Abstract

The aim of this study is to investigate the psychometric properties of the Snaith-Hamilton Pleasure Scale (SHAPS) and look at facets of extraversion as predictors of anhedonia. SHAPS is hypothesized to be multidimensional, stable over time in a non-clinical sample, and related to extraversion on both dimension and facet-level.

Data collection was conducted at baseline ($N = 362$) and at a ten-week follow-up ($N = 94$). The structural properties of SHAPS were analyzed using principal component analysis (PCA) and Confirmatory factor analysis (CFA). Multiple regression explored facets of extraversion as predictors of anhedonia.

The results show that SHAPS is stable across time (r =.71, p <.001), with high internal consistency (α = .89). In the PCA, a two-factor model emerged (Social and Physical anhedonia). The CFA indicated that the two-factor model consisting of physical (α =.81) and social anhedonia (α =.87) had a better fit than the one-factor model. Higher scores on Gregariousness and Positive emotions at baseline predicted higher scores on the SHAPS total and Social and Physical anhedonia (p <.05). Lower scores on Assertiveness predicted higher scores on Social anhedonia (p <.05).

These results support the view of anhedonia as a multidimensional concept that should be regarded as a trait, rather than a state or mere bypassing symptom. The relationship between anhedonia and extraversion is best understood by applying a multidimensional approach to anhedonia, and by focusing on the facet-level of extraversion.

Psychometric properties of the Snaith-Hamilton Pleasure Scale (SHAPS) and a facet-level analysis of the relationship between anhedonia and extraversion in a non-clinical sample

The last fifty years, anhedonia has been subject to research as a central symptom in various psychological disorders (Pelizza, Pupo & Ferrari, 2012). Recently, researchers have found new interest in anhedonia beyond this symptom focus (Olsen, Bjorkquist, Bodapati, Shankman & Herbener, 2015). By investigating anhedonia, researchers have found a new way to explain individual differences in personality and its relationship to psychopathology (Kendall et al., 2015; Thomson, Whybrow & Kringelbach, 2015). The results suggest a link to extraversion (Watson, Stasik, Ellickson-Larew & Stanton, 2015). Within neuroscience, the reward circuit has been used as framework for understanding both anhedonia (Thomsen et al., 2015) and extraversion (Allen & DeYoung, 2015). This study aims at investigating the properties of anhedonia as a trait by examining extraversion as a predictor of anhedonia.

Anhedonia

Traditionally, anhedonia has been defined as a loss of the ability to experience pleasure (Pelizza et al., 2012). It is known as an important symptom in psychiatric disorders such as depression (Olsen et al., 2015), schizophrenia (Chapman, Chapman & Raulin, 1976) and addiction (Thomsen et al., 2015). Anhedonia as a symptom affects treatment outcomes in depression, as these patients tend to be more resistant to treatment (Spijker, Bijl, Graaf & Nolen, 2001). It also predicts a higher relapse rate in addiction (Koob & Le Moal, 2001; Volkow, Fowler, Wang & Goldstein, 2002).

In addition to being described as a symptom, and therefore transient, anhedonia has more stable characteristics. In relation to schizophrenia, anhedonia is described as a trait rather that a state (Blanchard, Horan & Brown, 2001).

Recently, researchers have shown new interest in anhedonia, suggesting that reduced hedonic capacity can be regarded as an enduring trait in non-clinical samples (Chan et al., 2012, 2016; Wang et al., 2014). Hence, Individual differences in anhedonia is relevant also in non-clinical populations (Franken, Rassin & Muris, 2007; Harvey, Pruessner, Czechowska & Lepage, 2007). Furthermore, research suggest a relationship between stable personality traits, like extraversion, and disorders related to anhedonia (Watson, Stasik, Ellickson-Larew & Stanton, 2015). As a trait, anhedonia is interesting because it might predict the development of psychological disorders later in life (Kendall et al., 2015). Exploring clinical correlates of trait anhedonia in the general population may provide clues to the pathogenesis of psychiatric disorders (Chan et al., 2012).

