is negatively associated with entrepreneurial intentions.

3. Data

3.1 Participants

The sample (45.9% male) consists of $n = 246$ students, who participated in filling in the survey designed by Carver and White (1994) to measure their sensitivity to the BIS-BAS scales. The sample has a mean age of $M = 20.83$ years ($SD = 2.91$ years), ranging from 17 to 44 years (Table 1). The survey was run on two different occasions, in 2017 and 2019, with different participants. The students were all attending the Erasmus University Rotterdam or the Technical University Delft. The students are from a diverse set of departments, most of them coming from the psychology, economics, and business department. They had the opportunity to apply for participation in the survey via the ESE-econlab (specifically for economics students), the ERAS-system (specifically for psychology students) and the EURO-system (accessible to everyone). Participants that were recruited via the EURO-system and ESE-econlab were compensated with a small fee of €25 for participating. Participation of the psychology students, who applied via the ERAS-system, is mandatory for them to attain full credits in their bachelor's degree.

Incomplete responses were removed from the sample. I also removed the responses of people that participated in filling in the survey for the second time in 2019, to ensure that every observation corresponds to a unique person. Additionally, I checked the data set for any extreme outliers and removed them from the data set.

The sample is comparable to other similar studies, because it also uses Dutch university students, similarly aged (mean around 21 years old), a similar distribution of gender (around 50% male and 50% female and a sample size of a few 100 students. BIS/BAS sensitivity scores are also very similar around the 3.0 mark, although this sample tends to score a bit lower on BAS-RR (Lerner et al., 2018; Leung et al., 2020).

Additionally, I attached the summary statistics by gender in Appendix A. As already mentioned the sample is fairly balanced in terms of gender (45.9% male) and age (21 years old). Male and female score similarly on the BAS-FS, BAS-RR and BAS-D scale. As predicted by the literature, females score higher on BIS, with almost 0.5 points in this sample. Furthermore, almost double the amount of males have entrepreneurial intentions compared to the females in the sample.

Table 1: Descriptive statistics

	Mean	SD	α
Intention	.37	.484	-
BAS-FS	2.808	.566	0.549
BAS-RR	2.683	.509	0.694
BAS-D	3.338	.437	0.722
BIS	2.898	.582	0.831
Age	20.833	2.914	-
Gender	.459	.499	-

Notes. Gender (male = 1; female = 0); Intention (Yes = 1; No = 0); SD=standard deviation, α =Cronbach's alpha, Intention=entrepreneurial intention, BAS-FS=behavioural approach system fun seeking, BAS-RR= behavioural approach system reward responsiveness, BAS-D=behavioural approach system drive, BIS=behavioural inhibition system. N=246 students.

3.2 Procedure

The participants that were selected received an email containing more elaborate information on the study and what was expected of them. They were instructed to fill in the survey using a link to Qualtrics. It was required of the students to find a quiet spot while filling in the survey, where there were little to no distractions. The students had unlimited time to fill in the survey, but it took them 20 minutes on average to complete it. The survey consists of 24 questions, where each item corresponds to a different subscale of BIS/BAS. The participants had to indicate to what extent they agreed or disagreed with the statements. They were also instructed to not take into account answers to previous questions and thus treat every question as a separate one. Four questions were fillers (items 1, 6, 11 and 17), and were used to check for any irregularities in the responses. The responses were also checked for obvious patterns, filtering out unusable responses. The survey was conducted in Dutch and the original English version was translated using the forward-backward translations method. The Dutch survey that was used in this research is included in Appendix A.

3.3 Measures

3.3.1 BIS/BAS subscales

BIS and BAS were evaluated using the self-report measures created by Carver and White (1994). BIS is measured using seven items and the BAS is measured using thirteen items, on a four-point Likert scale. The Likert scale was divided into (1) “very true for me”, (2) “a little true for me”, (3) “a little false for me”, and (4) “very false for me”. The results were rescaled, resulting in higher scores indicating higher levels of BIS/BAS sensitivity. The BAS is divided into three sub-scales: BAS drive (BAS-D, four items), BAS fun seeking (BAS-FS, four items) and BAS reward responsiveness (BAS-RR, five items). The internal consistency measured by Cronbach’s alpha’s was comparable to previous studies (Geenen et al., 2016; Lerner et al., 2018) and ranges from modest to satisfactory (Table 1).

3.3.2 Entrepreneurial intentions

The entrepreneurial intention of the participants was measured using a dichotomous question which was answered yes or no. The question was: “Have you ever seriously considered starting your own business?”. Although it is preferable that entrepreneurial intention is measured using a multi-item scale, because it would capture multiple aspects of entrepreneurial intention, there is only this single question which captures it. This is due to the fact that the sample was originally used in a psychological paper, which focused more on BIS/BAS sensitivity and brain activity instead of entrepreneurship. However, other papers have also used a single-item scale to measure entrepreneurial intentions of participants (Krueger et al., 2000; Wilson et al., 2007).

3.3.3 Control variables

In the present study age and gender are introduced to the models as control variables. The limited number of controls is the result of the limited number of variables that were available. However, this is in line with the objective of this paper to examine whether BIS/BAS sensitivity might be important to take into account in future research on entrepreneurial intentions and not to establish a causal relationship. Furthermore, other similar studies have also used age and sex as controls (Geenen et al., 2016; Lerner et al., 2018; Leung et al., 2020).

