DOES ALEXITHYMIA HAVE A MEDIATING EFFECT BETWEEN IMPULSIVITY AND EMOTIONAL-BEHAVIOURAL FUNCTIONING IN ADOLESCENTS WITH BINGE EATING DISORDER?

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Abstract

Objective: Binge Eating Disorder (BED) has recently been included in the DSM-5. Like many other eating disorder symptoms, BED is often present in adolescence. No studies have specifically investigated the influence of impulsivity and alexithymia on the emotional-behavioural functioning of adolescents diagnosed with BED.

Method: In this study, we recruited N = 162 adolescents (age range: 14-18) and divided them into two groups: 78 adolescents diagnosed with BED, according to the DSM-5 criteria (Group A), and 84 healthy controls (Group B). Participants completed the Youth Self-Report (YSR/11-18), the Toronto Alexithymia Scale (TAS-20) and the Barratt Impulsiveness Scale (BIS-11).

Results: The results showed that Group A had higher scores of alexithymia, impulsivity and maladaptive emotional-behavioural functioning than Group B. Furthermore, alexithymia had a mediating effect on the relationship between impulsivity and emotional-behavioural functioning.

Conclusions: These results allow us to hypothesise that alexithymia is a key variable influencing the emotional and behavioural problems of adolescents affected by BED. Our data confirms the previous studies underlining the association of impulsivity and alexithymia with the diagnosis of BED in adolescents, and our study contributes to the previous literature, emphasising the central role of alexithymia in the mediating effect between impulsivity and emotional and behavioural problems. These results suggest the importance of promoting prevention and treatment polices focused on alexithymia.

Key words: binge eating disorder, adolescents, impulsivity, alexithymia, emotional-behavioral problems

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Introduction

Several studies have confirmed that Binge Eating Disorder (BED) is a validated eating disorder, distinguishable from both bulimia nervosa and obesity (Mitchell et al. 2010, Striegel-Moore and Franko 2008) and it was recently included in DSM-5 (American Psychiatric Association 2013). Subjects affected by BED show an unusually large food intake without compensatory behaviour within a discrete time period, and a subjective experience of losing control characterises the disorder. Before binge-eating episodes, subjects experience intense cravings (Schag et al. 2013).

Research has shown that subjects suffering from BED have higher levels of impulsivity (Manasse et al. 2016) and difficulties identifying and describing their own emotions (Karukivi et al. 2014). Recent studies suggest that subjects from the general population with high levels of alexithymia tend to behave more impatiently than subjects with low levels of alexithymia (Scarpazza et al. 2017). Despite the growing scientific interest in BED, few studies have investigated the role of these variables, and the present study aims to assess their role in the diagnosis of BED in adolescent populations.

Binge Eating Disorder in adolescence

The Developmental Psychopathology theoretical framework offers an integrative conceptualisation to the course of development during adolescence,

particularly the emergence of psychopathology during this developmental period (Cicchetti and Rogosch 2002). To better understand the phenomenological manifestations of psychological suffering during adolescence, it is useful to consider that adolescence is commonly divided into early (from 11 to 14 years), middle (15-17) and late adolescence (18-21; Herpertz-Dahlmann et al. 2013). Researchers have noted some peculiarities in these specific sub-stages; for instance, it has been suggested that during mid-adolescence, both boys and girls could experience the onset of depression and anxiety symptoms (Van Oort et al. 2009). More recently, Cerniglia et al. (2014) indicated the adolescence developmental period is at risk for the onset of eating disorders, which is in accordance with Pearson's studies that defined puberty as an important period for the start of binge-eating behaviours (Pearson et al. 2015). In fact, disordered eating and unhealthy eating behaviours, such as BED, have been reported to be more severe among adolescents (Darby et al. 2009, Pavlova et al. 2010). During this period in life, several biological, psychological and social changes occur (e.g. puberty, new and more intense relationships with peers and new social hierarchies; Collins and Laursen 2004, Rosenblum and Lewis 2003). These changes have been associated with adolescents' increased vulnerability to internalising problems (Allen and Sheeber 2008). During adolescence, basic neuroanatomical modifications occur, including a reduction of cerebral grey matter (probably due to synaptic pruning) and an increase of white matter (Giedd et al. 1999, Nelson and Parker 2005). Furthermore, the limbic system – associated with emotional and motivational stimuli – tends to prevail over the immature prefrontal cortex, which exercises control functions. This could explain the fluctuations of mood that are common in adolescence and that are frequently seen in subjects with eating disorders (Giedd 2009). Although such fluctuations are not necessarily a sign of a psychiatric disorder, the 'systems imbalance' of adolescence may account for the increasing incidence of affective and impulse-control disorders in this period of life (Konrad et al. 2013).

