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Financial Decision-Making in Adults With ADHD

Dorien F. Bangma, Janneke Koerts, and Anselm B. M. Fuermaier
University of Groningen

Christian Mette and Marco Zimmermann
LVR Hospital Essen, Essen, Germany, and University of Duisburg-Essen

Anna K. Toussaint, Lara Tucha, and Oliver Tucha
University of Groningen

Objective: Attention-deficit/hyperactivity disorder (ADHD) in adulthood is associated with problems in multiple domains of everyday life, including financial decision-making (FDM). Research on FDM in adults with ADHD is, however, limited and FDM has never been examined in an objective standardized manner in these patients. The aim of the present study is to explore FDM abilities of adults with ADHD, using both subjective and standardized objective measures. ***Method:*** Adults with ADHD (n = 45) and healthy controls (n = 51) completed a comprehensive test battery, including an evaluation of their personal financial situation, a neuropsychological assessment and standardized tests and questionnaires measuring various aspects of FDM. ***Results:*** Adults with ADHD reported to have a significantly poorer financial situation than healthy controls, including having less income, more often debts and less often a savings account. Furthermore, adults with ADHD showed significantly lower scores than healthy controls in standardized tests measuring financial competence and capacity (i.e., understanding bank statements/protocols and evaluating financial problems) as well as in a test measuring decision making with implications for the future. Furthermore, compared with healthy controls, adults with ADHD reported more often to buy on impulse and to use an avoidant or spontaneous decision-making style. A mediating effect of numeracy was found for 2 measures of FDM (i.e., financial competence and capacity); however, group differences on these measures remained statistically significant. ***Conclusions:*** Adults with ADHD have difficulties with several aspects of FDM. These difficulties may at least partly explain the poorer financial situation of adults with ADHD.

General Scientific Summary
The present study shows that adults with ADHD have difficulties with several aspects of financial decision-making, as examined with standardized objective measures. These results are of significance for adults with ADHD, their family members, health care providers as well as for society, because these difficulties presumably result in a less optimal personal financial situation.

Keywords: financial decision-making, money management, adult ADHD, cognition, finances

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Attention-deficit/hyperactivity disorder (ADHD) is a developmental disorder that is characterized by symptoms of inattention, hyperactivity, and impulsivity (American Psychiatric Association, 2013). The symptoms of ADHD persist into adulthood in about 50% of children with ADHD (range 32.8–84.1%; Lara et al., 2009), resulting in a prevalence of adult ADHD of approximately 3.4% (range 1.2–7.3%; Fayyad et al., 2007). ADHD is a condition which has a negative impact on several aspects of everyday functioning, including educational and occupational performances (Barkley, Murphy, & Fischer, 2008; Daley & Birchwood, 2010), social functioning (Michielsen et al., 2015; Nijmeijer et al., 2008), and driving (Barkley, Murphy, Dupaul, & Bush, 2002; Fuermaier

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Dorien F. Bangma, Janneke Koerts, and Anselm B. M. Fuermaier, Department of Clinical and Developmental Neuropsychology, University of Groningen; Christian Mette and Marco Zimmermann, LVR Hospital Essen, Essen, Germany, and Department of Psychiatry and Psychotherapy, Faculty of Medicine, University of Duisburg-Essen; Anna K. Toussaint, Lara Tucha, and Oliver Tucha, Department of Clinical and Developmental Neuropsychology, University of Groningen.

Anna K. Toussaint now at Rehabilitation Center Weserland, Department of Psychology, Bad Pyrmont, Germany. Christian Mette is now at Department of Social work and Education, Protestant University of Applied Sciences Bochum, Germany.

Correspondence concerning this article should be addressed to Janneke Koerts, Department of Clinical and Developmental Neuropsychology, University of Groningen, Grote Kruisstraat 2/1, 9712 TS Groningen, the Netherlands. E-mail: janneke.koerts@rug.nl

et al., 2017). Financial decision-making (FDM) is also a domain of everyday functioning that is of utmost importance for independent living, in particular for adults who have to make numerous financial decisions with often far-reaching consequences (e.g., concerning insurances, mortgages, or pension schemes). FDM describes various aspects of functioning related to decision-making in a financial context, such as dealing with money, paying bills, or making financial decisions for the future. Poor FDM can have serious negative consequences, such as debts, poverty, or financial dependency. So far, very few studies focused on FDM in patients with ADHD and the studies that have been performed only applied self-report measures and interviews. These studies reported that symptoms of ADHD (both hyperactivity-impulsivity and inattention) were found to be associated with financial problems (Altszuler et al., 2016; Barkley & Fischer, 2010; Das, Cherbuin, Butterworth, Anstey, & Easteal, 2012). Adults with ADHD specifically reported less often to have a credit card or a savings account and also to be more often financially dependent on their parents or welfare systems than healthy individuals (Altszuler et al., 2016). Some studies found that adults with ADHD and healthy individuals do not differ with regard to income level and the amount of debts (Altszuler et al., 2016; Barkley, Fischer, Smallish, & Fletcher, 2006). The participants in these studies were, however, relatively young (age at assessment was between 19 and 25) and predominantly male. In a follow-up of the Milwaukee study (Barkley et al., 2008), participants with ADHD aged 27 reported significantly more often problems with money management than age-matched controls, including difficulties with managing money, problems with buying on impulse, exceeding credit card limits, a lower monthly income, a lower saving–income ratio, and problems with saving money. Similar money management problems were found in the UMASS study of Barkley, Murphy, and Fischer (2008) in adults with ADHD with an average age of 32.4 years. However, in the latter study the healthy comparison group was with an average age of 36.4 years significantly older than the adults with ADHD, which needs to be taken into account. Biederman and Faraone (2006) included adults with ADHD up to 64-years-old and also found significantly lower income levels in their ADHD group compared with a healthy control group. In summary, the limited research available clearly indicates that adults with ADHD are more vulnerable to money management problems than healthy controls; problems that may become more evident when becoming older.

Indications that adults with ADHD may experience difficulties with FDM also come from the field of general decision-making. Within this field, standardized tests are used that do not focus on FDM, but are context independent instead. Two systems of information processing are suggested to be involved in general decision-making: an affective/experiential processing of information relying on affect or intuition and deliberative/analytic processing of information relying on cognitive control (see Evans, 2008 for review). It is suggested that decision-making requires the input and integration of both systems (Kahneman, 2003; Peters, Hess, Västfjäll, & Auman, 2007). Poor decision-making of adults with ADHD appears to be particularly evident in situations requiring a high cognitive control and it has been suggested that poor decision-making is mediated by impairments of working memory or response inhibition (Mäntylä, Still, Gullberg, & Del Missier, 2012). This is consistent with the impairments in executive functioning that are often found in adults with ADHD (Alderson, Kasper, Hudec, & Patros, 2013; Boonstra, Kooij, Oosterlaan, Sergeant, & Buitelaar, 2010; Boonstra, Oosterlaan, Sergeant, & Buitelaar, 2005; Fuermaier et al., 2015; Hervey, Epstein, & Curry, 2004) and corresponds with the view that ADHD can be described as a disorder of cognitive dysregulation (Sonuga-Barke, 2003). However, following the argumentation of the dual pathway model of ADHD, ADHD can also be described as a disorder of motivational-affective dysregulation (Shaw, Stringaris, Nigg, & Leibenluft, 2014; Sonuga-Barke, 2003). In the context of general decision-making, ADHD has been linked to problems with reward processing and delay aversion which might result in impulsivity and risk taking (Groen, Gaastra, Lewis-Evans, & Tucha, 2013; Luman, Oosterlaan, & Sergeant, 2005; Scheres, Tontsch, & Thoeny, 2013; Sonuga-Barke, 2003). However, these problems appear to be less evident in adults with ADHD (Groen et al., 2013; Mowinckel, Pedersen, Eilertsen, & Biele, 2015).

In conclusion, adults with ADHD seem to be vulnerable to problems with FDM. Research on FDM in adults with ADHD is, however, very limited and most studies applied self-report measures and interviews and included relatively young and predominately male participants (Altszuler et al., 2016; Barkley et al., 2006; Barkley & Fischer, 2010; Das et al., 2012). Moreover, studies that focused on general decision-making in patients with ADHD used standardized but context independent tests and, therefore, do not allow conclusions about FDM. The present study is the first study that explores FDM abilities of adults with ADHD compared with healthy controls by including participants with a broad age range and by using subjective as well as objective measures of FDM. For this purpose, a recently developed comprehensive objective and standardized test battery will be used assessing multiple aspects of FDM (i.e., financial competence, financial decision-making capacity, financial decision styles, ability to apply rules, decisions with implications for the future, impulsive buying tendency, and emotional decision-making; Bangma, Fuermaier, Tucha, Tucha, & Koerts, 2017). Furthermore, cognitive functioning of adults with ADHD and healthy controls and the associations between cognition and the ability to make financial decisions will be evaluated. Due to the scarcity of research on FDM in adults with ADHD, it is difficult to formulate well-founded hypotheses. Nevertheless, based on the few studies reporting poorer money management of young adults with ADHD, it is expected that adults with ADHD have a less optimal financial situation (e.g., have more often debts or save less often money for the future) than healthy controls which may be due to adults with ADHD also having more difficulties with FDM than healthy controls.

