

## Attention-Deficit Hyperactivity Disorder Symptoms and Entrepreneurial Orientation: A Replication Note

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There is a small body of literature linking attention-deficit hyperactivity disorder (ADHD) and its symptoms to entrepreneurial manifestations. Some studies take a subclinical perspective by studying the presence of symptoms, while other studies take a clinical perspective by studying the formal diagnosis of ADHD. The entrepreneurial manifestations examined range from entrepreneurial intention to the choice to become self-employed and from entrepreneurial orientation (EO) to entrepreneurial success. Despite its prominence in the entrepreneurship literature, to date only one study tested for a link with EO. The present study aims to replicate the relationship between ADHD symptoms and EO using a large data set of French small business owners. We do so by discriminating between the two dimensions of ADHD, namely attention-deficit and hyperactivity, as well as the three dimensions of EO, namely innovativeness, proactiveness, and risk-taking. We do not find a link between ADHD and EO, although we do find a positive link between ADHD and the risk-taking subdimension of EO. Hyperactivity symptoms are positively related to EO, which is mainly

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driven by the subdimensions proactiveness and risk-taking. We do not find a link between attention-deficit symptoms and EO, though there is a negative link between attention-deficit and proactiveness.

## INTRODUCTION

Attention-deficit hyperactivity disorder (ADHD) is a neurodevelopmental disorder that is diagnosed in both children and adults. Over the last decade, the diagnosis of ADHD has increased dramatically (American Psychiatric Association, 2013; Davidovitch, Koren, Fund, Shrem, & Porath, 2017). ADHD is associated with numerous disadvantageous outcomes, such as a lower socioeconomic status and the completion of fewer years of education (Barkley, Fischer, Smallish, & Fletcher, 2006; Goodman, 2007). In addition, people who are diagnosed with ADHD are often confronted with stigmas, which, in turn, may lower their well-being and life satisfaction (Mueller, Fuermaier, Koerts, & Tucha, 2012).

Recently, several empirical studies have shed light on the potential benefits of ADHD. A positive link was found between subclinical levels of ADHD and different manifestations of entrepreneurship, such as entrepreneurial intention, the choice to become self-employed, entrepreneurial orientation and entrepreneurial success. See Antshel (2018) for a review of this subject. These studies are usually interpreted by the authors as a proof of concept approach: to what degree can the nonclinical measures of mental disorders be linked with occupational choice and behaviour (Wiklund et al., 2019)? Although the emphasis here is on ADHD and entrepreneurship, measures of other mental disorders and/or other occupations could be investigated in a similar fashion.

With the exception of pioneering studies building on the person-environment fit literature (Verheul et al., 2015; Wiklund, Yu, Tucker, & Marino, 2017) and those that introduce the notion of disinhibition and non-reasoned action to the field of entrepreneurship (Lerner, 2016; Lerner, Hunt, & Dimov, 2018a), the emerging academic literature linking ADHD and entrepreneurship to date has a strong empirical focus, and there is less attention paid to theorising. Hence, replication studies in this field are important to minimise the likelihood that subsequent theory building is based on spurious correlations.

To date, only one study has examined the specific link between ADHD symptoms and entrepreneurial orientation (EO): Yu, Wiklund, & Pérez-Luño (2018).<sup>1</sup>

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<sup>1</sup> A new version of this paper (Yu et al., 2018) is forthcoming in *Entrepreneurship Theory and Practice* (Yu et al., 2020). We based our replication on the 2018 version published in *Academy of Management Proceedings*.

EO is the strategic posture of a firm which captures how entrepreneurial activities are performed (Lumpkin & Dess, 1996) in terms of taking risks, being proactive in entering new market areas, and focusing on product and process innovation (Anderson, Covin, & Slevin, 2009; Miller, 1983). Using a unidimensional measure of firm-level EO, Yu et al. (2018) examined the relationship between firm-level EO and the separate dimensions of ADHD (attention-deficit and hyperactivity). Using one Spanish and one mainly US American data set, they demonstrated that EO is positively related to the hyperactivity/impulsivity dimension and not to the attention-deficit dimension of ADHD.