BED, along with other eating disorders, is often present in early adolescence (Tanofsky-Kraff et al. 2011). Although it is less common among males (Treasure et al. 2010), BED's prevalence in adolescents aged 14 years is 0% in males and 1.8% in females, while the same sample of adolescents aged 17 years presented 1.2% on males and 1.4% in females (Allen et al. 2013). Several studies have investigated eating disorders using adolescent participants (Lewinsohn et al. 2000, Patton et al. 2003), suggesting that many adolescents show a high rate of remission. However, further studies are needed to investigate the onset of eating disorders. If it is true that many adolescents show a remission of symptoms, it is also true that, in some cases, the disorder will persist. Stice et al. (2009) found that participants with BED and bulimia nervosa were more likely to experience symptom relapses. Furthermore, even after the eating disorder's remission, other psychiatric difficulties may develop or persist (Lewinsohn et al. 2000).

Factors associated with the Binge Eating Disorder

Some researchers have suggested that BED during adolescence can be associated with specific psychopathological profiles, typically characterised in females as internalising symptoms (e.g. withdrawal, depression) and in males as externalising symptoms (e.g.

aggressive behaviour; Zaider et al. 2002). Furthermore, Sinclair-Mc Bride and Cole (2016) found a link between depressive symptoms and binge-eating behaviours in adolescents, and Tafà et al. (2016) found that female adolescents diagnosed with BED show high symptoms of interpersonal sensitivity and psychoticism.

Besides various relevant factors, such as perfectionism (Feltman and Ferraro 2011), body shame (Mustapic et al. 2016) and feelings of guilt (Bybee et al. 1996), impulsivity has been indicated as an important individual characteristic contributing to the onset and maintenance of BED (Schag et al. 2013, Manasse et al. 2016, Scherr et al. 2010, Tambelli et al. 2017). Impulsivity can be defined as a predisposition toward unplanned reactions to external or internal stimuli; the impulsive reaction occurs without considering the possible negative consequences for the impulsive individual or for others (Moeller et al. 2001). In healthy children and adolescents, impulse control and the inhibition of irrelevant responses develop as part of more complex functions that are formed during adolescence (Christ et al. 2001, Klenberg et al. 2001, d'Acremont and Van der Linden 2005). Shulman et al. (2015) found differences between girls and boys regarding the development of impulsivity. Although boys show higher levels of impulsivity than girls, researches have highlighted that females reach peak levels of sensation-seeking earlier and decline in sensation-seeking more rapidly thereafter. Males also increase in impulse control more gradually than females. Consequently, sex differences in both impulse control and sensation-seeking increase with age (Shulman et al. 2015). Interestingly, the gender differences in impulsivity development are extremely similar to the epidemiological data regarding the onset of BED among adolescents, as collected by Allen et al. (2013).

The authors that have investigated impulsivity in eating disorders have found conflicting results. Although there are evidences that patients with binge-eating behaviours had higher scores for impulsivity compared with patients affected by anorexia nervosa-restrictive type (Claes et al. 2006, Nasser et al. 2004, Rosval et al. 2006), these studies did not consider patients diagnosed for BED but subjects with binge-eating behaviours (co-occurring in bulimia nervosa and anorexia nervosa-binge/purge type). Waxman (2009) underlines that, taken together, these findings suggest that binging and restricting behaviours may be on opposite ends of a spectrum of impulsive behaviours and that BED cohorts may be distinguished by the presence or absence of impulsive characteristics. However, this did not clarify what role impulsivity plays in the onset of binge-eating behaviours.

Some authors that have investigated impulsivity in adults have found neurobiological associations between externalising problems, impulsivity and verbal deficit (Barratt et al. 1997, Miller et al. 2008), suggesting that these deficits could disrupt the influence of language on emotional regulation. Teten et al. (2008) found that a factor involved in impulsive behaviours is alexithymia, a construct that describes an inability to recognise and articulate one's emotional experience despite an adequate emotional vocabulary (Sifneos 1973). However, there are no studies that have investigated the relationship between these variables in adolescents affected by BED.