Method

Participants

In total, 138 adults (i.e., 50 adults with ADHD and 88 healthy controls) who were between 19- and 64-years-old participated in this study. All patients with ADHD were diagnosed and currently treated at the Department of Psychiatry and Psychotherapy, University of Duisburg-Essen, Germany and were invited to participate in the current study by their clinician. All adults with ADHD were diagnosed by trained psychologists or psychiatrists prior to

and independent of the study. The diagnosis of ADHD was established based on the criteria for ADHD as outlined in the *Diagnostic and Statistical Manual of Mental Disorders, 5th Edition* (*DSM–5*; American Psychiatric Association, 2013). The assessment procedure used for diagnosing ADHD included semistructured interviews which are used to evaluate ADHD psychopathology (i.e., the Wender-Reimherr-Interview, Retz-Junginger, Giesen, Philipp-Wiegmann, Rösler, & Retz, 2017; and the Essen-Interview-for-school-days-related-biography, Grabemann et al., 2017). Additionally, self-report questionnaires were used for both the retrospective assessment of childhood symptoms as well as current symptoms (i.e., the Wender Utah Rating Scale—Childhood [WURS-K] and the ADHD self-report scale [ADHD-SR], respectively; Rösler, Retz-Junginger, Retz, & Stieglitz, 2008). The diagnostic evaluation also included objective measures such as evidence derived from school reports and reports of failure in academic and/or occupational achievement, and comprised multiple informants for all patients (e.g., employer evaluation, partner- or parent-reports). Adults with ADHD were free of ADHD-medication (i.e., stimulants) for 48 hr prior to the assessment of the present study, except one participant who was therefore excluded from the sample. Healthy controls were recruited via the contacts of the researchers and invited using e-mail, social media, or word-of-mouth.

All participants were assessed with the ADHD-SR and the WURS-K. Adults with ADHD were excluded when they scored below the cut-off on both questionnaires (i.e., ADHD-SR <18 and WURS-K < 30; Rösler et al., 2008), while healthy controls were excluded when they scored above the cut-off on one or both questionnaires (i.e., ADHD-SR ≥ 18 and WURS-K ≥ 30; Rösler et al., 2008). Three healthy controls with scores above the cut-off on one or both questionnaires and one adult with ADHD with scores below the cut-off on both questionnaires were, therefore, excluded from the sample. Furthermore, students were excluded from both samples (i.e., 34 healthy controls and three adults with ADHD) to reduce confounding effects, because students are often in a very particular life situation with regard to finances (e.g., no or low income and financial dependency).

Data of 45 adults with ADHD ($M_{age} = 36.6 \pm 10.2$ years; 57.8% males) and 51 healthy controls ($M_{age} = 38.9 \pm 13.2$ years; 51.0% males) were used for analysis. Groups did not differ significantly with regard to age, gender and years of education (see Table 1). As expected, adults with ADHD reported significantly more often childhood and current symptoms of ADHD (WURS-K and ADHS-SR, respectively) than healthy controls (see Table 1). Based on the clinical diagnoses, most adults with ADHD showed a combined presentation ($n = 26$), others showed a predominantly inattentive presentation ($n = 10$) or the presentation was not further specified ($n = 9$). Seven adults with ADHD were diagnosed with a comorbid adjustment disorder (unspecified), six with a depressive disorder, five with a personality disorder, and three with substance dependency (i.e., cannabis, alcohol or coffee). None of the healthy participants was diagnosed with a neurological or psychiatric condition.

Table 1
Demographics and Clinical Characteristics of Adults With ADHD (n = 45) and Healthy Controls (n = 51)

Demographics and clinical charactristics	ADHD	Healthy controls	*p*-value
Age range in years	19–61	20–64	
Age *M* (*SD*) in years	36.6 (10.2)	38.9 (13.2)	.332[a]
Gender male:female	26:19	26:25	.505[b]
Education *M* (*SD*) in years	16.6 (3.3)	16.9 (3.8)	.668[a]
Work status %			.839[b]
Full-time	51.1	58.8	
Part-time	24.4	17.6	
Unemployed	13.3	11.8	
Other	11.1	11.8	
WURS-K M (*SD*)	42.9 (13.1)	13.0 (8.1)	<.001*[a]
ADHD-SR M (*SD*)	35.6 (8.6)	11.1 (7.5)	<.001*[a]

Note. ADHD-SR = ADHD self-report scale; WURS-K = Wender Utah Rating Scale—Childhood.
[a] Group differences evaluated with t-tests. [b] Group difference evaluated with Pearson's chi-square test.
* $p < .01$.

Measures

Personal financial situation. Nine questions about participants' financial situation were asked to evaluate differences in the personal financial situation of adults with ADHD and healthy controls. Most questions required a yes or no response, that is: "*Do you have debts other than mortgage or study loans?*"; "*Do you receive social security?*"; "*Do you have a savings account?*"; "*Do you save actively, that is, do you put money on your savings account on a regular basis?*"; "*Do you save for retirement?*"; and "*Do you own a house?*." Annual gross income was scored on a 5-point scale, that is: *<€15,000*; *€15,000–€25,000*; *€25,000–€35,000*; *€35,000–€ 45,000*; and *>€45,000*. In addition, participants were asked to indicate the amount of money they retain each month after deduction of fixed expenses and, if applicable, the approximate amount of social security they receive each month.

Financial decision-making. A recently developed, objective, and standardized FDM test battery was administered to all participants (see Bangma et al., 2017 for a comprehensive description of all tasks). Seven out of the eight tasks previously applied were used in this study.

The Financial Competence Assessment Inventory (FCAI) was used to evaluate *financial competence*. The test consists of 38 practical and theoretical questions about everyday FDM and gives an overview of strengths and weaknesses regarding six different domains of financial competence (Kershaw & Webber, 2004; Kershaw & Webber, 2008; Webber, Reeve, Kershaw, & Charlton, 2002): financial abilities (range 0–36); financial judgment (range 0–32); financial management (range 0–22); financial cognitive functioning (range 0–24); debt management (range 0–4); and financial support resources (range 0–16). The total score (range 0–134) gives an indication of the overall financial competence of an individual with higher scores indicating better financial competence. A previous study demonstrated a good to excellent internal consistency (i.e., Cronbach's alpha $> .80$) for the total score and all domains with the exception of "financial support resources" (Cronbach's alpha = .54; Kershaw & Webber, 2008).

The Financial Decision-Making Interview (FDMI) determines *financial decision-making capacity* using two hypothetical financial situations (i.e., repairing or selling a car and selling and buying a house). Using a semistructured interview, participants are re-

quested to answer questions in order to determine their decision-making capacity. Scores (range 0–4) are calculated for five different scales (Appelbaum & Grisso, 1988; Suto, Clare, Holland, & Watson, 2005), that is: identification, understanding, reasoning, appreciating, and communication. Furthermore, a total score (range 0–20) based on the sum of all scales was calculated with higher scores indicating better financial decision-making capacity. The internal consistency of the total score in the present study was, however, questionable (Cronbach's alpha = .67).

The Financial Decision Style (FDS) questionnaire is used to evaluate to what extent participants make use of specific *financial decision styles* when making financial decisions (Loo, 2000; Scott & Bruce, 1995; Spicer & Sadler-Smith, 2005). The questionnaire consists of 24 questions scored on a 5-point scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). Sum scores are calculated for five decision-making styles, that is: rational (range 5–25); intuitive (range 5–25); dependent (range 5–25); avoidant (range 5–25); and spontaneous (range 5–20). The internal consistency in the present study was acceptable to excellent with Cronbach's alpha = .82, .75, .79, .93, and .81, respectively.

The Competence in Decision Rules (CDR) is used to evaluate more complex FDM and assesses *the ability to make financial decisions using decision rules*. The CDR is originally a subtest of the Adult Decision-Making Competence battery (Bruine de Bruin, Parker, & Fischhoff, 2007; Parker & Fischhoff, 2005). In the current version, participants have to indicate for 10 scenarios with increasing complexity which of five televisions they would choose using specific decision rules. For each correct decision a score of 1 was given. A total score, that is, number of correct answers, was calculated (range 0–10). The internal consistency of the total score was found to be acceptable (Cronbach's alpha = .73; (Bruine de Bruin et al., 2007).

To evaluate the capacity to make *decisions with implications for the future* the Temporal Discounting Task (TDT) is used (Green, Fry, & Myerson, 1994). For 18 different hypothetical scenarios, participants have to indicate the lowest amount of money they would accept today (or after 1 week or 1 month) instead of a higher amount of money later in time, that is, in 1 week, 1 month, or 1 year. For example, participants have to indicate how much money they would accept in 1 week instead of €500 in 1 year. Six different time intervals are presented (i.e., today vs. 1 week; today vs. 1 month; today vs. 1 year; 1 week vs. 1 month; 1 week vs. 1 year; and 1 month vs. 1 year), which are combined with an amount of money participants can receive after a delay (i.e., €100, €500, or €1,000). The percentages of the chosen amount of money relative to the amount of money participants can receive after a delay were calculated, for example, if a participant chose to receive €75 today instead of €100 in 1 week, a score of 75% was given. Finally, an average total score is calculated for all scenarios, which has been found to have an excellent internal consistency in the present study (Cronbach's alpha = .97).