Thurik, Khedhaouria, Torres, and Verheul (2016) also studied the relationship between ADHD and EO. However, after their discovery that the results of their paper could not be recomputed, they took the initiative to retract their article. In the present study, we redo the analysis of Thurik et al. (2016) using an improved working sample with the aim of replicating the findings of Yu et al. (2018). Additionally, we will provide a more nuanced understanding of the relationship between ADHD and EO. Like Yu et al. (2018), we examine this relationship distinguishing between attention-deficit and hyperactivity. Moreover, we investigate the association between overall ADHD and EO. Furthermore, in our analyses, we distinguish between the underlying dimensions of EO (risk-taking, innovativeness, and proactiveness). Finally, we use both OLS and partial least squares structural equation modeling (PLS-SEM) to analyse the relationships. The benefit of OLS is that it is more widely known and easier to interpret. PLS-SEM, however, considers the latent structure of our measures and estimates all relationships simultaneously within one model. In our replication analyses, we use a large data set of 802 French small business owners.

By investigating the ADHD-EO relationship, the present study contributes to the literature on ADHD and entrepreneurship. First, the replication itself is important in a field where the theoretical contributions thus far have been limited. By replicating the results regarding the relationship between EO and ADHD symptoms, the present study may open (or close) the door for more theorising about why attention-deficit and hyperactivity could be conducive to an entrepreneurial orientation, whether at the level of the individual or the organisation. Second, we provide a more nuanced understanding of the underlying mechanisms that explain the relationship between ADHD and EO, examining the difference between attention-deficit and hyperactivity on the one hand and all three pillars of EO on the other hand. Indeed, Yu et al. (2018) already demonstrated that the existence of a relationship depends on the type of ADHD symptoms individuals experience. Third, as stressed by previous studies, studying the relationship between ADHD and entrepreneurship has important societal implications. Such investigation could contribute to destigmatising psychological disorders. Showing that

higher levels of experienced ADHD symptoms can have a beneficial side may change the societal attitude towards people who suffer from ADHD, and this may spill over to people with other psychological disorders who potentially have extraordinary talents. In fact, Wiklund, Hatak, Patzelt, and Shepherd (2018, p. 183) note that “it appears possible then that the very symptoms and traits associated with certain disorders may be advantageous and provide benefits in the performance of some entrepreneurial tasks.” At the same time, people with ADHD symptoms who have difficulty finding a suitable job as an employee may be inspired to start their own business.

The remainder of the paper is structured as follows. First, we will give a concise overview of the literature on EO, ADHD, and their relationship. In the next chapter, the data collection, variables, measures, and methodology are described. Subsequently, the OLS and PLS-SEM results are presented, followed by a conclusion.

## LITERATURE

### Entrepreneurial Orientation (EO)

Entrepreneurship can be assessed in many different ways. A widely used construct that can be used to measure entrepreneurship at the firm level as well as at the individual level is entrepreneurial orientation (EO). EO refers to how entrepreneurial activities are performed. It captures the competence of a firm in adapting, competing, and performing successfully in a competitive environment (Anderson et al., 2009; Lumpkin & Dess, 1996). The importance of entrepreneurial orientation is best illustrated by the fact that it has been connected to entrepreneurial behaviour, entrepreneurial success, and firm performance (Rauch, Wiklund, Lumpkin, & Frese, 2009; Wiklund, Patzelt, & Shepherd, 2009; Yu et al., 2018).

Originally, EO was developed as a firm’s “unidimensional strategic orientation” (Covin & Slevin, 1988, p. 79) with three main underlying dimensions or simultaneously occurring behavioural manifestations: risk-taking, innovativeness, and proactiveness (Covin & Slevin, 1988, 1991; Miller, 1983). However, several studies have argued that EO may alternatively be seen as a multidimensional construct, the dimensions of which vary independently of one another (Kreiser, Marino, & Weaver, 2002; Lumpkin, Brigham, & Moss, 2010). The EO construct has also been conceptualised and measured at the level of the individual using the same three elements as in firm-level EO (Bolton & Lane, 2012; Kollmann, Stöckmann, Meves, & Kensbock, 2017; Goktan & Gupta, 2015). Particularly in small firms, EO is strongly influenced by the owner/manager and can therefore be captured at the individual level (Miller, 1983).

For the purpose of our study, EO refers to individual-level EO. In line with Covin and Slevin (1988), EO is captured by three underlying dimensions:

innovativeness, risk-taking, and proactiveness. Innovativeness reflects the tendency to develop new ideas, innovate, experiment, and introduce new products and practices. Proactiveness reflects the extent to which one is able to anticipate future changes. Risk-taking captures the tendency to favour risky projects that have uncertain outcomes or high profits and losses (Lumpkin & Dess, 1996).

