

Domains Of Pleasure Scale (DOPS): assessing pleasure across domains

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## Abstract

The Domains Of Pleasure Scale (DOPS) is a newly developed questionnaire designed to measure the multifaceted aspects of pleasure. It assesses levels of pleasure across different domains (e.g., social, physical). The psychometric properties of the DOPS were tested in two studies (Study 1:  $N = 2937$ ,  $M_{\text{age}} = 21.4$  years,  $SD = 1.9$ ; Study 2:  $N = 1187$ ,  $M_{\text{age}} = 22.84$ ,  $SD = 2.23$ ). In line with the multifaceted view of pleasure experiences, comparisons with a one factor solution showed that pleasure may be best investigated domain specific rather than aggregated over all items. Across studies, exploratory and confirmatory factor analysis showed that pleasure was reliably measured in the domains of social pleasure, sexual pleasure, perceptual pleasure, and pleasure in personal achievements. Measurement invariance was established across sex and educational level in Study 1, but not in Study 2. The DOPS is a promising instrument to measure pleasure across different domains and may help researchers and clinicians to pinpoint interventions.

*Keywords:* Domains Of Pleasure Scale (DOPS), consummatory pleasure, loss of pleasure, anhedonia

The ability to experience pleasure is important for human functioning and well-being. The decrease or inability to experience pleasure, also called anhedonia, is common in different sorts of psychopathology, for example schizophrenia and substance use, but most prominently in depression, where it is one of the two core symptoms (American Psychiatric Association, 2013; Blanchard & Cohen, 2006; Franken, Rassin, & Muris, 2007). The majority of people with Sixty-five to 77% of people with a Major Depressive Disorder report anhedonia (65-77%; Buchwald & Rudick-Davis, 1993; Lewinsohn, Petit, Joiner, & Seeley, 2003; Roberts, Lewinsohn, & Seeley, 1995).

Pleasure can be experienced in different domains. A common distinction is between pleasure derived from physical experiences (e.g. touch, smell, hearing) and pleasure derived from social experiences (Kringelbach, 2010). Other, partly overlapping, domains are sexual pleasure, appetitive pleasure, pleasure from pastime activities and pleasure experiences that come from activities related to self-actualization (Berridge & Robinson, 1998; Kennedy, Dickens, Einfeld, & Bagby, 1999; Rizvi et al., 2015; Snaith et al., 1995). Although all hedonic pleasure experiences involve shared brain circuitries and neurotransmitters (Kringelbach, 2010), research on loss of pleasure has shown that pleasure and loss of pleasure may occur domain specific. For example, schizophrenic patients with social anhedonia have decreased pleasure responses towards social rewards compared to controls, but do not differ in their response towards monetary rewards (Xie et al., 2014). Furthermore, physical anhedonia has been related to attenuated responses to pleasure-inducing stimuli (Blanchard, Bellack, & Mueser, 1994; Fitzgibbons & Simonst, 1992; Kaviani et al., 2004; but see e.g. Berenbaum & Oltmanns, 1992; Berenbaum, Snowwhite, & Oltmanns, 1987), while social anhedonia may not affect pleasure responses to affective stimuli (Blanchard et al., 1994; but see e.g. Dowd & Barch, 2010). Together these findings suggest that physical and social anhedonia constitute

partly different kinds of impairments. In sum, evidence is supportive of the notion that pleasure experiences may occur domain-specific.

If pleasure experiences can occur domain specific, it would benefit researchers and clinicians to be able to measure pleasure domain specific. We present the Domains Of Pleasure Scale (DOPS) which was developed to measure domain specific pleasure experiences as well as general pleasure experiences. The DOPS is designed to measure pleasure in the most researched area of pleasure, consummatory pleasure, which refers to pleasure experienced during the activity itself (as opposed to motivational and anticipatory pleasure). In the remainder of this introduction, we briefly introduce the currently existing pleasure or loss of pleasure questionnaires. Next, we elaborate on what the DOPS adds to existing questionnaires. We focus on self-report questionnaires because of their ease of administering, and will leave experimental or interview based assessment methods aside.

### **Existing Pleasure and Anhedonia Questionnaires**

To date, the most frequently cited anhedonia and pleasure questionnaires are the 61-item Revised Physical Anhedonia Scale (RPAS; Chapman & Chapman, 1978) and the 40-item Revised Social Anhedonia Scale (RSAS; Eckblad, Chapman, Chapman, & Mishlove, 1982). The two Chapman scales were originally developed to measure social and physical anhedonia in schizophrenia patients by posing descriptive items, presented in a true/false response format. Other often-cited scales include the Fawcett-Clark Pleasure Scale (FCPS; Fawcett, Clark, Scheftner, & Gibbons, 1983), the Snaith-Hamilton Pleasure Scale (SHAPS; Snaith et al., 1995), and The Temporal Experiences of Pleasure Scale (TEPS, Gard, Gard, Kring, & John, 2006). The FCPS is a 36-item pleasure scale that asks participants to imagine how much pleasure they could experience in a variety of situations regardless of the real life applicability of the situation. The SHAPS is a 14-item questionnaire developed as an easy and quick instrument to measure anhedonia. The TEPS consists of a 10-item anticipatory pleasure

and 8-item consummatory pleasure scale. More recently developed questionnaires are the Anticipatory and Consummatory Interpersonal Pleasure Scale (ACIPS; Gooding & Pflum, 2014), the Dimensional Anhedonia Rating Scale (DARS; Rizvi et al., 2015), the Motivation and Pleasure Scale – Self-Report (MAP-SR; Llerena et al., 2013), the Specific Loss of Interest and Pleasure Scale (SLIPS; Winer, Veilleux, & Ginger, 2014), and the Leuven Affect and Pleasure Scale (LAPS; Demyttenaere, Mortier, Kiekens, & Bruffaerts, 2017). Table 1 depicts the domains of pleasure that are covered by the above mentioned questionnaires. Due to their scope and content, these questionnaires share one or more of the below-described limitations.

The main issue with existing questionnaires is that, with the exception of the DARS and Chapman scales, they do not differentiate between domains of pleasure. The Chapman scales only cover physical and social pleasure and consist of a large number of items, making them potentially cumbersome to fill in. Other questionnaires contain items mostly aimed at a single domain, like perceptual pleasure (TEPS) or social pleasure (ACIPS). The SHAPS and the SLIPS do cover multiple domains, but do not differentiate between them by means of subscales. The DARS is the exception with subscales covering multiple domains. A disadvantage of the DARS is that its domain scores represent a mix of consummatory, motivational and anticipatory pleasure, making it unclear whether scores around the middle of the scale represent overall moderate pleasure across consummatory, motivational and anticipatory pleasure, or high scores on one dimension and low scores on another. Additional issues concern the item quality and appropriateness. The FCPS, RPAS, RSAS and the TEPS contain several items that may be considered outdated (e.g. items about organ music; RPAS), are possibly not pleasurable to many people (e.g. “I love it when people play with my hair”; TEPS), or are only relevant for specific cultural or age groups (e.g. items about snow, TEPS, RPAS and FCPS; items about sex, RPAS, FCPS). To assure wide validity, pleasure measures

should contain items that are appropriate for all individuals and conditions and should contain items which are relevant to the majority of people.

## **The DOPS**

We have highlighted the need to conceptualize pleasure as a multifaceted construct, and argued that there are currently no pleasure questionnaires available that sufficiently differentiate between the various domains of consummatory pleasure. The Domains Of Pleasure Scale (DOPS) was developed to differentiate between physical pleasure, social pleasure, sexual pleasure, intellectual activities or esthetic activities, and pleasure derived from hobbies. Additional features of the DOPS reported in the Supplemental materials are the assessment of change in pleasure, which can be used to determine loss of pleasure, and the duration and possible cause of loss of pleasure, if any.