The Impulsive Buying Questionnaire (IBQ) was used to evaluate the *impulsive buying tendency* (Beatty & Ferrell, 1998; Coley & Burgess, 2003; Rook, 1987; Verplanken & Herabadi, 2001). The questionnaire contains 31 questions about impulsive buying behavior scored with a 4-point scale from *strongly disagree* to *strongly agree* and assesses three components of impulsive buying, that is: cognitive component (15 questions); affective component (12 questions); and situational component; (four questions). The internal consistency of the cognitive component and affective component was found to be good (Cronbach's alpha = .82 and α = .82, respectively). However, the internal consistency of the situational component was low (Cronbach's alpha = .07). The total score (range 27–108; Cronbach's alpha = .89), which is calculated by adding up the scores on the cognitive and affective component, reflects an individual's overall impulsive buying tendency with higher scores indicating a stronger tendency to buy on impulse.

Finally, the Iowa Gambling Task (IGT; Bechara, Damasio, Damasio, & Anderson, 1994; Grasman & Wagenmakers, 2005) was included in the test battery. According to a review of Buelow and Suhr (2009) the IGT is considered to be a measure of affective or *emotional decision-making*. Using a computerized version of the IGT, participants have to choose 100 times between disadvantageous (A and B) and advantageous (C and D) decks that are associated with certain gains and losses of money. Participants receive a hypothetical startup capital of €2000 and are asked to make decisions as it concerns their own money. Participants are not informed, however, about which deck results in relatively high gains or losses; they therefore have to learn from trial and error. A total net score over 100 trials is calculated, that is, number of times the advantageous decks were chosen minus the number of times the disadvantageous decks were chosen.

Cognitive functioning. The Cognitive Functions ADHD test battery (CFADHD; Tucha et al., 2014) of the Vienna Test System (Schuhfried, 2013) assesses cognitive functions in which adults with ADHD have been shown to present difficulties and was used in the present study to explore the association between cognitive impairments and FDM. Nine cognitive functions were examined, that is, *information processing speed* (Trail Making Test—Part A [TMT-A]), *vigilance and selective attention* (Perception and Attention Functions Test: Vigilance and Selective Attention [WAFV and WAFS, respectively]), *inhibition* (response inhibition go/no-go task [INHIB]), *interference* (Stroop interference test [STROOP]), *figural fluency* (5-Point Test [5POINT]), *cognitive flexibility* (Trail Making Test—Part B [TMT-B]), *task switching* (task switching test [SWITCH]), and *verbal working memory* (*N*-Back Verbal test [NBV]). In addition to the CFADHD, the arithmetic subtest of the Wechsler Adult Intelligence Scale IV (WAIS-IV Arithmetic; Wechsler, 2008; Wechsler, 2012) was included to assess *numeracy*.

Procedure and Ethics Statement

The Ethical Committee of the Medical Faculty of the University of Duisburg-Essen, Germany, approved this study. Participants were assessed individually. The total duration of the assessment was approximately 4.5 hr. Participants received as many breaks as needed and were given the opportunity to complete the second half of the assessment (i.e., the CFADHD) later in time. Prior to assessment, all participants were informed about the content and aim of the study and signed a written informed consent. Participation was voluntary and participants did not receive any compensation for participation.

Data Analysis

Effect sizes were calculated for all group comparisons and converted to Cohen's *d*. Furthermore, 99% confidence intervals

(99% CI) were calculated for effect sizes and results were considered significant when $p \leq .010$ to control for overoptimism or Type I errors. Effect sizes were interpreted (Cohen, 1988) as small: $d = .20$ ($1 - \beta = .09$); medium: $d = .50$ ($1 - \beta = .53$); and large: $d = .80$ ($1 - \beta = .94$).

Cognitive performance. All cognitive variables were normally distributed. Group differences between adults with ADHD and healthy controls on measures of cognition (i.e., CFADHD and WAIS-IV Arithmetic) were determined by using *t* tests. One healthy participant and 18 adults with ADHD did not complete the second half of the assessment (i.e., the CFADHD) due to personal or logistic reasons, resulting in 27 adults with ADHD and 50 healthy controls for these analyses, who did not differ with regard to age ($p = .967$), gender ($p = .881$), years of education ($p = .781$), and work status ($p = .695$). The adults with ADHD ($n = 27$) and healthy controls ($n = 50$) in the remaining sample did significantly differ on the ADHD measures (i.e., WURK-S $p < .001$ and ADHS-SR $p < .001$). Furthermore, no differences were found regarding clinical and demographic variables between adults with ADHD who did and who did not complete the second half of the assessment (i.e., age, $p = .033$; gender, $p = .324$; years of education, $p = .834$; work status, $p = .962$; WURK-S, $p = .751$; and ADHS-SR, $p = .741$).

Personal financial situation. Group differences between adults with ADHD ($n = 45$) and healthy controls ($n = 51$) with regard to the personal financial situation of participants were evaluated using Pearson's chi-square tests. Differences in the range of income between groups were analyzed with a Mann–Whitney-*U* test and group differences on questions about free money to spend and amount of social security were analyzed with *t* tests. The variable free money to spend was not normally distributed which was corrected by using a log transformation.

FDM performance. To compare the performances of adults with ADHD and healthy controls on FDM tests ($n = 45$ and 51, respectively), *t* tests were performed for each FDM test. All data was normally distributed except for the TDT. Therefore, an arcsine transformation for percentage data (i.e., $2*arcsine\sqrt{X_i/100}$; Cohen, Cohen, West, & Aiken, 2003) was executed which resulted in a normally distributed variable.

FDM—Clinical interpretation. Based on procedures used in previous studies on FDM (Giannouli & Tsolaki, 2014; Marson et al., 2000; R. Martin et al., 2008) and in the field of clinical neuropsychology in general, the individual performances of adults with ADHD on FDM tests (i.e., total scores) were categorized using cut-off scores relative to the mean performance and standard deviation (*SD*) of healthy controls. Scores were classified as *normal* if scores were less than 1.5 *SD* below the mean. Scores were classified as *low* if scores were between 1.5 and 2.0 *SD* below the mean and as *very low/impaired* if the scores were more than 2.0 *SD* below the mean.

Cognition and FDM. To determine to what extent cognition influenced the performances of adults with ADHD ($n = 27$) and healthy controls ($n = 50$) on measures of FDM, bootstrapped mediation regression analyses (1,000 random samples) were performed, using PROCESS Version 3.0 (Hayes, 2013) for those measures of FDM which show significant group differences between adults with ADHD and healthy controls. Measures of cognition on which adults with ADHD showed significantly lower performances compared with healthy controls were included as mediation variables. A mediation effect of cognition is indicated when cognition is found to have a significant influence on the difference between adults with ADHD and healthy controls regarding FDM (path ab; Figure 1).

Results

Cognitive Performance

Compared with healthy controls, adults with ADHD showed significantly lower scores (medium effect sizes) on measures of vigilance (WAFV reaction time [RT]; $t = -2.85$, $p = .006$, $d = 0.68$); interference (STROOP interference; $t = -2.98$, $p = .005$, $d = 0.77$); and numeracy (WAIS-IV arithmetic accuracy; $t = 2.84$, $p = .006$, $d = 0.57$). No significant group differences were found for the other measures of cognition (Supplementary Table S1).

Personal Financial Situation

On five out of nine aspects of personal finances statistically significant group differences between adults with ADHD and healthy controls were found (see Table 2). The median income of adults with ADHD was between €15,000 and €25,000, which was significantly lower than the annual gross income of healthy controls (M*dn* = €35,000 to €45,000). Adults with ADHD also had significant less money to spend each month (M = €529.28, SD = €412.27) compared with healthy controls (M = €1096.17, SD = €798.56). Although one out of four adults with ADHD (i.e., 24.4%) reported to receive social security, group differences with healthy controls (i.e., 7.8% of healthy controls received social security) did not reach statistical significance. However, almost

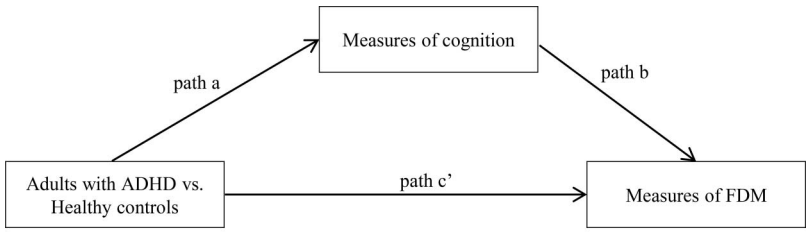
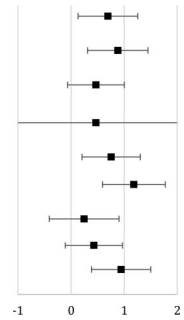


Figure 1. Schematic overview of the hypothesized mediating effect of cognition on the difference between adults with ADHD and healthy controls regarding FDM.