## ADHD

Attention-deficit hyperactivity disorder (ADHD) is a neurodevelopmental disorder characterised by two different types of symptoms: attention-deficit and hyperactivity-impulsivity. Most people with an ADHD diagnosis have a combined type of ADHD and experience both types of symptoms simultaneously. However, there are also people who have symptoms of attention-deficit but are not hyperactive and vice versa (American Psychiatric Association, 2013). Attention-deficit symptoms include, among others, difficulties in concentrating or focusing for a long time and being forgetful. Hyperactivity-impulsivity symptoms include, among others, having difficulties sitting still, constantly fidgeting, or interrupting people (American Psychiatric Association, 2013). The symptoms of ADHD start during childhood, and it was long thought to be a children's disorder. However, follow-up research has demonstrated that ADHD persists into adulthood (Fayyad et al., 2007; Kessler et al., 2005a). It is estimated that in the United States, almost 10 million adults meet the criteria for ADHD (Hinshaw & Ellison, 2015).

ADHD is associated with a number of disadvantageous outcomes. On average, people diagnosed with ADHD finish fewer years of education, change jobs more frequently, are less likely to be employed full time, have more difficulties maintaining employment, have a lower social and economic status and are more likely to engage in criminal behaviour (Barkley, Fischer, Smallish, & Fletcher, 2006; Barkley, Murphy, & Fischer 2008; Goodman, 2007; Pratt, Cullen, Blevins, Daigle, & Unnever, 2002).

## ADHD and EO

While ADHD is typically linked to negative outcomes, recent studies suggest that the (subclinical) manifestation of ADHD may be beneficial in certain contexts, including entrepreneurship. Highly successful entrepreneurs such as Richard Branson (founder of Virgin Airlines) and Ingvar Kamprad (founder of IKEA) have been diagnosed with ADHD (Patel, 2016). Different studies on suitable work environments for individuals with ADHD suggest a positive link with entrepreneurship. We will discuss several of them below.

People who suffer from ADHD generally have trouble concentrating, but when they are passionate about something, they can show intensive levels of concentration (Schecklmann et al., 2008). They tend to flourish in an

environment that is characterised by a high level of flexibility and independence, where individuals are able to determine their own tasks and work pace (Biederman et al., 2005). In addition, a stimulating workplace where work is demanding, novel, requires multitasking, and is intrinsically interesting has been shown to reduce ADHD symptoms (Lasky et al., 2016). In summary, these studies suggest that an entrepreneurial work environment that allows for flexible and independent working could be a good fit for people with ADHD.

Based on these findings and on anecdotal evidence, researchers became interested in studying the relationship between ADHD and entrepreneurship. The emerging literature thus far confirms a positive relationship between ADHD symptoms and different manifestations of entrepreneurship (Antshel, 2018). Dimic and Orlov (2014) showed that being diagnosed with ADHD increases the likelihood that an individual becomes an entrepreneur. Additionally, an increase in the presence of ADHD symptoms goes together with an increase in the intention of becoming an entrepreneur and being self-employed in general (Verheul et al., 2015, 2016). Lerner, Verheul, & Thurik (2018b) found a positive relationship between the clinical diagnosis of ADHD on the one hand and entrepreneurial intentions and entrepreneurial action on the other. Focusing specifically on entrepreneurs diagnosed with ADHD, Wiklund, Patzelt, and Dimov (2016) showed that impulsive behaviour is an important driver for entrepreneurial actions, such as acting under uncertainty. In another study, Wiklund et al. (2017) demonstrated that the multifaceted impulsivity trait mediates the relationship between ADHD symptoms and entrepreneurial preferences, start-up behaviour, and performance in different ways. In particular, hyperactivity symptoms have a positive effect in the context of entrepreneurship, mostly through the sensation-seeking dimension of impulsivity (Wiklund et al., 2017).

Only one study so far has researched the link between ADHD symptoms and EO (Yu et al., 2018). Using one Spanish and one mainly US American sample, Yu et al. (2018) found a positive association between firm-level EO and hyperactivity-impulsivity symptoms. They found no association between EO and attention-deficit symptoms. Yu et al. (2018) did not distinguish between the underlying dimensions of EO.