Alexithymia appears to be a common personality trait normally distributed in the population, with a prevalence of approximately 10% among adults, and it is more commonly identified in men than in women (Franz et al. 2008). Research shows that the prevalence of alexithymia in adolescence is comparable; however,

no gender difference has been shown (Honkalampi et al. 2009). Furthermore, previous studies have showed that a limited capacity for identifying emotions can predict negative effects (e.g. fear), alcohol addiction (Craparo 2014, Craparo et al. 2014), Internet addiction (Schimmenti et al. 2017, Monacis et al. 2017) or pathological gambling (Gori et al. 2016).

Research data indicates a higher prevalence of alexithymic characteristics in adult patients with BED (Pinaquy et al. 2003, Zeeck et al. 2011). More recently, Karukivi et al. (2014) found that adolescents with binge-eating behaviours show more difficulties in recognising and communicating their emotions than do their peers. Some researchers have suggested the relationship between alexithymia and binge eating is a consequence of the subject's inadequate capacity to modulate negative effects, which favours the pursuit of the emotional relief offered by eating (Nock and Prinstein 2004).

Extensive literature reviews (e.g. Hexel 2003, Zimmermann et al. 2005) show that alexithymia and impulsivity are considered as two separate constructs.

Loftis (2012) has studied the role of alexithymia and impulsivity in the suicidal behaviour of young adults. The author found that when variables were included together in a regression model, only alexithymia remained statistically significant, suggesting that the presence of alexithymia was the stronger predictor of suicidal behaviours connected to internalising and externalising problems (Szanto et al. 2012).

The present study

Previous literature has posited that alexithymia may have a mediating role between impulsivity and emotional-behavioural functioning (Bonnet et al. 2013, Szanto et al. 2012). However, to our best knowledge, no other studies have specifically investigated the relationship between impulsivity and alexithymia in adolescents with BED and their influence on adolescents' emotional-behavioural functioning. Therefore, this study aimed to verify whether:

1. adolescents who were diagnosed with BED show higher impulsivity, alexithymia and a more maladaptive emotional-behavioural functioning when compared to adolescents from the general population;
2. alexithymia has a mediating effect between adolescents' impulsivity and their emotional-behavioural profiles.

Materials and method

Procedure and participants

Over a period of one year, N = 189 adolescents (age range: 14-17 years) contacted a network of public and private consultants in Central Italy, requesting clinical support for adolescents' disordered eating. At the time of the first assessment interview, N = 142 adolescents were diagnosed by a group of trained psychologists for Binge Eating Disorder (BED) according to the DSM-5 criteria (American Psychiatric Association 2013).

Through an anamnestic self-report questionnaire administered for the aims of this study, we excluded from the sample: adolescents who refused to participate in the study (N = 13); adolescents whose parents denied consent for their son or daughter to participate in the research (N = 16); adolescents who had already been involved in a psychological, psychiatric and/or drug

treatment (N = 17) and adolescents who were diagnosed in comorbidity with other psychiatric disorders (N = 18).

Missing data (3%) was corrected using multiple imputation in the Statistical Package for the Social Sciences, SPSS software (IBM Corp. 2013).

Finally, our clinical sample was composed of N = 78 adolescents. Furthermore, we recruited a group of adolescents from the general population, thanks to collaborations with schools in Central Italy. This group was paired with the clinical group per socio-demographic characteristics.

Thus, the research groups were as follows: Group A - adolescents diagnosed with Binge Eating Disorder (N = 78; 40 boys and 38 girls); Group B - adolescents from the general population (N = 84; 52 boys and 32 girls).

The subjects' mean age was 15.4 (s.d. = 0.85). Most of the adolescents recruited for the study lived in families with a middle socioeconomic status (84.2%; Bornstein and Bradley 2014).

In accordance with the Declaration of Helsinki, the study was approved before its start by the Ethical Committee of the Department of Dynamic and Clinical Psychology at Sapienza, University of Rome, and all adolescents' parents signed an informant consent. Before starting the treatment plan and after the assessment, the adolescents who filled out the anamnestic questionnaire (which the research group had prepared for the study) and accepted to participate in the study were administered the following self-reporting instruments. Questionnaires were administered in an a counterbalanced order (randomly decided).