Table 2
Personal Financial Situation of Adults With ADHD (n = 45) and Healthy Controls (n = 51)

Questions about participants' financial situation	ADHD	Healthy controls	Group differences: Statistics	Group differences: *p*-value	Group differences: *d* (99% CI)
"What is approximately your annual gross income?" *Mdn*	€15,000 to €25,000	€35,000 to €45,000	$U = 667.0$	.001*	
"How much money can you approximately spend each month after deduction of fixed expenses?" *M (SD)*	€529.28 (€412.27)	€1096.17 (€798.56)	$t(88) = 4.28$	<.001*	
"Do you receive social security?"% *yes*	24.4%	7.8%	$\chi^2(1) = 5.00$	.025	
"If you receive social security, how much money do you approximately receive each month?" *M (SD)*	€357.00 (€189.78)	€273.33 (€125.03)	$t(10) = -.70$	.499	
"Do you have debts other than mortgage or study loans?" % *yes*	48.9%	15.7%	$\chi^2(1) = 11.86$	.001*	
"Do you have a savings account?" % *yes*	53.3%	86.3%	$\chi^2(1) = 23.07$	<.001*	
"Do you save actively, i.e., do you put money on your savings account on a regular basis?" % *yes*	58.3%	70.5%	$\chi^2(1) = 1.02$	.313	
"Do you save for retirement?" % *yes*	44.4%	62.7%	$\chi^2(1) = 4.13$	.042	
"Do you own a house?" % *yes*	13.3%	52.9%	$\chi^2(1) = 17.28$	<.001*	



Note. CI = confidence interval.
* $p < .01$.

half of the adults with ADHD (i.e., 48.9%) reported to have debts other than mortgage and study loans which is significantly more often than healthy controls (i.e., 15.7% of healthy controls reported to have debts). Furthermore, only 53.3% of adults with ADHD reported to have a savings account, which is significantly less often than 86.3% of healthy controls. No group differences were found, however, with regard to the active use of a savings account (i.e., 58.3% of adults with ADHD and 70.5% of healthy controls use their savings account actively) and with regard to saving for retirement (i.e., 44.4% of adults with ADHD and 62.7% of healthy controls save for their retirement). Significant group differences were found with regard to owning a house; healthy controls more often owned a house (i.e., 52.9%) compared with adults with ADHD (i.e., 13.3%; Table 2).

Financial Decision-Making

FDM performance. Adults with ADHD showed significantly lower scores on the FCAI total score compared with healthy controls (large effect size; Table 3). With regard to the subscales of the FCAI, adults with ADHD scored significantly lower on financial abilities, financial judgment, financial management, and financial support resources compared with healthy controls (large effect sizes). No significant group differences were found for the subscales financial cognitive functioning and debt management.

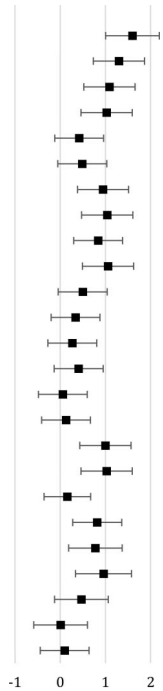
On the FDMI, adults with ADHD also obtained a significantly lower total score than healthy controls (large effect size; Table 3). More specifically, adults with ADHD had more difficulties with the identification and understanding of information (i.e., identification and understanding; large effect sizes) than healthy controls. No group differences were observed for the other subscales of the FDMI (i.e., reasoning, appreciating, and communication; Table 3).

Groups also did not differ with regard to their scores on the rational, intuitive, and dependent FDS subscales (see Table 3). However, adults with ADHD used significantly more often the avoidant and spontaneous financial decision styles than healthy controls (large effect sizes). Adults with ADHD also showed more temporal discounting than healthy controls (i.e., TDT total; large effect size). Furthermore, groups also differed regarding the total score of the IBQ (large effect size) and the cognitive component of the IBQ (large effect size). No group differences were found for the other two components of impulsive buying (i.e., affective component and situational component of the IBQ; Table 3). Furthermore, no statistically significant group differences were found on the CDR and IGT (see Table 3).

FDM—Clinical interpretation. Based on the mean scores and *SD*s of the healthy control sample, one out of four (i.e., 26.7%) adults with ADHD was classified as scoring very low or impaired (i.e., more than 2.0 *SD* below the mean) on the FCAI and 28.9% of the adults with ADHD showed a low performance (i.e., between 1.5 and 2.0 *SD* below the mean) on this measure. Less than half of the adults with ADHD (i.e., 44.4%) could be considered as normal or unimpaired (i.e., scoring less than 1.5 *SD* below the mean) on the FCAI. On the FDMI, 71.1% of the adults with ADHD showed a normal performance; 20.0% of the adults with ADHD had a low performance on the FDMI, while 8.9% of the adults with ADHD could be classified as impaired on this measure. Regarding the CDR, the performance of almost all adults with ADHD (i.e., 95.6%) could be classified as

Table 3
Performances on FDM Tests of Adults With ADHD (n = 45) and Healthy Controls (n = 51)

FDM tests	ADHD *M* (*SD*)	Healthy controls *M* (*SD*)	*t*	*p*-value	*d* (99% CI)
FCAI total	94.62 (9.51)	112.16 (12.10)	7.94	<.001*	
Financial abilities	23.44 (4.32)	29.63 (5.13)	6.34	<.001*	
Financial judgment	20.49 (4.45)	25.57 (4.85)	5.32	<.001*	
Financial management	16.38 (2.82)	18.96 (2.17)	4.98	<.001*	
Financial cognitive functioning	21.96 (1.67)	22.76 (2.10)	2.07	.041	
Debt management	2.53 (1.25)	3.06 (.90)	2.33	.022	
Financial support resources	9.82 (2.39)	12.18 (2.58)	4.63	<.001*	
FDMI total	16.22 (2.47)	18.41 (1.73)	5.09	<.001*	
Identification	3.11 (.94)	3.73 (.49)	3.95	<.001*	
Understanding	2.82 (.89)	3.63 (.63)	5.07	<.001*	
Reasoning	3.49 (.84)	3.82 (.43)	2.40	.019	
Appreciating	3.11 (.94)	3.39 (.72)	1.66	.101	
Communication	3.69 (.67)	3.84 (.42)	1.34	.186	
FDS rational	17.47 (4.66)	19.12 (2.95)	2.01	.049	
FDS intuitive	14.86 (3,91)	14.65 (3.54)	−.28	.778	
FDS dependent	15.63 (4.63)	16.37 (3.61)	.88	.383	
FDS avoidant	15.26 (5.22)	10.49 (4.67)	−4.67	<.001*	
FDS spontaneous	11.64 (3.67)	8.35 (2.61)	−4.95	<.001*	
CDR total	6.92 (1.99)	7.25 (2.18)	.75	.453	
TDT total	75.61 (18.96)	88.20 (11.41)	4.27	<.001*	
IBQ total	65.97 (12.61)	57.82 (8.87)	−3.45	.001*	
Cognitive component	38.78 (6.62)	32.63 (4.96)	−4.89	<.001*	
Affective component	28.00 (6.43)	25.20 (4.80)	−2.32	.023	
Situational component	9.77 (1.80)	9.75 (1.55)	−.08	.936	
IGT total	15.67 (41.96)	11.88 (37.72)	−.46	.646	



Note. FCAI = Financial Competence Assessment Inventory; FDMI = Financial Decision-Making Interview; CDR = Competence in Decision Rules; FDS = Financial Decision Style Questionnaire; TDT = Temporal Discounting Task; IBQ = Impulsive Buying Questionnaire; IGT = Iowa Gambling Task; CI = confidence interval.
* $p < .01$.

normal; two adults with ADHD showed either a low or very low/impaired performance. On the IBQ only one adult with ADHD (i.e., 2.2%) could be classified as very low/impaired. On the IGT none of the adults with ADHD could be classified as very low/impaired and of the adults with ADHD only one (i.e., 2.2%) and three (i.e., 7.0%) showed a low performance on the IBQ and IGT, respectively. On the TDT, the performances of 22.2% adults with ADHD were classified as very low/impaired. The performance of one other adult with ADHD was classified as low. All other adults with ADHD (i.e., 75.6%) showed a normal performance on the TDT. In contrast, normal performances on measures of FDM were obtained by healthy controls in more than 90% of the cases (see Table 4).

When taking the FDM tests together, one out of three adults with ADHD (i.e., 34.2%) showed a normal performance on all measures of FDM. However, 36.8% adults with ADHD showed a

Table 4
FDM Outcome Classification of Adults With ADHD (n = 45) and Healthy Controls (n = 51)

	Adults with ADHD			Healthy controls		
FDM tests	Impaired % (*n*)	Low % (*n*)	Normal % (*n*)	Impaired % (*n*)	Low % (*n*)	Normal % (*n*)
FCAI total	26.7% (12)	28.9% (13)	44.4% (20)	2.0% (1)	2.0% (1)	96.1% (49)
FDMI total	8.9% (4)	20.0% (9)	71.1% (32)	5.9% (3)	0% (0)	94.1% (48)
CDR total	2.2% (1)	2.2% (1)	95.6% (43)	5.9% (3)	0% (0)	94.1% (48)
TDT total	22.2% (10)	2.2% (1)	75.6% (34)	7.8% (4)	0% (0)	92.2% (47)
IBQ total	3.1% (1)	2.1% (1)	93.8% (30)	2.0% (1)	5.9% (3)	92.2% (47)
IGT total	0% (0)	7.0% (3)	93.0% (40)	0% (0)	2.0% (1)	98.0% (50)

Note. Results of the Financial Decision Style Questionnaire are not included, because lower/higher scores do not represent better or worse scores. FCAI = Financial Competence Assessment Inventory; FDMI = Financial Decision-Making Interview; CDR = Competence in Decision Rules; TDT = Temporal Discounting Task; IBQ = Impulsive Buying Questionnaire; IGT = Iowa Gambling Task.

very low/impaired performance and an additional 28.9% showed a low performance on one or more FDM tests. This is twice as often as in healthy controls (i.e., 19.6% and 7.8% of the healthy controls showed a very low/impaired or low performance, respectively, on one or more FDM tests).