## METHOD

### Data set

In the current paper, we will study the relationship between ADHD and EO using a data set of French small business owners. These data were collected by the French research organization Amarok ([www.observatoire-amarok.net](http://www.observatoire-amarok.net)) in France. Founded in January 2010, Amarok aims to study French small firm owners' beliefs, attitudes, and behaviours in relation to their physical and

mental health. Because we are interested in individual-level EO, only entrepreneurs with small and medium-sized firms (with a high level of managerial discretion) were included in our analyses. Firms with over 250 employees were not approached or were excluded. The sample is consistent with the European definition of a small and medium-sized enterprise (SME) (fewer than 250 employees).<sup>2</sup> Additionally, entrepreneurs who owned less than 5 per cent of the financial capital of the firm were not approached or were excluded. Finally, participants with missing values on ADHD or EO measures were excluded from the data sets.

The data set was created by combining three data samples of French entrepreneurs collected at different points in time. The combined data set includes a total of 802 respondents. To recruit participants, email invitations were sent to different groups of entrepreneurs. All participants were interviewed by telephone using a similar structured questionnaire.

Sample 1 was collected between March 2011 and December 2012. Invitations to participate in the survey were sent to the 3,500 SME owners who are part of the “Centre des Jeunes Dirigeants” (CJD). CJD is a young business leader network that represents business owners and senior managers from many industrial sectors throughout France. After excluding participants based on the rules discussed above, a sample of 309 owner-managers remained. The same data set was used in the now retracted paper by Thurik et al. (2016). Since we wanted to apply the same rules for all three subsamples, this resulted in a slightly different sample than the one used by Thurik et al. (2016): the sample overlaps for 92 per cent of the respondents.

Sample 2 was collected between January 2013 and December 2014. To elicit participation in the survey, an email invitation was sent again to the 3,500 members of the CJD who were SME owners, as well as to 4,000 Malakoff Médéric policyholders registered as SME owner-managers. Malakoff Médéric is a French mutual insurance company that partnered with Amarak and funded the survey campaign. After filtering out participants based on the aforementioned rules and deleting 20 respondents who were already part of Sample 1, 238 respondents remained.

Sample 3 was collected between January 2015 and December 2016. For this sector-specific survey, Amarak partnered with the French Building Federation (FFB). The FFB represents all professions and trades in the building industry and has 50,000 member firms. An e-mail invitation was sent via the network of FFB departmental branches, targeting members running a

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<sup>2</sup> Definition according to EU recommendation 2003/361: staff headcount < 250 and turnover ≤ €50m or balance sheet total ≤ €43m. [https://ec.europa.eu/growth/smes/business-friendly-environment/sme-definition\\_en](https://ec.europa.eu/growth/smes/business-friendly-environment/sme-definition_en)

business with fewer than 250 employees. Removing participants based on the rules discussed resulted in a data set of 255 respondents.

These three samples were merged into one large data set.<sup>3</sup> The 802 SME owners in this data set, on average, employ 21.77 individuals, with a standard deviation (SD) of 33.08 individuals. The average age of the respondents was 46.06 years, with an SD of 7.61 years. A total of 19.83 per cent of the entrepreneurs are women. Regarding education, 77.88 per cent of the interviewees completed at least a two-year degree after high school (“bac plus deux”).

Tests for measurement equivalence/invariance were conducted for the first-order reflective constructs of both ADHD and EO across the three French subsamples. Following the approach by Liu, Nauta, Yang, & Spector (2018), we first estimated baseline models of both measures across the three samples. These models showed good measures of fit, indicating configural invariance. Second, we examined these models with constrained factor loadings. The change in CFI from the baseline model to the constrained model was below  $-.02$  for both measures, which indicated metric invariance across the three French subsamples<sup>4</sup> (Rutkowski & Svetina, 2014).

## Concepts, Variables, and Measures

*ADHD.* To measure ADHD symptoms, we used the ADHD Adult Self-Report Scale Screener (ASRS-6) (Kessler et al., 2005b). The ASRS-6 consists of a subset of 18 questions that make up the WHO Adult Self-Report Scale (ASRS-V1.1) symptom check list. The ASRS-6 was created by selecting the six most predictive items of the ASRS-18 by means of a stepwise logistic regression analysis. The ASRS-6 is found to have high consistency scores, strong concordance with clinical diagnoses, and high test-retest reliability in both ADHD-diagnosed and non-diagnosed adult samples (Adler et al., 2006; Kessler et al., 2005b, 2007; Silverstein, Alperin, Faraone, Kessler, & Adler, 2018). Scores on the ASRS-18 and ASRS-6 are highly correlated, though the ASRS-6 outperforms the ASRS-18 in terms of sensitivity, specificity, and total classification accuracy (Das, Cherbuin, Anstey, Abhayaratna, & Easteal, 2017; Kessler et al., 2005b, 2007). Previous studies on ADHD and entrepreneurship have likewise used the ASRS-6 to measure ADHD symptoms (Canits et al., 2019; Verheul et al., 2016; Yu et al., 2018). For the current study, the French version of ASRS-6 was used as published in <https://www.hcp.med.harvard.edu/ncs/asrs.php>.