Instruments

Assessment of the personality/behavioral construct of impulsiveness

The *Barratt Impulsiveness Scale* (BIS-11; Patton and Stanford 1995) is a self-report questionnaire designed to assess the personality/behavioural construct of impulsiveness, and it is the most widely cited instrument for the assessment of impulsiveness (Stanford et al. 2009). BIS-11 is composed of 30 items describing common impulsive or non-impulsive (for reverse scored items) behaviours and preferences. Items are scored on a 4-point scale (1 = Rarely/Never; 2 = Occasionally; 3 = Often; 4 = Almost always/Always). The BIS-11 provides a total score and assesses impulsivity on the subscales *attentional impulsivity* (inability to focus attention or concentrate; e.g. I have 'racing' thoughts), *motor impulsivity* (acting without thinking; e.g. I act 'on impulse') and *non-planning impulsivity* (lack of future orientation or forethought; e. g. I get easily bored when solving thought problems). However, a recent review (Vasconcelos et al. 2012) does not confirm the stability of the three factors identified by Barratt, and we do not use these subscales in this work. The Italian version (Fossati et al. 2001) shows good psychometric qualities (Cronbach's alpha = .79; test-retest reliability r = .889).

Emotional and behavioral assessment

Youth self-report/11-18 (YSR/11-18; Achenbach 1991; Italian version: Frigerio et al. 2001) is a self-report questionnaire that covers behavioural and emotional problems experienced over the past six months. The YSR contains 112 items, which are scored on a 3-point scale (0 = Not true; 1 = Somewhat or sometimes true; 2 = Very or often true). The YSR total problem scale can be divided into nine syndrome subscales: *Withdrawn*, *Somatic complaints*, *Anxious/Depressed*,

Social problems, *Thought problems*, *Attention problems*, *Delinquent behaviour*, *Aggressive behaviour*, *Self-destruct Identity*. The subscales *Withdrawn*, *Somatic complaints* and *Anxious/Depressed* together comprise the *Internalizing problems* scale (31 items), whereas *Delinquent* and *Aggressive behaviours* together constitute the *Externalizing problems* scale (32 items; Achenbach 1991). Higher scores on these scales indicate more maladaptive functioning. Some YSR/11-18 items are included in the *Other problems* subscale (32 items). Achenbach and Rescorla (2001) found that the internal consistency for the empirically based problem scales was supported by Cronbach's alphas that ranged from .71 to .95.

Assessment of the ability to describe and identify emotions

The *Toronto Alexithymia Scale* (TAS-20) is a self-report scale comprised of 20 items (Bagby et al. 1994a, Bagby et al. 1994b; Italian version: La Ferlita et al. 2007). Each item is rated on a 5-point Likert scale, ranging from 1 (Strongly disagree) to 5 (Strongly agree); five items are negatively keyed. The scale's 3-factor structure was found to be theoretically congruent with the alexithymia construct. The first factor (F1) consists of items assessing the ability to identify feelings and to distinguish them from the somatic sensations that accompany emotional arousal. Factor 2 (F2) consists of five items assessing the ability to describe feelings to others. Factor 3 (F3) consists of eight items assessing externally oriented thinking. Higher scores on these scales indicate more maladaptive functioning. The tool demonstrates good internal consistency and test-retest reliability (the total score's internal reliability coefficient is .86). In addition, the TAS-20 has been found to be stable and replicable across clinical and nonclinical populations (Parker et al. 2003), and Craparo et al. (2015) assessed its psychometric properties in younger adolescents. TAS-20 has already been used in several studies on adult and adolescent samples with eating disorders (Franzoni et al. 2013, Corcos et al. 2000).

Statistical analyses

To examine the adolescents' personality/behavioural construct of impulsiveness and the emotional and behavioural profiles in two groups, we carried out multivariate analyses of variances (MANOVAs), considering the effects of age and gender. We considered as dependent variables the BIS-11 total score, the TAS-20 F1, F2 and F3 and total score and the YSR/11-18 subscale and total score, while we considered group (Group A and B), sex and age as the independent variables. In all the analyses we conducted, the adolescents' age and sex showed no significant effect on the variables. In all MANOVAs, univariate analyses were then conducted on significant effects, and the Bonferroni's test was used for contrasts.

