

EXTRAVERSION IS ASSOCIATED WITH NON-ALCOHOL RELATED ACTIVITIES

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Abstract

BACKGROUND: The personality trait extraversion is both theoretically and empirically linked with the engagement of healthy pleasant activities, but also with an early onset of alcohol drinking.

Therefore the predictive value of extraversion on the engagement of non-substance related activities remains inconclusive in both clinical and non-clinical samples, whereas extraversion is thought to be confounded with other personality aspects such as impulsivity. **OBJECTIVE:** In a nested case control design, by means of correlational and mediational analyses the relationships of extraversion and two facets of impulsivity were investigated on substance/non-substance related activities.

METHODS: Fifty-two alcohol dependent inpatients and thirty-five healthy controls were recruited and completed the NEO-FFI extraversion scale, the Dickman Impulsivity Inventory (DII) and an adapted version of the Pleasant Activities List (PAL).

RESULTS: Analyses indicated consistent positive intercorrelations between extraversion, functional impulsivity and non-substance related activities in both patients and controls. Mediational analyses confirmed that extraversion predicted only non-substance related activities. Analogue trends for controls indicated that functional impulsivity mediated the positive association between extraversion and non-substance related activities. In the collapsed sample, a conditional effect of dysfunctional impulsivity on substance related activities was shown. **CONCLUSION:** The present study indicated that extraversion is a discrete predictor of non-substance related activities in both patients and controls.

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1. Introduction

Over the last few decades there has been a growing interest in identifying personality measures that predict alcohol abuse. Although studies generally failed to identify a designated “alcoholic personality,” several personality traits have been associated with the initiation and continuation of alcohol use disorders (AUDs). Research on personality correlates consistently showed that neuroticism, impulsivity and extraversion emerged in the literature as key factors in patients with AUDs (Sher, Grekin & Williams, 2005). A strong link between neuroticism and alcohol problems has been demonstrated (Ball, 2002; Ball, 2004; Brooner, Templer, Svikis, Schmidt & Monopolis, 1990; Khan, Jacobson, Gardner, Prescott & Kendler, 2005; McGue, Slutske, Taylor & Lacono, 1997; Meszaros, Willinger, Fischer, Schonbeck & Aschauer, 1996; Sher & Trull, 1994; Sher, Trull, Bartholow & Vieth, 1999; Trull, Waudby & Sher, 2004). Also impulsivity, characterized by a loss of inhibitory control, plays a prominent role in the development and maintenance of AUDs (Clark, Vanyukov & Cornelius, 2002; Congdon & Canli, 2005; Dawes, Tarter & Kirisci, 1997; de Wit, 2008; Dick et al., 2010; Habeych, Folan, Luna & Tarter, 2006; Sher & Trull, 1994; Verdejo-Garcia, Lawrence & Clark, 2008; Vuchinich & Simpson, 1998).

A link between extraversion and substance dependence has also been demonstrated, albeit somewhat weaker and less straightforward as compared to neuroticism and impulsivity. Extraversion has been implicated in the early onset of AUDs (Hill, Shen, Lowers, & Locke, 2000; Hill & Yuan, 1999). Moreover, there is evidence that extraversion is associated with heavy alcohol drinking (Martsh & Miller, 1997) and alcohol-related problems (Flory, Lynam, Milich, Leukeveld & Clayton, 2002) in non-clinical samples. Other studies found inverse associations, whereby low levels of extraversion were found to be a risk factor for relapse in patients with AUDs, six months after treatment (Bottlender & Soyka, 2005), or failed to find a meaningful association between extraversion and AUDs (LoCastro, Spiro, Monnelly & Ciraulo, 2000; Stacy & Newcomb, 1998). Hence, the role of extraversion on drinking outcomes remains inconclusive due to the inconsistent findings in both clinical and non-clinical samples.

Conversely, extraversion has also been linked to physical and social activity engagement in non-clinical samples (Diener, Larsen & Emmons, 1984; Eysenck, Nias & Cox, 1982; Furnham, 1981; Kirkcaldy & Furnham, 1991; Lu & Hu, 2005). According to Eysenck's theory (1985) extraverts are chronically under aroused and consequently seek activities that provide the maximum opportunity for excitement. Extraversion plays an important role in patients' engagement in pleasant activities and perceived pleasure (Eysenck, 1967; Roozen, Evans, Wiersema & Meyers, 2009). Besides, extraversion has been connected with activation within pleasure-reward-sensitive regions (Carver, Sutton, & Scheier, 2000; Depue & Collins, 1999). Building upon these findings, quality of life appears to be associated with activity engagement (Eklund & Leufstadius, 2007; Law, Steinwender & Leclair,

1998). Such engagement in valued and pleasant activities has recently been estimated to account for 40% of the variance in well-being (Lyubomirsky, Sheldon, & Schkade, 2005). Activity participation is positively related to the quality of life among people with psychiatric disorders (Eklund & Bäckström, 2005; Rüesch Graf, Meyer, Rössler, & Hell, 2004). Consequently, the engagement in pleasant activities may be a third-variable explanation of the extraversion-quality of life relation.