4. Method

4.1 Correlations

By examining the pairwise correlation in Table 2, I find that all the BAS subscales are significantly and moderately correlated with each other. This is in line with earlier research that established that the BAS scale can be sub-divided into three dimensions (Carver & White, 1994). However, the BIS scale is weakly correlated with BAS-RR, which is not in line with earlier research that found that BIS and BAS scales are independent of each other (Carver & White, 1994). The correlation between BIS and the other two BAS scales (BAS-D and BAS-FS) are negligible (<0.2). I also ran a Spearman's rank correlation test ($\rho = -0.045$), because the relationship between the dependent and independent variable might be non-linear, however there are no big differences between the results of this test and the pairwise correlation test (Appendix B1).

Table 2: Pairwise correlations between variables

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) Intention	1.000						
(2) BAS-FS	0.183**	1.000					
(3) BAS-RR	0.053	0.396***	1.000				
(4) BAS-D	0.209**	0.425***	0.466***	1.000			
(5) BIS	-0.205**	-0.131*	0.248***	-0.037	1.000		
(6) Age	0.079	0.026	0.047	0.061	-0.042	1.000	
(7) Gender	0.236***	0.038	-0.209**	-0.019	-0.380***	-0.078	1.000

Notes. Gender (male = 1; female = 0); Intention (Yes = 1; No = 0); Intention=entrepreneurial intention, BAS-FS=behavioural approach system fun seeking, BAS-RR=behavioural approach system reward responsiveness, BAS-D=behavioural approach system drive, BIS=behavioural inhibition system. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, two-tailed.

4.2 Relationship between BIS/BAS sensitivity and entrepreneurial intention

To examine the relationship between BIS-BAS sensitivity and entrepreneurial intentions I used a logistic regression model (logit model), using maximum likelihood estimation. I chose this model since it has certain advantages that are applicable to this research. First, the dependent variable is dichotomous (yes/no) and the logit model was specifically designed to model binary outcomes. The logit model allows for estimating the probability of a certain event occurring based on a number of predictors. Another advantage is that the logit model accommodates both continuous and categorical independent variables, which were both employed in this research. Furthermore, the logit model does not assume the error term is normally distributed. Additionally, the logit model can model nonlinear relationships between the dependent and independent variables, which may not be captured by a simple linear regression model using OLS. Since there is no conclusive evidence on the linearity of the relationship between BIS/BAS and entrepreneurial intention, the logit model is preferable over a linear probability model, which assumes the relationship is linear. The logit model also allows for adjusting for confounders, which enables you to control for confounding factors that may influence the outcome (Tansey et al., 1996).

A logit regression does not have a traditional error term like in a linear regression. In a linear regression model the error term is the difference between the observed values and the predicted values. We assume that the error term is normally distributed with a mean of zero, and it is independent of the predictor variables (Alwan et al., 2020). In a logistic regression where the dependent variable is binary, the observations are assumed to follow a Bernoulli distribution. Using the logit model we estimate a mean parameter, which is the expected probability, based on the values of the independent variables. For every observation there are only two possible observed outcomes, either 0 or 1, but the expected probability is often not exactly 0 or 1. Every observation has its own unknown probability of the event happening ($y = 1$), following a Bernoulli distribution. This means there is no common error distribution which is not conditional on the values of the independent variables. In other word, the error term is different for each observation conditional on the values of the independent variables and that is why we say there is no error term. Although there is no traditional error term, the logit model estimates the coefficients to maximize the likelihood of observing the values in

the data set and the residuals, which are the differences between observed outcomes and the predicted probabilities, are used to evaluate the goodness of fit of the model (Hilbe, 2009).

As a rule of thumb when using a logit model you need a minimum of 10 observations per independent variable to have unbiased results (Peduzzi et al., 1996). The model has six independent variables, which would mean we need 6 observations and at least 10 observations per independent variable, after adjusting for outliers and missing values. The sample consists of 246 observations, which is sufficient to achieve reliable results. I conducted the analysis in the STATA environment (Version 17, 64 bits). After running the logit model, I used the results to calculate the average marginal effect (AME) of each predictor, which can be interpreted as probabilities.

The above results in the following model:

$$\begin{aligned} \mathbf{Entrepreneurial\ Intention}_i = & \beta_0 + \beta_1 * \mathbf{BAS\ Fun\ Seeking}_i + \beta_2 * \\ & \mathbf{BAS\ Reward\ Responsiveness}_i + \beta_3 * \mathbf{BAS\ Drive}_i + \beta_4 * \mathbf{BIS}_i + \beta_5 * \mathbf{Gender}_i + \beta_6 * \\ & \mathbf{Age}_i \end{aligned} \quad (1)$$

Where *Entrepreneurial Intention* is the log odds of the entrepreneurial intention of individual *i*, β_0 is a constant and the other β_j 's are the coefficients of the independent variables.

I evaluated the goodness of fit of the model using the McFadden's R^2 , the Likelihood Ratio (LR) test, which is similar to the F-test in linear regression models and lastly the Hosmer-Lemeshow test, which evaluates the goodness of fit of the model by dividing the data into groups based on predicted probabilities and comparing the observed and expected frequencies within each group, using a chi-squared distribution (Hosmer & Lemeshow, 1980).

To check the robustness of the results of the model I also predicted a linear probability model using ordinary least squares regression (OLS), to compare with the results of the logit model.