The DOPS was initially assessed in a small sample, and, after improvements, assessed in two larger community samples of young adults. Adolescents and young adults are a highly relevant population in this respect, as research suggests that around 20% of adolescents and young adults experience periods of anhedonia (Bennik, Nederhof, Ormel, & Oldehinkel, 2014). We examined (a) the factor structure and reliability of the DOPS, (b) measurement invariance, (c) the interrelations of the DOPS measures, (d) possible sex and educational differences, (e) test-retest reliability, and (f) associations of the DOPS with other pleasure, anhedonia and depression measures. All data, syntaxes and output of the reported studies are made available via the Open Science Framework (<https://osf.io/gcn3d/>), as is the DOPS itself.

## **Study 1**

### **Methods**

#### **Scale Development**

Originally the DOPS was designed to measure not only consummatory pleasure, but motivational and anticipatory pleasure as well. Since the motivational and anticipatory measures appeared to require further development, we chose to exclude those items from the DOPS and to omit their description here. We shortly elaborate on this decision further in the discussion and provide information about the motivational and anticipatory items via the OSF page (<https://osf.io/gcn3d/>).

Item selection was an iterative process in which we first identified domains of pleasure that were explicitly or implicitly mentioned in the relevant literature, that is, physical, social, sexual, achievement and self-actualization, and esthetic pleasure. We inspected existing (at that time) pleasure and anhedonia scales (RPAS, RSAS, TEPS, SHAPS and SLIPS) for suitable items, and adjusted and created new items to cover all domains. This resulted in an item pool of 180 items, which was evaluated on suitability by the authors of the present article. In order to be judged as suitable, consensus was needed among the authors that an item was contemporary and suitable to all ages and conditions, and that it was likely to reflect experiences that are considered pleasurable by the majority of people.

This screening of possible suitable items resulted in a preliminary selection of 26 pleasure experiences, covering the five before-mentioned domains. Responses concerned pleasure experiences during the past two weeks, and had to be indicated on a Visual Analogue Scale (VAS) with “*Not at all*” and “*Very much*” as left and right anchors. The anchors corresponded with the values 0 and 100 respectively. Due to its wide range, a VAS has the advantage of allowing to detect subtle individual differences and intra-individual changes after repeated measures. In addition, we asked participants to rate their overall, domain-overarching pleasure. For this item, the anchors on the VAS scale were “*I hardly ever enjoy myself*” and “*I almost always enjoy myself*”. This yielded a total of 27 pleasure items.

This initial version of the DOPS was piloted in a sample of 273 intermediate vocational educational and university students (mean age = 19.6 years, SD = 3.2, 68% female). Twenty-one specific pleasure items were retained after discarding items concerning situations that were not generally considered as pleasurable (i.e., mean pleasure score below 60; five items), combining two overlapping items, and adding one new social item (I enjoy being with family or good friends). The discarded items were about (1) feeling a soft carpet, beach or grass on bare feet, (2) hearing certain sounds (e.g., singing birds, leaves rustling), (3) activities requiring light exercise (e.g. going for a walk, yoga), (4) reading a book or magazine, and (5) activities that require hard thinking (e.g. chess, studying, puzzles, and challenging computer games). The combined item was made out of an item describing seeing something beautiful outside (e.g. landscape, sunset, beautiful sky), and an item describing seeing something beautiful in general (e.g. an artwork or movie). For six items the content was adjusted (e.g. removing an example). The item to assess overall pleasure was retained. Because of feedback from participants, items relating to sexual experiences were accompanied with the statement “I have no experience of this”, which could be selected in order to skip the question.

The above-listed alterations resulted in a questionnaire consisting of 22 pleasure level (21 domain-specific + 1 overall). This final version of the DOPS was administered to the sample described below.

### **Participants and Procedure**

Data collection was part of the broader No Fun No glory project, and the data were collected between February and April 2015. For a full overview of all measures we refer to the study protocol (van Roekel et al., 2016). We aimed to include participants from the three main secondary and tertiary educational levels in the Netherlands (intermediate vocational education, higher vocational education and university). Participants were recruited from



schools and (applied) universities in the northern provinces of the Netherlands. Invitations to subscribe were distributed via e-mail, electronic learning environments, flyers, social media, and oral presentations during classes and lectures. Participants could subscribe online. After subscription, participants automatically received a link to the survey. In addition to administration via the website, the survey was administered in classes during school hours. This approach was used only in intermediate vocational education institutes, whose cooperation was important because participants with lower educational levels are known to be more likely to refuse participation (Dillman et al., 2009; Goyder, Warriner, & Miller, 2002; Tolonen et al., 2006). The classroom sessions were supervised by research assistants, who could answer questions if necessary.

Of a total of 3,247 subscriptions to receive the URL to fill in the survey, 3,035 were actually activated by the participants. Removal of duplicate cases and individuals who did not complete the DOPS resulted in a final sample of 2,937 participants. The average age was 21.4 years ( $SD = 1.9$ ) and most of the participants were female (78%). Almost all participants were enrolled in education (54% university, 30% higher vocational education, 11% intermediate vocational education, 1% other sort of education, 4% no education). Upon completion of the survey, participants were sent a 10 Euro gift voucher and participated in a lottery for additional prizes (fashion vouchers, tablets and a 4-day city trip). The study was approved by the Medical Ethical Committee from the University Medical Center Groningen (no. 2014/508).

### **Additional Measures**

In order to compare the DOPS with another pleasure measure, the 18-item Temporal Experience of Pleasure (TEPS; Gard et al., 2006) was included in the survey. The TEPS contains a consummatory (TEPS-CONS;  $\alpha = .64$ ) and an anticipatory pleasure scale (TEPS-ANT;  $\alpha = .66$ ). Positive affect and depressive, anxiety, and withdrawal symptom scales were

included for the purpose of comparison as well. Positive affect (PA) was measured using 10 items (feeling interested, joyful, determined, calm, lively, enthusiastic, relaxed, cheerful, satisfied, energetic;  $\alpha = .96$ ), rated on a VAS ranging from “Not at all” to “Very much”. This measure is much alike the original positive affect scale of the PANAS (Watson, Clark, & Tellegen, 1988), with the major difference that, next to high arousal items (e.g. energetic, enthusiastic), we also included low arousal items (i.e. calm and relaxed). Depressive symptoms were measured with the 9-item Patient Health Questionnaire (PHQ-9;  $\alpha = .84$ ; Kroenke, Spitzer, & Williams, 2001), responses were given on a 4-point scale ranging from 0 “Not at all” to 3 “Every day” and summed to create a scale score. In addition, anxiousness and depression were measured using the 18-item Anxious/depression subscale ( $\alpha = .91$ ) of the Adult Self-report Scale (ASR; Achenbach, Dumenci, & Rescorla, 2003). Withdrawal was measured with the 9-item ASR withdraw subscale ( $\alpha = .79$ ; Achenbach, Dumenci, & Rescorla, 2003). Responses on the ASR scales were indicated on a scale from 0 “Not true” to 2 “Very true or often true” and scores were averaged to create scale scores.

### **Statistical Analysis**

The dataset was randomly split into two subsets, each containing about 50% of the data. The first dataset (1,459 cases, 78% females) was used to conduct an Exploratory Factor Analysis (EFA) on the 21 consummatory pleasure level items, using Mplus 8.0 (Muthén & Muthén, 1998-2017). There were 218 participants who had missing data because they had no experience on at least one of the three items about sexual pleasure. Full Information Maximum Likelihood (FIML) was used to handle the missing data on those items and a robust estimator (MLR) to handle non-normal distribution of the data, in combination with oblique (Geomin) rotation because factors were assumed to correlate. Items had to have a minimum factor loading of .30 on their own factor and cross-loadings lower than .30 on the

other factors in order to be retained in the item pool.<sup>1</sup> The initial number of factors to retain was established with parallel analyses (Hayton, Allen, & Scarpello, 2004; Horn, 1965). Factors with eigenvalues greater than the 95<sup>th</sup> percentile of eigenvalues in the permuted dataset were retained. The reliabilities of extracted factors were assessed with Cronbach's alphas.