<sup>3</sup> More detailed information and the results of the separate analyses for the three French subsamples are available from the authors upon request.

<sup>4</sup> The results of the measurement equivalence analyses are available from the authors upon request.

Previous studies have shown that the ASRS-6 has two latent factors: attention-deficit and hyperactivity (Hesse, 2013; Oerbeck et al., 2019). We confirmed this by conducting a confirmatory factor analysis comparing models with one or two factors in SEM. As seen from Table 1, the two-factor model has better measures of fit than the one-factor model. In the ASRS-6, attention-deficit is measured by four items, and hyperactivity is measured by two items.

To achieve a score on the items, participants had to describe how they had felt and conducted themselves over the past 6 months, that is, how often they experienced the described symptoms, on a 5-point Likert scale (1 = never to 5 = very often). Attention-deficit was measured by four questions: “How often do you have trouble wrapping up the final details of a project, once the challenging parts have been done?,” “How often do you have difficulty getting things in order when you have to do a task that requires organization?,” “How often do you have problems remembering appointments or obligations?,” and “When you have a task that requires a lot of thought, how often do you avoid or delay getting started?” Hyperactivity was measured by two questions: “How often do you fidget or squirm with your hands or feet when you have to sit down for a long time?,” and “How often do you feel overly active and compelled to do things, like you were driven by a motor?” To assess ADHD for the OLS analyses, the weighted average score of all six items was used, where attention-deficit and hyperactivity items were weighted such that they had an equal contribution in the ADHD score.

In the present study, we do not focus on the clinical diagnosis of ADHD; rather we examine the relationship between subclinical scores on the two underlying subdimensions of ADHD (i.e., attention-deficit and hyperactivity), their weighted average in the total score of ADHD symptoms, and entrepreneurial orientation. Therefore, we measure ADHD as a first-order reflective, second-order formative construct in PLS-SEM.

In Table 2, the correlations, means, standard deviations, and Cronbach’s alphas are displayed. As seen, hyperactivity and attention-deficit symptoms

TABLE 1  
Confirmatory Factor Analysis ASRS-6 ( $N = 802$ )

	$\chi^2$ ( $df$ )	$\chi^2/df$	CFI	RMSEA	AIC	BIC
One factor	98.35(9)**	10.93	.80	.11	122.35	122.57
Two factors	19.59(8)*	2.45	.97	.04	45.59	45.82

Note: For acceptable fit, measures should be  $\chi^2/df < 3$ , CFI (Comparative Fit Index)  $> .95$ , RMSEA (Root Mean Square Error of Approximation)  $< .05$ . For both AIC (Akaike Information Criterion) and BIC (Bayesian Information Criterion) a lower value indicates better fit (Schermelleh-Engel et al., 2003).

\* $p < .05$ ; \*\* $p < .01$ .

TABLE 2  
Descriptive Statistics (N = 802): Cronbach's Alphas, Means, Standard Deviations and Correlations

	$\alpha$	Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Innovativeness	.79	4.20	1.46	-												
2. Proactiveness	.67	4.87	1.29	.30**	-											
3. Risk-taking	.65	3.79	1.30	.41**	.19**	-										
4. EO	.76	4.29	0.99	.80**	.68**	.72**	-									
5. Attention-deficit	.56	2.48	0.72	-.02	-.08*	.02	-.04	-								
6. Hyperactivity	.51	3.00	1.08	.03	.06	.08*	.07*	.24**	-							
7. ADHD	.58	2.74	0.72	.01	.00	.07	.04	.68**	.87**	-						
8. Physical health	-	2.90	0.78	-.05	.04	-.01	-.01	-.06	-.12**	-.12**	-					
9. Mental health	-	2.90	0.78	.02	.05	.04	.05	-.10**	-.12**	-.14**	.49**	-				
10. Gender (male = 0)	-	0.20	0.40	.01	-.02	-.02	-.01	.01	.07	.05	-.11**	-.09*	-			
11. Age (years)	-	46.06	7.61	-.03	-.07*	-.02	-.06	-.09*	-.12**	-.13**	.01	.00	-.04	-		
12. Education level	-	4.18	1.17	.04	.07*	.05	.07*	.03	-.03	-.01	-.03	.06	.07*	-.24**	-	
13. Firm size	-	0.51	0.50	-.06	-.02	.08*	-.00	.01	.00	.00	.04	.80**	-.09**	.05	-.01	-

