



BIS and BAS: Biobehaviorally rooted drivers of entrepreneurial intent



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ABSTRACT

We document the predictive relevance of the behavioral inhibition system (BIS) and the behavioral approach system (BAS) in a novel domain of societal importance: entrepreneurship. Based on structural equation models, Study 1 ($N = 320$) reveals that BAS reward responsiveness (BAS-RR) has a negative and BAS fun seeking (BAS-FS) has a positive association with entrepreneurial intent. Similar results emerge for Study 2 ($N = 470$): BAS-RR is negatively and BAS drive (BAS-D) is positively related to entrepreneurial intent. Additionally, Study 2 includes entrepreneurial experience, which is negatively related with BAS-RR and positively with BAS-D. We do not find any significant relationship between the BIS and entrepreneurial intent or experience. Our results support the multidimensionality of the BAS, with the subscales being differently associated with both entrepreneurial intent and experience. Finally, by simultaneously including intent and experience, Study 2 makes a methodological contribution related to the validity of student samples when analyzing entrepreneurial intent.

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1. Introduction

Governments across the world are pouring substantial amounts of financial resources into stimulating entrepreneurs and small businesses. The U.S.' Small Business Administration (SBA), for example, was planning to invest a total budget of \$ 710 million during the fiscal year 2015 in small businesses and their founders (SBA, 2015). In Europe, in 2014, the German government alone spent nearly € 490 million of public subsidies on the entrepreneurship community by promotional programs such as “Central Innovation Program for Medium-Sized Businesses” (FMEE, 2015). These figures vividly illustrate the importance that modern societies attach to entrepreneurial activities as presumable engines of job creation and economic growth. However, despite a large body of research in entrepreneurship, and many important insights gained over the past decades, many issues remain poorly

understood. A key puzzle is what factors predispose individuals to develop entrepreneurial intentions (Stam et al., 2012).

The objective of the present research is two-fold. First, complementing prior work, we contend that Gray's Reinforcement Sensitivity Theory (RST) (Gray, 1970) and revised Reinforcement Sensitivity Theory (rRST) (Gray & McNaughton, 2000), respectively—specifically, the behavioral inhibition system (BIS) and the behavioral approach system (BAS)—have a significant potential to inform the debate in economics and entrepreneurship research about antecedents of entrepreneurial intentions. The BIS and the BAS constitute fundamental motivational systems, which are central to theories of personality psychology (Brenner, Beauchaine, & Sylvers, 2005). Together, they appear to be at the heart of interpersonal differences in appetitive and aversive motivation—motivations that can be expected to be highly relevant in the context of entrepreneurship, which is charged with intense experiences of pleasant and unpleasant events and emotions. Therefore, we relate variations in entrepreneurial intent to interpersonal differences in the sensitivity of the BIS and the BAS. In so doing, this study supplements the range of previously identified predominantly social–cognitive influences on entrepreneurial intentions by deeper-level biobehavioral factors that are rooted in human neurophysiology. Second, by extending the scope of application of these constructs to a novel domain—entrepreneurship—we test whether prior

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claims that, dependent on the outcome variable, a single general BAS-factor disguises distinct dimension-specific effects, hold also for other outcome variables (here, entrepreneurial intent).

1.1. Behavioral inhibition system (BIS)/behavioral approach system (BAS)

The BIS and the and BAS (Fowles, 1980, 1993; Gray, 1982, 1987; Gray & McNaughton, 2000) are both central to theories of personality psychology (Brenner et al., 2005) and rooted in human neurophysiology.³ Individuals differ in their sensitivity of the BIS and the BAS to environmental cues of reward and punishment (Carver & White, 1994; Depue & Iacono, 1989; Fowles, 1980, 1993; Gray, 1982, 1987; Gray & McNaughton, 2000).

The BAS activates responses to reward and non-punishment cues (Fowles, 1980, 1988; Gray, 1982, 1987; Gray & McNaughton, 2000). High BAS sensitivity has generally been related to a tendency to engage in goal-directed efforts (Carver & White, 1994) and, more specifically, has been positively associated with approach traits such as extraversion (Eysenck & Eysenck, 1985), impulsivity (Gray, 1994; Smillie, Jackson, & Dalgleish, 2006) and novelty seeking (Cloninger, 1987), and (indirectly) negatively with such traits as social anxiety (e.g., Kimbrel, Nelson-Gray, & Mitchell, 2012) and with states that result from approach or reward such as energetic arousal (Thayer, 1986) and positive affect (Watson, Wiese, Vaidya, & Tellegen, 1999). The BAS is frequently characterized along three different dimensions (Carver & White, 1994), i.e., BAS-drive (BAS-D), BAS-fun seeking (BAS-FS), and BAS-reward responsiveness (BAS-RR).

The BIS represents a conflict detection, risk assessment, and appraisal system. It activates reactions of avoidance or withdrawal when individuals are confronted with anxiety-related signals such as punishment, non-reward, and novelty (Fowles, 1980, 1988; Gray, 1982, 1987; Gray & McNaughton, 2000) and directs attention to the potential threat. Inhibiting ongoing behavior, it is geared at preventing negative or painful consequences in a direct response to an anticipated punishment contingency. High BIS activation has been related to arousal, vigilance, negative affect, neuroticism, and anxiety and social anxiety (e.g., Fowles, 1988; Gray, 1994; Kimbrel et al., 2012). Recent studies divide the BIS into two dimensions (e.g. Beck, Smits, Claes, Vandereycken, & Bijttebier, 2009; Heym, Ferguson, & Lawrence, 2008; Poythress et al., 2008), although it is an unresolved issue whether the BIS scale might constitute a unitary scale for some populations (e.g., community samples) but divide into distinct sub-scales for others (e.g., offenders) (Poythress et al., 2008).

1.2. Entrepreneurial activities

Entrepreneurial activities have frequently been associated with economic growth and prosperity (Nyström, 2008; Sternberg & Wennekers, 2005). A better understanding of “how, by whom, and with what effects opportunities to create future goods and services are discovered, evaluated, and exploited” (Shane & Venkataraman, 2000, p. 218) has, therefore, evolved into a major challenge for researchers. Scholars have identified *entrepreneurial intent* as a critical first step in the process of becoming an entrepreneur (Bird, 1988), and as a crucial antecedent of entrepreneurial activities and the creation of new ventures (Krueger, Reilly, & Carsrud, 2000; Lee, Wong, Der Foo, & Leung, 2011).