The resulting factor structure was cross-validated in the second dataset (1,478 cases, 77% females) with Confirmatory Factor Analysis (CFA) using Mplus 8.0. The 233 participants that indicated having no experience on at least one of the items about sex remained in the dataset because FIML with a robust estimator (MLR) was used. Goodness-of-fit indices included the Chi-square, Comparative Fit Index (CFI), Root Mean Square Error of Approximation (RMSEA), and the Standardized Root Mean Square Residual (SRMR). As the significance level of the Chi-square is highly dependent on the sample size, we based model evaluations on the CFI, RMSEA and SRMR. Models with CFI values  $>.90$  are considered to have acceptable fit and models with a CFI  $>.95$  good fit, RMSEA and SRMR values  $<.08$  indicate acceptable fit and  $<.05$  good fit (Bentler & Bonett, 1980; Hu & Bentler, 1999).

Subsequently, we assessed measurement invariance of the subscales across sexes and the three main educational levels of our sample, using a hierarchical analyses strategy. To achieve sufficient group sizes on all levels, we conducted these analyses using the entire sample. We first tested model fit for males and females and for each of the three main educational levels separately. 149 participants were not currently enrolled in one of the three main educational levels and could therefore not be included in the measurement invariance analyses relating to educational level. If needed and theoretically justified, errors were allowed to correlate to improve model fit. Correlated errors can occur when items with similar

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<sup>1</sup> The .30 criterion for factor loadings was based on a rule of thumb once given to the first author. It is however, very close to the .32 as proposed by Tabachnick and Fidell (2007) as the minimal factor loading to be considered significantly important, and conclusions would not have differed.

wording are included (Floyd & Widaman, 1995). We then tested the separate models together in a configural model. Configural invariance indicates that the structural model is the same across groups, i.e. that the same items load onto the same factors across groups. In the configural model the factor structure was constrained to be the same for all groups, while all other parameters were free to vary. Correlated errors in the separate models were included in the configural model. Metric invariance was established by comparing the configural model with the metric model, which imposed the additional constraint of equal factor loadings. Metric invariance indicates that items have the same importance across groups. In case of metric invariance, we compared the metric model with the scalar model to establish scalar invariance. The scalar model had the additional constraint of equal intercepts. Scalar invariance indicates that individuals with the same latent factor score, also on average have the same observed scores on the individual items (Sass, 2011). Following recommendations by Chen (2007), we considered metric invariance as established when  $\Delta CFI < .01$ ,  $\Delta RMSEA < .015$  and  $\Delta SRMR < .03$ , and scalar invariance when  $\Delta CFI < .01$ ,  $\Delta RMSEA < .015$  and  $\Delta SRMR < .01$ . We applied a stringent approach, that is, the change for all fit indices had to be within the limits.

In order to investigate relations between the specific scales of the DOPS, Pearson product-moment correlations were conducted. In addition we investigated how the subscales of the DOPS related to the overall pleasure measure, by conducting multiple regression analysis with the domain-specific pleasure scores as independent variables and the overall pleasure measure as dependent variable. Mean differences on the DOPS scales among sex and educational level were examined using appropriate statistical tests (i.e., independent T-tests and ANOVAs) for each comparison.

We examined correlations of the DOPS with the TEPS scales, as well as with positive affect (PA), depressive symptoms (PHQ-9), anxiousness and depression (ASR), and

withdrawal (ASR). The relations of the domains of pleasure and the single-item pleasure measure with PA and depressive symptoms were explored separately and simultaneously using a series of multivariate multiple regression analyses.

## Results

### Factor Structure and Reliability

**Exploratory Factor Analysis (EFA).** In order to explore the factor structure of the DOPS pleasure items, we conducted an EFA on the 21 specific pleasure level items using the first dataset. Parallel-analyses indicated a four-factor solution. The four factors related to pleasure derived from (1) social experiences, (2) sexual experiences, (3) perceptual experiences, and (4) personal achievements (Table 2). The factors correlated moderately to strongly ( $r$  .39 - .58) with each other, indicating distinct but related domains of pleasure. All four factors had acceptable to good reliabilities: social pleasure  $\alpha$  = .82, sexual pleasure  $\alpha$  = .83, perceptual pleasure  $\alpha$  = .78 and personal achievements  $\alpha$  = .70<sup>2</sup>.

**Confirmatory Factor Analysis (CFA).** Before cross-validating the four-factor model, we first tested the most parsimonious model, that is, a one-factor model with all 21 items loading on the same factor. This model had a poor fit:  $\chi^2(189, N = 1478) = 1898.55, p < .001$ , CFI = .76, RMSEA = .08, SRMR = .06. The four-factor model as found in the EFA showed acceptable to good fit with the data ( $\chi^2(183, N = 1478) = 732.79, p < .001$ , CFI = .924, RMSEA = .045, SRMR = .039), showing support for the four-factor structure. Inspection of the modification indices showed that parts of the unexplained variance shared a common cause, indicated by correlated error terms. We allowed correlated errors of two item pairs (items 8-9 and 11-12) involving items that followed each other directly in the survey. This resulted in the final model with the following model fit:  $\chi^2(181, N = 1478) = 604.40, p < .001$ ,

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<sup>2</sup> We conducted a sensitivity analysis to check whether, despite the FIML estimation, missing data on the sexual items influenced the factor structure by running factor analysis without the three sexual items. The results showed the expected three factor structure.

CFI = .942, RMSEA = .040, SRMR = .035. For the standardized factor loadings related to this model please see the supplemental Table S1.

### **Measurement Invariance**

Model fit statistics for the separate models and measurement invariance models are presented in Table 3. The results show that the separate models had acceptable to good model fits. Full configural and metric invariance was established across sex and educational level. Scalar invariance was not fully established. Freeing equality constraints of three items across sexes and just one item across educational levels was sufficient to establish partial scalar invariance, with acceptable changes in all three fit indices.

### **Correlations Between DOPS Measures**

To examine the relations between the DOPS subscales, we calculated mean scores for each of them. The overall mean pleasure score was based on the average of the four pleasure subscales to give the same weight to every subscale. The correlations between the domain-specific subscales were all moderate to strong (Table 4). The single-item measure correlated moderately to strongly with all other DOPS measures; the highest correlation was with the social subscale. The regression analyses revealed that all four domain-specific sub-scales (social  $\beta=0.33$ , 95% CI [0.29, 0.38],  $p<.001$ ; sexual  $\beta=0.13$ , 95% CI [0.09, 0.17],  $p<.001$ ; perceptual  $\beta=0.11$ , 95% CI [0.07, 0.16],  $p<.001$ ; personal achievements  $\beta=0.11$ , 95% CI [0.07, 0.16],  $p<.001$ ) were uniquely related to the overall single-item pleasure measure ( $R^2=.32$ ,  $p<.001$ ).

### **Sex and Educational Differences in Pleasure Level**

Sex differences on the pleasure level subscales are depicted in Table 5. Males scored higher on the sexual and personal achievements scales, and females higher on the social and perceptual scales, but they did not significantly differ on the mean pleasure scale. However, the significant differences were small, with a maximum effect size (Hedges'  $g$ ) of .23. To test for statistically significant differences between educational levels, two ANOVAs were conducted, one separately for the sexual pleasure scale due to the missing data, and one for the other scales. There were small significant differences between the educational levels, as depicted in Table 6.

