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Mentalization in adults with attention deficit hyperactivity disorder: Comparison with controls and patients with borderline personality disorder

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ABSTRACT

Emotion dysregulation and interpersonal hardships constitute core features of borderline personality disorder (BPD). Research has established the link between these core dysregulations and fluctuations in the capacity to appreciate the mental states that underlie behavior (mentalizing, operationalized as reflective functioning (RF)). As emotion dysregulation and interpersonal hardships also characterize adults with attention deficit hyperactivity disorder (ADHD), this study sought to examine the potential RF impairments affecting this population. 101 adults with ADHD, 108 with BPD and 236 controls were assessed using the RF questionnaire (RFQ), evaluating how individuals employ information about mental states to better understand their own and others' behaviors. The RFQ comprises two dimensions, certainty (RF_c) and uncertainty (RF_u) about mental states. RF scores helped distinguish ADHD from controls, but also from BPD ($F = 48.1_{(2/441)}$; $p < 0.0001$ for RF_c and $F = 92.5_{(2/441)}$; $p < 0.0001$ for RF_u). The ADHD group showed intermediary RF scores compared to the controls ($b = -0.70$; $p < 0.0001$ and $b = 0.89$; $p < 0.0001$ for RF_c and RF_u) and BPD group ($b = 0.44$; $p = 0.001$ and $b = -0.56$; $p = 0.001$ for RF_c and RF_u). Lower RF scores correlated with poor anger control and high levels of impulsivity. Higher severity of ADHD (more attentional and hyperactive/impulsive symptoms) was correlated with RF impairments. In conclusion, RF may constitute an important process underlying attentional, hyperactive/impulsive as well as emotional symptoms in ADHD; it should therefore be considered in the assessment of these patients.

1. Introduction

Attention deficit hyperactivity disorder (ADHD) and borderline personality disorder (BPD) share a number of key clinical features, namely impulsivity, emotion dysregulation and interpersonal difficulties (Prada et al., 2014). Developmentally, ADHD represents a potential risk marker for the emergence of BPD in adulthood (Faraone et al., 2003; Matthies and Philipsen, 2014). Furthermore, the development of social cognitive processes, subsumed under the term of mentalizing, appears to be altered in both disorders, which seems to critically contribute to emotional dysregulation and dysfunctions in interpersonal relationships (Bateman and Fonagy, 2004, 2016; Jeung and Herpertz, 2014; Uekermann et al., 2010). Mentalizing encompasses the processes sustaining the attribution of intentional mental states underlying one's own and others' behaviors; for research purposes, it has been operationalized as the psychological process called reflective functioning (RF) (Fonagy et al., 2002). RF is a multidimensional construct that partially overlaps with more narrowly defined social cognitive constructs, such as empathy (targeting the affective and cognitive understanding others' emotions), theory of mind (targeting the cognitive understanding of others' beliefs), and mindfulness (targeting emotional self-awareness), but which seeks to capture the complexity of thinking both about self and others, in emotional as well as cognitive terms, within the interpersonal context (for further discussion on mentalizing dimensions, see (Choi-Kain and Gunderson, 2008; Fonagy and Luyten, 2009). Having good RF implies the acknowledgement of the

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opaqueness of mental states, while being able to form a relatively sensitive model of the mind of oneself and others. This reflective way of thinking about interpersonal relationships helps us to predict, manage and give meaning to one's self and others' behaviors and intentions, and reduces experiences of confusion, loss of control and distrust when faced with strong emotions in ourselves or others. RF is thus fundamental for developing one's sense of agency and sustaining an individual sense of continuity and coherence over time and situation (Fonagy et al., 2002) Consecutively, RF participates in the management of difficult interpersonal situations by helping regulation of distressing feelings.

Pertinently to ADHD, the consolidation of robust RF is dependent upon attentional control and emotional self-regulation during early development (Fonagy et al., 2002). In this perspective, ADHD as a neurodevelopmental disorder may hamper the development of RF. In this context, it appears warranted to examine potential RF deficits in ADHD, in contrast to healthy controls as well as to impaired RF typically observed in BPD.

Several studies attest to the disruptive role of ADHD symptoms along the developmental cascade of acquisitions in social cognition. For example, inattentive symptoms of ADHD have been shown to be associated with the impaired affect recognition abilities found in ADHD subjects (Herrmann et al., 2009; Ibanez et al., 2011; Uekermann et al., 2010). Furthermore, the severity of impairment in first- and second-order Theory of Mind (ToM) tasks observed in ADHD children has sometimes been compared to deficits observed in subjects suffering from autistic spectrum disorders (Bora and Pantelis, 2016); these impairments appear to contribute, at least partly, to social functioning in youths with ADHD (Caillies et al., 2014; Da Fonseca et al., 2009; Ibanez et al., 2011).

Attention deficits might also partially account for the lack of empathy (a construct closely linked to mentalizing) often observed in subjects suffering from ADHD; difficulties to focus attention while interacting with someone could certainly lead to difficulties in understanding their feelings and the ability for cognitive and emotional perspective-taking (Braaten and Rosen, 2000; Deschamps et al., 2015; King et al., 2009; Marton et al., 2009; Matthys et al., 1999; Roy et al., 2013). Taking these findings into account, one might hypothesize that the lack of empathy and the poor social cognition found in ADHD subjects is partly the result of poor RF. Although partially overlapping, RF aims at different targets than empathy and mindfulness, as it typically tries to increase interpersonal understanding and to regulate relationships by helping the subject consider the self-in-relation to others and vice versa (Fonagy and Bateman, 2011).