Various factors influence entrepreneurial intent through their impact on perceived desirability (perceptions of the personal appeal of starting a business) and perceived feasibility (degree to which one feels capable of doing so), with an individual's propensity to act as an important moderator (Ajzen, 1991; Krueger & Brazeal, 1994; Krueger et al., 2000; Shapero & Sokol, 1982). Scholars have identified as individual-level

antecedents of entrepreneurial intent, for example, low job satisfaction (Lee et al., 2011), exposure to dedicated entrepreneurship education programs (Souitaris, Zerbinati, & Al-Laham, 2007), family background (Laspita, Breugst, Hebllich, & Patzelt, 2012), high (entrepreneurial) self-efficacy (Lee et al., 2011), and personality traits such as extraversion (Zhao, Seibert, & Lumpkin, 2010). Despite these very broad research efforts, it is however not yet entirely clear where entrepreneurial intentions actually “come from” (Krueger, 2004, p. 53). Specifically, the question as to the roots of individuals' motivation to engage in entrepreneurial behavior still reflects a puzzle. Are the underlying mechanisms highly contextualized or can they, perhaps, be traced back to fundamental individual characteristics that may even be manifested in the neural and biological substrates of decision-making and behavior (e.g., Lawrence, Clark, Labuzetta, Sahakian, & Vyakarnum, 2008)?

Here, we introduce BIS/BAS as a novel set of antecedents of entrepreneurial intent, which is conceptualized at a very fundamental level. The BIS and the BAS have been established as important predictor variables in many other, highly diverse domains such as psychiatric disorders (e.g., Johnson, Turner, & Iwata, 2003), social anxiety (Kimbrel et al., 2012), (coping with) anger and aggression (Smits & Kuppens, 2005), study behavior and outcomes, and student well-being (Van Beek, Kranenburg, Taris, & Schaufeli, 2013), and, generally, motivational theories such as those regarding psychopathy (Poythress et al., 2008). Despite their fundamental nature, however, very few studies have, to date, investigated the influence of BIS/BAS in the economic domain. Extant studies on the impact of differences in BIS/BAS sensitivity on issues of direct economic relevance include, for instance, decision-making in gambling tasks (e.g., Franken & Muris, 2005; Kim & Lee, 2011; Van Honk, Hermans, Putman, Montagne, & Schutter, 2002), experimental asset markets (Muehlfeld, Weitzel, & van Witteloostuijn, 2013), and public good settings (Skatova & Ferguson, 2011), as well as senior-executive job performance (Hutchison, Burch, & Boxall, 2013). In the current study, we aim to investigate the BIS/BAS' predictive relevance in another, novel, and broad economic domain of significant societal relevance: entrepreneurship.

1.3. Differences in BAS scales and entrepreneurial intent

Building on the notion of the BAS as a multidimensional construct, the individual dimensions of the BAS may have separate albeit interdependent effects. Therefore, we separately discuss each of the dimensions' expected effects. First, differences in *BAS-D* sensitivity capture differences across individuals in the *persistent pursuit* of desired goals (Carver & White, 1994). In entrepreneurship research, an individual's pronounced willingness and/or ability to persevere—to committedly pursue a chosen course of action even when faced with setbacks—is often viewed as a key feature of entrepreneurial behavior (Markman, Baron, & Balkin, 2005). Markman and Baron (2003), for example, list perseverance as one of those factors “for which empirical evidence for links to entrepreneurial success are strongest” (Markman & Baron, 2003, p. 287). To the extent that a greater willingness or capability to persevere is typical of actual entrepreneurs, and given that (entrepreneurial) intentions towards a particular behavior have been identified as strong indicators of that behavior (Fishbein & Ajzen, 1975), one might expect a positive association between a tendency towards perseverance and entrepreneurial intent. Therefore, we expect a positive relationship between an individual's *BAS-D* score and the person's entrepreneurial intent.

Second, differences in *BAS-FS* sensitivity cover interpersonal differences in “both a desire for *new* rewards and the willingness to approach a potentially rewarding event on the *spur of the moment*” (Carver & White, 1994, p. 322; emphases added). The essence of the entrepreneurs' function lies in the identification and implementation of *new* opportunities (Schumpeter, 1934). Recent literature has characterized entrepreneurs as being more open to new options (Burmeister & Schade, 2007), and favoring exploration and experimentation (Busenitz, 1996; Wang, 2008). This suggests that openness to new experiences and novelty-

³ For example, Amodio, Master, Yee, and Taylor (2008) examined the neurocognitive correlates of BAS/BIS and found that self-reported BIS was strongly related to neural mechanisms associated with sensitivity to threat cues and conflict monitoring, whereas self-reported BAS was associated with neural correlates of approach motivation.

seeking may be typical features of entrepreneurs (Zhao & Seibert, 2006)—traits that have also been associated with greater BAS-FS sensitivity (Cloninger, 1987; Eysenck & Eysenck, 1985; Segarra, Poy, López, & Moltó, 2014). The tendency of high BAS-FS individuals to act spontaneously parallels the notion that entrepreneurs are quicker and/or more ready than other individuals to seize an opportunity as they discover it or as it presents itself (Ardichvili, Cardozo, & Ray, 2003). We therefore expect a positive relationship between an individual's BAS-FS score and the person's entrepreneurial intent.

Third, BAS-RR relates to how strongly individuals respond to the occurrence or anticipation of a reward. While the previous two dimensions of the BAS primarily relate to the possibility that individuals (e.g., entrepreneurs) experience an inherent rejoicing in (experimentation) activities and in pursuing them persistently, this third dimension of BAS captures how strongly an individual responds to the occurrence or anticipation of the reward itself. A substantial body of prior research, mainly in economics but also partially in entrepreneurship, argues that financial reward constitutes a primary driver for individuals to become entrepreneurs (e.g., Kuratko, Hornsby, & Naffziger, 1997; Schumpeter, 1934). This proposition is not without controversy (see, e.g., Shepherd & DeTienne, 2005), though. Consequently, there is a need to further our understanding of whether or not individuals with pronounced entrepreneurial intentions exhibit heightened responsiveness to rewards *in general*—i.e., whether or not high BAS-RR is positively associated with entrepreneurial intent. Overall, we expect a positive relationship between an individual's BAS-RR score and the person's entrepreneurial intent.