### **Association with Related Constructs**

Correlations with related constructs are depicted in Table 4. Comparing the DOPS with the TEPS showed little to no differentiation in associations between the consummatory and anticipatory scales of the TEPS. Both the TEPS-CONS and TEPS-ANT were most strongly related to the DOPS perceptual scale and the mean pleasure scale, with moderate correlations (.38 to .43). Of all related constructs, the DOPS measures overlapped the most with PA, as indicated by moderate to strong (.43 to .71) correlations. Depressive symptoms as measured with the PHQ-9, had a strong negative correlation with the DOPS single-item pleasure measure, moderate correlations with the social, sexual and personal achievement measures (-.31 to -.39) and a weak correlation with the perceptual pleasure scale. The correlations with the anxious/depressed scale showed a very similar pattern. Supporting the validity of the DOPS social measure, withdrawal had a strong correlation with the DOPS social pleasure measure, weak to moderate correlations with the other DOPS subscales, and a strong correlation with the single-item measure.

Results of the (multiple) regression analyses are reported in Table S3. Multivariate regression analyses with the four subscales as independent variables and PA and depressive symptoms as dependent variable showed that all four subscales were uniquely related to PA ( $R^2 = .36$ ) and depressive symptoms ( $R^2 = .17$ ). For PA this relation was strongest for the social subscale ( $\beta = 0.31$ , 95% CI [0.27, 0.36]) and weak for the perceptual pleasure subscale ( $\beta = 0.05$ , 95% CI [0.05, 0.09]). After including the single-item to the model, perceptual pleasure did not significantly predict PA anymore. The four subscales were all significantly related to depressive symptoms, with the strongest association for the social subscale ( $\beta = -0.23$ , 95% CI [-0.29, -0.18]). The weakest association was surprisingly a positive association with the perceptual subscale ( $\beta = 0.10$ , 95% CI [0.04, 0.15]). After including the single-item, all associations remained significant.



## Study 2

The results of Study 1 indicated a clear 4-factor structure, identifying the domains of social pleasure, sexual pleasure, perceptual pleasure and pleasure derived from personal achievements. To replicate the study in another sample and to further evaluate the validity of the DOPS measures, we conducted a second study, in which we included additional questionnaires to compare the DOPS with, and investigated the test-retest reliability of the DOPS measures. Because the data of Study 1 showed highly correlated errors between two item pairs with similar wording that were very close to each other, we reordered the items so that these items were not close to each other in Study 2, with the aim to mitigate the problem of correlated errors.

## Methods

### Participants and Procedure

Two different samples were recruited for this study. Data were collected between March and April 2017. The first sample consisted of 962 participants who previously participated in Study 1 two years earlier and had given permission to be contacted for future research, in the remainder indicated as Sample 1 (17% men;  $M_{\text{age}} = 23.31$ ,  $SD = 1.85$ ; 94% enrolled in or completed higher vocational education or university; 97% Caucasian). The second sample was an independent sample naïve to the DOPS and consisted of 225 first-year psychology students from Tilburg University, in the remainder indicated as Sample 2 (29% men;  $M_{\text{age}} = 20.82$ ,  $SD = 2.59$ ; 84% Caucasian). The participants received invitations per email, and filled in the questionnaires at home. Completion of the questionnaires took about 35 minutes. Upon completion, participants of Sample 1 received €7,50 in digital vouchers and participants of Sample 2 received course credits. At the end of the questionnaire, part of the participants were asked whether they would be willing to participate in a short re-test two weeks. The retest consisted of the DOPS, the DARS and the SHAPS, and took around 10

minutes to complete. Sample 1 participants received an additional €5.00 worth of digital vouchers, Sample 2 participants additional course credits. From Sample 1, we invited 168 participants from the first 800 participants to do the retest, stratified by sex. Of those, 149 participants (40% men) completed the retest (mean time in days between test-retest = 15.00, SD = 1.75). All Sample 2 participants were invited for the retest, of whom 194 completed the retest (27% men, mean time in days between test-retest = 15.36, SD = 2.37). The ethical approval for Study 1 applied to the data collection for Sample 1 of this Study 2. For Sample 2, ethical approval was granted by the Tilburg University School of Social and Behavioral Sciences ethics review board (EC-2017.10).

## Measures

At baseline we administered the DOPS, TEPS-ANT ( $\alpha = .65$ ), TEPS-CONS ( $\alpha = .64$ ) and PHQ-9 ( $\alpha = .87$ ), ASR Anxious depressed ( $\alpha = .92$ ) and Withdrawn ( $\alpha = .82$ ) measures as in Study 1, together with the additional measures as listed below. Reliabilities of the DOPS measures are presented on the diagonal of Table 4.

Positive Affect (PA;  $\alpha = .87$ ) and Negative Affect (NA;  $\alpha = .89$ ) were measured with the Positive And Negative Affect Schedule (Watson et al., 1988). The scale consists of a positive affect scale with 10 words describing positive feelings and emotions (e.g. interested, enthusiastic), and a negative affect scale with 10 words describing negative emotions and feelings (e.g. scared, anxious). In contrast to the VAS-scale used in Study 1, responses were given on a 5-point Likert scale ranging from 1 "Never" to 5 "Very often".

The Dimensional Anhedonia Rating Scale (DARS; Rizvi et al., 2015) consists of 17 items measuring a mixture of consummatory, anticipatory and motivational pleasure with a total scale ( $\alpha = .89$ ) and four subscales: Pastimes/Hobbies ( $\alpha = .91$ ), Foods and Drinks ( $\alpha = .81$ ), Social activities ( $\alpha = .84$ ), and Sensory experiences ( $\alpha = .89$ ). For each subscale, participants had to list at least two of their favorite activities or experiences, after which four

or five questions (e.g. “Spending time doing these things would make me happy”) about the listed activities had to be answered on a 5-point scale ranging from 1 “Not at all” to 5 “Very much”.

The Snaith-Hamilton Pleasure Scale (SHAPS; Snaith et al., 1995;  $\alpha = .87$ ) consists of 14 items measuring pleasure experiences in the past few days. Answers were provided on a scale from 1 “Absolutely agree” to 4 “Absolutely disagree”. Scores were summed with higher scores indicating higher levels of anhedonia. An example item is “I would be able to enjoy my favorite meal”. The SHAPS has been shown to be valid for use in Dutch clinical and non-clinical samples (Franken et al., 2007).

To measure pleasure in the sexual domain, we used the 14-item Changes in Sexual Functioning Questionnaire (CSFQ-14). The CSFQ measures sexual pleasure, desire and functioning. Because we were only interested in pleasure and desire, we selected the 6 items ( $\alpha = .78$ ) belonging to the pleasure and desire scales of the CSFQ-14. Items were scored on a 5-point scale, indicating frequency (ranging from “never” to “every day”; 4 items) or level of pleasure (ranging from “no pleasure” to “a lot of pleasure”; 2 items). Items scores were summed to calculate a sum score. For the first item, “Compared with the most enjoyable it has ever been, how enjoyable or pleasurable is your sex life right now?” we included the option “I have no experience with this yet”. The other items clearly stated that they could relate to sexual experiences without a partner as well. If the option “I have no experience with this yet” was indicated, the response was recoded as missing value.

Approach and avoidance motivation were measured with the 20-item Behavioral Inhibition Scale (BIS;  $\alpha = .81$ ) and Behavioral Activation Scale (BAS; Carver & White, 1994). Answers were given on a 4-point scale ranging from “very not true” to “very true”. An example BIS item is “I worry about making mistakes”. The BAS measure consists of three

subscales, reward responsiveness (BAS RR;  $\alpha = .58$ ), Drive ( $\alpha = .74$ ), and Fun Seeking ( $\alpha = .59$ ). An example of a BAS item is “I go out of my way to get things I want”.