4.3 Mediating effect of gender

For the second part of the research, where gender as a possible mediator for the relationship between BIS/BAS sensitivity and entrepreneurial intention is examined, I employed a logit model, using maximum likelihood estimation. The results are reported as log odds ratios. I added interaction terms between gender and the different dimensions of BIS/BAS resulting in the following model:

$$\begin{aligned}
\mathbf{Entrepreneurial\ Intention}_i = & \beta_0 + \beta_1 * \mathbf{BAS\ Fun\ Seeking}_i + \beta_2 * \\
& \mathbf{BAS\ Reward\ Responsiveness}_i + \beta_3 * \mathbf{BAS\ Drive}_i + \beta_4 * \mathbf{BIS}_i + \beta_5 * \\
& (\mathbf{BAS\ Fun\ Seeking}_i * \mathbf{Gender}_i) + \beta_6 * (\mathbf{BAS\ Reward\ Responsiveness}_i * \mathbf{Gender}_i) + \\
& \beta_7 * (\mathbf{BAS\ Drive}_i * \mathbf{Gender}_i) + \beta_8 * (\mathbf{BIS}_i * \mathbf{Gender}_i) + \beta_9 * \mathbf{Gender}_i + \beta_{10} * \mathbf{Age}_i \quad (2)
\end{aligned}$$

Where *Entrepreneurial Intention* is the log odds of the entrepreneurial intention of individual *i*, β_0 is a constant and the other β_j 's are the coefficients of the independent variables.

I also estimated a LPM model using OLS and heteroscedastic robust standard errors. I used robust standard errors, since the error term is always heteroscedastic in a LPM (Aldrich & Nelson, 1984). The decision to also report the results of the LPM model was mainly made because the coefficient are more intuitive to interpret, since they can be interpreted as probabilities (Hellevik, 2009). There is also an ongoing and controversial debate on whether the coefficient of an interaction term in a logit model is interpretable at all (Ai & Norton, 2003; Berry et al., 2010). In light of this debate and its more intuitive interpretation I decided to also report the LPM results. The main disadvantage of the LPM is that the coefficients might take on values below 0 and above 1, which is impossible since a probability is always between 0 and 1 (Lewbel et al., 2012). However, the results of a logit model and a LPM are very similar in most cases, especially when the probabilities are not close to 0 or 1 (Hellevik, 2009). The resulting model is added to appendix B.

$$\begin{aligned}
\mathbf{Entrepreneurial\ Intention}_i = & \beta_0 + \beta_1 * \mathbf{BAS\ Fun\ Seeking}_i + \beta_2 * \\
& \mathbf{BAS\ Reward\ Responsiveness}_i + \beta_3 * \mathbf{BAS\ Drive}_i + \beta_4 * \mathbf{BIS}_i + \beta_5 * \\
& (\mathbf{BAS\ Fun\ Seeking}_i * \mathbf{Gender}_i) + \beta_6 * (\mathbf{BAS\ Reward\ Responsiveness}_i * \mathbf{Gender}_i) + \\
& \beta_7 * (\mathbf{BAS\ Drive}_i * \mathbf{Gender}_i) + \beta_8 * (\mathbf{BIS}_i * \mathbf{Gender}_i) + \beta_9 * \mathbf{Gender}_i + \beta_{10} * \mathbf{Age}_i + \\
& \varepsilon_i \quad (3)
\end{aligned}$$

Where *Entrepreneurial Intention* is the probability that an individual *i* has entrepreneurial intentions, β_0 is a constant, the other β_j 's are the coefficients of the independent variables and ε_i is the random error term.

Additionally, I also ran a regression of gender on the different BIS/BAS scales using an OLS model with heteroscedasticity robust standard errors to check for any differences in BIS/BAS sensitivity between male and female participants in the sample. Furthermore I used *age* as a control variable.

5. Results

5.1 Goodness of fit

The first goodness of fit test that I ran for the full logit model (Equation 1) was the Hosmer-Lemeshow test (Hosmer & Lemeshow, 1980). I got a test-statistic of 5.68, computed from the χ^2 -distribution using eight degrees of freedom, with a p -value of 0.684. Since the p -value is > 0.05 , we cannot reject the null hypothesis that the model fits the data. Second, I also ran the LR test, to investigate the overall explanation power of the predictors. The resulting test-statistic is 12.05 with a p -value of 0.0024 (< 0.01), which implies that the full unrestricted model has a significantly better fit than the restricted model. Third, the McFadden's R^2 of the model is 0.109, which indicates the model explains 10.9% of the variation in the dependent variable. The pseudo R^2 measure tends to be much lower for logistic model compared to the regular R^2 used in linear regression, so the pseudo R^2 indicates the model has a reasonable fit (McFadden, 1974). From these three measures, I conclude that the results of the model fit the data reasonably well and significantly, however, it does not explain much of the variance in the dependent variable.

5.2 Results direct effect BIS/BAS sensitivity on entrepreneurial intentions

The logit regression results for the effect of BIS/BAS sensitivity on entrepreneurial intentions are reported in Table 3. The reported coefficients represent the average marginal effects. The logit model with the regular logit coefficient is attached in the Appendix C1. Model 1 includes all dimensions of BIS/BAS, without controlling for any other variables. Model 2 and 3, control for age and gender respectively. Model 4 includes all control variables. The control variables age and gender are both significantly and positively correlated with entrepreneurial intention. This implies being older and being male, compared to being female, is associated with a higher probability of having entrepreneurial intentions.