It has been found that extraversion is positively associated with self-reported non-substance related activities in patients with substance use disorder (Roozen et al., 2009). However, it cannot be ruled out that these designated non-substance related activities occurred while participants were actively drinking alcohol or using illicit drugs. From that perspective substance abuse could have contributed as a secondary reinforcer to the level of engagement in the activity and to the enjoyability ratings. Therefore it remains inconclusive whether extraversion acted as a discrete predictor variable for substance related activities or purely non-substance related behavior in patients with substance use disorders.

A controversy exists whether extraversion comprises a unitary construct, since it has been suggested that the extraversion dimension contains both sociability and impulsivity components (Anderson & Revelle, 1994; Eysenck, 1967). It has been implicated that the suggested sociability component of extraversion may be initially associated with early onset heavy drinking (Sher et al., 2005). Another hypothesis is that high levels of extraversion could be more indicative of the disinhibition component than sociability; both assumed underlying extraversion (Sher et al., 2005). More recently, it has been suggested that extraversion may play an important role in the selection of drinking-relevant environments (Park, Sher, Wood & Krull, 2009). However, it appears that the continuation of heavy drinking is not related to extraversion, but can be attributed to changes in the associations with neuroticism and impulsivity (Littlefield et al., 2009).

It is widely accepted that impulsivity has a multidimensional nature (de Wit, 2008), frequently delineated as a loss of inhibitory control or lack of “brake” (Stanford, Mathias, Dougherty, Lake, Anderson & Patton, 2009). In a dysfunctional sense it is believed the tendency to act with less forethought than most people with equal ability when this tendency is a source of difficulty (Dickman, 1990). On the other hand, impulsivity could be valuable for making *ad hoc* decisions at well-timed moments (Crews & Boettiger, 2009). That is, impulsiveness is associated with functional features as well (Gullo & Dawe, 2008). Dickman (1990) describes functional impulsivity as ‘the tendency to act with relatively little forethought when such a style is optimal. Functional impulsivity appears to be related to extraversion (Chico, 2000; Chico, Tous, Lorenzo-Seva, & Vigil-Colet, 2003) and is weakly correlated with other impulsivity scales (Miller, Joseph & Tudway, 2003).

The present research examined the impact of extraversion on the frequency and rewarding value (i.e. enjoyability) of both alcohol related activities and non-alcohol related activities in an inpatient population of alcohol dependent individuals and healthy controls. An adapted activity self-report measure was used in order to unravel alcohol related activities from non-alcohol related events, and

subsequently, to determine the proportion of reinforcement received from substance-related activities relative to non-substance related activities (Correia, Simons, Carey, & Borsari, 1998). The activity ratios (proportion of non-substance related activities and substance-related activities), all in terms of frequency and enjoyability as proximal indices of reinforcement, were investigated. Since extraversion is considered a multifaceted construct, two impulsivity constructs (i.e., functional and dysfunctional impulsivity) were included in correlational and mediational analyses to examine the associations and the differential contribution of extraversion on (non-)alcohol related activities.

2. Method

2.1 Participants

By means of a nested case control design, fifty-two actively drinking alcohol dependent patients were recruited, who were consecutively admitted for alcohol-detoxification in the inpatient treatment center in Utrecht, the Netherlands (Centrum Maliebaan). The patient sample consisted of primary alcohol dependent patients according DSM-IV (American Psychiatric Association, 2000) and subsequently their alcohol use was defined as the primary substance that was used $\geq 80\%$ of the time during the year that preceded treatment admission (Gonzalez, Bechara, & Martin, 2007; Verdejo-García, Bechara, Recknor, & Pérez-García, 2006). Next to alcohol dependency, inclusion criteria were: 18 years or older, a score equal to or higher than 25 on the Mini Mental State Exam (MMSE; Folstein, Folstein, & McHugh, 1975) to examine their global cognitive functioning, the expression of a clear wish to be become alcohol abstinent, and familiarity with the Dutch language. Several individuals reported a co-occurring substance use disorder (Nicotine 78.8%, Gambling 3.8%, Cocaine 11.5%, Benzodiazepine 9.6%, Cannabis 7.7%, and Amphetamine 3.8%). Furthermore, 5.8% reported poly substance use disorders. Medical doctors and psychiatrists conducted the screening for criteria for substance abuse or dependency by means of clinical interview.