\* $p < .05$ ; \*\* $p < .01$ .

are positively and significantly correlated with each other. Furthermore, the table shows that the internal consistency of the ADHD measure reflected by Cronbach's alpha is not consistently high. In particular, the Cronbach alpha of hyperactivity is low ( $\alpha = .51$ ). This could be the result of using only two items (Streiner, 2003). Additionally, Kessler et al. (2007) pointed out that we would not expect a very high Cronbach alpha, given that the ASRS-6 screener was created by selecting the least redundant ASRS-18 items using stepwise logistic regression analysis, thereby optimising inconsistency among the items.

*Entrepreneurial Orientation.* EO was measured at the individual level by applying the widely used scale of Covin and Slevin (1988). The scale consists of nine items in total, of which each of the three subdimensions (innovativeness, proactiveness, and risk-taking) is measured by three items.<sup>5</sup> Participants indicated how much they agreed with a statement when considering the last three years of their lives on the basis of a 7-point Likert scale (1 = strongly disagree to 7 = strongly agree). For the nine items of EO, the French translation of Messeghem (1999) was used.

Innovativeness was measured by the following three items: In the past three years, "You have introduced many new products or services to the market," "You have largely renewed your range of products or services," and "In general, you promote R&D, technological advances and innovation."

Proactiveness was measured by the following three reverse-scored items: In the past three years, "It is rare that you launch new products/services, new management techniques or operating technologies on the market first," "You typically tend to respond to the actions of your competitors, rather than precede them," and "You tend to follow your competitors to adapt to the market rather than anticipating it."

Risk-taking was measured by the following three items, "You tend to favor high risk projects," "Owing to the nature of the environment, you favor bold, large-scale actions to achieve your goals," and "In a situation of uncertainty, you generally adopt an aggressive posture of seeking new opportunities."

An aggregate total score of EO was calculated on the basis of the scores on all nine items.

Several researchers have argued that the three EO dimensions vary independently of one another (Kreiser et al., 2002; Lumpkin & Dess, 1996). Thus, a high score on one of the dimensions does not necessarily imply a high score on the other two dimensions. This suggests that EO is a formative construct

<sup>5</sup> For the French subsample 1, the third innovativeness question was different and scored reversely: "I made minor changes in product or service lines offered by my company." For the French subsample 3, a different subject was used in all items: that is, instead of "You have," "I have" was used. We do not expect this to have affected the answers.

made up of the reflective dimensions such as innovativeness, proactiveness, and risk-taking. Following the approach of others (Anderson, Kreiser, Kuratko, Hornsby, & Eshima, 2015; Casillas, Moreno, & Barbero, 2010), in this paper, we therefore construct EO as a first-order reflective, second-order formative construct. We note that the approach is debated in the literature (Covin & Lumpkin, 2011).

In Table 2, the correlations, means, standard deviations, and Cronbach alphas are displayed. The internal consistency of the measures of the sub-dimensions of EO is quite high ( $\alpha \geq .65$ ). All EO subdimensions are significantly correlated with each other.

*Controls.* Several control variables were used in the analyses. We controlled for the self-reported mental and physical health of the entrepreneurs, which is motivated by the existence of an association between health status and entrepreneurship (Andersson, 2008; Rietveld, van Kippersluis, & Thurik, 2015). Both mental and physical health were measured by asking participants to describe their physical/mental health over the last months on a reversed 5-point Likert scale (5 = Very bad to 1 = Excellent).

Furthermore, since EO is strongly influenced by the owner/manager in smaller firms (Miller, 1983), we control for firm size (using a dichotomous variable, distinguishing between  $\leq 10$  employees;  $> 10$  employees). Fifty-one per cent of the entrepreneurs own a firm with more than 10 employees.