One potential objection to the role of mentalizing in ADHD may come from the argument that to date, it is mindfulness, rather than mentalizing, that has been heralded as the principle social cognitive mechanism underlying ADHD manifestations. ADHD subjects display deficits in mindfulness skills all along their development (Cairncross and Miller, 2015). Mindfulness is defined as receptive *attention* to present experience, with both state and trait qualities (Smalley et al., 2009). Given the primary role of attention in mindfulness, including dimensions such as the capacity to focus attention on what is experienced here and now, it is clear how the mindfulness construct yields mechanistic clarity to impairments in adults with ADHD (Smalley et al., 2009). Moreover, mindfulness-based therapy has shown to be effective in ADHD subjects (Mitchell et al., 2015). Yet, as any other construct, mindfulness is unlikely to account, by itself, for the complexity of ADHD manifestations. Similarly to mentalizing, mindfulness can be said to implicate imaginative processes dedicated to better understanding one's intentional mental states when determining one's behavior; however it does not explicitly include the orientation of attention to others' mental states (Kabat-Zinn and Hanh, 2009). Furthermore, mindfulness is better recognized as facilitating self-regulation, while mentalizing typically seeks to enhance interpersonal understanding and better regulate relationships, and critically requires the consideration of the self-in-relation to others and vice versa (Fonagy and Bateman, 2011). Therefore, the potential importance of mentalizing in the social cognitive patterns of ADHD cannot entirely be accounted for by mindfulness skills.

The main objective of this study was to examine the potential involvement of impairments of RF/mentalizing, as measured by the Reflective Functioning Questionnaire (RFQ) (Badoud et al., 2015; Fonagy et al., 2016), in a sample of adults suffering from ADHD. First, we compared impairments in RF between ADHD, BPD patients and a healthy control group. Since ADHD patients, compared to controls, have emotion dysregulation and interpersonal difficulties, although at a lesser level than BPD subjects (Nicastro et al., 2016; Prada et al., 2014), we hypothesized that patients with ADHD would score somewhere in between BPD patients and controls on RF. Secondly, as mindfulness skills are believed to be closely related to RF, we wanted to explore whether RF scores would help distinguish ADHD subjects from control subjects and from BPD subjects, over and above effects attributable to mindfulness skills. Finally, we expected RF scores to be associated with current severity of ADHD symptoms (i.e., a higher level of attentional and impulsive/hyperactivity symptoms would be correlated with lower RF capacities) and other clinical dimensions, such as anger control/expression, impulsivity and social functioning.

2. Methods

2.1. Participants

101 adult outpatients suffering from ADHD (female = 41 (41%), Mage = 33.48, SDage = 10.45), and 108 suffering from BPD (female = 101 (94%), Mage = 32.01, SDage = 9.54) were recruited in a specialized center for the diagnosis and care of adults suffering from these disorders at the University Hospitals of Geneva, Switzerland. 236 controls (female = 154 (65%), Mage = 23.27, SDage = 2.69) were recruited from the local Geneva community through written advertisements and word of mouth. The only inclusion criterion was to a minimum age of 18.

2.2. Diagnostic procedure

Participants with ADHD were examined by either general practitioners or psychiatrists for an initial assessment or re-assessment of ADHD psychiatric status. These patients were screened for BPD using the borderline symptom list (BSL-23), assessing specific symptoms of BPD (Nicastro et al., 2016). Subjects positively screened for BPD were then assessed by three trained psychiatrists (NP, SW and PP). Only subjects with ADHD, but without comorbid BPD, were included in the ADHD group. ADHD diagnosis was established according to the DSM-5 criteria, based on a clinical interview with trained psychiatrists. Five or more inattentive and/or hyperactive-impulsive symptoms were required and must have been present before the age of 12. The number of symptoms was used to determine the ADHD presentation (see Table 1). A semi-structured interview assessing childhood and adulthood ADHD based on DSM-IV criteria (DIVA 2.0) ("Entretien diagnostique pour le TDAH chez l'adulte") (Kooij and Francken, 2010) was administered to participants with ADHD. In addition, all subjects with ADHD completed the Wender Utah Rating Scale (WURS) (Ward et al., 1993), a self-report questionnaire assessing the severity of childhood ADHD, and the Adult ADHD Self-Report Scale (ASRS v1.1) (Romo et al., 2010), which assesses the severity of adult ADHD.

BPD patients were referred by their physician or other medical services, due to severe suicidal or self-damaging behaviors and/or emotional dysregulation. Patients were interviewed by a trained psychologist using the Screening Interview for Axis II Disorder (SCID-II) (First et al., 1997) BPD part; only those meeting DSM-IV/V criteria for BPD were accepted in the program. The ASRS v1.1 was used to screen for comorbid ADHD. Subjects positively screened for ADHD were then

Table 1
Clinical and demographic characteristics of ADHD and BPD subjects.