Samples of thirty-five healthy controls were additionally recruited from the similar community setting via word-of-mouth referrals. The mean age of the total sample was 44.26 (SD=11.71) years; 48 % were males, and 94% was European-Caucasian. No group differences were found regarding the matching variables: gender, age and ethnicity ($ps > .05$). Sixty-six percent of the controls were married or living together, compared to 25 % of the patients, [$\chi^2(1, 87) = 14.30, p < .001$]. Of the controls, 69 % completed higher education compared to 39% of patients [$\chi^2(1, 87) = 7.59, p < .01$]. Also, none of the

healthy controls was unemployed while 71% of the patients were unemployed [$\chi^2(1, 87)=43.33$, $p<.001$].

Group differences were demonstrated regarding alcohol outcomes. Pertaining to the Alcohol Use Disorder Identification Test (AUDIT), developed by World Health Organisation (Babor, Higgins-Biddle, Saunders & Monteiro, 2001), patients reported statistically significant [$t(72.31) = 22.19$, $p<.001$] higher scores ($M=28.09$; $SD=6.95$) than the controls ($M=3.83$; $SD=2.95$). Patients also reported a statistically significant [$t(51.95) = 9.81$, $p<.001$] higher number of alcohol units in the 30 days prior to assessment ($M=443.49$; $SD=310.55$) when compared to healthy controls ($M=19.02$; $SD=24.55$).

2.2 Procedure

Recruitment took place between June 2011 and February 2012. Assessment of patients took place at the second or third day of admission at the detoxification unit ($M=2.77$; $SD=1.04$). All eligible patients and controls filled in a written informed consent prior participation. After explanation of the rationale and procedure, all patients were assessed by means of interviews (e.g. socio-demographic and substance use related information) and self-reports.

2.3 Instruments

2.3.1 NEO-FFI

The NEO-FFI personality inventory is based on the five-factor model of personality (Costa & McCrae, 1992). All participants completed the extraversion scale of the NEO-FFI. Items are scored on a five-point Likert scale varying from “totally agree” to “totally disagree”. This widely used inventory has good consistency, reliability and sufficient validity (Costa & McCrae, 1992; Hoekstra, Ormel, & De Fruyt, 1996). The Cronbach’s alpha in the collapsed sample is .87.

2.3.2 Dickman Impulsivity Inventory (DII)

A short version of the Dickman Impulsivity Inventory (DII; Dickman, 1990) was used, measuring functional and dysfunctional impulsivity using a dichotomously True/False format. The Dutch 23-item version (Claes, Vertommen & Braspenning, 2000) contains 12 dysfunctional impulsivity items resembling reckless or undirected impulsive behavior. In addition, the instrument includes 11 items regarding functional impulsivity concerning opportunistic or directed impulsive behavior. Both subscales in the collapsed sample have Cronbach’s alphas of 0.84 and 0.85, respectively.

2.3.3 *Pleasant Activities List (PAL)*

The 139-item self-report Pleasant Activities List (PAL; Roozen, Wiersema, Strietman, Feij, Lewinson, Meyers, Koks & Vingerhoets, 2008) measures the frequency and subjective pleasure of the engagement in activities comprised by two parameters of reinforcement: (a) the amount of time engaged in the activity and (b) the respondent's subjective enjoyment of the experience associated with each of the activities during the previous 30 days. Consequently, the PAL has a double five-point rating scale ranging from "not at all" to "very often" on both frequency and enjoyability. In the present study the total scale general activities (GA) for all 139 items was applied. Furthermore, an adaptation was made consistent with the methodology of (Skidmore & Murphy, 2010). Each item was administered twice to obtain separate substance related and non-substance related frequency and enjoyability ratings. For example, participants rated (a) how often they went to parties while sober and how enjoyable they found these experiences and (b) how often they went to parties while using illicit drugs or alcohol and how enjoyable they found these experiences. Furthermore, double cross-product scores were calculated by multiplying the frequency and enjoyability ratings of substance related and non-substance related items. Cross-product scores are considered an estimate of total reported pleasure (Grosscup & Lewinsohn, 1980). In the present study for the collapsed sample the Cronbach's alpha's for the frequency and enjoyability of non-substance related activity rates and the enjoyability and frequency of substance related activity rates were .98, .99, .95, .96 respectively. The Cronbach's alpha for the cross product substance related and non-substance related scores were .98, .94, respectively.