One instrument used to measure anhedonia in both clinical and non-clinical samples is the Snaith-Hamilton Pleasure Scale, SHAPS (Snaith, Hamilton, Morley, Humayan, Hargraves & Trigwell, 1995). Although the prevalence of depression is almost doubled among women compared to men (Faravelli, Scarpato, Castellini & Sauro, 2013), SHAPS does not present gender differences in the general population (Snaith et al., 1995) nor in outpatients with major depressive disorder (Nakonezny et al., 2010). Previous studies have shown that SHAPS is a reliable and valid questionnaire to assess hedonic tone in non-clinical populations, and its briefness makes it fit for use in research settings (Franken, Rassin & Muris, 2007). A previous study found high internal consistency with α above .90 in both clinical and non-clinical samples. The same study investigated the structural properties of SHAPS and found a three-factor structure (Franken, Rassin & Muris, 2007). Although all items loaded on one forced factor, this three-factor structure supports the recent view on anhedonia as a multidimensional concept. Anhedonia was divided into the two factors Physical and Social anhedonia in early research (Chapman, Chapman & Raulin, 1976). Later, Thomsen and colleagues has (2015) proposed a reconceptualization of anhedonia, which include the three dimensions wanting, liking and learning. This revised definition is more in line with recent research stating that anhedonia is heterogeneous across major psychiatric disorders, and may be caused by an imbalance in different brain circuits (Olsen et al., 2015; Thomsen et al., 2015).

Extraversion

Among the factors in the five-factor model (FFM), neuroticism is the trait that is most associated with clinical populations. This trait has been described as "an almost ubiquitously elevated trait within clinical populations" (Widiger & Costa, 1994, p. 81). However, recent research has found a relationship between depression and "Positive emotions", a facet of extraversion in FFM (Watson et al., 2015). High scores in neuroticism is a more general tendency in clinical populations, while facets of extraversion have more diagnosis-specific relationships (Watson et al., 2015). For instance, the facet Positive emotions is negatively associated with major depressive disorder, and there is a negative relationship between the facet Gregariousness and negative symptoms of schizophrenia (Rector, Bagby, Huta & Ayearst, 2012). Moreover, the shared relationship between specific disorders and both anhedonia and extraversion further supports the link between extraversion and anhedonia (Chapman et al., 1976; Olsen et al., 2015; Rector et al., 2012; Watson et al., 2015)

Recognition of a hierarchical understanding of personality is critical for understanding individual differences in both personality and psychopathology (Markon, Krueger & Watson, 2005). As the domain level of personality is important for use in empirical settings, the facet level is more useful in clinically applied settings and has greater predictive power than higher order traits (Reynolds & Clark, 2001). These findings emphasize the use of facets instead of, or in addition to, the personality domains when investigating the predictive power of personality in psychological disorders.

Neuroscience as a framework for understanding anhedonia and extraversion

The mesolimbic reward circuit in the brain is a complex circuit detecting and responding to reward-related cues (Leung & Balleine, 2015). It affects the degree of reward approach, the level of pleasure and associative learning (Thomsen et al., 2015). Central brain structures in the circuit are the nucleus accumbens (NAc), the anterior cingulate cortex (ACC) and the ventral tegmental area (VTA). Dopamine is the neurotransmitter most referred to in the reward system, but GABA and opioids are included as well (see Heshmati & Russo, 2015 for a more thorough explanation of the reward circuit).

As researchers have a renewed interest in the various aspects of anhedonia, a growing body of research has appeared linking it to to specific brain circuits. In MDD, anhedonia has been linked to dopamine systems (Treadway & Zald, 2011) and reduced activity in brain structures such as NAc and ACC (Satterthwaite et al., 2015). The reduced reward learning associated with anhedonia predicts poorer prognosis in psychological disorders. Furthermore, trait anhedonia is associated with reduced reactivity in brain regions involved in reward processing, including NAc and VTA (Keller et al., 2013). Based on neuroimaging reward processing in the brain, Thomsen and colleagues (2015) proposed a reconceptualization of anhedonia. The three aspects of wanting, liking and learning represent differential parts or stages of the reward circuit. Thus, impairments in different parts of the circuit may result in different subtypes of anhedonia. Wanting refers to anticipating or reward incentive; liking to consummation or pleasure; and learning to association forming or predictions (Thomsen et al., 2015).