### **Statistical analyses**

To investigate whether the factor structure of Study 1 would replicate, we conducted two separate CFAs on Sample 1 and 2. We subsequently combined the datasets and investigated measurement invariance across sexes. It was not possible to investigate measurement invariance across educational level, because there were not enough cases in the lower educational categories. Subsequent test-retest and correlational analyses among the DOPS measures and convergent and divergent validity were investigated using the combined dataset. Results of these analyses for the separate samples are available in the Supplemental Materials. Notable differences between the samples are mentioned in text.

## **Results**

### *Confirmatory Factor analyses*

As in Study 1, we first tested a one factor CFA in both samples. This model did not fit the data well in Sample 1,  $\chi^2(189, N = 962) = 1531.29, p < .001$ , CFI = .749, RMSEA = .086, SRMR = .064, nor in Sample 2 ( $\chi^2(189, N = 225) = 507.18, p < .001$ , CFI = .773, RMSEA = .086, SRMR = .076). The four factor structure had acceptable model fit in Sample 1,  $\chi^2(183, N = 962) = 705.86, p < .001$ , CFI = .902, RMSEA = .054, SRMR = .047. Although the model could be significantly improved by allowing correlations between the errors of item 18 “I enjoy getting better at something” and item 21 “I enjoy learning new things”, we decided against it to avoid making sample specific adjustments. The four factor solution had acceptable model fit in Sample 2 as well,  $\chi^2(183, N = 225) = 304.440, p < .001$ , CFI = .914, RMSEA = .054, SRMR = .055. Standardized factor loadings on the four factors for Sample 1 and Sample 2 are presented in Table S5 of the Supplemental Materials.

### *Measurement invariance across sexes*

The model fit of the combined Samples 1 and 2 was acceptable,  $\chi^2(183, N = 1187) = 764.71$ ,  $p < .001$ , CFI = .911, RMSEA = .052, SRMR = .043. The model was acceptable for women as well,  $\chi^2(183, N = 958) = 661.69$ ,  $p < .001$ , CFI = .914, RMSEA = .052, SRMR = .043. However, the model fit for the men was insufficient,  $\chi^2(189, N = 229) = 380.64$ ,  $p < .001$ , CFI = .841, RMSEA = .069, SRMR = .067. Modification indices did not provide directions for meaningful improvements. We therefore did not continue to test for measurement invariance because the requirement of acceptable separate models was not fulfilled.

### **Test-retest reliability**

The domain specific subscales all had strong test-retest correlations with their respective scales on T1, with correlations ranging from .75 to .78. The mean pleasure scale had a test-retest correlation of .81; the single item pleasure measure of .56. The correlational tables for the test-retest DOPS measures are given in the Supplemental Materials (Table S6) for Sample 1 and Sample 2. Most notable differences between the two samples were that test-retest correlations tended to be higher in absolute values in Sample 1 than Sample 2, which may be related to the fact that the retest for Sample 2 fell in or around exam week.

### **Correlations Between Pleasure Level Measures**

The correlation between the domain specific scales and the one item overall pleasure measure were all moderate to strong (Table 4). The social domain had the strongest correlation with the overall pleasure measure, but regression analyses indicated that all four domain-specific subscales (social  $\beta = 0.30$ , 95% CI [0.23, 0.37],  $p < .001$ ; sexual  $\beta = 0.17$ , 95% CI [0.11, 0.24],  $p < .001$ ; perceptual  $\beta = 0.11$ , 95% CI [0.04, 0.18],  $p < .01$ ; personal achievements  $\beta = 0.12$ , 95% CI [0.05, 0.18],  $p < .001$ ) were uniquely related to the overall single-item pleasure measure ( $R^2 = .33$ ,  $p < .001$ ). These results were highly similar to the results found in Study 1.

### **Sex Differences in Pleasure Level**

We report on differences between males and females on the DOPS measures (See Table 5) with the warning that measurement invariance across sexes was not established, which means it is not certain that sex differences can be meaningfully interpreted. In Sample 1, men and women reported similar scores across the domains, differences that were statistically significant had only small effect sizes. In Sample 2, men reported higher pleasure levels than women on all DOPS measures except on perceptual pleasure and the single item pleasure measure. The largest differences were found on the personal achievements scale ( $g = .77$ ) and the mean pleasure scale ( $g = .49$ ). In the retest, men reported significantly more pleasure than women on the personal achievements scale, the mean pleasure scale, and the single-item pleasure measure, with weak to moderate effect sizes ( $g = .42 - .58$ ).

### **Association with Related and Divergent Constructs**

Correlations of the DOPS measures with related and divergent constructs are presented in Table 4. The closest comparison between the DOPS subscales and other measures could be made between the DOPS and the DARS, and more specifically the social scales of both measures. The DOPS social subscale correlated strongly with the DARS social subscale, and only weakly to moderately with the other DARS subscales, thus showing support for convergent and divergent validity. Further supporting the convergent validity of the DOPS social scale was that, like in Study 1, it correlated strongly with the withdrawn scale, whereas the other DOPS subscales had only moderate correlations with the withdrawn scale.

The validity of the DOPS sexual pleasure scale was supported by the strong correlation with the CSFQ, whereas the correlation was small for the other DOPS subscales. More indirect support for the convergent validity of the DOPS sexual pleasure scale was

provided by its moderate correlations with the DARS sensory subscale -the vast majority of participants indicated sex or being intimate as one of their favorite sensory experiences.

The convergent validity of the DOPS perceptual scale was supported by its moderate correlation with the TEPS consummatory scale, which consists of mostly perceptual items. However, it has to be noted that as in Study 1, absolute correlations were again stronger with the TEPS anticipatory scale than the TEPS consummatory scale. The other domain-specific scales of the DOPS had only weak correlations with the TEPS consummatory scale. To explore possible causes of the pattern of the DOPS scales having higher correlations with the TEPS anticipatory than TEPS consummatory scale across studies, we conducted a set of post-hoc psychometric analyses on the TEPS scales. The reliabilities of the consummatory and anticipatory scales were rather low, and confirmatory factor analysis showed that the two scales had insufficient model fit with regard to the CFI in Study 1 ( $\chi^2(134, N = 2854) = 1778.98, p < .001, CFI = .752, RMSEA = .066, SRMR = .054$ ) and Study 2 ( $\chi^2(134, N = 1178) = 841.66, p < .001, CFI = .750, RMSEA = .067, SRMR = .057$ ). The low CFIs, with at the same time acceptable RMSEA and SRMR, are probably partly caused due to the low mean inter-item correlations ( $< .20$ ). Further inspection of the factor loadings showed that the anticipatory scale had 4 items loading below .30 and the consummatory scale 1 item loading below .30. This misfit may explain why the associations with the TEPS were not as expected, although we are not sure how this resulted in stronger correlations with the seemingly most problematic anticipatory scale of the TEPS.

The SHAPS mostly consists of social and perceptual related items, and indeed, the DOPS social and perceptual measures had the highest and strong correlations with SHAPS. The BAS reward responsiveness and the BAS drive scales had the strongest correlation with the DOPS personal achievement scale, and were of moderate strength.

Comparing the DOPS with measures that do not predominantly consist of items relating to one or more of the DOPS domains resulted in less diverse correlation patterns. The DOPS domain-specific subscales were only moderately related to the PHQ-9 and ASR. Anxious/depressed measures, and correlated more strongly with PA than with NA, suggesting that the DOPS is closer related to positive affect than negative affect. Pleasure or a lack of pleasure was only weakly associated with behavioral inhibition, indicating divergent validity.

As indicated by Study 1, the single item pleasure measure seems to relate to an overall form of pleasure and well-being. This item correlated most strongly with the PHQ-9 and PA, and also had a strong negative correlation with NA. The single-item pleasure measure had the strongest correlation with the social scales of the DOPS and DARS, indicating that social experiences have especially strong impact on overall pleasure experiences.