We then conducted a correlation analysis on the impulsivity, emotional-behavioural functioning and alexithymia scores of both groups. The Pearson's product-moment correlation coefficient was applied to the BIS-11 total score, to the TAS-20 F1, F2 and F3 and to the YSR/11-18 Internalising and Externalising problem scales to test for associations between impulsiveness, alexithymia and the presence of emotional/behavioural problems. Analyses were run on both Group A and Group B. Significant correlations between the measures were found in Group A. Given the presence of such associations, a path analysis model was created to

investigate the role alexithymia played in mediating the effect of impulsiveness on the presence of internalising and externalising problems. Both direct and indirect effects (mediated by TAS-20 F1, F2 and F3) of the BIS-11 were hypothesised on the YSR/11-18 Internalising and Externalising problem scales. The model was tested using LISREL 8.80 (Jöreskog and Sörbom 2006), which gives the possibility to consider complex sets of relationships in a simultaneous fashion. The procedure provides path coefficients as part of the model results, i.e. parameter estimates of the relative effect of one variable on another. Standardised regression weights β indicate the strength of the linear relation and imply a direct relation between changes in the connected variables. Furthermore, to assess the overall fit of the data to the model, the LISREL procedure also provides chi-square values, goodness-of-fit indices and squared multiple correlations. The chi-square assessment of fit refers to the possibility for a hypothesised model to adequately fit the data. Goodness-of-fit indices range from 0 to 1, with values close to 1 indicating good fit. Squared multiple correlations are indications of the amount of variability accounted for by the given equation. The results reported poor chi-square values and goodness-of-fit indices, suggesting the need to revise the model. A second model was created that excluded non-significant parameters.

The analyses were performed with Statistical Package for the Social Sciences, SPSS software (IBM Corp. 2013) and the LISREL 8.80 statistical analysis package (Jöreskog and Sörbom 2006).

Results

To verify whether adolescents diagnosed with BED showed high scores for impulsivity, maladaptive emotional-behavioural functioning and difficulties in identifying and describing their own feelings, a MANOVA was conducted on the two groups with the subscales of BIS-11, YSR/11-18 and TAS-20. Analyses showed a group effect ($\lambda = .062$; F[17,130] = 116.612; p < .001); however, no gender and age effects were found in the scores. **Table 1** shows the mean scores, standard deviations, F and p-values.

The adolescents' scores for BIS-11 Total Score were significantly higher in Group A as compared to Group B (Bonferroni post-hoc test; p < .001); N = 46 adolescents of Group A and none of Group B exceeded 2-3 standard deviations in the mean score of BIS Total Score for the Italian populations (Fossati et al. 2001).

Adolescents' scores on all YSR/11-18 scales were significantly higher in Group A, except for *Delinquent behaviour* and *Attention problems*. Scores on the *Delinquent behaviour* scale were significantly higher in Group B (Bonferroni post-hoc test; p < .001). N = 38 adolescents of Group A and none of Group B exceeded the YSR/11-18 clinical cut-off for the Italian population (Frigerio et al. 2001).

Furthermore, adolescents' scores on all subscales of TAS-20 were significantly higher in Group A (Bonferroni post-hoc test; p < .001). N = 30 adolescents in Group A and none in Group B exceeded the TAS-20 clinical cut-off for the Italian population (La Ferlita et al. 2007).

To verify the presence of associations between variables, the Pearson's product-moment correlation coefficient was applied to the BIS-11 total score, to the TAS-20 F1, F2 and F3 and to the YSR/11-18 Internalising and Externalising problem scales. Analyses were run on both Group A and Group B. **Table 2** reports the

Table 1. *Mean scores, standard deviations, F and p values*

		Group A	Group B	F	p values
YSR/11-18	Withdrawn	8.82 (3.23)	4.06 (1.75)	98.79	.000
	Somatic complaints	9.67 (3.75)	4.55 (2.04)	78.73	.000
	Anxious/depressed	15.8 (8.3)	4.58 (2.41)	115.68	.000
	Social problems	8.05 (2.8)	4.29 (1.93)	59.99	.000
	Thought problems	4.95 (1.45)	4.18(1.53)	9.1	.003
	Attention problems	3.36 (1.42)	3.73 (1)	2.52	.115
	Delinquent behavior	3.01 (1.12)	3.94 (1.07)	25.02	.000
	Aggressive behavior	18 (7.23)	6.54 (2.02)	120.353	.000
	Self-destruct Identity	12.32 (3.96)	6.73 (2.19)	69.49	.000
	Other Problems	15.88 (4.93)	6.67 (2.1)	138.176	.000
	Internalizing problems	25.4 (10.22)	7.25 (1.73)	189.18	.000
	Externalizing problems	27.54 (9.31)	7.25 (1.73)	256.56	.000
	Total problems	55.22 (28.75)	7.29 (1.87)	158.82	.000
BIS-11	Total Score	89.67 (11.35)	37.42 (3.15)	988.94	.000
TAS-20	F1	22.22 (6.21)	7.13 (1.99)	303.54	.000
	F2	9.79 (3)	7.45 (1.31)	21.75	.000
	F3	23.47 (7.57)	6.54 (2)	271.39	.000

correlation matrix, and significant correlations between the measures were found in Group A.