It was assumed early on that individual differences in reward system sensitivity is partly responsible for variation in personality (Gray, 1973) and that extraversion is the trait related to these sensitivity differences (Pickering & Gray, 1999). Although the relationship between extraversion and reward sensitivity is demonstrated in a large number of studies, the core feature of extraversion is still perceived to be sociability (Ashton, Lee & Paunonen, 2002), or a preference for social stimuli. Moreover, individuals with a high score on extraversion associate people with reward (Wilkowski & Ferguson, 2014). Differences in the reward system may explain the processes underlying the link between extraversion, sociability and higher level of positive emotions (Smillie, 2013).

Allen & DeYoung (2015) summarize the research on personality neuroscience by stating that there is e a link between the neurotransmitter dopamine and extraversion. This link refers to both learning and wanting (De Young, 2013). Extraversion is associated with the dopaminergic signals specified in reinforcement learning, and this further generalizes to reward anticipation (Cooper et al., 2014). Depue & Fu (2013) for instance, found a relationship between high extraversion and sensitivity to the rewarding effect of dopamine, using Pavlovian conditioning on human participants. Concerning specific brain regions linked to the reward circuit, extraversion predicts activity in NAc (Wu, Samanez-Larkin, Katovich & Knutson, 2014) and in ACC (Wacker, Chavanon & Stemmler, 2010). Additionally, a number of smaller studies also confirm activation in various other regions connected to reward processing (Allen & DeYoung, 2015).

Similar parts of the reward circuit are associated with both anhedonia and extraversion. The concepts of wanting, liking and learning seem to be similar for reward processing, extraversion and anhedonia. Since personality traits and the reward circuits are parts of the normal psychological domain, the relationship between extraversion and anhedonia should be prominent in non-clinical samples and in specific diagnosis groups.

Aim and hypothesis

This research aims to obtain a broader understanding of the predictive role of personality on anhedonia in a non-clinical sample. In addition, the psychometric properties of SHAPS are investigated to assess its ability to measure anhedonia as a trait in non-clinical samples. The goal is to provide a more thorough understanding of anhedonia. Parts of the study will focus on validating the instrument (SHAPS) in a non-clinical sample. By assuming that anhedonia is a trait-like concept implies that it should be stable over time.

Based on previous research, two hypotheses were outlined. First, we expect SHAPS to have a multidimensional structure, a strong test-retest correlation and high internal consistency. Second, we expect to find the differential impact of the facets of extraversion in predicting anhedonia and that the use of facet-level analysis is superior to the domain level.

Method

Participants and procedure

Psychology students at The Norwegian University of Science and Technology (NTNU) were invited to participate in the study. Questionnaires were distributed electronically through an intranet platform for students. The data collection took place in two separate stages. The first stage (T1) measured extraversion and anhedonia. At this stage, the participants were also instructed to generate a personal code. Ten weeks later the follow-up stage (T2) of the data collection took place. At this stage only anhedonia was measured.

Sample one ($N = 362$) consisted of all the participants recruited to the study. In this sample 76.5% were females ($N = 277$) and 22.1 % males ($N = 80$). Five participants (1.4%) did not report gender. The mean age was 21.22 ($SD = 3.05$). Sample two ($N = 94$) consisted of the participants who also completed the follow-up stage of the data collection and had a matching personal code for both stages. Of these participants 83 % were female ($N = 78$), 14.9% male ($N = 14$) and 2.1% did not report gender ($N = 2$). Mean age was 21.25 ($SD = 3.64$). Both samples ranged from age 18 to 43. Females are overrepresented in the two samples. Measures were taken to preserve statistical power (Cohen, 1992) by not overfitting the regression model.