1.4. Differences in BIS sensitivity and entrepreneurial intent

Following previous research (e.g., Beck et al., 2009; Heym et al., 2008; Poythress et al., 2008), the BIS scale includes two sub-scales. We follow Heym et al. (2008), who suggest that these two sub-scales can be referred to as *Anxiety* (BIS-ANX) and *Fear* (BIS-FEA). Anxiety captures the notion of worry about social comparison (e.g., 'criticism or scolding') and failure (e.g., 'making mistakes'), which are more associated with conflict or uncertainty (Heym et al., 2008). Fear, in turn, relates to the fight/flight-system, which has been viewed as the causal basis of fear and a threat response system mediating defensive aggression (fight) or escape responses (flight) when activated by unconditioned aversive stimuli (Heym et al., 2008). We expect that, in view of the significant challenges associated with starting a new venture and the uncertainties surrounding entrepreneurial activities, an individual's BIS-ANX and BIS-FEA scores and the person's entrepreneurial intent will be negatively associated.

1.5. General methodological approach

We conducted two studies. In Study 1, using a student sample, we assessed the relationship between the degree of BIS/BAS sensitivity and participants' intentions to engage in entrepreneurial activities. Study 2 serves two goals. First, Study 2 is a replication of Study 1 in order to probe the reproducibility of Study 1's empirical findings with a different sample (on the need to assess the replicability of empirical findings, see, in particular, Open Science Collaboration, 2015), and in order to boost the reliability and increase the precision of estimations (cf. Bonett, 2012).

Second, if BIS/BAS affect entrepreneurial intent and if participants of the study have already taken action towards entering entrepreneurship or have already selected into entrepreneurial contexts, then they may have already collected entrepreneurial experiences. As previous studies have documented that even entrepreneurial intent of sixteen-year-olds relates to subsequent entrepreneurial activities (Schoon & Duckworth, 2012), students with entrepreneurial intent may indeed have already acted upon their intent—i.e., they may have already engaged in entrepreneurial activities prior to participating in our study. These experiences can affect perceptions of related desirability and feasibility beliefs, and may hence affect entrepreneurial intent (Krueger, 1993).

Thus, if BIS/BAS sensitivity is related to entrepreneurial intent, it could also be linked to individuals' prior entrepreneurial experience. Therefore, in addition to replicating Study 1, Study 2 includes entrepreneurial experience as additional dependent variable. The interpretation of resulting estimations is, however, based on the limiting assumption that current BIS/BAS scores are related to the unobserved earlier BIS/BAS scores.

As entrepreneurial experience may affect intent (and vice versa), this entrepreneurial experience may confound the observed link between BIS/BAS and entrepreneurial intent, thereby rendering a causal explanation more difficult. Thus, controlling for experience can shed more light on how a potential link between BIS/BAS and entrepreneurial intent should be interpreted. Hence, Study 2 also facilitates interpreting the results of Study 1.

2. Study 1 — method

2.1. Participants and procedure

Three hundred twenty students (33% are females ($N = 106$); and average age = 18.80 years, $SD = 1.37$, and range = 17–34 years) who were enrolled in a Business Degree Program (B.Sc.) at a large Dutch university participated in a web-based survey as part of a larger study in the autumn of 2011. The students were enrolled in a compulsory introductory course on organization studies, and had to participate in accompanying tutorials. They were advised—but, due to university regulations, not obliged—to voluntarily participate in the online survey, for which they received email invitations during the first week of the semester. The survey remained online for two weeks. The purposes of the study were not revealed to the participants; the survey was announced to be part of the teaching to be addressed later on during the course. On average, it took participants approximately 30–45 minutes to complete the survey. We excluded incomplete responses.

2.2. Measures

2.2.1. Entrepreneurial intent

As a measurement of entrepreneurial intent, we used an adaptation of Rosse and Hulin's (1985) three-item turnover intention scale. For the first item—"How likely is it that you will actively look for business opportunities for an own start-up in the next three years?"—respondents were asked to choose between "not at all likely" (1), "somewhat likely" (3), "quite likely" (5), and "extremely likely" (7). For the other two items—"I often think about starting my own business" and "I will probably look for opportunities to start my own business in the next three years"—respondents had to indicate on a standard seven-point Likert scale to what degree those statements applied to them, ranging from (1) "strongly disagree" to (7) "strongly agree". Furthermore, we included as an additional item the self-reported three-year probability of starting a business as a percentage between 0 and 100 (cf. Krueger et al., 2000); this response was re-scaled to the range 1 (equal to 0%) to 7 (equal to 100%). The four items display a very high internal reliability ($\alpha = .89$).

2.2.2. BIS/BAS scales

Behavioral inhibition system (BIS) and *behavioral activation system* (BAS) were measured using the BIS/BAS scales of Carver and White (1994). Their established self-report scale assesses the two general motivational systems BIS (7 items) and BAS (13 items) with a four-point-Likert-type scale ranging from (1) "very true for me" to (4) "very false for me". The BAS-scale consists of three sub-scales: *BAS drive* (BAS-D, 4 items), *BAS fun seeking* (BAS-FS, 4 items) and *BAS reward responsiveness* (BAS-RR, 5 items). The BIS scale includes the two sub-scales *Anxiety* (BIS-ANX, 4 items) and *Fear* (BIS-FEA, 3 items). We decided to assign the BIS-item "If I think something unpleasant is going to happen, I usually get pretty worked up" to the BIS-FEA dimension (Heym et al., 2008). In contrast, other researchers assign this item to the BIS-ANX subscale

(e.g., Johnson et al., 2003; Poythress et al., 2008), implying that the “fear” component of the BIS is reflected in only two items.

We control for this dissent in the literature by correlating the errors of the aforementioned item with the other BIS-ANX items. Furthermore, following the results of Jorm et al. (1998), we excluded the item “When I see an opportunity for something I like, I get excited right away”, because this item loads on two factors—i.e., BAS-RR and BAS-D. In order to facilitate interpretation, we re-coded the scores such that a higher BIS-ANX (BIS-FEA, BAS-D, BAS-FS, BAS-RR) score implies higher BIS-ANX (BIS-FEA, BAS-D, BAS-FS, BAS-RR) sensitivity. Comparable to earlier studies, which sometimes report even alphas below .6 (Franken & Muris, 2006; Heym et al., 2008), internal consistency ranged from modest to satisfactory (BIS-ANX: $\alpha = .72$, BIS-FEA: $\alpha = .62$, BAS-D: $\alpha = .78$, BAS-FS: $\alpha = .64$, BAS-RR: $\alpha = .66$).