A path analysis model was created to investigate the role played by alexithymia in mediating the effect of impulsiveness on the presence of internalising and externalizing problems, excluding non-significant parameters. The chi-square value for this model was 9.73 (df = 5; p = .083) and resulted good (Schermelleh-Engel et al. 2003). Regarding the goodness-of-fit indices, the Non-Normed Fit Index (NNFI) and the Comparative Fit Index (CFI) were .97 and .99, respectively. The high level of both indices indicated the model's good fit to the actual data. The resulting value for the Root Mean Square Error of Approximation (RMSEA) was higher than expected (RMSEA = .09). Usually, the range of [.01-.08] has been proposed to indicate excellent to acceptable fits (Schermelleh-Engel et al. 2003);

by F1 (β = .37; p < .05) and F3 (β = .48; p < .05), whereas the effect on the internalising problems was both direct (β = .24; p < .05) and mediated by F1 (β = .23; p < .05) and F3 (β = .42; p < .05).

Discussion and Conclusions

The present paper aimed to assess the emotional and behavioural profiles in adolescents diagnosed with BED. Our study aimed to investigate if adolescents diagnosed with BED show higher impulsivity, alexithymia and a more maladaptive emotional-behavioural functioning when compared with adolescents from the general population. Furthermore, we wanted to verify alexithymia's role in mediating impulsivity in adolescents' emotional-behavioural functioning.

As far as our first objective is concerned, we carried

Table 2. *Correlations between Impulsiveness, Alexithymia, Internalizing and Externalizing problems*

|		BIS-11	F1	F2	F3
Internalizing Problems	Group A	.709**	.666**	-.371**	.721**
	Group B	.020	.011	.268*	.090
Externalizing Problems	Group A	.649**	.682**	-.428**	.720**
	Group B	-.159	.170	.017	.132

* Correlation is significant at the .05 level (2-tailed)
** Correlation is significant at the .01 level (2-tailed)

however, other authors have suggested the .1 value as the higher cut-off when employing this model (Browne and Cudeck 1992). Furthermore, recent literature has criticised the use of fixed cut-off points in the RMSEA test statistic due to the lack of empirical support (Chen et al. 2008). Therefore, the model was judged globally adequate to fit the data. **Figure 1** gives the statistically significant standardised structural parameter estimates for the model. Impulsivity significantly affected all the dimensions of alexithymia (p < .05) and demonstrated effects on TAS-20 F1 (β = .69; p < .05), F2 (β = -.40; p < .05), F3 (β = .65; p < .05). Furthermore, impulsivity played a significant role in determining the presence of internalising and externalising problems. The effect on the externalising problems was only indirect, mediated

out multivariate analyses of variances (MANOVAs) considering the effects of age and gender. In line with previous research studies (Ackard et al. 2003, Sierra-Baigrie et al. 2009), our analyses showed differences between those adolescents diagnosed with BED and adolescents from the general population in all factors in the emotional-behavioural profile, except for attention problems and delinquent behaviour. Allen et al. (2013) underlined that externalising behaviour problems may prospectively predict persistent eating pathology in youth. We can therefore hypothesise that the presence of lower scores of delinquent behaviours could lead to a better prognosis in the clinical sample, considering that it is composed of adolescents who have made a request for help. Another interesting note