FDM and Cognition

The group difference regarding the FCAI total score was significantly associated with numeracy (WAIS-IV arithmetic; Figure 1, path ab). Significant associations were also found between numeracy and group differences regarding FCAI subscales (with the exception of financial abilities) and the FDMI total score. The group differences for all these measures of FDM (Figure 1, path c'), however, remained significant ($p < .010$). This indicates that the differences between adults with ADHD and healthy controls on the FCAI and FDMI can only partly be explained by numeracy. No significant effects of numeracy were found for the other measures of FDM nor for vigilance (WAFV RT) and interference (STROOP interference; Table 5).

Students

Because a large group of students ($n = 37$) was excluded from the current study, we repeated the group comparisons with regard to cognitive functioning, personal financial situation, and FDM performance with the samples including the 37 students. This analysis revealed that group differences concerning annual gross income and the amount of money that could be spent freely were no longer significant. All other results were similar to the results of the analyses excluding students (Supplementary Tables S2–S5).

Discussion

The goal of the present exploratory study was to investigate FDM in adults with and without ADHD, using a recently published comprehensive test battery (Bangma et al., 2017). The results show that the personal financial situation of adults with ADHD was less optimal than the financial situation of healthy controls. Furthermore, adults with ADHD showed significantly decreased performances compared with healthy controls in five out of seven tasks measuring FDM and on measures of vigilance, interference, and numeracy. However, mediation analyses indicated that differences in cognitive functioning cannot fully explain the differences with regard to FDM between adults with ADHD and healthy controls.

Personal Financial Situation

The gross annual income of adults with ADHD was lower than that of healthy individuals, resulting in significant less money to spend each month for adults with ADHD compared with healthy controls. Previous research showed that income levels of relatively young adults with and without ADHD (i.e., younger than 24 years of age) are more or less similar (Altszuler et al., 2016; Barkley et al., 2006), but that adults with ADHD of 24 years and older have a lower gross annual income than healthy controls (Barkley et al., 2008; Biederman & Faraone, 2006). Fischer and Barkley (2006) found even higher income levels in adults with ADHD who were on average 21-years-old compared with age-matched controls. However, they argue that this is probably due to the fact that

Table 5
Bootstrapped Mediation Regression Analyses of Cognition on the Difference Between Adults With ADHD ($n = 27$) and Healthy Controls ($n = 50$) Regarding FDM

FDM tests	Direct effect of *Group* on FDM (path c')		Indirect effect with *Vigilance*[a] as Mediator (path ab)		Indirect effect with *Interference*[b] as Mediator (path ab)		Indirect effect with *Numeracy*[c] as Mediator (path ab)	
	Effect (*SE*)	99% CI	Effect (*SE*)	Bootstrapped 99% CI	Effect (*SE*)	Bootstrapped 99% CI	Effect (*SE*)	Bootstrapped 99% CI
FCAI total	−14.26 (2.63)	[−21.23, −7.28]*	−.09 (.95)	[−2.77, 2.77]	−.39 (.81)	[−3.37, 1.63]	−3.70 (1.38)	[−7.91, −.17]*
Financial abilities	−5.93 (1.29)	[−9.24, −2.43]*	.06 (.41)	[−1.10, 1.27]	−.04 (.39)	[−1.42, .97]	−1.07 (.48)	[−2.83, .54]
Financial judgment	−3.93 (1.11)	[−6.88, −.99]*	.03 (.08)	[−.18, .25]	−.08 (.72)	[−.29, .08]	−.24 (.10)	[−.55, −.03]*
Financial management	−2.17 (.61)	[−3.79, −.56]*	−.11 (.29)	[−1.15, .57]	.14 (.20)	[−.51, .79]	−.84 (.32)	[−1.85, −.05]*
Financial support resources	−1.86 (.65)	[−3.59, −.14]*	.06 (.08)	[−.11, .40]	−.05 (.09)	[−.32, .17]	−.19 (.09)	[−.47, −.01]*
FDMI total	−1.58 (.45)	[−2.77, −.39]*	−.08 (.15)	[−.56, .29]	.02 (.14)	[−.50, .42]	−.37 (.18)	[−.98, .03]*
Identification	−.55 (.19)	[−1.07, −.04]*	.00 (.07)	[−.43, .25]	.02 (.07)	[−.16, .26]	−.12 (.08)	[−.36, .04]
Understanding	−.80 (.19)	[−1.32, −.29]*	−.01 (.05)	[−.18, .14]	.05 (.06)	[−.09, .26]	−.10 (.06)	[−.27, .07]
FDS avoidant	5.35 (1.35)	[1.79, 8.92]*	.02 (.08)	[−.21, .23]	−.03 (.09)	[−.30, .24]	−.02 (.08)	[−.27, .28]
FDS spontaneous	3.39 (.86)	[1.12, 5.67]*	.34 (.39)	[−.56, 1.62]	−.07 (.31)	[−.96, .81]	.02 (.25)	[−.73, .86]
TDT total	−.31 (.10)	[−.59, −.04]*	.01 (.09)	[−.26, .23]	.05 (.08)	[−.16, .28]	−.15 (.08)	[−.41, .04]
IBQ total	7.98 (2.83)	[.47, 15.49]*	1.18 (1.27)	[−1.51, 5.40]	−.63 (.65)	[−2.88, 1.16]	1.07 (1.02)	[−1.25, 4.84]
Cognitive component	6.48 (1.53)	[2.43, 10.52]*	.68 (.62)	[−.53, 2.78]	−.14 (.49)	[−1.36, 1.56]	.33 (.47)	[−.82, 1.83]

Note. FCAI = Financial Competence Assessment Inventory; FDMI = Financial Decision-Making Interview; FDS = Financial Decision Style Questionnaire; TDT = Temporal Discounting Task; IBQ = Impulsive Buying Questionnaire.
[a] Vigilance is evaluated with the Perception and Attention Functions Test—Vigilance (WAFS). [b] Interference is examined with the Stroop interference test (STROOP). [c] Numeracy is examined with the arithmetic subtest of the Wechsler Adult Intelligence Scale IV (WAIS-IV).
* $p \leq .010$.

healthy individuals are more often students at this age than young adults with ADHD. Furthermore, Altszuler et al. (2016) reported that, although income levels of adults with ADHD and healthy controls sometimes appear to be similar, young adults with ADHD receive more often social security from welfare systems or are financially dependent on parents or relatives than healthy controls. In the present study, it was found that one out of four adults with ADHD received social security; however, compared with 7.8% of healthy controls receiving social security this was not significantly more often than in healthy controls.

With regard to having debts, almost half of the adults with ADHD reported to have debts other than mortgages or study loans, which is significantly more frequent than in the healthy control group (i.e., 15.7%). Previous studies reported inconsistent findings with regard to debts of adults with ADHD (Altszuler et al., 2016; Barkley et al., 2006; Barkley et al., 2008; Fischer & Barkley, 2006), which might be a result of the relatively young age of participants included in previous studies. Furthermore, despite the finding that adults with ADHD did not differ from healthy controls with regard to saving for retirement and actively saving money when they have a savings account, the present results indicate that financial future planning of adults with ADHD is not as optimal as the planning of healthy controls, that is, significantly fewer adults with ADHD had a savings account or bought a house compared with healthy controls, which can both be understood as investments for the future.

Financial Decision-Making

Consistent with the findings described above, lower performances on various standardized objective tests of FDM were found in adults with ADHD compared with healthy controls, which are substantiated by mainly large effect sizes. With regard to two relatively fundamental aspects of FDM (i.e., financial competence and capacity) poorer performances were found in adults with ADHD compared with healthy controls. This shows that adults with ADHD have more difficulties with the (mental) ability or capacity to make financial decisions and have less knowledge about the execution of relatively simple financial transactions than healthy controls. More specifically, adults with ADHD experienced it as more difficult to identify a financial problem and to consider the risks and benefits of the given problem (i.e., FDMI identification and understanding). The results further show that in comparison to healthy controls adults with ADHD have more problems with financial judgment and management and are less capable to find financial support.

The mechanisms underlying the problems in financial competence and capacity in adults with ADHD are unclear. Numeracy seems to play a role in financial competence and capacity, which is consistent with previous research (Niccolai et al., 2017; R. C. Martin et al., 2012; Sherod et al., 2009) and group differences on these aspects of FDM were found to be mediated by numeracy. However, direct effects of the group differences between adults with ADHD and healthy controls on financial competence and capacity remained significant, which implies that group differences on these measures of FDM cannot be fully explained by difficulties with numeracy of adults with ADHD. Also, adults with ADHD were found to show impairments in vigilance and interference, however, these aspects of cognition did not mediate the group differences on measures of FDM. It is, however, important to keep in mind that not all participants completed the cognitive test battery, resulting in a relatively small sample size for the analyses including standard measures of cognition. Furthermore, the relative conservative p value used for all analyses may have increased the likelihood of Type II errors and may have masked existing effects. Especially for small effects, the power of our analyses (i.e., 9% for small effects) is problematic and should be considered when interpreting nonsignificant results. Studies with large sample sizes on the influence of cognition on FDM in adults with ADHD are therefore desirable. The power for medium (i.e., 53%) and large effects (i.e., 94%) are, however, good considering the average power of studies in psychology (Bakker, van Dijk, & Wicherts, 2012; Cohen, 1962). It is conceivable that the performances of adults with ADHD on financial competence and capacity are the result of motivational deregulation, because both aspects of FDM are considered as relatively basic and simple which is reflected by the high scores obtained by healthy individuals. It is therefore possible that boredom plays a role (Matthies, Philipsen, & Svaldi, 2012) and may affect task performance adversely. This suggestion is consistent with the finding that adults with ADHD were found to show a decreased temporal discounting compared to healthy controls (i.e., adults with ADHD prefer immediate over delayed rewards, see below).