BAS-FS and BAS-RR are not significantly correlated with entrepreneurial intention in any of the specifications of the model. BAS-FS has a positive sign in all of the models, which is in line with hypothesis 1. BAS-RR is negatively correlated with entrepreneurial intention in model 1 and 2, but positively in model 3 and 4. Based on the insignificance of the coefficients of BAS-FS ($\beta = 0.809$, $p = 0.215$) and BAS-RR ($\beta = 0.00595$, $p = 0.943$) I cannot reject the null hypothesis of no effect and hypotheses 1 and 2 cannot be accepted.

BIS ($\beta = -0.0912, p < 0.1$) is negatively and significantly correlated with entrepreneurial intention in all specifications of the model. Implying that having greater BIS sensitivity is associated with a lower probability of having entrepreneurial intentions. In model 1 and 2, the coefficient of BIS is highly significant at the 1% level. Adding only gender in model 3 or adding all control variables in model 4 results in a slightly less, but still significant coefficient of BIS at the 10% level.

BAS-D ($\beta = 0.152, p < 0.05$) is positively and significantly correlated with entrepreneurial intention. This implies a 1 point increase in the BAS-D sensitivity score is associated with a 7.62% higher probability of having entrepreneurial intentions. The coefficient of BAS-D is significant at the 1% level in model 1 and 3, and significant at the 5% level in model 2 and 4.

Table 3: Logit regression results for the average marginal effects of BIS/BAS sensitivity on entrepreneurial intention

VARIABLES	(1)	(2)	(3)	(4)
	no controls Logit	only age Logit	only gender Logit	full model Logit
BAS-FS	0.0762 (0.0664)	0.0858 (0.0665)	0.0707 (0.0653)	0.0809 (0.0653)
BAS-RR	-0.0220 (0.0859)	-0.0269 (0.0852)	0.0106 (0.0849)	0.00595 (0.0839)
BAS-D	0.159*** (0.0617)	0.152** (0.0617)	0.159*** (0.0612)	0.152** (0.0611)
BIS	-0.153*** (0.0525)	-0.148*** (0.0523)	-0.0989* (0.0551)	-0.0912* (0.0548)
Age		0.0150 (0.00996)		0.0175* (0.0102)
Gender			0.192*** (0.0640)	0.200*** (0.0635)
Observations	246	246	246	246

Notes. Gender (male = 1; female = 0); BAS-FS=behavioural approach system fun-seeking, BAS-RR=behavioural approach system reward responsiveness, BAS-D=behavioural approach system drive, BIS=behavioural inhibition system. Standard errors are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

5.3 Robustness check

As a robustness check I also estimated the same model using the LPM. The results can be found in the Appendix C2. The results are very similar in terms of significance, effect sizes and directions. The only big difference is that BIS is not significantly correlated with entrepreneurial intention in the model including all control variables, but it is significant in the model with no controls or when only controlling for gender or age. As was the case in the logit model, BAS-D sensitivity is significantly and positively correlated with entrepreneurial intention in all specifications of the model. BAS-FS and BAS-RR were not significantly correlated with entrepreneurial intention, in line with the results of the logit model. The control variables age and gender were also significant in both types of models. From this I conclude the results are relatively robust to the choice of estimation method, especially in terms of effect sizes and direction of the effects and the significant association BAS-D has with entrepreneurial intention.

5.4 Results effect of BIS/BAS sensitivity on entrepreneurial intention, mediated by gender

Table 4 displays the regression results for the effect of BIS/BAS sensitivity on entrepreneurial intention, including interaction terms between the BIS/BAS dimensions and gender. Model 1 and 2 are logit models and the results are reported as odds ratios. The odds ratio is the probability of having entrepreneurial intentions divided by the probability of not having entrepreneurial intentions. Model 3 and 4 show results for the LPM and the coefficients can be interpreted as probabilities. Model 1 and 3 do not control for age and model 2 and 4 do control for age. Interaction terms between gender and BIS/BAS dimension are included in all models. Regular logit regression coefficients are attached in the appendix C3.

In the logit model, BAS-D is the only significant variable out of the four dimensions of BIS/BAS. Since the odds ratio is more than one, the direction of the effect is positive. The coefficient is significant at the 5% level in both the models with and without controls. Age is also significant and the odds ratio points towards a positive relation between age and entrepreneurial intention. All the interaction terms between BIS/BAS sensitivity and gender are insignificant at any conventional significance level, thus I cannot reject the null hypothesis of no effect and hypothesis 5 cannot be accepted. In this sample there is no evidence for gender as a possible mediator in the relationship between BIS/BAS sensitivity and entrepreneurial intention.

Similarly, in the LPM model, BAS-D is the only significant predictor of the BIS/BAS scales for entrepreneurial intention. The coefficient is significant at the 5% level and is positively associated with entrepreneurial intention. The control variable age is also significantly and positively correlated with entrepreneurial intention. None of the interaction terms between BIS/BAS sensitivity and gender are significant, thus I cannot reject the null hypothesis of no effect and hypothesis 5 cannot be accepted.

In both the logit model and the LPM the interaction terms are insignificant. The direction of the effects of the interaction terms is also the same for both types of models. BAS-D is also significant in both models as is the control variable age.

The results of the OLS regression of gender on the BIS/BAS scales is attached in the appendix C. The results indicate that gender is not significantly correlated with BAS-D ($\beta = 0.031, p = 0.621$) and BAS-FS ($\beta = 0.027, p = 0.647$). Gender is negatively and significantly associated with BAS-RR ($\beta = -0.100, p < 0.05$) sensitivity. Being male compared to being female is associated with a decrease in the BAS-RR score of 0.100 and is significant at the 5% level. Furthermore, being male compared to being female is also negatively and significantly correlated with BIS ($\beta = -0.367, p < 0.001$) sensitivity. Being male compared to being female is associated with a decrease in the BIS score of 0.367 and is significant at the 0.1% level.