Correlational patterns between the DOPS and the DARS and SHAPS at retest are presented in the Supplemental Materials (Table S7). The correlational pattern is similar to as above described, but with overall somewhat stronger correlations. The correlational patterns of the DOPS measures with the other questionnaires are presented separately for Sample 1 and Sample 2 in the supplemental Table S8.

## **Discussion**

Driven by the notion that the experience of pleasure and a lack thereof is multifaceted (N. Ho & Sommers, 2013; Treadway & Zald, 2011), the DOPS was developed to provide researchers and clinicians with a questionnaire that can measure pleasure in different domains. There is a need for such a questionnaire since existing questionnaires do not differentiate between domains of pleasure, contain cultural- or age-specific items, or mix consummatory, anticipatory and motivational aspects of pleasure. Special care was taken to develop a questionnaire that included items that are likely pleasurable to the majority of people and not



to any cultural or age group in specific, or provide the option to leave out questions that may be age inappropriate (e.g., about sexual activities).

Across studies, the DOPS showed to be able to reliably measure pleasure in the domains of social pleasure, sexual pleasure, perceptual pleasure, and pleasure in personal achievements, with good test-retest reliability. In line with a multifaceted view of pleasure experiences, we repeatedly found that one factor solutions showed a poor fit to the data, thus pleasure may be best investigated domain specific rather than aggregated over all items.

Across the two studies, we compared the DOPS measures with related pleasure and anhedonia measures. Support for convergent and divergent validity was found for all four subscales of the DOPS. One may argue that for some of the comparisons of the DOPS with other measures, there was little variation in associations across the different DOPS subscales, thus questioning the divergent validity. However, similar correlations were mainly found when the DOPS subscales were compared with broader constructs (like PA and NA). In those cases overlap with all subscales is exactly what would be expected. When comparing the subscales of the DOPS with domain specific scales, differences in correlational patterns were apparent. The sexual pleasure scale had a strong correlation with the CSFQ, while the other three DOPS scales had only weak correlations, and the ASR withdrawn scale had a strong correlation with the social pleasure subscale, and only weak to moderate correlations with the other scales. Comparing the DOPS with other anhedonia and pleasure measures also typically resulted in at least moderate correlations with all or most DOPS subscales, but this is again what would be expected when a general factor is assumed to explain at least part of the variance. Supporting the validity of the DOPS, is that the DOPS scales most similar to the measure of comparison, indeed had the strongest correlation. For example, although the SHAPS is a general anhedonia measure, most items are social or perceptually orientated and no items related to sexual activities are included. As expected, the DOPS social and

perceptual subscales had the highest correlation with the SHAPS, while the sexual subscale had the lowest correlation. The DOPS social scale had the highest correlation with the DARS social scale. A large part of our participants indicated sex as one their pleasurable sensory experiences on the DARS sensory subscale, which is reflected in fact that the DOPS perceptual and DOPS sexual subscales had the highest correlations with the DARS sensory scale.

Across the studies, the DOPS correlated moderately to strongly with depressive symptoms, as might be expected considering that loss of pleasure is a core symptom of depression according to the DSM-5 (American Psychiatric Association, 2013). The correlational patterns of the DOPS scales with depressive symptoms are similar to what has been found with the other multi-domain pleasure questionnaire, the DARS (Rizvi et al., 2015), but stronger than the correlational patterns found in pleasure and anhedonia questionnaires that consider fewer domains of pleasure, such as the TEPS and SHAPS (Franken et al., 2007; Gard et al., 2006; Snaith et al., 1995). Although low or insignificant correlations between pleasure/anhedonia measures and depression measures have been previously explained as evidence for the independence of anhedonia as a construct, our results, together with those earlier found with the DARS, suggest that other questionnaires may lack the specificity to show the association. To be clear, we do believe that anhedonia or loss of pleasure can occur independently of other depressive symptoms, but considering that loss of pleasure is one of the core symptoms of depression and is reported by around 70% of people experiencing a depression (Lewinsohn et al., 2003), we also expect at least moderate correlations with depressive symptoms.

After controlling for each other, the domains showed differential associations with positive affect and depressive symptoms. Consistent with research showing that social contact is an important factor contributing to human well-being (e.g. Baumeister & Leary, 1995),

pleasure derived from social contact appeared to be a major determinant of an individuals' overall pleasure experience, positive affect and depressive symptoms. Controlling for the other pleasure domains, perceptual pleasure had the weakest association with positive affect and depressive symptoms. Surprisingly, the weak association between perceptual pleasure and depressive symptoms was positive instead of negative. Tentatively, the part of perceptual pleasure that is not shared with the other domains may be sensitivity to environmental influences, which has been proposed to be a risk factor in negative contextual conditions (Belsky & Pluess, 2009). However, regardless of the direction of the association, the effect was weak, suggesting that perceptual pleasure may not play an important unique role in positive affect and depression. This finding is in line with several studies reporting on the relation between loss of pleasure and depression which used perceptual or sensory measures like the sweet taste test and the TEPS to assess anhedonia (Arrondo et al., 2015; Dichter, Smoski, Kampov-Polevoy, Gallop, & Garbutt, 2010; Gard et al., 2006; Treadway & Zald, 2011).

In addition to the pleasure subscales, the DOPS contains an item to measure overall pleasure experience, which may encompass more than what is covered by the scores on the DOPS pleasure subscales. Compared to the rest of the DOPS scales, the single-item measure had the highest correlation with both PA and depressive symptoms. A plausible explanation is that individuals differ in how important pleasure derived from specific situations or domains is for their overall pleasure experience. Whereas this interindividual heterogeneity attenuates correlations of the subscales with PA and depressive symptoms, the single-item may mainly reflect the amount of pleasure derived from the pleasure areas that each individual considers most important, resulting in higher correlations with PA and depressive symptoms. Related to this, the single-item explained substantially more of the variance of PA and depressive symptoms than the domain-specific subscales. These correlational patterns speak for the

validity of measuring pleasure with just one item. A disadvantage of single-item measures is that random measurement error is not filtered out across items. The high correlations with other multi-item measures suggest that random measurement error was limited. Speaking against this interpretation is the lower test-retest correlation compared to the other DOPS subscales. Although measurement error will probably have played a role, overall pleasure levels may be less stable than domain specific pleasure as well because it may be more influenced by mood than the domain specific measures which are probably influenced by more concrete domain related experiences. Altogether, the single-item measure seems to be a valid and effortless measure of overall pleasure if one is not interested in domain-specificity. The domain-specific measures provide highly valuable additional information that enables researchers and clinicians to refine phenotypes of pleasure and loss of pleasure, which opens the door to novel research questions and more focused interventions. In sum, the results show that the DOPS is capable of measuring pleasure in different domains adequately, and that the overall single-item pleasure rating provides relevant complementary information with regard to overall pleasure.

### **Sex and Educational Differences**

Unlike previous anhedonia and pleasure questionnaires, we tested the DOPS for measurement invariance across sexes and educational level. This is important because in order for group differences to be reliably assessed, measures should be measurement invariant across groups. Educational level may be related to how items are interpreted and answered. Therefore for the DOPS to be applicable for a broad population, measurement invariance across educational levels is necessary. In addition, studies investigating depression or anhedonia often investigate whether effects differ across sexes, making it important to test whether the DOPS is invariant across sexes. Tests for measurement invariance of Study 1 showed that scores on the DOPS subscales can be meaningfully compared across sexes and

educational levels. We were not able to establish full scalar invariance when applying stringent criteria, but partial scalar invariance does not preclude meaningful comparisons across groups as long as more than two items are invariant (Byrne, Shavelson, & Muthén, 1989; Steenkamp & Baumgartner, 1998) in a measurement model, and we expect bias to be small when composite scores are used. Study 2 did not have enough diversity in educational levels to investigate measurement invariance across educational level. In Study 2 the measurement invariance across sexes could also not be tested because the model fit of the configural model for men was insufficient. This may be due to a too small sample of male participants because there were no clear indications of model misspecification. However, we cannot be certain that this is indeed the cause so more research is needed to further investigate the issue of measurement invariance across sexes.