With regard to the use of decision styles, adults with ADHD more often used a spontaneous decision-making style than healthy controls, which corresponds with a stronger tendency of adults with ADHD to buy on impulse which was also found in the present study. These results indicate that adults with ADHD more often have difficulties with suppressing the urge to buy on impulse or to make decisions in a more deliberative manner. Interestingly, adults with ADHD also seem to avoid financial decisions more often than healthy controls. Previous research demonstrated that the use of both the avoidant and spontaneous decision-making style are negatively related to decision-making competence and might be a result of problems with (general) decision-making (Bavol'ár & Orosová, 2015).

Adults with ADHD also showed more difficulties with making financial decisions that have implications for the future compared with healthy controls. This means that adults with ADHD discounted the value of money that they could receive later in time (i.e., temporal discounting) stronger than healthy controls. The effect of temporal discounting has been frequently described in children and adolescents with ADHD (Barkley, Edwards, Laneri, Fletcher, & Metevia, 2001; Demurie, Roeyers, Baeyens, & Sonuga-Barke, 2012; Scheres et al., 2013) and was attributed to a motivational deregulation or self-control problem (Scheres et al., 2013). However, research on temporal discounting of adults with ADHD is limited and results are inconsistent (see Mowinckel et al., 2015 for recent meta-analysis). This inconsistency may be the result of third variables that are likely to interact with someone's temporal discounting tendency, such as income or financial reserves (Green, Myerson, Lichtman, Rosen, & Fry, 1996).

No differences were found between adults with ADHD and healthy controls regarding emotional decision making (i.e., IGT) and the ability to apply decision-rules in financial situations (i.e., CDR). These findings are in contrast with Mäntylä, Still, Gullberg, and Del Missier (2012) who observed that adults with ADHD have difficulties with applying decision-rules. This inconsistency may

be explained by the fact that the participants in our study received on average 5 years of education more than the participants in the study of Mäntylä et al. (2012) and the finding that years of education seems to be a significant predictor of the ability to apply decision-rules (Bangma et al., 2017). Inconsistent results are also found by previous studies that applied the IGT in adults with ADHD (Groen et al., 2013; Mowinckel et al., 2015). In the present study, no difference was found between healthy controls and adults with ADHD on this measure of emotional decision-making. Therefore, the present data adds evidence suggesting that adults with ADHD have no pronounced problems in risky or emotional decision-making. However, in this context third variables such as level of education might also play a role (Davis et al., 2008; Fry, Greenop, Turnbull, & Bowman, 2009). Furthermore, the latter result appears to be in contrast with the difference found between adults with ADHD and healthy controls regarding temporal discounting, as it has been suggested that a preference for immediate over delayed rewards (i.e., a decreased temporal discounting) would result in increased risky behavior (Groen et al., 2013; Sonuga-Barke, 2003). A recent study in children with ADHD, however, indicates that the tendency to choose the least delayed option does not result in increased risk taking. Instead, children with ADHD were found to have more difficulties with adjustment in relation to changing risk probabilities than healthy controls (Sørensen et al., 2017), probabilities that do not change during the IGT that was used in the present study.

When interpreting the results of the present study, some limitations need to be taken into account. First, in the present sample, 19 adults with ADHD with comorbid disorder(s) of which three with substance dependency were included. These comorbid disorders may be relevant with regard to the differences found between adults with ADHD and healthy controls. Additional analyses excluding the adults with ADHD with substance dependency ($n = 3$ excluded, data of additional analyses not reported) replicated the results with regard to the objective measures of FDM. Also when excluding all adults with ADHD with comorbid disorders ($n = 19$), largely similar results were found (data not reported). Only the difference between adults with ADHD and healthy controls for IBQ total score was no longer significant (when applying the conservative p value of $p \leq .01$). There is thus no strong evidence that comorbid disorders, including substance dependency, account for the group differences between adults with ADHD and healthy controls found on objective measures of FDM.

A second limitation of the present study is that researchers were not blind to the diagnosis of participants, which might have led to an observer bias. However, the use of a protocolary and objective approach for both the assessment and scoring probably minimized this effect. Third, although all healthy controls indicated to not have ADHD, no clinical evaluation of ADHD has been performed in these participants. Self-report questionnaires for current and retrospective symptoms of ADHD (i.e., ADHD-SR and WURS-K ADHD-SR, respectively) were used to give additional support to the diagnostic status of the participants, however, due to underreporting of symptoms (Sibley, Campez, & Raiker, 2017) and the underdiagnosis of adult ADHD (Ginsberg, Quintero, Anand, Casillas, & Upadhyaya, 2014) it is conceivable that adults with ADHD are included in the healthy control group. Fourth, adults with ADHD were off medication during assessment and it is, therefore, unclear what the effect of stimulants will be on their performances on measures of FDM. Not only the stimulant itself, but also the onset of medication use and other treatments (e.g., cognitive–behavioral therapy or coaching) might have an influence on FDM. The influence of treatment use should, therefore, be explored in future research on FDM and adults with ADHD. Fifth, other confounding factors should be considered in more detail in future research. For example, childhood socioeconomic status and parental education level may be of influence on one's personal financial situation and the ability to make financial decisions. Also, the motivation of participants should be evaluated. Especially in adults with ADHD, less optimal decision-making seems to be related to experienced boredom while making a decision (Matthies et al., 2012). Boredom may play a role in the assessment of relatively simple aspects of FDM (e.g., financial competence or capacity). Furthermore, the personal financial situation of participants was evaluated using self-report measures and only approximate indications of income, free money to spend, and amount of social security were asked. These questions rely on a good insight of one's own personal financial situation, which may not always be sufficient in adults with ADHD as well as in healthy controls. Finally, it has to be pointed out that the ecological validity of the FDM test battery needs further investigation in order to determine to what extent these impaired test performances translate into problems of daily life.

Nevertheless, the current study is the first to explore FDM in adults with ADHD by using self-report as well as standardized objective FDM tests and by including a sample of adults with a broad age range as well as including males and females with ADHD alike. Adults with ADHD were found to have difficulties with several aspects of FDM, that is, evaluating financial problems (i.e., financial decision-making capacity), understanding bank statements/protocols (i.e., financial competence), financial decisions with implications for the future, and impulsive buying. Furthermore, adults with ADHD more often used an avoidant and a spontaneous decision-making style when making financial decisions than healthy controls. When applying a more clinical approach, 34.2% of adults with ADHD are classified as impaired on at least one aspect of FDM compared with 19.6% of healthy controls, with a large number of adults with ADHD showing impairment in financial competence (i.e., 26.7% of adults with ADHD have an impaired performance on the FCAI compared with 2.0% of healthy controls). These difficulties with FDM and the use of disadvantageous decision-making styles presumably result in the less optimal personal financial situation that are commonly observed in adults with ADHD, such as having debts and not saving money. More research is needed to evaluate underlying mechanisms of these FDM problems and the daily life consequences of the observed difficulties with FDM in adults with ADHD. This knowledge may help in developing treatment approaches which may be offered to adults with ADHD to allow them a living in a more financially secure and less stressful situation.

References

Alderson, R. M., Kasper, L. J., Hudec, K. L., & Patros, C. H. G. (2013). Attention-deficit/hyperactivity disorder (ADHD) and working memory in adults: A meta-analytic review. *Neuropsychology, 27,* 287–302. http://dx.doi.org/10.1037/a0032371.supp

Altszuler, A. R., Page, T. F., Gnagy, E. M., Coxe, S., Arrieta, A., Molina, B. S. G., & Pelham, W. E. J., Jr. (2016). Financial dependence of young adults with childhood ADHD. *Journal of Abnormal Child Psychology, 44,* 1217–1229. http://dx.doi.org/10.1007/s10802-015-0093-9

American Psychiatric Association. (Ed.), (2013). *Diagnostic and statistical manual of mental disorders* (5th edition). Arlington, VA: American Psychiatric Publishing.

Appelbaum, P. S., & Grisso, T. (1988). Assessing patients' capacities to consent to treatment. *The New England Journal of Medicine, 319,* 1635–1638. http://dx.doi.org/10.1056/NEJM198812223192504

Bakker, M., van Dijk, A., & Wicherts, J. M. (2012). The rules of the game called psychological science. *Perspectives on Psychological Science, 7,* 543–554. http://dx.doi.org/10.1177/1745691612459060

Bangma, D. F., Fuermaier, A. B. M., Tucha, L., Tucha, O., & Koerts, J. (2017). The effects of normal aging on multiple aspects of financial decision-making. *PLoS ONE, 12,* e0182620. http://dx.doi.org/10.1371/journal.pone.0182620

Barkley, R. A., Edwards, G., Laneri, M., Fletcher, K., & Metevia, L. (2001). Executive functioning, temporal discounting, and sense of time in adolescents with attention deficit hyperactivity disorder (ADHD) and oppositional defiant disorder (ODD). *Journal of Abnormal Child Psychology, 29,* 541–556. http://dx.doi.org/10.1023/A:1012233310098

Barkley, R. A., & Fischer, M. (2010). The unique contribution of emotional impulsiveness to impairment in major life activities in hyperactive children as adults. *Journal of the American Academy of Child & Adolescent Psychiatry, 49,* 503–513.