2.4 *Statistical analyses*

χ^2 tests were applied for dichotomous outcomes and the independent *t*-test for continuous outcomes. Pearson product-moment correlations were applied to examine the strengths of the associations between scales. Missing data considering both continuous and dichotomous scale variables were systematically replaced through Missing Value Analysis (MVA) provided by the Expectation Maximisation (EM) imputation algorithm. The imputations were conducted separately for each scale and group (i.e. patients and controls). Conservatively, imputed values were generated if patients had provided valid data for >75% of the items on the scale. Little's chi-square statistic indicated that all missing values were missing at random (MCAR; all *ps* >.05). Furthermore, the mediational model applied in this study was theoretically based on the mediational model by Kenny and colleagues (e.g. Baron & Kenny, 1986). In this mediational model it was investigated whether two mediators DII functional impulsivity and DII dysfunctional impulsivity would mediate the association between NEO-FFI extraversion and PAL substance/non-substance related activities in terms of frequency,

enjoyability and cross-product scores. The multiple mediation model that was tested is depicted in Figure 1. To maintain comparability and consistency, the same analyses corresponding to this model was conducted separately for each of the PAL substance/non-substance activity score. The mediational analyses were based on nonparametric bootstrapping for standard errors, including bias-corrected and accelerated (BCa) 95% confidence intervals (CI) (Preacher & Hayes, 2005, 2008). The bootstrapped samples were set as $z=5000$. All p -values were two-sided and considered statistically significant at $p < .05$.

3. Results

3.1 Group effects

Patients reported statistically significantly higher levels than the control group in terms of DII dysfunctional impulsivity and on all three of the PAL substance related activity scores: frequency, enjoyability and cross product (Table 1). On the other hand, patients scored significantly lower than controls on NEO-FFI extraversion, DII functional impulsivity and the PAL enjoyability score of non-substance related activities.

3.2 Pearson product–moment correlations: collapsed sample

It was found that NEO-FFI extraversion was positively correlated with all three PAL non-substance related activity scores: frequency ($r = .41$), enjoyability ($r = .39$), and cross product ($r = .45$; all $ps < .001$), while it was virtually unrelated to PAL substance related indices (rs ranging from $-.19$ to $-.11$; $ps > .05$). Positive correlates also emerged between DII functional impulsivity and all three PAL non-substance related activity scores: frequency ($r = .34$), enjoyability ($r = .35$), and cross product ($r = .35$; all $ps \leq .001$). DII functional impulsivity appeared to be weak and negatively related to all three PAL substance related activity indices but these relations were not statistically significant ($ps > .05$). DII dysfunctional impulsivity was positively related to two PAL substance related indices: frequency ($r = .32$; $p = .003$), cross product ($r = .30$; $p = .005$), and subsequently, showed a statistical trend with respect to enjoyability ($r = .20$; $p = .059$). No meaningful relationships between DII dysfunctional impulsivity and PAL non-substance related activity scores were observed ($ps > .05$). NEO-FFI extraversion and DII functional impulsivity were moderately correlated ($r = .56$; $p < .001$), while a negative, but non-significant, relationship was found between NEO-FFI extraversion and DII dysfunctional impulsivity ($r = -.11$; $p > .05$). DII functional impulsivity and DII dysfunctional impulsivity emerged to be inversely correlated ($r = -.23$; $p = .029$).

3.3 Pearson product–moment correlations: subgroup analyses

Table 1 displays the intercorrelations tabulated for both patients and controls. Most correlates were globally comparable between both groups. Yet in the patient sample the correlation between NEO-FFI extraversion and DII dysfunctional impulsivity was weak and not statistically significant ($r=.06$; $p>.05$), while this relationship in the control group was much higher ($r=.32$) and exhibited a statistical trend ($p=.064$).

3.4 Mediation model: collapsed sample

Results based on bootstrapped samples indicated that NEO-FFI extraversion had a significant total effect on all three PAL non-substance related activity ratings: frequency ($C=3.43$, $p<.001$), enjoyability ($C=4.59$, $p<.001$) and cross product ($C=21.02$, $p<.001$), while no significant total effect on any of the PAL substance related activity ratings was observed (all $ps>.05$). Indirect effects of NEO-FII extraversion on PAL substance/non-substance related activity indices through DII functional impulsivity failed to reach significance, with intervals ranging from BCa 95% CI $-.15$ to $.92$ for the PAL enjoyability score of non-substance related activities to BCa 95% CI -5.72 to $.94$ for the PAL cross product score of substance related activities. Furthermore, an absence of indirect effects of NEO-FII extraversion on PAL substance/non-substance related indices through DII dysfunctional impulsivity were observed, with intervals ranging from BCa 95% CI $-.21$ to 3.07 for the PAL enjoyability score of non-substance related activities to BCa 95% CI -9.94 to 4.82 for the PAL cross product score of substance related activities. A statistically significant conditional effect of DII dysfunctional impulsivity on two of the PAL substance related activity indices was demonstrated; frequency ($B1=4.59$, $p=.006$) and cross product ($B1=22.74$, $p=.013$).