Table 1		ADHD (N = 101)		BPD (N = 108)				BPD + ADHD (N = 40)		BPD-ADHD (N = 68)			
		Mean	SD	Mean	SD	t	p	Mean	SD	Mean	SD	t	p
	Age	33.48	10.45	32.01	9.54	−1.06	0.29	30.45	10.1	32.93	9.15	−1.31	0.19
ADHD severity	ASRS Total Score	45.95	11.94	44.66	12.8	−0.65	0.52	50.3	12.4	42.34	11.22	3.08	0.0027
	ASRS Attentional	25.21	6.55	23.75	7.44	−1.31	0.19	25.88	7.55	22.86	6.69	1.94	0.06
	ASRS Hyp/impul	20.74	7.15	20.91	6.44	0.15	0.88	24.42	6.28	19.49	5.69	3.77	0.0003
Psychological distress	BDI	21.18	13.37	35.72	10.2	8.2	< 0.0001	35.3	10.8	35.98	9.94	−0.29	0.77
	BHS	7.79	4.74	12.59	5.09	6.5	< 0.0001	11.88	4.97	12.99	5.52	0.96	0.33
Cognitive functioning	KIMS AwJ	25.13	7.15	19.18	9.38	−4.74	< 0.0001	17.56	9.18	20.2	9.46	−0.23	1.21
	KIMS AwA	22.06	6.42	20.64	9.83	−1.15	0.25	18.21	9.24	22.15	9.98	−1.74	0.08
	KIMS Des	24.71	6.1	19.95	9.67	−3.95	0.0001	18.08	9.33	21.11	9.8	−1.35	0.18
	KIMS Obs	37.96	8.17	33	15.2	−2.74	0.007	30.11	14.3	34.8	15.66	−1.33	0.19
	KIMS Total Score	109.86	15.22	92.31	38.8	−4.01	0.0001	81.69	38.6	98.26	38.04	−1.8	0.08
Symptoms dimensions	STAXI Trait Anger	23.7	6.28	27.16	6.78	3.58	0.0004	29.12	6.47	25.95	6.74	2.16	0.03
	STAXI State Anger	18.63	7.26	23.81	8.04	4.58	< 0.0001	24.54	8.37	23.36	7.87	0.66	0.51
	STAXI Anger In	20.65	5.77	21.67	4.79	1.29	0.19	20.64	4.77	22.3	4.73	−1.58	0.12
	STAXI Anger Out	15.11	4.46	18.57	5.9	4.52	< 0.0001	20.58	5.51	17.35	5.84	2.55	0.01
	STAXI Anger Control	22.38	4.56	18.85	5.2	−4.9	< 0.0001	17.73	4.67	19.54	5.43	−1.59	0.12
	BIS Motor	22.95	8.14	25.68	8.48	2.23	0.03	30.82	7.39	22.54	7.56	4.99	< 0.0001
	BIS Attentional	25.58	6.49	23.74	7.23	−1.82	0.07	26.33	7.12	22.15	6.89	2.71	0.008
	BIS Non-planning	22.13	7.32	23.31	7.58	1.08	0.28	27.38	7.19	20.83	6.75	4.29	< 0.0001
	BIS Total Score	70.65	15.86	72.73	19.2	0.8	0.42	84.53	17.3	65.51	16.57	5.11	< 0.0001
		N	%	N	%	x2	p	N	%	N	%	X2	p
ADHD type	Attentional	31	30.69	–	–	–	–	15	37.5	–	–	–	–
	Hyp./impul.	6	5.94	–	–	–	–	2	5	–	–	–	–
	Combined	64	63.37	–	–	–	–	23	57.5	–	–	–	–
Lifetime/current mood disorder	yes	52	51.49	94	87	10.55	< 0.0001	32	80	62	91.18	2.79	0.095
	no	49	48.51	14	13			8	20	6	8.82		
Psychostimulants	yes	31	30.69	24	22.2	1.93	0.165	24	60	0	0	–	–
	no	70	69.31	84	77.8			16	40	68	100	–	–
Antidepressants and mood stabilizers	yes	28	27.72	67	62	24.78	< 0.0001	29	72.5	38	55.88	2.95	0.086
	no	73	72.28	41	38			11	27.5	30	44.12		

assessed by three trained psychiatrists (NP SW and PP). In addition, the French version of the Diagnostic Interview for Genetic Studies (DIGS) was used to assess Axis I disorders (Preisig et al., 1999). Those with severe cognitive impairments, severe depressive episodes, mania and hypomania, and/or psychotic symptoms that require more intensive care or hospitalization were not taken in the center.

40 subjects were diagnosed with a comorbid disorder (BPD + ADHD) and were first included in the sample of 108 BPD subjects. As BPD is thought to be the diagnosis paradigmatically associated with impaired mentalizing capacities, we were expecting that subjects presenting a comorbid disorder would naturally display very low mentalizing capacities, and thus included them in the BPD group. As stated above, the same clinicians (NP, SW or PP), having extensive experience in the evaluation of both ADHD and BPD, assessed all subjects. This procedure increases our confidence that ADHD subjects were BDP-free, and that BDP subjects without ADHD were not comorbid.