Table 4: Logit and LPM regression results of the effect of BIS/BAS sensitivity on entrepreneurial intention, including interaction terms with gender

VARIABLES	(1)	(2)	(3)	(4)
	no controls Logit	overall model Logit	no controls LPM	overall model LPM
BAS-FS	1.005 (0.458)	0.976 (0.4447)	0.00116 (0.0919)	-0.00431 (0.0909)
BAS-RR	0.833 (0.525)	0.863 (0.541)	-0.0360 (0.108)	-0.0309 (0.109)
BAS-D	2.364** (0.988)	2.354** (0.995)	0.152** (0.0740)	0.146** (0.0731)
BIS	0.829 (0.335)	0.878 (0.360)	-0.0325 (0.0740)	-0.0191 (0.0753)
BAS-FS*Gender	2.271 (1.498)	2.780 (1.897)	0.179 (0.144)	0.219 (0.145)
BAS-RR*Gender	1.613 (1.390)	1.499 (1.296)	0.0849 (0.166)	0.0665 (0.169)
BAS-D*Gender	0.805 (0.512)	0.747 (0.479)	-0.00682 (0.130)	-0.0152 (0.129)
BIS*Gender	0.522 (0.299)	0.497 (0.287)	-0.146 (0.110)	-0.156 (0.111)
Gender	0.623 (1.776)	0.676 (1.959)	-0.137 (0.571)	-0.125 (0.580)
Age		1.105* (0.0573)		0.0203** (0.00987)
Constant	0.0987 (0.213)	0.0096* (0.0241)	0.0547 (0.403)	-0.395 (0.479)
Observations	246	246	246	246
R-squared			0.142	0.156

Notes. Coefficients of the logit models show the odds ratio. Interaction terms with gender included in all models. Gender (male = 1; female = 0); BAS-FS=behavioural approach system fun seeking, BAS-RR=behavioural approach system reward responsiveness, BAS-D=behavioural approach system drive, BIS=behavioural inhibition system. Standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

6. Discussion and Conclusion

In this section I will discuss the results of this research and compare it to findings of previous studies. I will also discuss some of the limitations of this research and its relevance. Furthermore recommendations for future research will be made.

6.1 Discussion results

The aim of this research was to investigate the relationship between BIS/BAS sensitivity and entrepreneurial intention. Secondly, the possibility of gender as a mediator in this relationship was also investigated. The results support the notion that BIS/BAS sensitivity is an important factor to consider when studying entrepreneurship.

First, the positive and significant effect of age on entrepreneurial intention has been shown by similar studies looking into the relationship between BIS/BAS and entrepreneurship. Important to note here is that these studies, also including this one, use student samples with little variation in age (Geenen et al., 2016; Lerner et al., 2018). Studies that specifically looked at the effect of age on entrepreneurial intention using a broad variety of age actually found that there is a negative relationship between age and entrepreneurial intention (Hatak et al., 2015; Yukongdi & Lopa, 2017). Older individuals are less likely to have entrepreneurial intentions and this effect is stronger the more satisfied they are with their job and the longer they have been employed. An explanation for the positive effect of age in this paper might be that in the age group from approximately 20-25 years old, the older individuals have more financial means and more knowledge and skills. This might result in higher self-efficacy and a higher feasibility of starting a business, which are both predictors of entrepreneurial intention (Chen et al., 1998; Guerrero et al., 2008)

As was hypothesized I found that high BAS-D sensitivity is related to having entrepreneurial intentions. BAS-D captures the intrinsic motivation of individuals to pursue desired goals (Carver & White, 1994). As entrepreneurs face many difficult challenges and great losses are always looming, it is not surprising that people who desire to be an entrepreneur and to be successful as an entrepreneur, are more likely to have entrepreneurial intentions. This result is in line with earlier findings that found the BAS-D subdimension is positively correlated with entrepreneurial intention (Leung et al., 2020). Interestingly, Geenen et al. (2016) found that BAS-D is positively related to entrepreneurial intention, but only when individuals already have entrepreneurial experience. I do not have data on whether the people in this sample

have any entrepreneurial experience, but it is plausible most do not have any previous experience, since the sample consists only of university students. Lerner et al. (2018) investigated the effect of BIS/BAS on entrepreneurial action, a closely related concept to entrepreneurial intention, because entrepreneurial intention is positively correlated with entrepreneurial action (Kong et al., 2020). They found that higher BAS-D sensitivity is positively related to nascent entrepreneurial behaviour. In conclusion, this research substantiates evidence on the importance of BAS-D for entrepreneurial intention.

The results on the effect of higher BIS sensitivity on entrepreneurial intention were mixed. In the logit model without interaction terms, BIS was a significant predictor of entrepreneurial intentions. In contrast, BIS was insignificant in the logit model with interaction terms and both specifications of the LPM model. No other studies have found BIS to be significantly correlated with entrepreneurial intentions (Geenen et al., 2016; Lerner et al., 2018). The results of this research, however, do challenge this as I find evidence for the potential relevance of BIS sensitivity and entrepreneurship. The theoretical foundation for the importance of BIS sensitivity is strong as behavioural disinhibition (low BIS/high BAS) is associated with hyperactivity, impulsivity and ADHD which is in turn related to entrepreneurship ((Verheul et al., 2015; Wiklund et al., 2017). Moving forward, more research is needed to find more quantitative evidence for this relationship to help our understanding of the effect of BIS sensitivity on entrepreneurial intentions.