The mediation analyses yielded statistically significant R^2 values for the proportion of variance in PAL non-substance related activity indices in terms of frequency ($R^2 = .19$), enjoyability ($R^2 = .19$) and cross product ($R^2 = .22$; all $p<.001$). Significant R^2 values were also obtained for the proportion of variance in two of the PAL substance related activity indices predicted from the overall model regarding frequency ($R^2 = .13$, $p=.011$) and cross product scores ($R^2 = .11$, $p=.024$), while the proportion of variance predicted from the overall model in the PAL enjoyability score of substance related activities failed to reach statistical significance ($p>.05$).

3.5 Mediation model: subgroup analyses

Table 2 reflects the outcomes of the mediational analyses tabulated for both patients and controls. In the patient sample, NEO-FFI extraversion had a significant total effect on all three of the PAL non-substance related activity scores: frequency ($C=3.6, p=.003$), enjoyability ($C= 3.6, p=.026$) and cross product ($C= 20.66, p=.002$). No significant total effect of NEO-FII extraversion on any of the PAL substance related activity scores was shown. Furthermore, all indirect effects of NEO-FII extraversion on PAL substance/non-substance related indices through DII functional/dysfunctional impulsivity, failed to reach significance. For DII functional impulsivity, *BCa* 95% *CI* ranged from $-.54$ to 3.93 for the PAL enjoyability score of non-substance related activities to -13.85 to 6.27 for the PAL cross product score of substance related activities. For DII dysfunctional impulsivity, *BCa* 95% *CI* ranged from $-.26$ to 1.02 for the PAL enjoyability score of substance related activities to -1.75 to 3.56 for the PAL cross product score of non-substance related activities.

In the control sample, an indirect effect emerged between NEO-FFI extraversion and the frequency and cross-product score of PAL non-substance related activities through DII functional impulsivity. It was found that DII functional impulsivity *partially* mediates the relationship between NEO-FFI extraversion and the PAL cross-product score of non-substance related activities, as both the independent variable ($C'=22.52, p=.029$) and the mediator ($A2 \times B2 = 6.59, BCa\ 95\% \ CI\ .57\ to\ 17.85$) appeared significant. A *complete* mediational effect by DII functional impulsivity was demonstrated between NEO-FFI extraversion and the PAL frequency score of non-substance related activities, because the mediator appeared significant ($A2 \times B2 = 1.3, BCa\ 95\% \ CI\ .08\ to\ 3.52$) and the independent variable failed to reach statistical significance ($C'=2.93, p>.05$). An indirect effect of DII functional impulsivity on the relation between NEO-FFI extraversion and the PAL enjoyability score of non-substance related activities failed to reach statistical significance [*BCa* 95% *CI* $-.87$ to 3.49]. Other results were comparable to those of the patient sample. NEO-FFI had a significant total effect on the PAL enjoyability score of non-substance related activities ($C= 5.23, p=.028$). No statistical significant total effect of NEO-FII extraversion on any of the PAL substance related activity scores was shown. Finally, indirect effects of DII dysfunctional impulsivity between NEO-FFI extraversion and PAL substance/non-substance related activity scores failed to reach statistical significance with *BCa* 95% *CI* ranging from $-.74$ to $.36$ for the PAL frequency score of substance related activities to -14.90 to $.01$ for the PAL cross product score of non-substance related activities.

4. Discussion

The objective of this study was to investigate NEO-FFI extraversion in relation to PAL substance related activities, and alternatively, non-substance-related activity indices in inpatient alcohol-dependent patients and healthy controls. Extraversion is considered a multifaceted construct that contains both sociability and impulsivity elements (Anderson & Revelle, 1994; Eysenck, 1967). To examine the associations both correlational and mediational analyses were employed.

The correlational analyses demonstrated positive relations between NEO-FFI extraversion and PAL non-substance related activity indices in the patient and healthy controls sample. DII functional impulsivity had similar positive relations with PAL non-substance related activity indices in the collapsed sample although subgroup analyses yielded positive but weaker relations. DII dysfunctional impulsivity appeared positively related to two PAL substance related activity indices in the collapsed sample but failed to reach significance with PAL substance related activity indices in the patient sample and appeared to be virtually uncorrelated to these indices in the control sample.