Control subjects were assessed with the Symptom Checklist-90-Revised (SCL-90-R) (Pariente and Guelfi, 1990) and Adult Self-Report scales (Achenbach and Rescorla, 2003), which assess global functioning and general psychopathological domains. 167 (female = 116 (69.5%), Mage = 23.38, SDage = 2.63) of these subjects had a standardized score below 63 (t-score) on the SCL-90-R and corresponding low Adult Self-Report scores, which denote a low level of clinical psychopathology; they were thus expected to be free from any psychiatric disorders (Derogatis, 2000). Analyses of the control participants were first conducted with the entire sample, and then with the 167 subjects "more reliably" expected to be free from any psychiatric disorders.

The local institutional ethical review board of the University Hospitals of Geneva approved the study and all participants gave written informed consent before participating. The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008.

2.3. Measures

Participants with ADHD completed the Barratt Impulsiveness Scale (BIS-11), which assesses the three components of impulsivity: motor (behavior), attentional (cognitive) and non-planning (self-control and cognitive complexity) (Bayle et al., 2000). They also completed the State-Trait Anger Expression (STAXI), which estimates the experience and expression of anger (Spielberger, 1998). In order to assess current severity of depression and hopelessness, the Beck Depression Inventory and the Beck hopelessness scale (BHS) were used. The Kentucky Inventory of Mindfulness Skills (KIMS), a 39-item self-report questionnaire, was used to assess four facets of mindfulness: observing (*Obs*), or the ability to pay attention to what is noticeable in the present moment; describing (*Des*), or the ability to describe what is experienced and observed; Acting with Awareness (*AwA*), or the ability to engage in

activities or experiences, maintaining the focus of attention on whatever is being experienced without trying to avoid a painful feeling or extend a pleasant moment; Accepting without Judgment (*AwJ*), or the ability to accept what is observed in a nonjudgmental way rather than to evaluate the experience as good or bad, right or wrong. Finally, we assessed the social functioning with the *"Questionnaire de Fonctionnement Social"* (QFS – Social functioning questionnaire), which is a 16-item self-report questionnaire assessing the frequency of, and the satisfaction with, social behavior (Zanello et al., 2006). With the exception of the WURS, the QFS and the DIVA 2.0, subjects with BPD completed the same questionnaires as subjects with ADHD. In addition, all controls completed the KIMS.

2.3.1. Assessment of mentalizing

The *Reflective Functioning Questionnaire, brief version* (RFQ) (Badoud et al., 2015; Fonagy et al., 2016) was employed to assess RF, and more specifically the self–reported tendency to consider information on intentional mental states as relevant in understanding one's and others' behaviors, adapted from the self-report developed in English (Fonagy et al., 2016). It included eight items (e.g. "People's thoughts are a mystery to me"), rated on a seven-point scale (see Supplementary Fig. S1 for list of items). The scoring procedure yields two subscales measuring respectively the *Certainty* (RF_c) and the *Uncertainty* (RF_u) about mental state information, or how confident versus doubtful one is that actions are intrinsically intentional or motivated by internal mental states, such as emotions, thoughts or needs. Scores above the average range in RF_c describe people who have rigid certainty about the mental states they attribute to themselves and others, while mid-range scores designate people who typically engage in thinking about how mental states influence behaviors. At the opposite, above-average scores in RF_u signal individuals who do not typically employ mental state knowledge to understand actions. At the extreme, this will define people whose stance is characterized by an almost complete failure to take into account mental state information about themselves and others. Average-range scores on uncertainty reflect some acknowledgement of the opaqueness of one's own mental states and those of others.

In this study, the French version of the RFQ was used. This version of the scale was translated and validated in French by the authors (Badoud et al., 2015).

2.4. Statistics

Several analyses were done:

1. *Clinical and demographic differences between groups:* Student *t*-test was used to compare clinical and demographic data between ADHD and BPD groups, and between BPD with and without comorbid ADHD.
2. *Between-group differences in RFQ*: One-way analysis of covariance (ANCOVA), adjusted for age and gender, was used to assess between-group differences (controls, ADHD and BPD) in RF_c and RF_u scores. Linear regressions with adjustment on age and gender (with RF_c and RF_u scores as dependent variables) were secondarily used to assess differences between two groups (ADHD vs. Controls; ADHD vs. BPD; BPD with ADHD vs. BPD without ADHD, and so on). In order to ensure that the association between RF and ADHD was not better explained by depression severity, an ADHD group with no or minimal depression (BDI score $\leq$ 13; N = 34) was compared to the entire sample of controls in a linear regression, with RF_c and RF_u as dependent variables. In order to ensure that our results were not better explained by gender difference between groups, the analyses were repeated in the women-only sample. The results were unchanged, with the same level of significance and the same magnitude of effect. In addition, when the men-only sample was taken into account, the results remained unchanged.
3. *Predictive models of belonging to the ADHD group, disentangling the effects of RF and mindfulness on group affiliation (ADHD vs. Controls vs. BPD):* Logistic regressions using group membership (controls, ADHD and BPD) as dependent variables, and RF capacities and mindfulness skills as independent variables, with adjustment on age and gender, were used to disentangle how strongly RFs are associated with ADHD diagnosis, independently of mindfulness skills.
4. *Associations and correlations between RF certainty, uncertainty, and other variables:* Linear regressions were used to assess how RF_c and RF_u (as dependent variables) correlated with a number of variables: severity of adult ADHD and clinical dimensions (anger control/expression and impulsivity), and social functioning. In order to ensure that the associations linked to RF were independent of other confounding variables, linear regressions were adjusted on current severity of depression (to ensure that the associations were independent of mood states), and KIMS total score (to ensure that the associations were independent of mindfulness skills). In addition, clinical status (ADHD or BPD), age and gender were also added as a covariate to the models.