2.2.3. Entrepreneurial self-efficacy

As an important and frequently employed control variable when predicting entrepreneurial intent, we included entrepreneurial self-efficacy (ESE) defined as an individual's belief in her own competence to implement actions required to start a business. We measured ESE by a self-report-scale developed by Zhao, Seibert, and Hills (2005). We included all those items that Weitzel, Urbig, Desai, Sanders, and Acs (2010) identified as the “business talent” dimension of entrepreneurial self-efficacy. Participants were asked to rate from (1) “no confidence” to (5) “complete confidence” how confident they were in successfully identifying new business opportunities, creating a new product, and commercializing an idea or new development. Furthermore, we included adjustments proposed by Weitzel et al. (2010) by asking participants how confident they were to raise funds for a new business and to sell a new product or service. Reliability is satisfactory ($\alpha = .77$).

2.3. Analysis

We employ structural equation model (SEM) analysis using the maximum likelihood parameter estimation method, the computing environment R i386 3.2.2 and the *lavaan* (latent variable analysis) package (Rosseel, 2012). For evaluating the adequacy of the model fit, we apply the guidelines suggested by Bagozzi and Edwards (1998) for the following four goodness of fit indices: the Chi-squared test (χ^2 , should be non-significant), the Comparative Fit Index (CFI, should be $>.90$), the Standardized Root Mean Square Residual (SRMR, should be $<.01$) and the Root Mean Square Error of Approximation (RMSEA, should be $<.06$). Note, however, that these criteria, while common practice, are somewhat arbitrary and that there is still no consensus about a reference standard for an absolute model fit (Marsh, Hau, & Wen, 2004). For comparing competing models, we use the relative fit indices Akaike information criterion (AIC; Akaike, 1987) and Bayesian information criterion (BIC; Schwarz, 1978); in both cases, smaller values are better. Finally, the R^2 -statistics indicate the explained proportion of variance in endogenous variables.

3. Study 1 – results

Table 1 displays means, standard deviations, Cronbach's alphas and bivariate correlations. There are no univariate or multivariate outliers.

The measurement model reveals that items load onto their related latent variable: EIntent, ESE, BAS-RR, BAS-D, BAS-FS, BIS-FEA, and BIS-ANX. One item of BAS-FS shows a low standardized loading ($a = .36$), which explains the low internal consistency of BAS-FS. The structural model consists of eight exogenous variables: BAS-RR, BAS-D, BAS-FS, BIS-FEA and BIS-ANX, and ESE, and as controls sex and age. The endogenous variable is EIntent. The hypothesized model (M_{11}) shown in Fig. 1 fits the data well (see Fig. 1).

Increased EIntent is predicted by higher ESE, higher BAS-FS and, interestingly, lower BAS-RR. Moreover, age positively affects EIntent. 44.9% of the variance in entrepreneurial intent is accounted for by

BAS-FS, BAS-RR ESE and age. Individuals motivated by reward show lower entrepreneurial intent, whereas people enjoying the activity itself display higher entrepreneurial intent. Entrepreneurial self-efficacy (ESE) also has a significant influence on entrepreneurial intent.

4. Study 2 – method

4.1. Participants and procedure

Four hundred seventy students (30% are females ($N = 144$); and average age = 18.88 years, $SD = 1.20$, and range = 17–26 years) enrolled in a Business Program (B.Sc.) at a large Dutch university participated in a web-based survey as part of a larger study in 2012. The procedure was the same as in Study 1.

4.2. Measures

4.2.1. Entrepreneurial intent, BIS/BAS scales, and entrepreneurial self-efficacy

BIS/BAS, entrepreneurial intent and entrepreneurial self-efficacy are measured using the same scales as in Study 1. Again, internal consistency is found to range from modest to satisfactory/high (EIntent: $\alpha = .85$, BIS-FEA: $\alpha = .62$, BIS-ANX: $\alpha = .74$, BAS-D: $\alpha = .75$, BAS-RR: $\alpha = .62$, BAS-FS: $\alpha = .57$, and ESE: $\alpha = .74$).

4.2.2. Entrepreneurial experience

Conceptually similar to Zhao et al. (2005), we measured entrepreneurial experience (EXP) using four items. Participants were asked about their level of experience in 1) starting up a new, own business, 2) in being part of a new business, 3) in taking over an existing business, and 4) in establishing new organizations: The five-point response scale ranged from (1) “very low” to (5) “very high”. The reliability of EXP is high with $\alpha = .82$.

4.3. Analysis

We perform the same analyses as described in Section 2.3. We additionally pool data from Studies 1 and 2 to increase the reliability of estimates.

5. Study 2 – results

Table 2 displays means, standard deviations, Cronbach's alphas and bivariate correlations. There are no univariate or multivariate outliers.

We re-estimate our model from Study 1 on data from Study 2. Again, the measurement model has seven latent variables: EIntent, ESE, BAS-RR, BAS-D, BAS-FS, BIS-FEA, and BIS-ANX, onto which their respective items load. The structural model consists of eight exogenous variables: BAS-RR, BAS-D, BAS-FS, BIS-FEA, BIS-ANX, and ESE, as well as sex and age as controls. Again, EIntent is the endogenous variable (M_{12}). The model fits the data well. Standardized regression weights of the paths are presented in Fig. 1 (middle values). Increased EIntent is predicted by higher ESE and higher BAS-D. BAS-RR now only marginally decreases EIntent ($p = .068$). Nevertheless, in this model, excluding the controls sex and age (in this model, both are statistically not significant) results in a statistically significant negative affect of BAS-RR on EIntent ($\beta = -.23$, $p < .05$). 27.9% of the variance in EIntent is accounted for by BAS-D, BAS-RR and ESE. In sum, the negative influence of BAS-RR on EIntent is replicated. In contrast to Study 1, instead of BAS-FS, BAS-D has a significant direct effect on EIntent. Age is not significantly associated with EIntent. Again, in keeping with Study 1, neither BIS-FEA nor BIS-ANX are significantly related with EIntent.

In order to increase the reliability of our estimates, we also pool the data of Studies 1 and 2 for re-estimating the SEM. For model M_p (congruent to M_{11} and M_{12}), results indicate a good model fit (see Fig. 1, lowest values). Similar to estimations in Studies 1 and 2, as illustrated in Fig.

Table 1
Means, standard deviation, Cronbach's α and correlations between variables and latent factor ($N = 320$).