Mediational analyses in the collapsed sample confirmed that NEO-FFI extraversion was predictive of PAL non-substance related activity indices. Also, a conditional effect of DII dysfunctional impulsivity on the frequency and cross product score of PAL substance related activity indices was found in the collapsed sample, while this effect was absent in both subgroups. Analogue trends for controls indicated that DII functional impulsivity partially and completely mediated NEO-FFI extraversion's effect on the reported pleasure and frequency of non-substance related activities respectively. These findings suggest that high levels of NEO-FFI extraversion mainly attribute to the association between DII functional impulsivity and non-substance related activity engagement.

The results of this study are in support of the earlier notion that extraversion is associated with the engagement in valued and pleasant activities in clinical samples (Eysenck, 1967) and patients with substance use disorders in particular (Roozen, 2009). NEO-FFI extraversion appeared to be a significant predictor of PAL non-substance related activity indices in this study. This outcome mirrors previous findings that extraversion has been found to predict positive life outcomes across a wide variety of domains (Ozer & Benet-Martinez, 2006) from the experience of high levels of positive affect (Costa & McCrae, 1980; Lucas & Baird, 2004), satisfaction in social relationships (Paunonen, 2003) and job satisfaction (Thoresen, Kaplan, Barsky, Warren & de Chermont, 2003), to positive health outcomes (Danner, Snowdon & Friesen, 2001; Friedman et al. 1995). In the control sample, DII functional impulsivity exerted only a minor weight on the strong link between NEO-FFI extraversion and the reported engagement in non-substance related activities. Results of the collapsed sample point to an association between DII dysfunctional impulsivity and substance related activities. These findings confirm that DII functional impulsivity is positively associated with NEO-FFI extraversion (Chico, 2000; Chico et al., 2003), while DII dysfunctional impulsivity relates to SUD's (Maccallum,

Blaszczynski, Ladouceur & Nower, 2007; Semple, Patterson, Grant, 2004; Semple, Zians, Grant & Patterson, 2005).

Since it has been posited that impulsivity aspects may underlie extraversion, the hypothesis that high levels of extraversion may be indicative of disinhibition component (Sher et al., 2005), operationalized in the present study in terms of dysfunctional impulsivity, is not supported. Conversely, the findings indicate that extraversion may contain functional rather than dysfunctional components of impulsivity. It seems viable that these functional aspects of extraversion may serve as a driving force for the ad hoc selection and the lack of premeditation related to drinking-relevant social environments, often hold responsible for the initiation of alcohol drinking, but not the continuation of drinking (Park, Sher, Wood & Krull, 2009).

Clinically, the engagement in non-substance related activities appears to contribute to well-being in clinical (Eklund & Bäckström, 2005; Rüesch et al., 2004) and non-clinical samples (Lyubomirsky et al., 2005). Several Skinnerian based treatments promote the involvement in healthy activities, including the Community Reinforcement Approach (CRA; Hunt & Azrin, 1973; Meyers & Smith, 1995), Contingency Management (CM; Petry, Martin, Cooney & Kranzler, 2000; Iguchi, Belding, Morral, Lamb & Husband, 1997; Petry, Martin & Finocche, 2001) and applications of behavioral activation in the treatment of depression (BA; Lewinsohn, Biglan, & Zeiss, 1976). However, few attempts have been made to integrate personality findings with interventions to improve treatment outcomes (Staiger, Kambouropoulos & Dawe, 2007). In the present study, patients with high NEO-FFI extraversion ratings reported higher scores on PAL non-substance related activity indices, while inversely, patients with low NEO-FFI extraversion scores tended to report higher levels of PAL substance related activity indices. These findings suggest that interventions might be more effectively implemented after a screening of the personality dimension of extraversion at treatment entry. It could enable therapists to assist patients in composing an array of activities that match with their individual reinforcement needs while at the same time providing skills training in correspondence with their individual risk of engaging in (potential) high risk situations.

The present study has some methodological strengths to consider. The methodology of Hayes (2012) was used to estimate the direct and indirect effects of NEO-FFI extraversion on each of the PAL substance and non-substance related activities with DII functional and DII dysfunctional impulsivity. Compared to alternative methods of testing mediation, this approach has the advantage of assessing multiple mediating variables simultaneously and makes any violations of the assumption of normal distributions of scores less problematic (Hayes, 2012). To manage missing data the expectation maximization (EM) was used to in both samples. EM overcomes some of the limitations of other techniques that have been found to generate biased estimates and an underestimation of standard errors (Schafer & Olsen, 1998).