Instruments

This current study used the Norwegian version (Martinsen, Nordvik & Østbø, 2011) of the Revised NEO Personality Inventory (Costa & McCrae, 1992).. The instrument operationalizes extraversion with 48 items using a five-point Likert scale ranging from “strongly disagree” to “strongly agree.” The NEO PI R has been proven both stable and valid as a measurement for extraversion (Costa & McCrae, 1992). The extraversion facets subsuming this domain are Warmth, Gregariousness, Activity, Excitement-seeking, Assertiveness and Positive emotions.

The Snaith-Hamilton Pleasure Scale (SHAPS) measures hedonic tone (Snaith et al., 1995). In this study, the original international version of SHAPS were used. The scale provides an estimation of the degree in which a person is able to experience pleasure and the anticipation of a pleasurable experience (Snaith et al, 1995). It consists of 14 items answered on a four-point Likert scale ranging from “strongly agree” to “strongly disagree.”

Analysis

Analysis was conducted using IBM SPSS Statistics 23 and AMOS graphics 24. The internal consistency of SHAPS was measured using Cronbach's alpha, and a test-retest correlation was used to assess stability over time. The structural properties of SHAPS were explored using a principal component analysis (PCA), investigating the possibilities of both one and multiple factors from previous research (Franken et al., 2007). Initially, the PCA was done with one forced factor and the following analysis with oblique rotation (Direct oblimin). A confirmatory factor analysis (CFA) of the two models was done and the comparative fit index (CFI) and Root Mean Square Error of Approximation (RMSEA) were used to compare the fit according to established criteria and guidelines (Hu & Bentler, 1999).

Multiple regression analysis was used to investigate extraversion with facets measured at T1 as predictors of anhedonia measured at T2. All analysis initially controlled for age and gender. These variables showed no significant relation to anhedonia and were excluded in the preceding analysis to preserve statistical power. The initial regression analysis used forced entry of all the facets of extraversion. In the follow-up analysis, stepwise entry of the predictors was used, i.e. including only variables with a statistically significant effect while simultaneously adjusting for other co-variables (Steyerberg, Eijkemans & Haberma, 1999).

Results

Structural properties of SHAPS

The Snaith-Hamilton Pleasure Scale showed high internal consistency ($\alpha = .89$) in the initial sample. All items correlated with the global SHAPS score of $r = .40$ or higher. In the follow-up sample, internal consistency was .91. The test-retest analysis showed that hedonic tone assessed by SHAPS is highly stable over the time-lapse of ten weeks, $r = .71$, $p <.001$. Mean scores were 47.48 in females ($SD = 6.33$) and 47.84 in males ($SD = 5.18$). An independent sample t-test showed no significant gender differences in SHAPS. In the initial PCA with one forced factor with an eigenvalue of 5.94, all loadings were .46 or higher. This one-factor structure explained 42.45% of the variance. Assumptions for factor analyses were met with a KMO value of .911 and a significant Bartlett's test of Sphericity, $p < .001$.

The succeeding principal component analysis with direct oblimin rotation extracted two factors with eigenvalues above 1. The two factors together explained 50.42% of the variance. They were labelled "Social anhedonia" and "Physical anhedonia", based on the loadings in the two factors (Table 1). The first factor, "Social anhedonia" had an eigenvalue of 5.94. Eigenvalue for "Physical anhedonia" was 1.12. There was a moderate correlation between the two factors, $r = .53$. Confirmatory factor analysis using AMOS showed that the fit indices for the two-factor model were superior (CFI= .91, RMSEA=, .079, CI.068-.09, χ^2 (76) 244.99, p <.001 to the one-factor model (CFI = .88, RMSEA= .091,CI .08-.10), χ^2 (77) 305.44, p <.001). According to Hu and Bentler (1999) a RMSEA below or equal to .05 is considered as a close fit, above .05 and below or equal .08 a reasonable approximate fit, and a value of .10 or above is considered as a poor fit. The CFI should be above .90, preferable above .95 (Hu & Bentler, 1999). The two factors were computed as new variables and used in the succeeding analysis.