Figure 1. *Path model significant parameter estimates for the effects of impulsiveness on alexithymia and internalising and externalising problems (significant p<.05)*
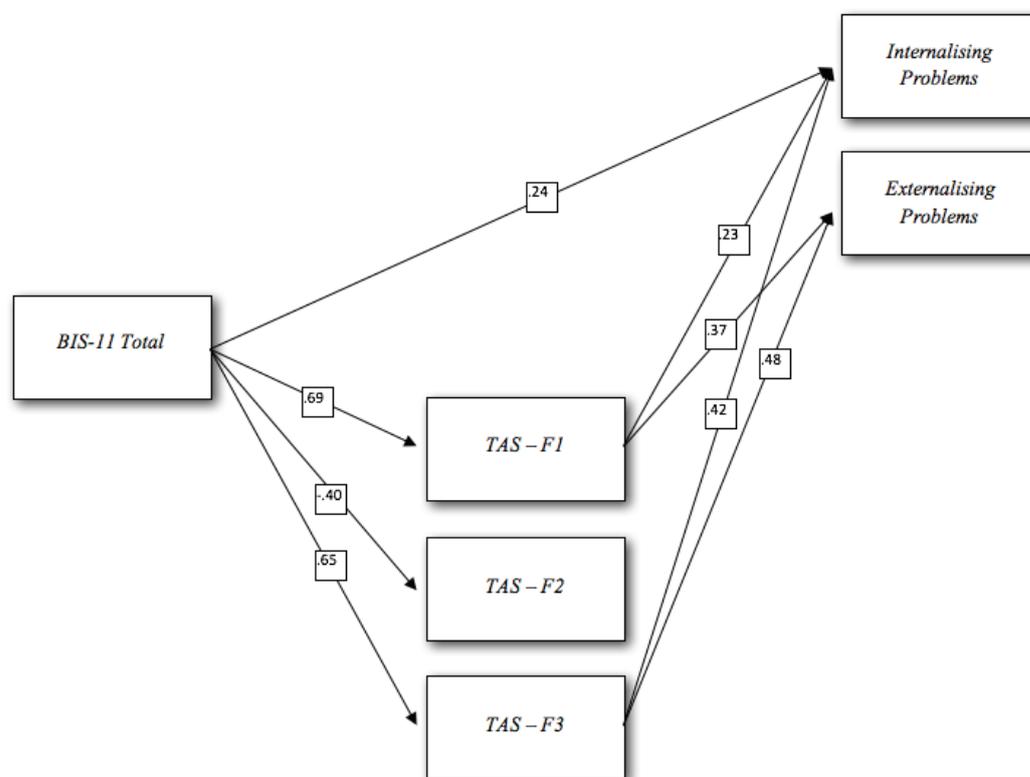
is that no gender differences were found in emotional and behavioural functioning. Although several authors underline that girls show higher internalising symptoms than males (Leadbeater et al. 1999, Gjerde et al. 1988, Piko and Balázs 2012), other studies have not found this difference (Samm et al. 2008) nor have they found males scoring higher than females (Kovacs 1992).

Furthermore, our results indicated that adolescents diagnosed with BED showed more impulsivity than adolescents from the general population. Previous researches (Schag et al. 2013, Svaldi et al. 2010) have proposed an explanation for this result, considering it a neurobiological functioning. For instance, Schienle et al. (2009) found that subjects with BED exhibited elevated activation in response to food pictures relative to normal-weight healthy control subjects in the medial orbitofrontal cortex (OFC), which is involved in reward processing. Furthermore, in agreement with previously reported data (Patton and Stanford 1995, Fossati et al. 2001), no significant gender differences were observed in this study.

In our sample, adolescents with BED showed higher levels of alexithymia, as supported by other studies that underlined adolescents and adults with eating disorders had difficulty recognising and communicating their feelings to others (Brewer et al. 2015, Speranza et al. 2007). While studies that have investigated alexithymia in adults have found higher levels in males, studies on populations of adolescents have not found this difference (Sakkinen et al. 2007), and our results are in line with theirs. Furthermore, in a recent review on alexithymia and eating disorders (Nowakowski et al. 2013), the authors underlined numerous studies that pointed out the central role of alexithymia in patients with BED. Zeeck et al. (2011) highlighted that adults diagnosed with BED showed more difficulties in identifying and

expressing feelings, and they hypothesised a complex interaction between psychic disturbance and problems in emotion regulation. While there are studies that have investigated the role of alexithymia and impulsivity in individuals with aggressive behaviours (Teten et al. 2008) and suicide risk (Loftis 2012), no studies have investigated the role of these variables on emotional-behavioural functioning in adolescents diagnosed with BED.