All analyses were conducted with STATA v13. All analyses were performed with z transformed (standardized) variables ((score-mean)/SD), and results of regressions may therefore be interpreted as effect sizes.

3. Results

3.1. Clinical and demographic differences between groups

Table 1 describes the clinical and demographic characteristics of ADHD and BPD groups. Taking into account the control group, there was a significant between-group difference in gender ($p < 0.0001$) and age ($p < 0.0001$); these variables were therefore used as covariates in the analyses of group comparisons. Nevertheless, as no difference in age was found between ADHD and BPD subjects, age was not used as covariate in the analyses comparing these two populations. In comparison to the BPD group, the ADHD group exhibited significantly-lower levels of depression, globally improved mindfulness skills, better anger control, less hopelessness, and less motor impulsivity. When comparing BPD with comorbid ADHD to those without the comorbidity, the former scored higher on the ASRSv1.1 (measuring current symptoms and severity of ADHD), mainly on the hyperactive/impulsive symptoms, had more anger directed outwardly, and were globally more impulsive than the latter.

3.2. RF certainty and uncertainty between groups

With regard to reflective functioning, there were significant group differences in both RF_c ($F = 48.1_{(2/441)}$; $p < 0.0001$) and in RF_u ($F = 92.5_{(2/441)}$; $p < 0.0001$). The same picture was found when considering BPD subjects without comorbid ADHD in the group comparison analysis ($F = 61.2_{(2/330)}$; $p < 0.0001$ and $F = 106.5(2/3330)$; $p < 0.0001$ for RF_c and RF_u respectively). The ADHD group showed intermediary RF_c and RF_u scores compared to the controls (beta (b) = −0.70; $p < 0.0001$ and b = 0.89; $p < 0.0001$ for RF_c and RF_u respectively) and BPD group (b = 0.44; p = 0.001 and b = −0.56; p = 0.001 for RF_c and RF_u respectively) (Fig. 1). The results were comparable when considering controls with an SCL-90-R score < 63 (Fig. 1). The ADHD group displayed higher RF_c and lower RF_u, even when compared to the BPD without ADHD group (b = 0.38; p = 0.015 and b = −0.43; p = 0.017). Of note, there was an combined effect of diagnoses; having both disorders (ADHD + BPD) was associated with the most impaired RF scores compared to BPD without comorbidity and ADHD (moving from BPD + ADHD to BPD-ADHD to ADHD was associated with a significant decrease of RF_c and a significant increase of RF_u: b = −0.28; p = 0.0001 and b = 0.44; $p < 0.0001$ respectively). Indeed, the comorbid BPD + ADHD group had lower (trend-like significance) RF_c and

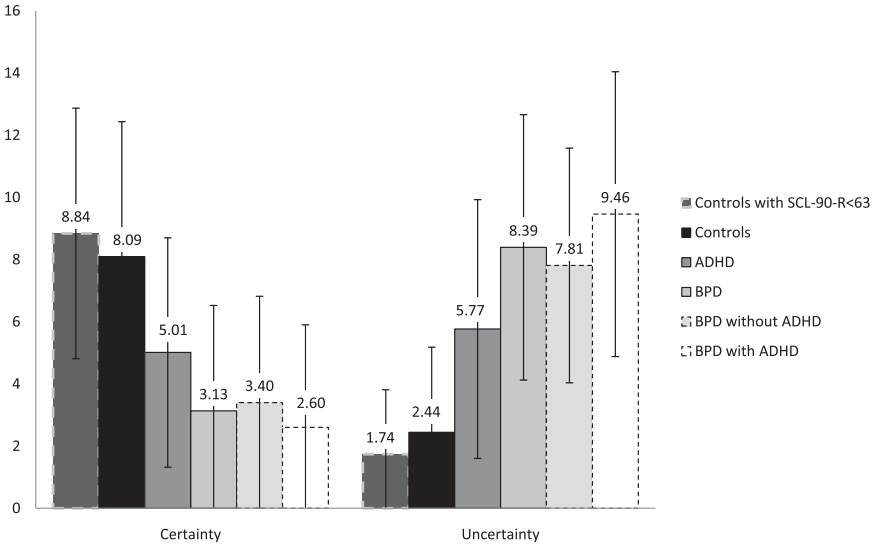

Fig. 1. Scores (Mean) of certainty and uncertainty for controls, controls with SCL-90-R scores below 63 (t-score), ADHD subjects, BPD subjects and BPD with and without comorbid ADHD. Error bars = Standard Deviation.

higher RF_u than non-comorbid BPD (b = −0.20; p = 0.076 and b = 0.39; p = 0.058).