Insert Table 1 here)

Extraversion and its facets as predictors of anhedonia

Table 2 presents the relationship between extraversion and anhedonia. Extraversion (α = .91, M = 3.40, SD = 0.42) measured at T1, explained 20.4% of the variance in anhedonia measured ten weeks later by SHAPSF (1, 91) = 23.35, p <.001. Extraversion explained 20.7% of the variance in "Social anhedonia", β = .46, p < .001, and 17.7 % in "Physical anhedonia," β = .42, p <.001. Results of the regression analysis is presented in table 3. The model including the six facets explained a total of 34.3% of the total variance, F (6,86) = 7.49, p < .001. Gregariousness was the only significant predictor. In "Social anhedonia," the total model of the six facets explained 36.5% of the variance F (6,87) = 8.34, p <.001. Gregariousness (β = .37, p = .003) and Assertiveness (β = -.27, p = .009) were significant predictors. . Regarding Physical anhedonia, the total model explained 29.9% of the variance, F (6,87) = 6.20, p <.001. Gregariousness contributed uniquely and significantly, β = .37, p = .002. The follow-up analysis using stepwise entry of the predictors showed that Positive emotions emerged as a significant predictor along with Gregariousness for SHAPS total (β =.29, p<.01, and "Physical anhedonia" (β =.23, p = .02). For "Social anhedonia", Positive emotions emerged as a significant predictor (β =.35, p <.01) together with Gregariousness and Assertiveness.

Insert table 2 and 3 here

Discussion

This study investigated the structural properties of the Snaith-Hamilton Pleasure Scale (Snaith et al., 1995) as a measure of anhedonia in a non-clinical sample. It also investigated the relationship between extraversion and anhedonia across a 10-week period. The aim was to obtain a broader understanding of anhedonia in non-clinical samples and the relationship between anhedonia and Extraversion.

Structural properties of SHAPS

SHAPS had a high test-retest correlation (.71) across a 10 week period. There were no gender differences in SHAPS, and the internal consistency was .91. The initial PCA with one forced factor showed that all items of SHAPS were loaded in this one factor. This suggests that the instrument measures one common construct: anhedonia. However, the two-factor structure of SHAPS in the second PCA with extraction criteria eigenvalue > 1.0 supports the recent view of anhedonia as a multidimensional concept (Chapman et al., 1976; Thomsen et al., 2015). Two items loaded on both factors, and these loadings were relatively weak. This suggest that the two items measure anhedonia poorly or that the specific content of each item may elicit both physical and social pleasure (e.g. enjoying a coffee). The number of factors extracted from SHAPS varies across multiple studies. Snaith and colleagues (1995) initially identified four domains of hedonic tone, while others have suggested three factors as well as one common factor for all items (Franken et al., 2007). When applying CFA, the two-factor model presented better fit-indices compared to the one-factor model. The indices for the two-factor solution are at best acceptable, suggesting that a further investigation of the dimensionality of SHAPS is needed. However, the results support the notion that anhedonia is better understood as a multidimensional construct (e.g. Thompson et al., 2015).

Extraversion and anhedonia

The stability of SHAPS across the 10 weeks between T1 and T2 (.71) found in this study is consistent with previous research (Franken et al., 2007; Snaith et al., 1995). This finding supports the assumption that anhedonia can be measured as a trait, making it relevant for personality dispositions (Chan et al., 2012, 2016; Wang et al., 2014). Previous research has found that anhedonia predicts treatment resistance and outcome as well as relapse (Spijker et al., 2001). This is in accordance with the results in this study, and consequently, anhedonia may persist as a trait even after other symptoms are treated.