There are some methodological limitations in this study that should be notified. First, due to the small sample sizes of this study, analyses were statistically underpowered, indicated by some results

obtained in the collapsed sample that failed to reach significance in sub-group analyses. Therefore, replication of this research with larger sample sizes would provide more validity and elucidation to the current findings. Second, the homogeneousness of the samples characterized by a non-selective group of alcohol dependent individuals and a group of healthy controls who were recruited from the similar community setting, limits the degree to which the results can be generalized to other populations. Third, impulsivity is a broad construct, probably consisting of a number of sub facets (Dick et al., 2010). Since many different measures of impulsivity are employed in human research that often show little correlation and different associations to outcomes (Dick et al., 2010, Whiteside & Lynam, 2001), replication of the present findings is needed with research that employs other types of assessment techniques such as performance based measures of impulsivity. Fourth, at the time of assessment, patients suffered from severe withdrawal symptoms such as irritability. We cannot rule out the influence of these symptoms on the reported high levels of dysfunctional impulsivity in the patient group. Fifth, we did not verify the self-reported alcohol and drug use by means of biochemical analyses in the past 30 days prior participation.

5. Conclusion

Extraversion was found to be clearly associated with non-substance related activity engagement, while the relationship between extraversion and substance related activities was absent in both patients and controls. In the collapsed sample, dysfunctional impulsivity was found to be related to substance related activity engagement. Functional impulsivity was positively related to both extraversion and non-substance related activities in the collapsed sample, and appeared to mediate the relationship between extraversion and non-substance related activities in the control group. More research is needed to confirm the present findings.

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Table 1. Univariate strength of correlations between measures

	1	2	3	4	5	6	7	8	9	Patients (n=52)		Controls (n= 35)		<i>t(df)</i>
										<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	
1 NEO-FFI extraversion	-	.51***	.06	.02	.41**	.03	.31*	.02	.42**	37.33	6.69	43.00	5.31	-4.20(85)***
2 DII functional impulsivity	.44*	-	-.15	-.02	.28*	-.03	.31	-.07	.28*	6.04	3.09	8.00	2.52	-3.12(85)**
3 DII dysfunctional impulsivity	.32	.08	-	.11	-.00	.10	-.04	.13	.04	5.17	3.78	1.77	1.85	5.57(78.75)***
4 PAL frequency substance related activities	.11	.18	-.06	-	.37**	.83**	.29*	.97***	.37**	220.36	54.16	161.4	30.31	6.49(82.66)**
5 PAL frequency non-substance related	.38*	.42*	-.02	-.15	-	.11	.58***	.26+	.96***	266.59	58.64	279.94	52.89	-1.08(85)
6 PAL enjoyability substance related activities	-.00	-.03	-.05	.63***	-.29+	-	.44**	.90***	.20	262.41	82.89	208.93	73.41	3.09(85)**
7 PAL enjoyability non-substance related activities	.37*	.28	-.06	-.23	.55**	.10	-	.29*	.75***	346.83	78.13	386.72	74.84	-2.38(85)*
8 PAL cross product substance related activities	.10	.10	-.06	.91***	-.20	.89***	-.03	-	.28*	564.70	314.45	288.41	166.89	5.32(81.27)***
9 PAL cross product non-substance related activities	.44**	.42*	-.08	-.18	.93***	-.17	.77***	-.15	-	849.32	325.81	943.73	299.21	-1.37(77.16)

Note: Figures are means, standard deviations, and Pearson product-moment correlations. Strong correlations (>0.50; Cohen, 1988, 1992) are presented in bold, very strong correlations (>0.70) are also underscored. The correlational values above the diagonal mirror the patient sample and those below the diagonal represent the control group.