When comparing the ADHD group with no or minimal depression (BDI score ≤ 13; N = 34) to the whole sample of controls, the ADHD group still scored significantly lower in RF_c and higher in RF_u scores (b = −0.47; p = 0.008 and b = 0.48; p = 0.0002 respectively).

There was no association between medication (antidepressants/mood stabilizers and psychostimulants) and RFQ subscales.

3.3. Predictive models of belonging to the ADHD group and influence of Mindfulness on group affiliation (ADHD vs. Controls vs. BPD)

RF_c and RF_u significantly predicted group affiliation (belonging to the ADHD group compared to controls), with respectively 9% and 14% of the variance explained (OR = 0.44 (CI = 0.33–0.58), p < 0.0001 and OR = 3.28 (CI = 2.3–4.6), p < 0.0001 for one standard deviation change in the score of RF_c and RF_u respectively) (Additional Fig. S2).

As illustrated in Fig. 2, ADHD subjects had impaired mindfulness capacities compared to controls subjects, although these were still better than in BPD subjects. When adding KIMS *Obs, Des, AwA,* or *AwJ* to the logistic models assessing group affiliation, none of them removed the significant effect that RF_c or RF_u had on belonging to the ADHD group. All the models were significantly better when adding RF_c or RF_u to the models (Likelihood Ratio Test < 0.01), suggesting that although mindfulness skills help distinguish controls from ADHD subjects, RF independently contributes to this difference. When comparing ADHD to controls with an SCL-90-R score < 63, RF_c and RF_u predicted 15% and 25% respectively of the variance in explaining group affiliation (OR = 0.32; 95%CI from 0.22 to 0.45; p < 0.0001 and OR = 6.43; 95%CI from 3.92 to 10.55; p < 0.0001 for a change of one standard deviation in the score of RF_c and RF_u respectively).

The opposite picture was observed when comparing ADHD patients to BPD ones. RF_c and RF_u were significantly associated with belonging to the ADHD group compared to BPD, respectively with 5% and 7% of the variance explained (OR = 1.98 (CI = 1.37–2.87), P = 0.0003 and OR = 0.52 (CI = 0.39–0.71), p < 0.0001 for a change of one standard deviation in the score of RF_c and RF_u respectively). All the models were significantly better when adding RF_c or RF_u (Likelihood ratio test < 0.001). This was highlighted by the fact that when adding KIMS *Obs, Des, AwA, or AwJ*, none of these variables removed the significant effect that RF_c or RF_u had on belonging to the ADHD group.

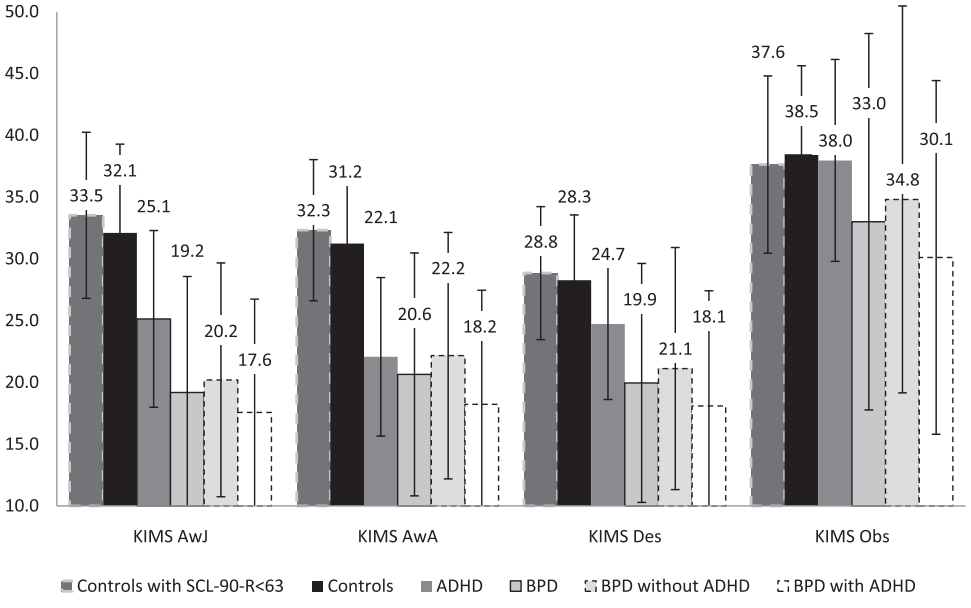

Fig. 2. Kentucky Mindfulness skills in controls, ADHD and BPD subjects.

Table 2
Results of the linear regressions (b = beta value on z-transformed variables) showing the strength of the associations between Certainty/Uncertainty and severity of ADHD and dimensional scales in the whole clinical sample, ADHD and BPD subjects.