	<i>M</i>	<i>SD</i>	α	Sex	Age	EIntent	ESE	BIS-FEA	BIS-ANX	BAS-RR	BAS-D	BAS-FS
Sex	.33	.47		1	-.12	-.18*	-.17*	.43**	.34**	.20**	.07	-.11
Age	18.80	1.37		-.12*	1	.15*	-.02	-.09	-.11	.05	.08	.15*
EIntent	3.40	1.56	.89	-.18**	.14*	1	.61**	-.34**	-.22**	.03	.34**	.33**
ESE	4.40	.83	.77	-.13*	-.01	.48**	1	-.42**	-.33**	.20*	.50**	.35**
BIS-FEA	2.81	.57	.62	.36**	-.05	-.25**	-.28**	1	.75**	.23**	-.24**	-.29**
BIS-ANX	2.89	.58	.72	.28**	-.08	-.17**	-.24**	.61**	1	.30**	-.07	-.22**
BAS-RR	3.48	.43	.66	.15**	.04	.02	.15**	.13*	.21**	1	.57**	.43**
BAS-D	2.82	.57	.78	.04	.08	.30**	.42**	-.17**	-.02	.41**	1	.41**
BAS-FS	2.80	.50	.64	-.10	.14**	.22**	.21**	-.19**	-.11*	.22**	.30**	1

Note. *M* = mean, *SD* = standard deviation, α = Cronbach's alpha, EIntent = entrepreneurial intention, ESE = entrepreneurial self-efficacy, BIS-FEA = behavioral inhibition system fear, BIS-ANX = behavioral inhibition system anxiety, BAS-RR = behavioral approach system reward responsiveness, BAS-D = behavioral approach system drive, and BAS-FS = behavioral approach system fun seeking. Means are reported as usually scored. Latent correlations are depicted in the upper triangle of the correlation matrix (model fit: $\chi^2 (367) = 653.7, p < .01; CFI = .905$). Significance levels (two-tailed): * $p < .05$, ** $p < .01$.

1, the standardized regression weights of the pooled model paths reflect a positive association between the two subscales BAS-D and BAS-FS, respectively, and EIntent. BAS-RR is negatively related to EIntent, and ESE predicts EIntent positively.

The second model in Study 2 includes EXP as an additional outcome variable of BIS/BAS dimensions and as a control variable when predicting EIntent. Thus, the measurement model has eight latent variables: EIntent, ESE, BAS-RR, BAS-D, BAS-FS, BIS-FEA, BIS-ANX and EXP, onto which their respective items loaded. Again, one item shows a low standardized loading ($a = .21$), which explains the low internal

consistency of BAS-FS. The structural model consists of eight exogenous variables: BAS-RR, BAS-D, BAS-FS, BIS-FEA, BIS-ANX, and ESE, and again sex and age as controls. EXP and EIntent are endogenous variables. The hypothesized model (M_{exp}) shown in Fig. 2 fits the data well.

Higher levels of EXP are predicted by higher BAS-D and lower BAS-RR; 12.3% of the variance in EXP is explained by BAS-D and BAS-RR. ESE, EXP, sex and (marginally) BAS-D predict EIntent; 38.6% of the variance in EIntent is accounted for by BAS-D, BAS-RR, ESE, and EXP. Entrepreneurial experience is linked to stronger entrepreneurial intent. Notably, when controlling for variations in entrepreneurial experience