Barkley, R. A., Fischer, M., Smallish, L., & Fletcher, K. (2006). Young adult outcome of hyperactive children: Adaptive functioning in major life activities. *Journal of the American Academy of Child & Adolescent Psychiatry, 45,* 192–202. http://dx.doi.org/10.1097/01.chi.0000189134.97436.e2

Barkley, R. A., Murphy, K. R., Dupaul, G. I., & Bush, T. (2002). Driving in young adults with attention deficit hyperactivity disorder: Knowledge, performance, adverse outcomes, and the role of executive functioning. *Journal of the International Neuropsychological Society, 8,* 655–672. http://dx.doi.org/10.1017/S1355617702801345

Barkley, R. A., Murphy, K. R., & Fischer, M. (2008). *ADHD in adults: What the science says*. New York, NY: Guilford Press. Retrieved from http://search.ebscohost.com.proxy-ub.rug.nl/login.aspx?direct=true&db=psyh&AN=2007-18100-000&site=ehost-live&scope=site

Bavol'ár, J., & Orosová, O. (2015). Decision-making styles and their associations with decision-making competencies and mental health. *Judgment and Decision Making, 10,* 115–122.

Beatty, S. E., & Ferrell, M. E. (1998). Impulse buying: Modeling its precursors. *Journal of Retailing, 74,* 169–191. http://dx.doi.org/10.1016/S0022-4359(99)80092-X

Bechara, A., Damasio, A. R., Damasio, H., & Anderson, S. W. (1994). Insensitivity to future consequences following damage to human prefrontal cortex. *Cognition, 50,* 7–15. http://dx.doi.org/10.1016/0010-0277(94)90018-3

Biederman, J., & Faraone, S. V. (2006). The effects of attention-deficit/hyperactivity disorder on employment and household income. *MedGenMed: Medscape General Medicine, 8,* 12.

Boonstra, A. M., Kooij, J. J. S., Oosterlaan, J., Sergeant, J. A., & Buitelaar, J. K. (2010). To act or not to act, that's the problem: Primarily inhibition difficulties in adult ADHD. *Neuropsychology, 24,* 209–221. http://dx.doi.org/10.1037/a0017670

Boonstra, A. M., Oosterlaan, J., Sergeant, J. A., & Buitelaar, J. K. (2005). Executive functioning in adult ADHD: A meta-analytic review. *Psychological Medicine, 35,* 1097–1108. http://dx.doi.org/10.1017/S003329170500499X

Bruine de Bruin, W., Parker, A. M., & Fischhoff, B. (2007). Individual differences in adult decision-making competence. *Journal of Personality and Social Psychology, 92,* 938–956. http://dx.doi.org/10.1037/0022-3514.92.5.938

Buelow, M. T., & Suhr, J. A. (2009). Construct validity of the Iowa Gambling Task. *Neuropsychology Review, 19,* 102–114. http://dx.doi.org/10.1007/s11065-009-9083-4

Cohen, J. (1962). The statistical power of abnormal-social psychological research: A review. *Journal of Abnormal and Social Psychology, 65,* 145–153. http://dx.doi.org/10.1037/h0045186

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd edition). Hillsdale, NJ: Erlbaum.

Cohen, J., Cohen, P., West, S. G., & Aiken, L. S. (2003). *Applied multiple regression/correlation analysis for the behavioral sciences* (3rd ed.). Mahwah, NJ: Erlbaum Publishers. Retrieved from http://search.ebscohost.com.proxy-ub.rug.nl/login.aspx?direct=true&db=psyh&AN=2002-18109-000&site=ehost-live&scope=site

Coley, A., & Burgess, B. (2003). Gender differences in cognitive and affective impulse buying. *Journal of Fashion Marketing and Management, 7,* 282–295. http://dx.doi.org/10.1108/13612020310484834

Daley, D., & Birchwood, J. (2010). ADHD and academic performance: Why does ADHD impact on academic performance and what can be done to support ADHD children in the classroom? *Child: Care, Health and Development, 36,* 455–464. http://dx.doi.org/10.1111/j.1365-2214.2009.01046.x

Das, D., Cherbuin, N., Butterworth, P., Anstey, K. J., & Easteal, S. (2012). A population-based study of attention deficit/hyperactivity disorder symptoms and associated impairment in middle-aged adults. *PLoS ONE, 7,* e31500. http://dx.doi.org/10.1371/journal.pone.0031500

Davis, C., Fox, J., Patte, K., Curtis, C., Strimas, R., Reid, C., & McCool, C. (2008). Education level moderates learning on two versions of the Iowa Gambling Task. *Journal of the International Neuropsychological Society, 14,* 1063–1068. http://dx.doi.org/10.1017/S1355617708081204

Demurie, E., Roeyers, H., Baeyens, D., & Sonuga-Barke, E. (2012). Temporal discounting of monetary rewards in children and adolescents with ADHD and autism spectrum disorders. *Developmental Science, 15,* 791–800. http://dx.doi.org/10.1111/j.1467-7687.2012.01178.x

Evans, J. S. B. T. (2008). Dual-processing accounts of reasoning, judgment, and social cognition. *Annual Review of Psychology, 59,* 255–278. http://dx.doi.org/10.1146/annurev.psych.59.103006.093629

Fayyad, J., De Graaf, R., Kessler, R., Alonso, J., Angermeyer, M., Demyttenaere, K., . . . Jin, R. (2007). Cross-national prevalence and correlates of adult attention-deficit hyperactivity disorder. *The British Journal of Psychiatry, 190,* 402–409. http://dx.doi.org/10.1192/bjp.bp.106.034389

Fischer, M., & Barkley, R. (2006). Young adult outcomes of children with hyperactivity: Leisure, financial, and social activities. *International Journal of Disability Development and Education, 53,* 229–245. http://dx.doi.org/10.1080/10349120600716182

Fry, J., Greenop, K., Turnbull, O., & Bowman, C. (2009). The effect of education and gender on emotion-based decision-making. *South African Journal of Psychology, 39,* 122–132. http://dx.doi.org/10.1177/008124630903900111

Fuermaier, A. B. M., Tucha, L., Evans, B. L., Koerts, J., de Waard, D., Brookhuis, K., . . . Tucha, O. (2017). Driving and attention deficit hyperactivity disorder. *Journal of Neural Transmission, 124,* 55–67. http://dx.doi.org/10.1007/s00702-015-1465-6

Fuermaier, A. B. M., Tucha, L., Koerts, J., Aschenbrenner, S., Kaunzinger, I., Hauser, J., . . . Tucha, O. (2015). Cognitive impairment in adult ADHD—Perspective matters! *Neuropsychology, 29,* 45–58. http://dx.doi.org/10.1037/neu0000108

Giannouli, V., & Tsolaki, M. (2014). Legal capacity of the elderly in Greece. *Hellenic Journal of Nuclear Medicine, 17,* 2–6.

Ginsberg, Y., Quintero, J., Anand, E., Casillas, M., & Upadhyaya, H. P. (2014). Underdiagnosis of attention-deficit/hyperactivity disorder in adult patients: A review of the literature. *The Primary Care Companion*

for CNS Disorders. Advance online publication. http://dx.doi.org/10.4088/PCC.13r01600

Grabemann, M., Zimmermann, M., Strunz, L., Ebbert-Grabemann, M., Scherbaum, N., Kis, B., & Mette, C. (2017). Neue wege in der diagnostik der ADHS bei erwachsenen: Das essener interview zur schulzeitbezogenen biografie bei adulter ADHS [New ways of diagnosing ADHD in adults: The Essen-interview-for-school-days-related-biography (EIS-B)]. *Psychiatrische Praxis, 44,* 221–227. http://dx.doi.org/10.1055/s-0043-100714

Grasman, R. P. P. P., & Wagenmakers, E. J. (2005). *A DHTML implementation of the Iowa Gambling Task*. Retrieved from http://purl.oclc.org/NET/rgrasman/jscript/IowaGamblingTask

Green, L., Fry, A. F., & Myerson, J. (1994). Discounting of delayed rewards: A life-span comparison. *Psychological Science, 5,* 33–36. http://dx.doi.org/10.1111/j.1467-9280.1994.tb00610.x

Green, L., Myerson, J., Lichtman, D., Rosen, S., & Fry, A. (1996). Temporal discounting in choice between delayed rewards: The role of age and income. *Psychology and Aging, 11,* 79–84. http://dx.doi.org/10.1037/0882-7974.11.1.79

Groen, Y., Gaastra, G. F., Lewis-Evans, B., & Tucha, O. (2013). Risky behavior in gambling tasks in individuals with ADHD—A systematic literature review. *PLoS ONE, 8,* e74909. http://dx.doi.org/10.1371/journal.pone.0074909

Hayes, A. F. (2013). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach*. New York, NY: Guilford Press. Retrieved from http://search.ebscohost.com.proxy-ub.rug.nl/login.aspx?direct=true&db=psyh&AN=2013-21121-000&site=ehost-live&scope=site

Hervey, A. S., Epstein, J. N., & Curry, J. F. (2004). Neuropsychology of adults with attention-deficit/hyperactivity disorder: A meta-analytic review. *Neuropsychology, 18,* 485–503. http://dx.doi.org/10.1037/0894-4105.18.3.485

Kahneman, D. (2003). A perspective on judgment and choice: Mapping bounded rationality. *American Psychologist, 58,* 697–720. http://dx.doi.org/10.1037/0003-066X.58.9.697