Table 2	ADHD + BPD				ADHD				BPD			
	Certainty		Uncertainty		Certainty		Uncertainty		Certainty		Uncertainty	
	b	p*	b	p*	R	p*	R	p*	R	p*	R	p*
ASRS Total Score	−0.21	0.002	0.3	0.0001	−0.24	0.008	0.32	0.001	−0.12	0.107	0.28	0.015
ASRS Attentional	−0.18	0.009	0.24	0.003	−0.21	0.029	0.28	0.009	−0.07	0.245	0.21	0.046
ASRS Hyp/impul	−0.19	0.004	0.3	0.0001	−0.2	0.016	0.27	0.003	−0.17	0.066	0.37	0.0001
STAXI Trait Anger	−0.39	< 0.0001	0.4	< 0.0001	−0.39	< 0.0001	0.41	< 0.0001	−0.37	< 0.0001	0.4	< 0.0001
STAXI State Anger	−0.23	0.003	0.26	0.004	−0.15	0.198	0.07	0.604	−0.28	0.003	0.41	< 0.0001
STAXI Anger In	−0.14	0.026	0.18	0.014	−0.14	0.199	0.13	0.151	−0.11	0.249	0.19	0.098
STAXI Anger Out	−0.36	< 0.0001	0.46	< 0.0001	−0.47	< 0.0001	0.62	< 0.0001	−0.29	0.0003	0.36	0.0001
STAXI Anger Control	0.32	< 0.0001	−0.35	< 0.0001	0.35	< 0.0001	−0.39	< 0.0001	0.28	0.002	−0.32	0.001
BIS Motor	−0.35	< 0.0001	0.37	< 0.0001	−0.4	< 0.0001	0.39	< 0.0001	−0.27	0.002	0.36	0.002
BIS Attentional	−0.21	0.001	0.18	0.016	−0.17	0.089	0.06	0.569	−0.21	0.012	0.28	0.009
BIS Non-planning	−0.15	0.021	0.12	0.113	−0.01	0.919	0.1	0.301	−0.3	0.001	0.15	0.23
BIS Total	−0.32	< 0.0001	0.31	< 0.0001	−0.3	0.002	0.32	0.003	−0.31	< 0.0001	0.3	0.004

p* = P values from linear regression analyses after adjustment on age, gender, current severity of depression (BDI) and KIMS total score (and category of diagnosis for the analyses related to the whole sample).

3.4. Associations and correlations between RF certainty, uncertainty and other variables

In the sample combining BPD and ADHD subjects, using linear regression with adjustment for age, gender, main diagnostic category (BPD or ADHD), KIMS total score and current severity of depression, RF_c and RF_u were significantly associated with severity of ADHD for both the attentional and hyperactive/impulsive levels. Both dimensions of RF were also associated with disposition towards anger, its expression and control, and with measures of impulsivity (with only the association between RF_u and non-planning being not significant) (Table 2). The results followed the same direction and magnitude for all the variables when looking at the ADHD and BPD patients separately (Table 2).

In the ADHD group only, after adjustment on age, gender, and KIMS total score, RF_u had a significant impact on social functioning (satisfaction) (b = −0.21; p = 0.032).

4. Discussion

This study reports on reflective functioning (RF) in ADHD, in comparison to BPD and healthy control groups. We found that participants with ADHD reported RF scores at mid-point between controls and participants with BPD. Consistently with our hypothesis, we observed that severity of ADHD was negatively correlated with RF scores on the RFQ-B. We also found that disposition towards anger and poor anger control were significantly associated with low RF scores in the ADHD group. We finally found that RF, as measured by certainty and uncertainty about the value of intentional mental state information when attempting to understand one's or others' behaviors, can significantly help distinguish ADHD subjects from controls and BPD subjects, independently of mindfulness skills.

Our results suggest that in comparison to controls, participants with ADHD scored lower on RF *certainty*, and higher on RF *uncertainty*. On the one hand, a low certainty score suggests they do not regularly engage in mental state thinking when trying to understand their own or others' behaviors. On the other hand, a high score on the uncertainty subscale suggests a lack of mental state information in their experience of their actions and those of others. Given that the instrument we used is a self-report, we cannot say whether the subscale scores relate to impairments in orienting towards or recognizing intentional mental states, or whether it consists in a repudiation of the value of mental state information, as may be the case in antisocial personality disorder.

More generally, the results are consistent with previously published work on ToM and mindfulness in ADHD, and may suggest, although indirectly and based on a cross-sectional study, that the basic psychological building blocks and partially overlapping social cognitive processes are already altered during development and may impair the emergence of robust mentalizing. It appears that in children with ADHD, negative emotions yield the greatest difficulties in recognition (Pelc et al., 2006; Rapport et al., 2002; Singh et al., 1998), and that this pattern of difficulties persists into adulthood (Cadesky et al., 2000; Rapport et al., 2002). Further studies are required to understand the developmental interactions that may link emotion recognition skills to mentalizing in ADHD, and to interpersonal difficulties they often experience (Hoza et al., 2005; Mannuzza and Klein, 2000; Owens et al., 2009).