Contrary to other findings I did not find a significant effect of BAS-FS on entrepreneurial intention, although the positive direction of the effect was the same (Geenen et al., 2016; Leung et al., 2020). This result is somewhat surprising as individuals with high BAS-FS tend to seek out new experiences and act impulsively when an opportunity arises (Carver & White, 1994). This would be in line with findings that indicate novelty-seeking is an important personality trait in entrepreneurs and entrepreneurship is characterized by novelty and new opportunities (McMullen & Dimov, 2013).

The effect of BAS-RR on entrepreneurial intention was insignificant and the direction of the effect varied based on the specification of the model. Geenen et al. (2016) did find BAS-RR to be significant and negatively associated with entrepreneurial intentions and this is the only finding that supports the importance of BAS-RR for entrepreneurial intent. They propose that entrepreneurs might be more intrinsically motivated (high BAS-FS and BAS-D), while

individuals that display high BAS-RR are more extrinsically motivated. The negative relation between BAS-RR and entrepreneurial intentions further substantiates the finding that entrepreneurs are more intrinsically motivated, contrary to the belief that entrepreneurs mainly want to start ventures to reap the potential high benefits (Cardon et al., 2009; Geenen et al., 2016).

The main addition to the existing literature that this research intended to provide is to examine whether gender mediates the relationship between BIS/BAS sensitivity and entrepreneurial intentions, based on the fact that males and female differ in their sensitivity to for example the BIS scale (Carver & White, 1994). The results, however, did not deliver any evidence for gender as a possible mediator, as all the interaction terms were insignificant. The summary statistics did show a clear difference in entrepreneurial intention between genders, which is also reflected in the significance of the gender coefficient of the regressions. Also a regression of gender on BIS/BAS shows that male and female do differ significantly in terms of BIS and BAS-RR sensitivity, which is in line with the findings of Carver and White (1994). However, the results did not indicate that BAS-D sensitivity is significantly different between males and females, which this research found to be the strongest predictor of entrepreneurship out of the four BIS/BAS scales.

Although theoretically it does make sense that gender plays a role there are likely many other factors at play that are also important for the gender gap in entrepreneurship. Further research is needed to find out how men and women differ in their BIS/BAS sensitivity, which could potentially provide an incentive to investigate the hypothesised mediating effect of gender in another research, using a different sample and/or different methods.

6.2 Limitations, relevance and future research

As a reminder, this research was intended to add to the emerging field of BIS/BAS and entrepreneurship and due to several limitations no causal claims can be made. It does, however, substantiate evidence for the importance of BIS/BAS sensitivity and its application to entrepreneurship.

First, the data set that was used to conduct this research was fairly limited in terms of the number of variables. Ideally, you would want to have more data on confounders of the relationship between BIS/BAS sensitivity and entrepreneurial intention, such as

entrepreneurial self-efficacy. Due to this limitation there is almost certainly omitted variable bias and the zero conditional mean assumption does not hold, meaning no causal inferences can be made. Although the estimators are likely biased, the results do still have relevance as the research did control for age, gender and BIS/BAS sensitivity, which accounts for many individual differences. Also the results indicate the importance of dividing the BAS scale into three sub-dimensions as they differentially affect entrepreneurial intention. Future research could combine data from self-report scales, like this research used, and data that is more rooted in direct physiological measurements. The self-report scales, however, have been extensively validated and are common practice in the field of social sciences (Carver & White, 1994). Furthermore, the operationalization of entrepreneurial intention was done in a fairly simple way using a dichotomous question. Future research could also use a more sophisticated measure of entrepreneurial intention, such as the validated questionnaire developed by Liñán and Chen (2009).

Second, the data set was somewhat limited in the number of observations and the design of the research is fairly simple. Studies using more complex methods and a larger number of observations could potentially reveal alternative explanations and more insightful results. Also, the sample consisted only of Dutch university students within a small age range. This resulted in limited generalizability of the findings as important factors, as culture for instance could also play a role (Hayton et al., 2002). Future research could focus on replicating the results of this research, but in a different cultural setting or using a more diverse sample. Furthermore the data set that I used was cross-sectional, meaning it only evaluated one period in time. By using a panel data set, individuals could be followed over time and this could reveal whether the relationships vary over time.

Third, the participants had to fill in the survey independently and could decide themselves the setting in which they would fill it in. Since there was no supervision and no control over the environment in which the test was taken the results are less reliable than in a more controlled lab-environment. The students were, however, instructed to find a quiet spot and had to apply themselves to participate, so I think it is safe to assume they were fairly motivated and their responses were serious. There could also be concerns about the difference in compensation the students got for participation. All students were compensated with a monetary amount, except for the students from the psychology department, for whom participation in

experiments is mandatory to attain a degree. This should not be a very big problem as both groups have a relatively similar incentive to participate in the experiment, since both groups have to gain something from participation.

Last, in terms of policy, I would recommend to consider BIS/BAS as a useful framework to find out who government policies, aimed at promoting entrepreneurship, should target. Identification of potential entrepreneurs on the basis of BIS/BAS sensitivity might be important as for instance high BAS-D is a significant predictor of entrepreneurship. For this reason, more research on BIS/BAS and the use of BIS/BAS profiling might be important for the effectiveness of programs that encourage entrepreneurship.