Finally, and in line with previous studies, we controlled for the demographic characteristics of age, gender (male = 0), and education level of the entrepreneurs. Education level was measured in an ordinal way based on the classification of the French education system. The following options were given: 1 = No secondary education (“Autodidacte”), 2 = Vocational education but not high school (“BEP/CAP”), 3 = High school (“BAC”), 4 = High school + 2/3 years of further education (“BAC + 2/3”), 5 = High school + 4/5 years of further education (“BAC + 4/5”), 6 = PhD (“Docteur”). The French term is given between brackets for those familiar with the French system. Age was measured as a continuous variable. The average age was 46.06 years. Male entrepreneurs are over-represented, with only 19.83 per cent of the sample being women.

We do not have an exact replication of the control variables used by Yu et al. (2018). In their study, Yu et al. (2018) did not control for physical and mental health. In addition to the controls that we use, Yu et al. (2018) controlled for firm age, industry experience, and industry in the analysis of their first sample and for firm age and industry experience in the analysis of their second sample, none of which were part of our data set.

In Table 2, the correlations, means, standard deviations, and Cronbach alphas of all variables are summarised.

## Methodology

For the analyses, we will conduct ordinary least squares (OLS) regressions and perform partial least squares SEM (PLS-SEM) because of the nature of our constructs.

PLS-SEM is a path modelling technique that focuses on maximising the explained variance of the dependent latent constructs (Hair, Ringle, & Sarstedt, 2011). Unlike covariance-based SEM, which requires a set of assumptions and a large sample size, PLS-SEM is more flexible and suitable for prediction and theory development (Hair et al., 2011). Since both ADHD and EO are considered to be first-order reflective, second-order formative (multidimensional) constructs that consist of independent and unique sets of subdimensions, PLS-SEM is deemed appropriate (Becker, Klein, & Wetzels, 2012; Lowry & Gaskin, 2014).

## RESULTS

Table 3 shows the results of the analyses. Using OLS, the relationship between (weighted) ADHD or its subdimensions attention-deficit and hyperactivity on the one hand and EO or its subdimensions on the other hand, was estimated. Using PLS-SEM, we estimated the link between ADHD and total EO as well as the link between attention-deficit and hyperactivity and total EO. In the analyses we included some control variables: physical health, mental health, gender, age, education level, and firm size.

Using OLS, we find no evidence for a link between ADHD and total EO. We do find an association between weighted ADHD and risk-taking ( $\beta = .07, p < .05$ ). ADHD is not related to any of the other subdimensions of EO. Using PLS-SEM, we likewise find no relationship between ADHD and total EO.

Studying the sub-dimensions of ADHD using OLS, hyperactivity is positively related to total EO ( $\beta = .10, p < .01$ ), and attention-deficit is not associated with total EO. Using PLS-SEM, we found similar results for these relationships (hyperactivity:  $\beta = .11, p < .01$ ). In terms of the EO dimensions, hyperactivity is not related to innovativeness but is related to both proactiveness ( $\beta = .10, p < .01$ ) and risk-taking ( $\beta = .09, p < .05$ ). Attention-deficit is not related to innovativeness and risk-taking but is related to proactiveness ( $\beta = -.11, p < .01$ ).

## DISCUSSION

Using a data set of French SME owners, we tried to replicate and extend the findings of Yu et al. (2018). We follow Yu et al. (2018) in distinguishing between the underlying dimensions of ADHD (attention-deficit and hyperactivity),

TABLE 3  
Results from OLS Regressions and PLS-SEM Analysis (N = 788)

	Innovativeness		Proactiveness		Risk-taking		Total EO		Total EO (PLS-SEM)	
	$\beta$	SE	$\beta$	SE	$\beta$	SE	$\beta$	SE	$\beta$	SE
<i>ADHD (weighted total)</i>										
ADHD	.02	.07	.01	.07	.07*	.07	.04	.05	.00	.04
Physical health	-.07	.08	.03	.07	-.03	.07	-.04	.05	-.05	.04
Mental health	.07	.08	.04	.07	.06	.07	.07	.05	.07	.06
Gender (male = 0)	.00	.13	-.02	.12	-.03	.12	-.02	.09	-.02	.04
Age (years)	-.01	.01	-.07	.01	.00	.01	-.04	.01	-.04	.03
Education level	.04	.05	.06	.04	.05	.04	.06	.03	.05	.03
Firm size	-.06	.11	-.02	.09	.08*	.09	.00	.07	-.01	.04
<i>ADHD (subdimensions)</i>										
Attention-deficit	-.02	.07	-.11**	.07	-.01	.07	-.06	.05	-.06	.04
Hyperactivity	.03	.05	.10**	.04	.09*	.05	.10**	.03	.11**	.04
Physical health	-.07	.08	.04	.07	-.03	.07	-.03	.05	-.04	.04
Mental health	.07	.08	.03	.07	.06	.07	.07	.05	.07	.04
Gender (male = 0)	.00	.13	-.02	.12	-.03	.12	-.02	.09	-.02	.04
Age (years)	-.01	.01	-.07	.01	.00	.01	-.03	.01	-.03	.03
Education level	.04	.05	.07	.04	.05	.04	.07	.03	.06	.04
Firm size	-.06	.11	-.01	.09	.08**	.09	.00	.07	-.01	.04