Kershaw, M. M., & Webber, L. S. (2004). Dimensions of financial competence. *Psychiatry, Psychology and Law, 11,* 338–349. http://dx.doi.org/10.1375/pplt.2004.11.2.338

Kershaw, M. M., & Webber, L. S. (2008). Assessment of financial competence. *Psychiatry, Psychology and Law, 15,* 40–55. http://dx.doi.org/10.1080/13218710701873965

Lara, C., Fayyad, J., de Graaf, R., Kessler, R. C., Aguilar-Gaxiola, S., Angermeyer, M., . . . Sampson, N. (2009). Childhood predictors of adult ADHD: Results from the WHO world mental health (WMH) survey initiative. *Biological Psychiatry, 65,* 46–54. http://dx.doi.org/10.1016/j.biopsych.2008.10.005

Loo, R. (2000). A psychometric evaluation of the general decision-making style inventory. *Personality and Individual Differences, 29,* 895–905. http://dx.doi.org/10.1016/S0191-8869(99)00241-X

Luman, M., Oosterlaan, J., & Sergeant, J. A. (2005). The impact of reinforcement contingencies on AD/HD: A review and theoretical appraisal. *Clinical Psychology Review, 25,* 183–213. http://dx.doi.org/10.1016/j.cpr.2004.11.001

Mäntylä, T., Still, J., Gullberg, S., & Del Missier, F. (2012). Decision making in adults with ADHD. *Journal of Attention Disorders, 16,* 164–173. http://dx.doi.org/10.1177/1087054709360494

Marson, D. C., Sawrie, S. M., Snyder, S., McInturff, B., Stalvey, T., Boothe, A., . . . Harrell, L. E. (2000). Assessing financial capacity in patients with Alzheimer disease: A conceptual model and prototype instrument. *Archives of Neurology, 57,* 877–884. http://dx.doi.org/10.1001/archneur.57.6.877

Martin, R., Griffith, H. R., Belue, K., Harrell, L., Zamrini, E., Anderson, B., . . . Marson, D. (2008). Declining financial capacity in patients with mild Alzheimer disease: A one-year longitudinal study. *The American Journal of Geriatric Psychiatry, 16,* 209–219. http://dx.doi.org/10.1097/JGP.0b013e318157cb00

Martin, R. C., Triebel, K., Dreer, L. E., Novack, T. A., Turner, C., & Marson, D. C. (2012). Neurocognitive predictors of financial capacity in traumatic brain injury. *The Journal of Head Trauma Rehabilitation, 27,* E81–E90. http://dx.doi.org/10.1097/HTR.0b013e318273de49

Matthies, S., Philipsen, A., & Svaldi, J. (2012). Risky decision making in adults with ADHD. *Journal of Behavior Therapy and Experimental Psychiatry, 43,* 938–946. http://dx.doi.org/10.1016/j.jbtep.2012.02.002

Michielsen, M., Comijs, H. C., Aartsen, M. J., Semeijn, E. J., Beekman, A. T. F., Deeg, D. J. H., & Kooij, J. J. S. (2015). The relationships between ADHD and social functioning and participation in older adults in a population-based study. *Journal of Attention Disorders, 19,* 368–379. http://dx.doi.org/10.1177/1087054713515748

Mowinckel, A. M., Pedersen, M. L., Eilertsen, E., & Biele, G. (2015). A meta-analysis of decision-making and attention in adults with ADHD. *Journal of Attention Disorders, 19,* 355–367. http://dx.doi.org/10.1177/1087054714558872

Niccolai, L. M., Triebel, K. L., Gerstenecker, A., McPherson, T. O., Cutter, G. R., Martin, R. C., & Marson, D. C. (2017). Neurocognitive predictors of declining financial capacity in persons with mild cognitive impairment. *Clinical Gerontologist, 40,* 14–23. http://dx.doi.org/10.1080/07317115.2016.1228022

Nijmeijer, J. S., Minderaa, R. B., Buitelaar, J. K., Mulligan, A., Hartman, C. A., & Hoekstra, P. J. (2008). Attention-deficit/hyperactivity disorder and social dysfunctioning. *Clinical Psychology Review, 28,* 692–708. http://dx.doi.org/10.1016/j.cpr.2007.10.003

Parker, A. M., & Fischhoff, B. (2005). Decision-making competence: External validation through an individual-differences approach. *Journal of Behavioral Decision Making, 18,* 1–27. http://dx.doi.org/10.1002/bdm.481

Peters, E., Hess, T. M., Västfjäll, D., & Auman, C. (2007). Adult age differences in dual information processes: Implications for the role of affective and deliberative processes in older adults' decision making. *Perspectives on Psychological Science, 2,* 1–23. http://dx.doi.org/10.1111/j.1745-6916.2007.00025.x

Retz-Junginger, P., Giesen, L., Philipp-Wiegmann, F., Rösler, M., & Retz, W. (2017). Der Wender-Reimherr-Selbstbeurteilungsfragebogen zur adulten ADHS [Wender-Reimherr self-report questionnaire on adult ADHD]. *Der Nervenarzt, 88,* 797–801. http://dx.doi.org/10.1007/s00115-016-0110-4

Rook, D. W. (1987). The buying impulse. *The Journal of Consumer Research, 14,* 189–199. http://dx.doi.org/10.1086/209105

Rösler, M., Retz-Junginger, P., Retz, W., & Stieglitz, R. (2008). *Homburger ADHS-skalen für erwachsene. untersuchungsverfahren zur syndromalen und kategorialen diagnostik der aufmerksamkeitsdefizit-/hyperaktivitätsstörung (ADHS) im erwachsenenalter* [Homburg ADHD scales for adults. Tools for the syndromal and categorial diagnostic of attention-deficit/hyperactivity disorder (ADHD) in adulthood]. Göttingen, Germany: Hogrefe.

Scheres, A., Tontsch, C., & Thoeny, A. L. (2013). Steep temporal reward discounting in ADHD-combined type: Acting upon feelings. *Psychiatry Research, 209,* 207–213. http://dx.doi.org/10.1016/j.psychres.2012.12.007

Schuhfried, G. (2013). *Vienna test system (VTS) 7 (Version 7.3.00)*. Moedling, Austria: SCHUHFRIED.

Scott, S. G., & Bruce, R. A. (1995). Decision-making style: The development and assessment of a new measure. *Educational and Psychological Measurement, 55,* 818–831. http://dx.doi.org/10.1177/0013164495055005017

Shaw, P., Stringaris, A., Nigg, J., & Leibenluft, E. (2014). Emotion dysregulation in attention deficit hyperactivity disorder. *The American Journal of Psychiatry, 171,* 276–293. http://dx.doi.org/10.1176/appi.ajp.2013.13070966

Sherod, M. G., Griffith, H. R., Copeland, J., Belue, K., Krzywanski, S., Zamrini, E. Y., . . . Marson, D. C. (2009). Neurocognitive predictors of financial capacity across the dementia spectrum: Normal aging, mild cognitive impairment, and Alzheimer's disease. *Journal of the International Neuropsychological Society, 15,* 258–267. http://dx.doi.org/10.1017/S1355617709090365

Sibley, M. H., Campez, M., & Raiker, J. S. (2017). Reexamining ADHD-related self-reporting problems using polynomial regression. *Assessment, 26,* 305–314.

Sonuga-Barke, E. J. (2003). The dual pathway model of AD/HD: An elaboration of neuro-developmental characteristics. *Neuroscience and Biobehavioral Reviews, 27,* 593–604. http://dx.doi.org/10.1016/j.neubiorev.2003.08.005

Sørensen, L., Sonuga-Barke, E., Eichele, H., van Wageningen, H., Wollschlaeger, D., & Plessen, K. J. (2017). Suboptimal decision making by children with ADHD in the face of risk: Poor risk adjustment and delay aversion rather than general proneness to taking risks. *Neuropsychology, 31,* 119–128. http://dx.doi.org/10.1037/neu0000297

Spicer, D. P., & Sadler-Smith, E. (2005). An examination of the general decision making style questionnaire in two U. K. samples. *Journal of Managerial Psychology, 20,* 137–149. http://dx.doi.org/10.1108/02683940510579777

Suto, W. M. I., Clare, I. C. H., Holland, A. J., & Watson, P. C. (2005). Capacity to make financial decisions among people with mild intellectual disabilities. *Journal of Intellectual Disability Research, 49,* 199–209. http://dx.doi.org/10.1111/j.1365-2788.2005.00635.x

Tucha, L., Fuermaier, A. B. M., Koerts, J., Aschenbrenner, S., Lange, K. W., & Tucha, O. (2014). *Vienna test system MANUAL cognitive functions ADHD—Adults (CFADHD)*. Moedling, Austria: Schuhfried.

Verplanken, B., & Herabadi, A. (2001). Individual differences in impulse buying tendency: Feeling and no thinking. *European Journal of Personality, 15,* S71–S83. http://dx.doi.org/10.1002/per.423

Webber, L. S., Reeve, R. A., Kershaw, M. M., & Charlton, J. L. (2002). Assessing financial competence. *Psychiatry, Psychology and Law, 9,* 248–256. http://dx.doi.org/10.1375/pplt.2002.9.2.248

Wechsler, D. (2008). *Wechsler adult intelligence scale* (4th ed.). San Antonio, TX: Pearson.

Wechsler, D. (2012). *WAIS-IV-NL: Wechler Adult Intelligence Scale, 4th ed*. Amsterdam, the Netherlands: Pearson Assessment and Information B. V.

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