Thus, we aimed to verify whether alexithymia had a mediating effect on impulsivity in the emotional and behavioural functioning of adolescents affected by BED. Finding associations between impulsivity, alexithymia and internalizing and externalizing problems in adolescents diagnosed with BED, we created a path analysis model. Considering the high level of the NNFI and the CFI, and that recent literature has criticised the use of fixed cut-off points in RMSEA test statistics due to the lack of empirical support (Chen et al. 2008), the model was judged globally adequate to fit the data. Analysis confirmed our hypothesis, showing that alexithymia had a mediating effect for impulsivity regarding externalising and internalising problems. However, impulsivity also had a direct effect on internalising problems. Rozenstein et al. (2011) found that depression explained group differences for the TAS-20 total score for patients with anorexia nervosa-restrict type but not for patients with bulimia nervosa and anorexia nervosa-binging/purging type, and they hypothesised that it may be increased impulsivity that underlies the patients' affective difficulties with binging and purging behaviours. Our data underlines that increased impulsivity is related with more internalising symptoms in adolescents with BED; however, this relationship is not only direct, as the presence of alexithymia mediated this relation.

Granieri and Schimmenti (2014) highlighted that one of the possible consequences of affect dysregulation is the development of a dysfunctional relationship with food and the subsequent development of eating disorders (ED). Our study found that there are great difficulties in identifying and describing their emotions, which have an important consequence on internalising and externalising symptoms. In line with the authors (Granieri and Schimmenti 2014), we believe that eating behavior of patients affected by BED expresses difficulties which otherwise cannot be expressed.

Furthermore, Ferriter and Ray (2011) suggested that female adolescents affected by BED may have not only a psychiatric disorder but also specific psychopathological profiles that are typically characterised by internalising symptoms (e.g. withdrawal, depression). However, Thompson et al. (1999) found that girls who endorsed binge-eating behaviours had a higher risk of aggressive behaviour than girls who did not show these behaviours. Our sample indicated higher levels in both internalising and externalising problems; the adolescents' difficulty in expressing their emotions mediates the relationship between impulsivity and externalising, such as aggressive behaviour.

This study has several limitations. First, we did not consider overweight adolescents. Carano et al. (2006) found that obese patients diagnosed with BED had significantly higher levels of alexithymia compared to female obese patients who were not diagnosed with BED. Regarding adolescence, the research sustained that depression-related symptoms appear to be important risk factors for disordered eating among overweight youth (Goldschmidt et al. 2015). Allen et al. (2014) underlined that young people's perception of their own weight is not an important risk factor; however, the parents' perception of the child's weight is critical. This connects with the study's second limitation: We did not evaluate parents' possible psychopathological risks and family functioning, which could influence the severity and form of their children's symptoms (Cerniglia et al. 2017, Cimino et al. 2016, Tambelli et al. 2015, Granieri and Schimmenti 2014, Capobianco et al. 2017). We were primarily interested in assessing adolescents' individual psychological characteristics and the influence of alexithymia and impulsivity on the onset of binge-eating behaviours. In fact, as suggested by Dinsmore and Stormshak (2003), although some aspects of family functioning are associated with adolescents' eating attitudes and behaviours, intra-personal competence mediated this relationship in adolescents. Third, although we used validated and frequently used tools, we administered self-report measures. It would be interesting to evaluate alexithymia through other tools, such as the Toronto Structured Interview for Alexithymia (Caretti et al. 2011), and to validate the results in clinical samples with eating disorders. Finally, the sample's homogeneity, in terms of cultural, geographical and socio-economic statuses, limits the study's replication in other countries or cultures.

Notwithstanding the above limitations, this study also has several strengths. We focused on adolescence, a crucial period for the onset of eating disorders, and we also considered a non-clinical population, which can be important for planning prevention/ intervention programmes. The present study adds to the existing literature, suggesting that alexithymia has a mediating effect between impulsivity and emotional and behavioural problems in adolescents affected by BED. Based on this result, we recommend replicating these studies with longitudinal studies, which may allow a greater understanding of the dynamics between impulsivity and alexithymia, to help clinicians in prevention and treatment programmes focus on specific alexithymia features. As reported by recent studies, in fact, patients with eating disorders need a clinical relationship that can help them get in touch with their emotions and their somatic states (Schimmenti 2012, Abbate-Daga et al. 2016). This is even more important in the developmental period considered. Adolescence is in fact seen by several authors as a period in which the subject is immersed in self-creation, where the Other/ psychotherapist plays a fundamental role (Monniello 2014).

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