Research in neurobiology suggest that extraversion and anhedonia are related to similar brain structures involved with reward processing (Allen & DeYoung, 2015; Keller et al., 2013;

Smillie & Wacker, 2015; Thomsen et al., 2015). The current study found a relationship between extraversion and anhedonia on a conceptual level. The relationship between the two concepts is central to the development of a more nuanced understanding of the role of personality in psychopathology. The relationship between personality and depression has been subject for investigation over several decades, but the focus has mainly been on neuroticism (Ormel et al., 2013). This current study emphasis the need to incorporate extraversion when investigating the link between personality and depression. While neuroticism is generally elevated in clinical populations, extraversion, especially on the facet-level analysis, has a more differentiated function in explaining psychological disorders, such as depression and addiction (Watson et al., 2015). SHAPS total, "Social anhedonia" and "Physical anhedonia", were best explained by the facet Gregariousness. For "Social anhedonia", Assertiveness was a significant negative predictor. The total scale of SHAPS measures the general hedonic tone. Gregariousness is about sociability and to what degree one feels comfortable in the company of others. This may also include the perceived reward extraverted people associate with other people (Wilkowski & Ferguson, 2014), which is thought to be a consequence of sociability. Thus, the activation of the reward circuit associated with a high score in Gregariousness (Smillie & Wacker, 2015) might explain these results. Assertiveness, on the other hand, is a more asocial facet, which may explain the negative contribution. Positive emotions were not a significant predictor of anhedonia in the initial regression analysis. However, the β-values of Positive emotions were among the highest in the SHAPS total (.22), "Social anhedonia" (.23) and "Physical anhedonia" (.23). The strong, yet non-significant, contribution of Positive emotions to anhedonia can best be explained by limited statistical power (Cohen, 1992). As stepwise regression analysis often are dissuaded (e.g. Steyerber et al., 1999), they were performed after traditional regression analysis with forced entry. In small samples, stepwise regression has an advantage as they are more powerful as they keep the number of predictors in the model to a minimum. In these succeeding analyses, Positive emotions were a significant of both SHAPS total, "Social" and "Physical" anhedonia. Positive emotions seems to play a role in trait-anhedonia. This is in line with previous research stating that low scores in Positive emotions predict psychological disorders related to anhedonia such as major depression (Naragon-Gainey & Watson, 2014). Future studies should strive towards larger samples when investigating the relationship between Positive emotions and anhedonia.

The facets Activity, Excitement seeking and Warmth, was related to SHAPS only at baseline, but did not predict anhedonia at T2. These results support that facets of extraversion have differentiated and specific prediction value regarding clinical phenomena (Watson et al., 2015).

Extraversion on the domain level in T1 explained a substantial part (20.4%) of the variance in anhedonia at T2, and the correlation between Extraversion and anhedonia was stronger than for each facet and anhedonia. This indicates that extraversion is a central in the understanding of the properties of anhedonia. However, when replacing the domain with all the facets of extraversion in the regression model, a larger part of the variance (34.3%) in anhedonia was explained. Opposite predictive values in the facet-level can contribute to weaker prediction ability when facets are merged together into the domain level. The differential pattern of beta values in the facets (some positive, others negative) addresses the importance of including both facet and domain levels to better understand the relationship between extraversion and anhedonia. It also stresses the advantages of using multiple levels of the personality hierarchy in different research settings for a better understanding of the phenomena under investigation (Reynolds & Clark, 2001: Markon et al, 2005).

Implications for research and clinical settings

Based on this study and previous findings, research going forward should aim to investigate trait anhedonia in treatment studies. Longitudinal studies using FFM can investigate whether personality dimensions or facets and trait anhedonia may work as risk or protection factors in the development of specific psychological disorders (Kendall et al., 2015). Neuroticism.

Research on anhedonia should aim to develop a measure of anhedonia that covers the three aspects of pleasure and reward. The relationship between extraversion at the facet-level and trait anhedonia found in this study needs replication in other, larger samples.

Limitations and Conclusion

This study is based on a sample of university psychology students, overrepresented by women. The size of the follow-up sample offers limited statistical power, and the study did not control for mental health status (e.g. psychiatric disorder). The relatively short interval between baseline and follow-up could inflate the stability coefficient, and future studies should explore the stability of SHAPS using a longer interval.

The results from this study supports the notion that anhedonia is best understood as a multidimensional construct. The relationship between extraversion and anhedonia found in this study contributes to a better understanding of the role of personality in psychopathology and the role of anhedonia in personality. The results from this study emphasize the need for applying a hierarchical approach, and to recognize the role of extraversion when investigating personality predispositions for psychopathology.

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