Scores on the DOPS scales were highly similar across educational levels, with only small differences on social and perceptual pleasure, indicating that overall, the experience of pleasure is approximately equal for young adults with different educational levels. Across studies, men and women also had comparable scores on the DOPS measures, especially in the more heterogeneous Study 1 and the first sample of Study 2. Although there were significant differences, effect sizes were small. This is in line with other anhedonia studies in which either no sex differences (Franken et al., 2007; Rizvi et al., 2015), or small sex differences were found with women reporting somewhat higher pleasure levels (Gard et al., 2006; Gooding & Pflum, 2014). An exception in our studies, and contradicting the common pattern, are the differences between men and women of the second sample of Study 2. On all scales, men reported more pleasure than women, with a significant medium to strong effect size on the mean pleasure scale, personal achievement scale and overall pleasure scale. Given the rather specific sample of first-year psychology students it is unclear how representative these specific differences are.

## Recommended Use

In line with the acclaims of others (N. Ho & Sommers, 2013; Treadway & Zald, 2011), we highly recommend to assess pleasure for each domain separately instead of using aggregated scores, because aggregating scores may obscure relevant effects. Nevertheless, if a total consummatory pleasure score is desired, we recommend averaging the means of the four subscales to give the same weight to every subscale. The single-item measure of consummatory pleasure can be used as a rather general indication of high positive (and low negative) affect. Although the items relating to sexual experiences have an opt-out option<sup>3</sup>, in certain populations (e.g. children) it may be desirable to omit these items altogether. To facilitate the dissemination of further DOPS validation studies, for example in clinical samples, the DOPS with available translations and its additional DOPS features (i.e., items to assess change in pleasure, the duration of loss of pleasure and possible causes of loss of pleasure) are published online (<https://osf.io/gcn3d/>).

## Limitations

The findings presented in this article should be considered in the light of a number of limitations. First, we aimed to develop a questionnaire suitable for all ages and conditions, but several sample characteristics limit the generalizability of our findings at this stage. Our studies consisted mostly of females, around 80 percent in both studies. In addition, participants with higher educational levels were highly overrepresented in both studies. Fortunately, the absolute numbers of males and participants with lower educational levels in Study 1 were sufficient to enable examination of measurement invariance and group differences among sex and educational levels. Although we put much effort in selecting items relevant for all ages we were not able to test whether the items are indeed invariant across age due to the restricted age range of our sample. In addition, we were not able to test for

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<sup>3</sup> In our study this option was “I have no experience of this” but this can be altered so that unwillingness to answer the question is also included.

invariance across different ethnic groups or cultural backgrounds, so it remains to be investigated whether the structure of the DOPS holds across different cultural groups. Moreover, as mentioned earlier, we were not able to establish measurement invariance across sexes in Study 2, possibly due to a too low number of men. We like to stress that the issue of measurement invariance has hardly been investigated for other existing pleasure and anhedonia measures, and in those cases where it was investigated, typically only at the configural level (i.e. whether items load on the same factor across groups), leaving it still unclear whether groups can be meaningfully compared for these scales as well.

Second, the DOPS only measures consummatory pleasure, thus omitting motivational and anticipatory aspects of pleasure. This is an important shortcoming given that research suggests that motivational and anticipatory deficits may have other psychopathological implications than a lack of consummatory pleasure, and may even be the core problem in depression and schizophrenia (e.g. Cohen et al., 2011; Treadway & Zald, 2011). The DOPS was initially designed to incorporate items relating to motivational and anticipatory pleasure. Motivational and anticipatory items were included in the pilot phase and subsequently modified for Study 1 and again for Study 2. In all cases, validity issues made it necessary to exclude those items from the questionnaire. The largest problem was that it proved hard to differentiate between motivation and anticipation and that, although to a lesser extent, responses did not differ enough from the consummatory responses either. Moreover, associations with other questionnaires showed hardly any differentiation across consummatory, motivational and anticipatory pleasure. Multiple unsuccessful attempts to validly measure motivational and anticipatory pleasure illustrate how difficult it is to do so. Not only we, but also authors of the DARS, ACIPS and LAPS tried to differentiate between motivational and or anticipatory pleasure and consummatory pleasure, but encountered similar problems. The authors of the DARS, ACIPS and LAPS decided to keep

consummatory, anticipatory and motivational items in their questionnaires, therefore measuring a broader aspect of pleasure, but at the cost of lower specificity and more heterogeneity. We aimed for specificity and therefore only included the consummatory items. For reasons of transparency, we published information about the anticipatory and motivational items and the results of analyses so far on the DOPS research platform and Open Science Framework, together with ongoing work on the further development of the motivational and anticipatory measures. We hope that this can help to accumulate knowledge and so lead to modifications of the DOPS that enable valid measurement of motivational and anticipatory pleasure as well. Anticipatory and motivational aspects of pleasure may turn out to be best investigated using computational tasks, in which promising progress is made (Cooper, Arulpragasam, & Treadway, 2018).

Third, comparisons of the DOPS measures with the TEPS were difficult to interpret because of unexpected correlational patterns in combination with questionable psychometric properties of the TEPS in our studies. Other studies have also reported issues with regard to the replicability of the factor structure, the functioning of specific items in other cultures than in which the TEPS was developed, and its ability to distinguish between consummatory and anticipatory pleasure (e.g., Chan et al., 2012; Garfield, Cotton, & Lubman, 2016; P. M. Ho, Cooper, Hall, & Smillie, 2015).

### **Conclusions**

The DOPS provides researchers and clinicians with the much needed possibility to reliably measure consummatory pleasure in the domains of social pleasure, sexual pleasure, perceptual pleasure and pleasure from achievements, and to differentiate between those domains. The DOPS has the potential to be an important instrument to increase our knowledge of pleasure. That said, challenges remain in the assessment of the dimensions



motivational and anticipatory pleasure. We hope that others will join our efforts to develop these measures and share their experiences with the DOPS.

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**Contributions**

Contributed to conception and design: MM, EVR, VEH, CV, AJO

Contributed to acquisition of data: MM, EVR, VEH, CV, AJO

Contributed to analysis and interpretation of data: MM, EVR, AJO

Drafted and/or revised the article: MM, EVR, AJO

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None of the authors have competing interests.