6.3 Conclusion

In conclusion, although this research has its limitations, the results still have relevance. The findings of the research indicate that BIS/BAS is an important factor to consider when studying entrepreneurship, as BAS-D and BIS were significantly correlated with entrepreneurial intention. BAS-RR and BAS-FS were not significantly associated with entrepreneurial intention. Similarly, no evidence was found for the hypothesised mediating effect of gender. I hope the results in this study inspire other researchers to also consider BIS/BAS as a useful framework to examine entrepreneurship. The practical implications are significant as BIS/BAS underlies many concepts that are currently studied in the entrepreneurship literature, like psychological disorders and personality, and the framework could work as a bridge connecting theory and research (Lerner et al., 2018; Leung et al., 2020).

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Appendix A

Questionnaire

The items on the survey in Dutch, which were answered on a four-point Likert-type scale, measuring BIS/BAS sensitivity.

1. Familie is het belangrijkste in iemands leven
2. Ik voel zelden angst of zenuwen, zelfs als me iets vervelends staat te wachten
3. Ik zal over mijn grenzen heen gaan om de dingen te krijgen die ik wil
4. Als ik iets goed doe, wil ik er graag mee doorgaan
5. Ik ben altijd bereid iets nieuws te proberen als ik denk dat het leuk zal zijn
6. Kleren zijn belangrijk voor me
7. Als ik krijg wat ik wil, voel ik me opgewonden en energiek
8. Kritiek of uitbranders raken mij behoorlijk
9. Als ik iets wil, zal ik er gewoonlijk alles aan doen om dit te krijgen
10. Vaak doe ik dingen alleen voor de lol
11. Ik heb vaak weinig tijd om dingen te doen
12. Als ik de kans zie iets te krijgen wat ik wil, zal ik die kans meteen grijpen
13. Ik voel me bezorgd of overstuur als ik denk of weet dat iemand boos op mij is
14. Als ik ergens een buitenkansje zie dan word ik meteen enthousiast
15. Ik doe vaak dingen in een vlag van opwelling
16. Ik raak enigszins gestrest als ik denk dat er iets vervelends staat te gebeuren
17. Ik vraag me vaak af waarom mensen doen zoals ze doen
18. Als ik iets leuks meemaak heeft dat duidelijk invloed op me
19. Ik voel me bezorgd als ik denk dat ik slecht heb gepresteerd
20. Ik verlang naar spanning en sensatie

21. Als ik iets van plan ben dan laat ik mij door niets weerhouden
22. Ik ervaar weinig angsten vergeleken met mijn vrienden
23. Als ik een wedstrijd zou winnen, zou ik erg enthousiast zijn
24. Ik pieker wel eens over het maken van fouten

Table A1: Descriptive statistics by gender

	Male			Female		
	Mean	SD	α	Mean	SD	α
Intention	0.496	0.502	-	0.263	0.442	-
BAS-FS	2.699	0.496	0.489	2.670	0.522	0.604
BAS-RR	3.239	0.460	0.718	3.423	0.399	0.644
BAS-D	2.797	0.540	0.711	2.816	0.589	0.740
BIS	2.657	0.553	0.794	3.102	0.528	0.811
Age	20.735	3.137	-	20.917	2.719	-
Observations	113			133		

Notes. Gender (male = 1; female = 0); Intention (Yes = 1; No = 0); SD=standard deviation, α =Cronbach's alpha, Intention=entrepreneurial intention, BAS-FS=behavioural approach system fun seeking, BAS-RR= behavioural approach system reward responsiveness, BAS-D= behavioural approach system drive, BIS=behavioural inhibition system.

Appendix B

Table B1: Spearman's rank correlation coefficients

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1)Intention	1.000						
(2) BAS-FS	0.199**	1.000					
(3)BAS-RR	0.063	0.327***	1.000				
(4) BAS-D	0.197**	0.410***	0.424***	1.000			
(5) BIS	-0.210***	-0.181**	0.231***	-0.030	1.000		
(6) Age	0.039	-0.022	-0.011	0.022	-0.071	1.000	
(7) Gender	0.240***	0.037	-0.217***	-0.034	-0.384***	-0.045	1.000

Notes. Spearman's rho = -0.045. Gender (male = 1; female = 0); Intention (Yes = 1; No = 0); Intention=entrepreneurial intention, BAS-FS=behavioural approach system fun seeking, BAS-RR=behavioural approach system reward responsiveness, BAS-D=behavioural approach system drive, BIS=behavioural inhibition system. *** p<0.001, ** p<0.01, * p<0.05, two-tailed.

Equation B2: Linear Probability model

$$\begin{aligned}
 \text{Entrepreneurial Intention}_i = & \beta_0 + \beta_1 * \text{BAS Fun Seeking}_i + \beta_2 * \\
 & \text{BAS Reward Responsiveness}_i + \beta_3 * \text{BAS Drive}_i + \beta_4 * \text{BIS}_i + \beta_5 * \\
 & (\text{BAS Fun Seeking}_i * \text{Gender}_i) + \beta_6 * (\text{BAS Reward Responsiveness}_i * \text{Gender}_i) + \\
 & \beta_7 * (\text{BAS Drive}_i * \text{Gender}_i) + \beta_8 * (\text{BIS}_i * \text{Gender}_i) + \beta_9 * \text{Gender}_i + \beta_{10} * \text{Age}_i + \\
 & \varepsilon_i \tag{4}
 \end{aligned}$$

Where *Entrepreneurial Intention* is the probability that an individual *i* has entrepreneurial intentions, β_0 is a constant, the other β_j 's are the coefficients of the independent variables and ε_i is the random error term.