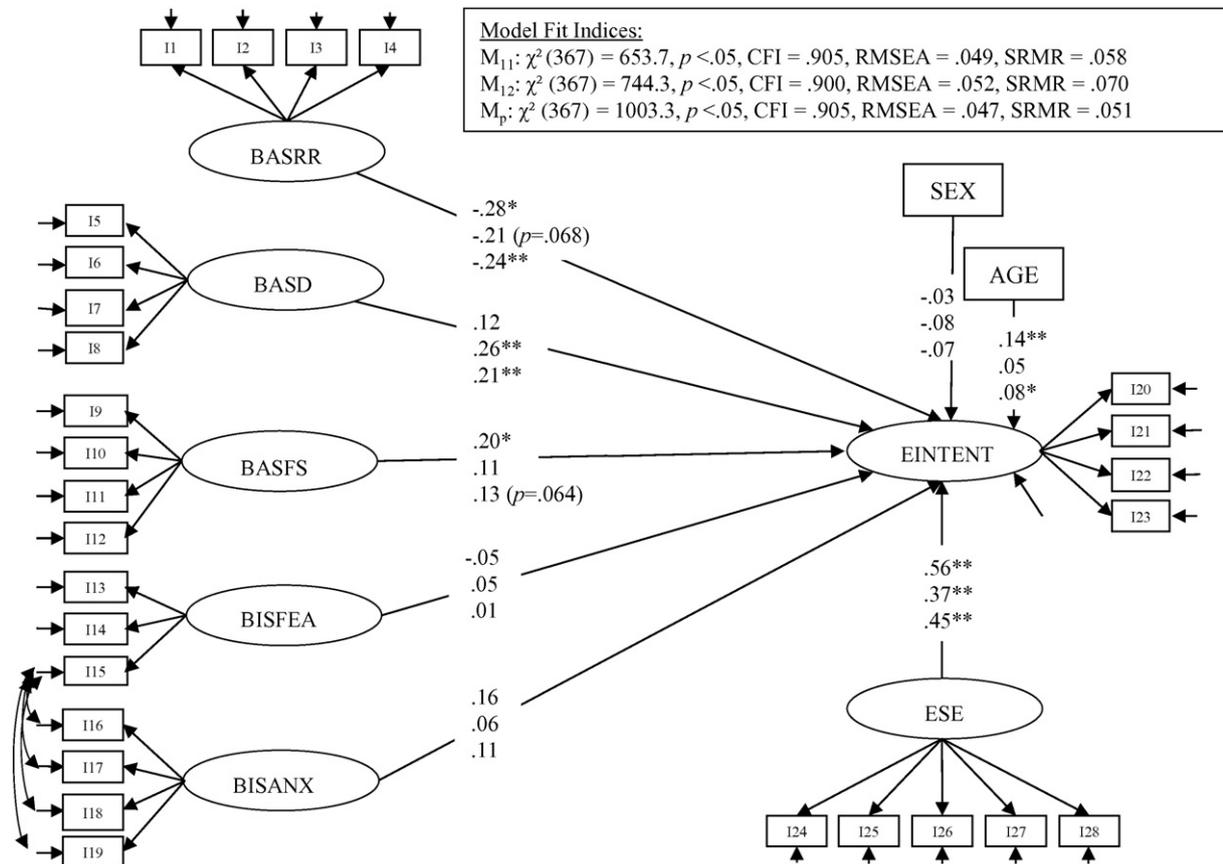


Fig. 1. Measurement and structural model relating BAS-D, BAS-FS, BAS-RR, BIS-FEA, and BIS-ANX to EIntent, controlling for ESE, sex and age. Given are maximum likelihood parameter estimates: standardized regression weights. The upper values present the 2011 data (M_{11}), values in the middle present the 2012 data (M_{12}), and the undermost values stem from the pooled data (M_p). In order to simplify presentation, the correlations between age, sex, and all latent variables, as well as the measurement model values are not shown in the figure. EIntent = entrepreneurial intention, ESE = entrepreneurial self-efficacy, BIS-FEA = behavioral inhibition system fear, BIS-ANX = behavioral inhibition system anxiety, BAS-RR = behavioral approach system reward responsiveness, BAS-D = behavioral approach system drive, and BAS-FS = behavioral approach system fun seeking. Significance levels (two-tailed): * $p < .05$, ** $p < .01$.

Table 2
Means, standard deviation, Cronbach's α and correlations between variables ($N = 470$).

	M	SD	α	Sex	Age	EIntent	ESE	BIS-FEA	BIS-ANX	BAS-RR	BAS-D	BAS-FS	EXP
Sex	.30	.46		1	-.05	-.17**	-.19**	.48**	.43**	.21**	.01	-.21**	.06
Age	18.88	1.20		-.05	1	.11*	.10	-.19**	-.11*	.03	.10	.13*	.16**
EIntent	3.36	1.51	.85	-.14**	.09	1	.43**	-.19**	-.10	.09	.35**	.30**	.46**
ESE	4.42	.73	.74	-.15**	.11*	.38**	1	-.32**	-.24**	.31**	.42**	.42**	.14
BIS-FEA	2.72	.57	.62	.38**	-.15**	-.11*	-.23**	1	.70**	.16*	-.10	-.41**	-.20
BIS-ANX	2.81	.57	.74	.37**	-.08	-.06	-.18**	.55**	1	.31**	.07	-.10	-.16
BAS-RR	3.51	.40	.62	.17**	.03	.07	.13**	.11*	.25**	1	.64**	.50**	-.10
BAS-D	2.85	.56	.75	-.01	.08	.29**	.34**	-.08	.06	.44**	1	.53**	.18
BAS-FS	2.84	.47	.57	-.17**	.09*	.16**	.24**	-.24**	-.09*	.22**	.29**	1	.06
EXP	1.64	.73	.82	-.07	.18**	.39**	.24**	-.14**	-.11*	-.06	.12**	.01	1

Note. M = mean, SD = standard deviation, α = Cronbach's alpha, EIntent = entrepreneurial intention, ESE = entrepreneurial self-efficacy, BIS-FEA = behavioral inhibition system fear, BIS-ANX = behavioral inhibition system anxiety, BAS-RR = behavioral approach system reward responsiveness, BAS-D = behavioral approach system drive, BAS-FS = behavioral approach system fun seeking, and EXP = entrepreneurial experiences. Means are reported as usually scored. Latent correlations are depicted in the upper triangle of the correlation matrix (model fit: $\chi^2(481) = 913.4, p < .01; CFI = .905$). Correlations of reduced measurement model (without EXP) are available upon request. Significance levels (two-tailed): * $p < .05$, ** $p < .01$.

(EXP), the initial effects of BIS/BAS on EIntent disappear and are replaced by corresponding effects on entrepreneurial experience.

6. Conclusion and general discussion

Identifying why some individuals are more entrepreneurial than others remains one of the great challenges of entrepreneurship research, to date (Schlaegel & Koenig, 2014). Our analyses reveal that the rather fundamental motivational systems of BAS-FS and BAS-D appear to foster entrepreneurial intent. In contrast, we do not find

significant support for the expected positive relationship between BAS-RR and entrepreneurial intent, but instead find a robust negative relationship. We do not find significant relationships between any of the BIS sub-scales and entrepreneurial intent. We replicate the relationships between BIS/BAS and entrepreneurial intent for entrepreneurial experience. Furthermore, when controlling for entrepreneurial experience, the effects of BIS/BAS on entrepreneurial intent are substituted by corresponding effects on experience. This does not falsify our contention that BIS/BAS may drive entrepreneurial intent. Instead, it suggests that those whose entrepreneurial intent is driven by BIS/BAS had