$\beta$  = standardized beta.  
\* $p < .05$ ; \*\* $p < .01$ .

but unlike Yu et al. (2018), we make a distinction between the underlying dimensions of EO (risk-taking, innovativeness, and proactiveness).

Several studies have shown a positive link between non-clinical ADHD (Verheul et al., 2015, 2016), the clinical diagnosis of ADHD (Dimic & Orlov, 2014; Lerner et al., 2018b; Wiklund et al., 2016) and various manifestations of entrepreneurship. To date, no study has examined the relationship between overall ADHD and EO. Yu et al. (2018) studied the association between the underlying two dimensions of ADHD and EO but did not take the average of all ASRS-6 items to assess total ADHD.

The present study does not find a relationship between total ADHD and EO. We do find a link between ADHD and the risk-taking dimension of EO.

Looking at the subdimensions of ADHD, the results of our analyses are mostly in line with the findings of Yu et al. (2018). Similar to Yu et al., we found a positive association between hyperactivity and EO. This effect seems to be driven by a positive relationship of hyperactivity with the subdimensions proactiveness and risk-taking and not by a relationship with innovativeness. We do not find a link between attention-deficit and total EO. However, we do find a negative link between attention-deficit and proactiveness.

Although we do not find an overall relationship between ADHD and EO, we provide insight into the underlying links between the two constructs. Furthermore, we are able to replicate the positive relationship found by Yu et al. (2018) between hyperactivity and EO using another data set. This is also in line with previous findings of Wiklund et al. (2017), who found a positive relationship between hyperactivity symptoms and entrepreneurial preferences and action mediated by the multifaceted impulsivity trait.

This study has several limitations. First, the Cronbach alpha values for the attention-deficit and hyperactivity measures are low to modest. An explanation for this may be that the two hyperactivity items capture distinct types of hyperactivity. In addition, these low values probably reflect the low number of items of the ASRS-6 and the fact that the least redundant items of the ASRS-18 were selected to cover the whole breadth of ADHD symptoms (Kessler et al., 2007). For further research, we recommend using the full ASRS-18 scale to distinguish between attention-deficit and hyperactivity/impulsivity symptoms. Second, we used self-reported measures for both ADHD and EO. Therefore, our study could suffer from common method bias. However, we expect this bias to be limited, since both ADHD and EO are unlikely to change drastically over time. Future studies could go a step further and collect data at different points in time and use other types of observations. Finally, we refrained from paying attention to the effect of social context on the relationship between ADHD and EO. A rich social context of an entrepreneur could compensate for personal weaknesses, which could have important consequences for how companies are managed and/or the choice for pursuing an

entrepreneurial career in the first place. This will be an interesting direction for further research.

Though we find various links between the underlying dimensions of ADHD and EO, we should be careful when drawing conclusions about causality, as our cross-sectional data do not allow for identifying causal effects: we merely demonstrate a link between two concepts. It is conceivable that there are confounding factors that are linked to both ADHD and EO. A possible confounder is optimism, though follow-up research is needed to assess the effects of this and other confounders.

Further research into the topic of psychiatric disorders and entrepreneurship could go one step further and incorporate measures of underlying neurocognitive constructs as possible mediators.

Taken together, using a large data set of French small business owners, we find a positive association between hyperactivity and EO. More specifically, hyperactivity is positively related to the subdimensions proactiveness and risk-taking, while it is not associated with innovativeness. Furthermore, we find no link between attention-deficit and total EO. However, we do find a negative relationship between attention-deficit and proactiveness. Finally, we do not find evidence for an overall relationship between ADHD and EO, but we do identify a relationship between ADHD and the risk-taking subdimension of EO.

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