Appendix C

Table C1: Logit regression results for the relationship between BIS/BAS sensitivity and entrepreneurial intention

VARIABLES	(1) no controls Logit	(2) only age Logit	(3) only gender Logit	(4) overall model Logit
BAS-FS	0.360 (0.317)	0.409 (0.321)	0.347 (0.323)	0.401 (0.327)
BAS-RR	-0.104 (0.405)	-0.128 (0.406)	0.0519 (0.416)	0.0295 (0.417)
BAS-D	0.752** (0.305)	0.725** (0.307)	0.778** (0.314)	0.753** (0.316)
BIS	-0.723*** (0.262)	-0.705*** (0.263)	-0.485* (0.276)	-0.453 (0.277)
Age		0.0713 (0.0482)		0.0869* (0.0519)
Gender			0.904*** (0.304)	0.952*** (0.309)
Constant	-1.228 (1.286)	-2.743* (1.648)	-2.915** (1.435)	-4.850*** (1.857)
Observations	246	246	246	246

Notes. Standard errors are in parentheses. Gender (male = 1; female = 0); BAS-FS=behavioural approach system fun seeking, BAS-RR= behavioural approach system reward responsiveness, BAS-D= behavioural approach system drive, BIS=behavioural inhibition system; *** p<0.01, ** p<0.05, * p<0.1.

Table C2: LPM regression results for the direct effect of BIS/BAS sensitivity on entrepreneurial intention

	(1)	(2)	(3)	(4)
	no controls	only age	only gender	full model
VARIABLES	LPM	LPM	LPM	LPM
BAS-FS	0.0771 (0.0721)	0.0863 (0.0723)	0.0704 (0.0705)	0.0803 (0.0707)
BAS-RR	-0.0213 (0.0825)	-0.0259 (0.0830)	0.0122 (0.0819)	0.00806 (0.0822)
BAS-D	0.154** (0.0626)	0.146** (0.0629)	0.149** (0.0615)	0.141** (0.0619)
BIS	-0.153*** (0.0542)	-0.148*** (0.0550)	-0.0980* (0.0560)	-0.0901 (0.0567)
Age		0.0152 (0.00969)		0.0168* (0.00949)
Gender			0.192*** (0.0656)	0.197*** (0.0657)
Constant	0.247 (0.275)	-0.0746 (0.349)	-0.0826 (0.300)	-0.446 (0.376)
Observations	246	246	246	246
R-squared	0.089	0.098	0.122	0.132

Notes. Gender (male = 1; female = 0; BAS-FS=behavioural approach system fun-seeking, BAS-RR=behavioural approach system reward responsiveness, BAS-D=behavioural approach system drive, BIS=behavioural inhibition system. Robust standard errors are in parentheses.

*** p<0.01, ** p<0.05, * p<0.1.

Table C3: logit regression results of the relationship between BIS/BAS and entrepreneurial intentions, including interaction terms for gender.

VARIABLES	(1) no controls Logit	(2) overall model Logit
BAS-FS	0.005 (0.456)	-0.025 (0.458)
BAS-RR	-0.183 (0.630)	-0.147 (0.626)
BAS-D	0.860** (0.418)	0.856** (0.423)
BIS	-0.188 (0.405)	-0.130 (0.410)
BAS-FS*Gender	0.820 (0.660)	1.029 (0.678)
BAS-RR*Gender	0.478 (0.862)	0.405 (0.865)
BAS-D*Gender	-0.217 (0.636)	-0.291 (0.641)
BIS*Gender	-0.650 (0.573)	-0.699 (0.577)
Gender	-0.473 (2.850)	-0.391 (0.458)
Age		0.100* (0.052)
Constant	-2.316 (2.163)	-4.643* (2.513)
Observations	246	246
R-squared		

Notes. Gender (male = 1; female = 0; BAS-FS=behavioural approach system fun-seeking, BAS-RR=behavioural approach system reward responsiveness, BAS-D=behavioural approach system drive, BIS=behavioural inhibition system. Standard errors are in parentheses.

*** p<0.01, ** p<0.05, * p<0.1.

Table C4: OLS regression results for the effect of gender on BIS/BAS sensitivity

VARIABLES	(1) BAS-FS	(2) BAS-RR	(3) BAS-D	(4) BIS
Gender	0.0278 (0.0607)	-0.100** (0.0483)	0.0310 (0.0625)	-0.367*** (0.0685)
BAS-RR	0.384*** (0.0776)		0.506*** (0.0860)	0.412*** (0.0942)
BAS-D	0.235*** (0.0638)	0.272*** (0.0468)		-0.101 (0.0722)
BIS	-0.167** (0.0519)	0.192*** (0.0383)	-0.0875 (0.0625)	
Age	-0.0135 (0.0122)	0.00360 (0.00702)	0.0138 (0.0108)	-0.0147* (0.00826)
BAS-FS		0.245*** (0.0527)	0.280*** (0.0739)	-0.229*** (0.0702)
Constant	1.492*** (0.369)	1.333*** (0.284)	0.322 (0.374)	2.897*** (0.328)
Observations	246	246	246	246
R-squared	0.267	0.364	0.294	0.230

Notes. Gender (male = 1; female = 0); BAS-FS=behavioural approach system fun seeking, BAS-RR= behavioural approach system reward responsiveness, BAS-D= behavioral approach system drive, BIS=behavioral inhibition system. Robust standard errors in parentheses.

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

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