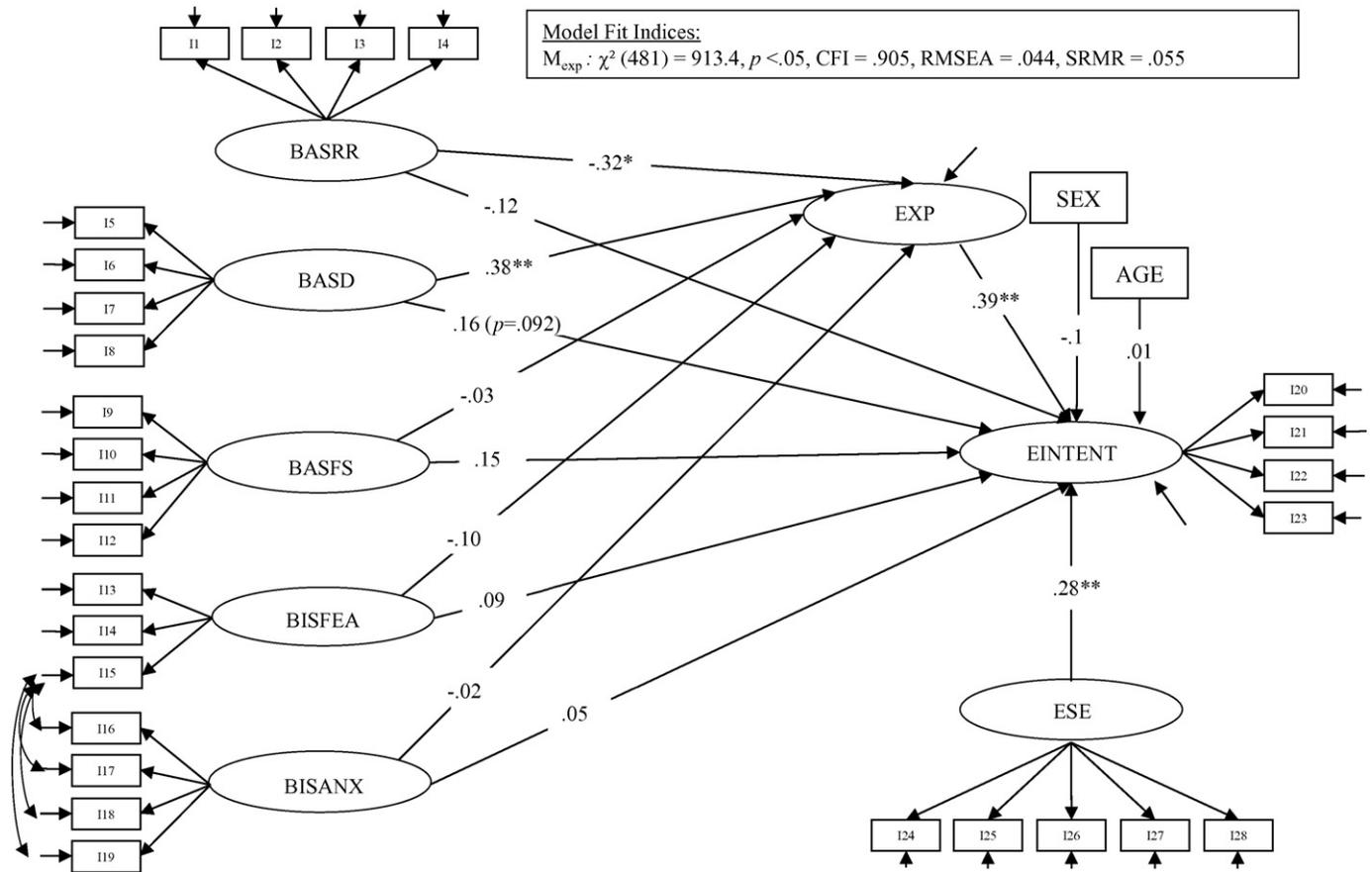


Fig. 2. Measurement and structural model relating BAS-D, BAS-FS, BAS-RR, BIS-FEA, and BIS-ANX to EIntent, mediated by EXP and controlling for ESE, sex and age (M_{exp}). Given are maximum likelihood parameter estimates: standardized regression weights. In order to simplify presentation, the correlations between age, sex, and all latent variables, as well as the measurement model is not shown in the figure. EIntent = entrepreneurial intent, ESE = entrepreneurial self-efficacy, BIS-FEA = behavioral inhibition system fear, BIS-ANX = behavioral inhibition system anxiety, BAS-RR = behavioral approach system reward responsiveness, BAS-D = behavioral approach system drive, BAS-FS = behavioral approach system fun seeking, and EXP = entrepreneurial experiences. Significance levels (two-tailed): * $p < .05$, ** $p < .01$.

already acted upon this intent prior to participating in our study, having already gained entrepreneurial experiences in the process.

Our two studies contribute to research on BIS/BAS. The different directions of the observed effects of BAS-RR, on the one hand, and BAS-D and BAS-FS, on the other hand, lend empirical support to multidimensional conceptualizations of the BAS (Corr, 2016) and, specifically, to the claim that the “three BAS subscales represent related, yet independent constructs” (Morean et al., 2014, p. 1008). Thus, dependent on the outcome variable, a single general BAS factor disguises possible distinct sub-scale-specific effects and, thereby, potentially contributes to the emergence of inconsistent results (Smillie et al., 2006; Voigt et al., 2009). Furthermore, supporting Taubitz, Pedersen, and Larson (2015) who demonstrated that a broad range of positive psychological functioning (internalizing, externalizing, affect regulation, and well-being) is uniquely predicted by BAS-RR, we reveal that BAS-RR is also an important predictor of outcome variables in another domain of contemporary societal debate—i.e., entrepreneurship, for which BIS/BAS has not been explored, yet.

In the present case, the different directions of the effects of BAS-RR and BAS-D/BAS-FS, respectively, might hint at the neural basis of two major types of individuals' motivations: extrinsic motivation referring to “doing something because it leads to a separable outcome” and intrinsic motivation referring to “doing something because it is inherently interesting or enjoyable” (Ryan & Deci, 2000, p. 55). While BAS-RR emphasizes future by referring to future-oriented planning, worry and management of uncertainty (Heym et al., 2008), both BAS-D and BAS-FS refer to instant gratifications (Heym et al., 2008), which are likely to be drawn from behavior itself rather than resulting outcomes of behavior. Individuals who score high on BAS-RR might, therefore, tend to be extrinsically motivated. High BAS-D and high BAS-FS individuals, in turn, may tend to be intrinsically motivated—a proposition that is worthwhile exploring in-depth in future research.

Supporting a multidimensional conceptualization of the BAS does not imply that these dimensions and their effects are independent of one another or that the BAS dimensions' effects are independent of the BIS. Building on Gray and McNaughton's (2000) revised Reinforcement Sensitivity Theory (rRST), Corr (2002)—in the context of the Joint Subsystems Hypothesis (JSH)—emphasizes that BIS-ANX is activated only when there is a conflict between approach and avoidance (i.e., a conflict between BIS-FEA and the BAS) and that BIS-ANX resolves such conflicts within and between the systems; otherwise, aversive stimuli are mediated solely by the FFS, best approximated in our case by BIS-FEA. It is interesting to note that, in conformity with the general principles of the JSH, we do find significant correlations between BIS-ANX and some of the BAS-sub-scales, such that some effects might be attributable to joint variations in these dimensions. Specifically, in both studies, BIS-ANX is positively correlated with BAS-RR, and negatively with BAS-FS, although the latter correlation is significant only in the 2011 data.

The JSH has been argued to be most applicable in situations that are characterized by the joint presence of reward and punishment cues, or weak appetitive or aversive stimuli (e.g., Gomez, Cooper, McOrmond, & Tatlow, 2004). Given the nature of entrepreneurial endeavors as offering potentially large (financial as well as non-monetary) rewards while simultaneously being afflicted by immense failure probabilities, entrepreneurial intentions appear to be a context where such interplays of rRST factors may matter. However, interplays between the different systems are empirically best identified through experimental research that manipulates stimuli (e.g., Corr, 2002). The survey context of this research with entrepreneurship as the sole “stimulus” does—in our opinion—not allow for a proper assessment of the JSH. Future research linking BIS/BAS and entrepreneurship, however, might benefit from acknowledging that a lack of entrepreneurial intent may, as emphasized by Corr (2013), result from two different “avoidance” mechanisms, one of which relates to pure avoidance and escape of aversive stimuli, while the other one refers to behavioral inhibition induced by detecting a goal conflict.