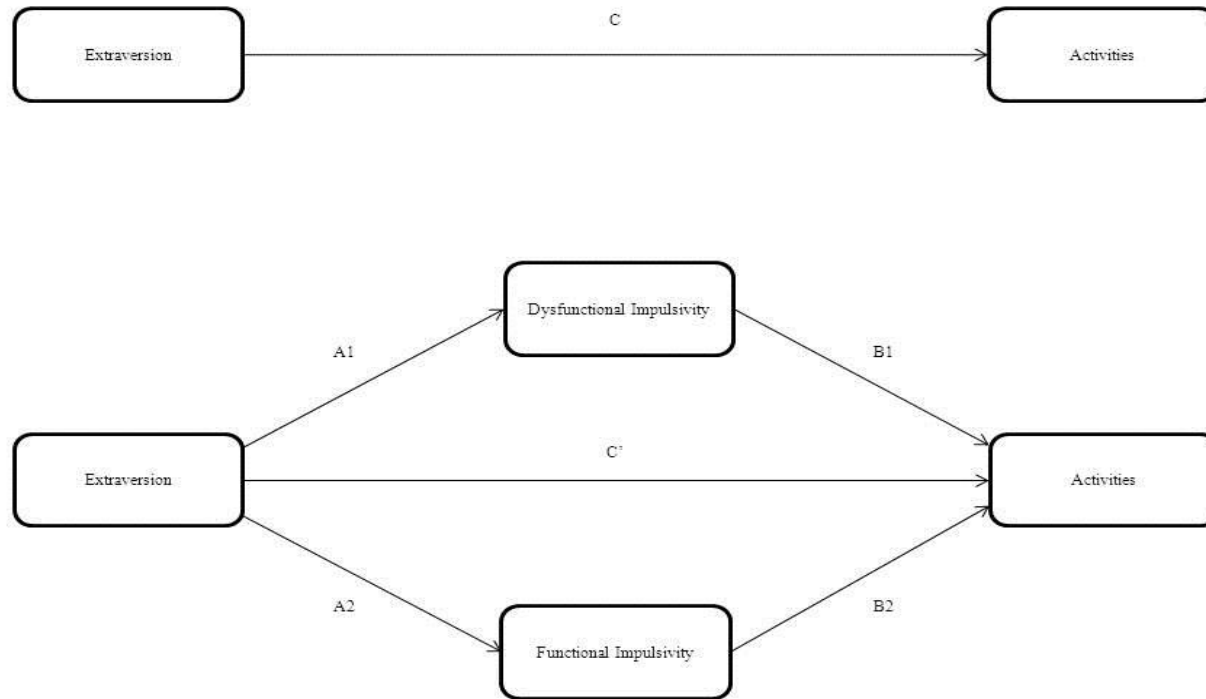
* $p < .05$, ** $p < .01$, *** $p < .001$.

Table 2. Results of mediation analysis for NEO-FII extraversion as predictor of PAL substance/non-substance related activities with paths to represent mediation by DII functional/dysfunctional impulsivity

	Total effect NEO-FII extraversion	Direct effect NEO-FII extraversion	Mediation by DII dysfunctional impulsivity			Mediation by DII functional impulsivity			Total R2
	C	C'	A1	B1	A1 x B1	A2	B2	A2 x B2	
PAL frequency of substance related activities	.15	.16	.03	1.56	.05	.23**	-.29	-.07	.01
	.64	.43	.11	-1.60	-.18	.21**	1.88	.39	.04
PAL frequency of non- substance related activities	3.60**	3.20*	.03	-1.14	-.005	.23**	1.72	.41	.17*
	3.78*	2.93	.11	-4.07	-.45	.21**	6.26	1.3	.24*
PAL enjoyability of substance related activities	.41	.60	.03	1.96	.06	.23**	-1.07	-.25	.01
	-.05	.41	.11	-2.02	-.22	.21**	-1.14	-.24	.00
PAL enjoyability of non- substance related activities	3.60*	2.43	.03	-.40	-.01	.23**	5.00	1.18	.13
	5.23*	5.25	.11	-7.71	-.85	.21**	4	.83	.19
PAL cross product substance related activities	.71	2.32	.03	9.56	.30	.23**	-8.09	-1.91	.02
	3.04	3.09	.11	-8.88	-.98	.21**	4.49	.93	.02
PAL cross product non- substance related activities	20.66**	18.34*	.03	2.36	.07	.23**	9.46	2.24	.19*
	24.98**	22.52*	.11	-37.3	-4.13	.21**	31.71	6.59	.31**

Note: Displayed are the outcomes of patients and controls. Results of patients are presented in bold.
+p<0.10, *p<.05, **p<.01, ***p <.001.

Figure 1. Path model for multiple mediation analysis



Note: In the upper panel of Figure 1, the path coefficient denoted C represents the total relationship between NEO-FFI extraversion and PAL substance/non-substance related activity engagement, not controlling for DII dysfunctional/functional impulsivity. The lower panel of Figure 1 illustrates the hypothesized causal model. The path denoted A represents the conditional effect of NEO-FFI extraversion on DII functional/dysfunctional impulsivity; the path denoted B represents the unconditional effect of DII functional/dysfunctional impulsivity on PAL substance/non-substance related activity engagement. The strength of the mediated connection is found by multiplying $A \times B$. The path denoted C' represents the direct association between NEO-FFI extraversion and PAL substance/non-substance related activity engagement, controlled for the mediated paths involving DII functional/dysfunctional impulsivity.