In terms of psychopathology severity, it is interesting to note that participants with comorbid BPD + ADHD achieved the worst RF functioning scores (highest *uncertainty*, lowest *certainty*). It is tempting to interpret a possible combined effect of both disorders on mentalizing. From a developmental and clinical perspective, it has been hypothesized that mentalizing constitutes a protective factor that works against the emergence of psychopathology (Fonagy et al., 1994). In this scenario, the multiple obstacles for developing solid mentalizing skills in ADHD, as well as in BPD, may pave the way to more comorbid, more severe psychopathology. This is consistent with recent longitudinal cohort studies, which suggest that severe psychopathology emerges through comorbidity and agglomerates around a single severity factor, called *p* (psychopathology) factor (Caspi et al., 2014). One hypothesis is that mentalizing, together with other higher-order cognitive processes (HOC), such as mindfulness, metacognition, etc. (Rudrauf, 2014), enhance resilience by providing re-routing of cognitive functions in the face of neurodevelopmental adversity. Pertinently to the development of mentalization-based interventions for ADHD, we found that *certainty* and *uncertainty* scores were correlated to the severity of current ADHD, regardless of the diagnosis. These results may bear clinical significance in suggesting early intervention and prevention studies focusing of specific social cognitive domains in ADHD. One of the main issues in the field of ADHD research lies in the determination of individual factors associated with the persistence or discontinuation of the disorder in adulthood. Although some factors have already been highlighted, such as childhood/adolescence maltreatment, interpersonal hardships or higher levels of emotion dysregulation, clinicians are still struggling to prevent the persistence of the disorder in adulthood. Based on our results showing the importance of RF in ADHD, we believe that targeting protective factors early in development, by means of targeted interventions that may be informed by mentalization-based treatment

(MBT), may help prevent the persistence of ADHD into adulthood, and also help prevent the development of comorbidities such as mood disorders and personality disorders that are often found in ADHD.

Interestingly, we found an association between poor mentalizing and the difficulty to control anger in the ADHD group. This strengthens the case for a critical association between mentalizing and emotion dysregulation in subjects with ADHD and in patients with BPD. Furthermore, this relationship is independent of a number of potential confounding variables. Emotion dysregulation is now considered as an additional dimension in ADHD, alongside attention deficit, hyperactivity and impulsivity (Reimherr et al., 2005; Shaw et al., 2014). Our results shed new light on this important domain of ADHD. Along these lines, our analyses in relation to ADHD found that higher RF uncertainty was associated with lower satisfaction in the domain of social functioning, independently of mindfulness skills. This further suggests that mentalizing constitutes a set of key processes that regulate interpersonal functioning in ADHD, as well as quality of life (as measured by the QFS in our study).

This study has several limitations. Firstly, the use of a self-report questionnaire is possibly less exhaustive than a clinician-rated one in the assessment of RF capacities (Fonagy et al., 1998). We used the RFQ-B as the only validated tool in French for assessing reflexive functioning, and these preliminary results justify further studies of the role RF plays in ADHD. Secondly, some items of the RFQ might partly overlap with the items from the ASRSv1.1, and more specifically those related to impulsivity. However, we found that the strongest association was observed with the attentional items of the ASRSv1.1, where no overlap exists. Thirdly, we did not control for other comorbidities that might hamper RF functioning, such as depressive disorder, which is more often found in BPD subjects than in ADHD ones Indeed the additive effect on RF of suffering from comorbid ADHD and BPD might be indicative of the effect attributable to the severity of the p factor, This clearly needs to be addressed in future research. Due to ceiling effect (almost all BPD patients were suffering from a lifetime comorbid mood disorder ($> 87\%$)), it was not statistically possible to adjust on lifetime comorbid mood disorder. However, we performed an adjustment on current severity of depression as a safeguard against such a bias. Fourthly, we were not able to control for other dimensions than mindfulness (such as anger disposition and/or impulsiveness) in the group comparison analyses. Controls did not complete any questionnaires other than the one dealing with mindfulness skills. However, as mindfulness is one of the main dimensions that may be confounded with RF, controlling for it ensures that our results were at least independent of this construct. Finally, at the clinical level, only 9% and 14% of the variance was explained by RF_c and RF_u in predicting group affiliation (belonging to the ADHD group compared to controls). The actual clinical relevance of this result will be assessed by the potential beneficial therapeutic effects of enhancing reflective function in ADHD.

In conclusion, we found that adults with ADHD have impaired RF and that these impairments are intrinsically linked and correlated to attentional and hyperactive/impulsive symptoms. Moreover, RF scores are associated with key features of ADHD such as impulsiveness, emotion dysregulation and mindfulness capacities. To our knowledge, the study represents the first of its kind, as it examines RF in adults with ADHD. Our results support the assessment of RF capacities in ADHD subjects, especially with regard to emotional regulation and interpersonal issues. Indeed, an improvement in maintaining attention and containing impatience, possibly by using mentalization-focussed interventions, could lead to better skills in social situations and professional performance (Roy et al., 2013). Future studies are clearly needed in this field in order to validate such a hypothesis.

Conflict of interests

N.P. has received honoraria for participating in expert panels and conferences from Lundbeck and Elli-Lilly.

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Author contribution

NP, MD, DB designed, analyzed and interpreted the data, drafted the first version of the paper, revised the final version and approved it to be published. RH, PP and RN assessed the participants of the study and helped drafting the first version of the paper. SW, RN, RH, ALK, PL, PF, AD, JMA, PP critically revised the paper for important intellectual content, and gave their final approval to the version for publication.

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Appendix A. Supplementary material

Supplementary data associated with this article can be found in the online version at http://dx.doi.org/10.1016/j.psychres.2017.06.087.

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