Our research further adds to existing literature on entrepreneurial intentions by providing empirical evidence for neurophysiological correlates of entrepreneurial intent. We document a significant relationships between the BAS and both entrepreneurial intent and entrepreneurial experience. While entrepreneurial intent might be considered as being distant from actual entrepreneurial activities, Study 2 reveals that the relationships linking the BAS and entrepreneurial intent also hold for previous *entrepreneurial experience as an additional dependent variable* of interest. In both studies, we observe that entrepreneurial intent is negatively related to *outcome orientation* (as reflected in BAS-RR), which captures how strongly an individual responds to the occurrence or anticipation of a reward itself. As the BAS is a fundamental motivational system independent of specific types of incentives (e.g., money, status, or other external rewards), our results not only confirm prior research that has suggested that entrepreneurs do not primarily care about *financial* rewards (Benz, 2009; Hamilton, 2000). Our results go beyond the narrow focus on financial rewards and, more generally, suggest that entrepreneurial intent is higher for individuals who are relatively immune to *any kind of reward*.

Furthermore, persistently pursuing a desired goal (BAS-D) and pursuing a goal for its own sake (BAS-FS)—two more *procedural orientations*—are each identified in one study as positively associated with entrepreneurial intent. Taken together, our results further substantiate claims that entrepreneurs are, for a large part, intrinsically motivated by their entrepreneurial activities (Cardon, Wincnet, Singh, & Drnovsek, 2009), rather than by the prospect of—perhaps—earning some highly uncertain Schumpeterian rent at some point in the future (Benz & Frey, 2008). Indeed, failure rates of entrepreneurial endeavors are very high—figures reported in the business press range up to 90% (e.g., Forbes, 2015). Therefore, it seems plausible that individuals who are shielded by low BAS-RR sensitivity from a significant realistic future orientation and planning, while simultaneously being stimulated by instant gratification (BAS-FS and BAS-D) and lack of future contemplation (BAS-FS) (Heym et al., 2008), would be more prone to exhibit entrepreneurial intentions.

Study 2 further makes a methodological contribution to entrepreneurship research that is related to the validity of student samples when analyzing entrepreneurial intent (e.g., Bönnte, Procher, & Urbig, in press, McGee, Peterson, Mueller, & Sequeira, 2009, Shook, Priem, & McGee, 2003). Scholars have sometimes argued that investigating entrepreneurial intent in student samples is inappropriate because these individuals are at too early a stage in their lives in order to have developed meaningful entrepreneurial intentions (Robinson, Huefner, & Hunt, 1991). In contrast, our findings (i.e., effects related to entrepreneurial intent disappear once we *control for entrepreneurial experiences*) rather suggest that, if anything, it might actually be *too late* to study university students, at least if one aims at understanding the drivers of ‘pure’ entrepreneurial intentions, not yet confounded by any prior entrepreneurial experience. Our results suggest that those with entrepreneurial intent are more likely to have already collected experiences related to entrepreneurship and, thus, have acted upon their intent. This prior acting on their entrepreneurial intentions leads to potential threats of reverse causality, which have already been acknowledged with respect to cross-sectional studies of entrepreneurial intent (e.g., Krueger, 2007). Thus, for assessing and analyzing biological or neurobiological antecedents to entrepreneurial intent (e.g., Bönnte et al., in press)—without intent being confounded by entrepreneurial experiences—complementary future research might follow Robinson et al. (1991), turning to even younger participants like, for example, high-school students, and following their development.

7. Limitations

The current study has several limitations that could be addressed in future research. First, the measurements are self-report scales; thus, there is a potential for common-method variance—a phenomenon

that is currently being discussed rather controversially in the literature (e.g., Chang, Van Witteloostuijn, & Eden, 2010). Therefore, collecting complementary data ascertained by further methods—for example, using neuroscientific approaches—would certainly be useful in future research in order to probe the robustness of our results. However, we strongly believe that, as a stepping stone, our findings are highly valuable, not least because in gathering them, we followed established recommendations for reducing common-method variance by, for example, ensuring strict anonymity of the responses and by using different scale types (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003).

Second, rooted in the cross-sectional design of our study, the data only reflect a snapshot at one point in time. For detecting intra-individual changes over time—such as, for example, an increase in entrepreneurial intent with age—it would be necessary to opt for a panel design. Nevertheless, the cross-sectional data collected for this study enable us to identify, as a first step, important correlations between the physiologically rooted exogenous variables and entrepreneurial intent. Relatedly, third, given the non-experimental character of the study, no inferences regarding causality can be drawn. However, given the fundamental nature of BIS/BAS, we believe that by considering them jointly with measuring entrepreneurial intentions, the results provide important evidence for an association between neurophysiologically anchored dispositions and entrepreneurial intent. The results may, therefore, help guide future research into the foundations of who really develops entrepreneurial intentions—and why.

Fourth, finally, recent developments related to the conceptualization and measurement of approach and avoidance behaviors suggest promising future extensions of this research. One limitation of our work relates to the absence of the Fight–Flight–Freeze–System (FFFS) in the original Carver and White (1994) BIS/BAS scales that we employed. These scales are generally known for yielding good reliability and validity. Also, recent studies have argued that two BIS factors may be extracted (as we do in this study, relating to FFFS–fear and BIS–anxiety). Still, the scale was originally developed for capturing only one general avoidance system, implying in particular a likely incomprehensive assessment of the presumable FFFS–fear sub-scale (e.g., Corr, 2016). Together with the unsupportive results in our two studies with regard to the BIS (sub-dimensions) based on the Carver and White (1994) scale, future research should probe these findings using one of the recently developed revised RST scales, which explicitly accounts for two separate avoidance factors (Corr, 2016). Furthermore, scholars have recently proposed that instead of constituting a single sub-dimension related to reward (BAS-RR), it might be important to separate *reward interest* and *reactivity to rewards* as they could come into play at different stages of approach (e.g., Corr, 2013). Employing a revised RST-3 scale such as, in particular, the Reinforcement Sensitivity Theory of Personality Questionnaire (RST-PQ), which distinguishes between four BAS factors and two unitary defensive factors (Corr, 2016), and comparing the results with our findings could, therefore, yield even more fine-grained insights into the drivers of entrepreneurial intentions.

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