**Data accessibility statement**

All data of the project are available via the Open Science Framework: <https://osf.io/gcn3d/>

Table 1. *The Domains, Level and Change Of Pleasure or Anhedonia Measured by Existing Questionnaires*

	RPAS	RSAS	FCPS	SHAPS	TEPS	ACIPS	DARS	MAP-SR	SLIPS	LAPS
Domains										
Social		☐	☐	☐		☐	☐		☐	☐
Physical / Perceptual	☐		☐	☐	☐		☐	☐	☐	☐
Other			☐	☐			☐	☐	☐	
Differentiates domains							☐			
Level of pleasure/anhedonia measured	☐	☐	☐	☐	☐	☐	☐	☐		☐
Change in pleasure measured									☐	

Note. RPAS = Revised Physical Anhedonia Scale; RSAS = Revised Social Anhedonia Scale; FCPS = Fawcett-Clark Pleasure Scale; TEPS = Temporal Experiences of Pleasure Scale; ACIPS = Anticipatory and Consummatory Interpersonal Pleasure Scale; DARS = Dimensional Anhedonia Rating Scale; MAP-SR = Motivation And Pleasure Scale–Self-Report; SLIPS = Specific Loss of Interest and Pleasure Scale; LAPS = Leuven Affect and Pleasure Scale

Table 2. *Factor Loadings for Exploratory Factor Analysis on the Pleasure Level Items and the Reliability and Correlations of the Factors*

No.	Item	Factor			
		Social	Sexual	Perceptual	Personal achievements
11	I enjoy having close friendships	<b>.80</b>	-.01	.02	-.03
12	I enjoy being with family or good friends	<b>.78</b>	-.02	.04	-.05
19	I enjoy doing things with other people	<b>-.62</b>	.07	-.04	.14
2	I enjoy swapping stories and experiences with other people	<b>.56</b>	.05	.03	-.07
13	I enjoy meeting new people	<b>.45</b>	.00	.03	.24
5	I enjoy sex (alone or with someone else)	-.05	<b>.87</b>	-.01	.01
20	I enjoy feeling sexually aroused	.02	<b>.75</b>	-.01	.15
15	I enjoy sexual intimacy (for example kissing, touching each other, cuddling)	.05	<b>.68</b>	.13	-.05
9	I enjoy pleasant smells	-.03	-.03	<b>.67</b>	-.01
8	I enjoy a hot bath or a refreshing shower	-.03	.03	<b>.53</b>	.05
16	I enjoy seeing beautiful things	.01	-.02	<b>.50</b>	.27
4	I enjoy listening to music	.01	.07	<b>.44</b>	-.01
3	I enjoy those moments when I can really relax	.05	.08	<b>.40</b>	-.02
10	I enjoy a nice drink (for example coffee, tea, coke, beer)	.15	.02	<b>.37</b>	.06
1	I enjoy a good meal	.05	.24	<b>.36</b>	-.01
14	I enjoy the small things in life	.26	.00	<b>.37</b>	.15
18	I enjoy getting better at something	-.02	-.02	.04	<b>.74</b>
21	I enjoy learning new things	.07	-.02	.01	<b>.66</b>
17	I enjoy spending time on my hobbies	.07	.09	.16	<b>.39</b>
6	I enjoy winning in games or in sports	-.07	.15	.02	<b>.39</b>
7	I enjoy physical activity (anything from light exercise to intensive sports)	.10	.09	-.04	<b>.33</b>
<i>Factor correlations</i>					
	Social	-			
	Sexual	.50	-		
	Perceptual	.58	.47	-	
	Personal achievements	.54	.39	.53	-

Table 3. *Model Fit For the Domain Measures for Sex and Educational Level Separately and Measurement Invariance Across Sex and Educational Level*

Comparison	Model (N)	Item freed	$\chi^2$	df	CFI	$\Delta$ CFI	RMSEA	$\Delta$ RSMEA	SRMR	$\Delta$ SRMR	Status
Sex	Males (650) <sup>a</sup>		363.57	181	0.937		0.039		0.041		
	Females (2287) <sup>a</sup>		961.65	181	0.933		0.043		0.036		
	IVE (332) <sup>a</sup>		339.47	181	0.920		0.051		0.050		
	HVE (872) <sup>a</sup>		445.22	181	0.937		0.041		0.037		
	U (1584) <sup>a</sup>		703.70	181	0.929		0.043		0.039		
	Configural invariance		1349.37	362	0.934		0.040		0.037		accept
	Metric invariance		1369.00	379	0.934	0	0.040	-0.001	0.039	0.002	accept
	Scalar invariance		1683.19	396	0.914	-0.02	0.047	0.005	0.044	0.005	reject
	Partial scalar invariance	5,9,14	1509.09	393	0.925	-0.009	0.044	0.002	0.041	0.002	accept
	Configural invariance		1507.92	543	0.930		0.044		0.040		accept
Education	Metric invariance		1546.79	577	0.929	-0.001	0.043	-0.001	0.044	0.004	accept
	Scalar invariance		1723.76	611	0.919	-0.01	0.044	0.001	0.047	0.003	reject
	Partial scalar invariance	IVE:7	1690.67	610	0.921	-0.008	0.044	0.001	0.047	0.003	accept

*Note.* df degrees of freedom; CFI comparative fit index; RMSEA root mean square error of approximation; SRMR standardized root mean squared residual.

$\Delta$  = difference compared to the last invariant model; IVE intermediate vocational education; HVE higher vocational education; U university.

<sup>a</sup> Errors of items allowed to correlate: 8-9 and 11-12

Table 4. *Correlations Between the DOPS Measures and Comparison Measures Study 1 and Study 2 and Reliabilities DOPS Measures*

	Study 1						Study 2					
	1	2	3	4	5	6	1	2	3	4	5	6
<b>DOPS measures</b>												
(1) Social	<b>.82</b>						<b>.81</b>					
(2) Sexual	.47	<b>.83</b>					.49	<b>.86</b>				
(3) Perceptual	.60	.48	<b>.78</b>				.60	.50	<b>.79</b>			
(4) Personal achievements	.53	.43	.53	<b>.70</b>			.57	.50	.55	<b>.72</b>		
(5) Mean pleasure	.82	.79	.80	.77	-		.81	.82	.80	.80	-	
(6) 1-item pleasure	.53	.39	.44	.41	.56	-	.53	.43	.45	.46	.58	-
<b>Other questionnaires</b>												
Positive affect <sup>a</sup>	.55	.43	.44	.49	.60	.71	.48	.35	.42	.49	.53	.63
TEPS-CONS	.32	.22	.42	.25	.38	.20	.28	.25	.41	.25	.36	.21
TEPS-ANT	.37	.25	.43	.25	.41	.27	.40	.29	.45	.30	.44	.31
PHQ-9	-.36	-.31	-.24	-.32	-.39	-.59	-.42	-.34	-.31	-.40	-.46	-.62
ASR Anxious depressed	-.33	-.29	-.22	-.27	-.36	-.54	-.35	-.32	-.28	-.35	-.40	-.53
ASR Withdrawn	-.50	-.33	-.26	-.28	-.45	-.50	-.51	-.32	-.29	-.34	-.46	-.48
Negative affect							-.31	-.28	-.21	-.29	-.35	-.50
BIS							-.12	-.15	-.08	-.20	-.17	-.26
BAS RR							.37	.27	.30	.48	.44	.30
BAS Drive							.26	.18	.24	.30	.30	.21
BAS Fun seeking							.28	.17	.20	.24	.28	.22
DARS Total							.46	.38	.51	.42	.55	.40
DARS Hobby/pastime							.33	.24	.41	.42	.43	.34
DARS Food and drinks							.22	.16	.33	.18	.27	.16
DARS Social							.56	.35	.37	.40	.52	.45
DARS Sensory							.28	.36	.39	.28	.41	.26
CSFQ							.20	.57	.24	.24	.40	.23

SHAPS	-.52	-.39	-.57	-.48	-.60	-.49
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Note. All correlations significant at  $p < .001$ . Bold values indicate Cronbach's alpha values.

<sup>a</sup> Positive affect measures was measured in Study 1 with an altered positive affect scale using a VAS-scale, while Study 2 used the original items and a 5-point Likert scale.

Table 5. Scores on the Pleasure level Measures for Males and Females Study 1 and Study 2

	Test							Retest						
	Male		Female		<i>t</i>	<i>df</i>	<i>g</i> [95% CI]	Male		Female		<i>t</i>	<i>df</i>	<i>g</i> [95% CI]
	<i>M</i> ( <i>SD</i> )	<i>n</i>	<i>M</i> ( <i>SD</i> )	<i>n</i>				<i>M</i> ( <i>SD</i> )	<i>n</i>	<i>M</i> ( <i>SD</i> )	<i>n</i>			
Study 1														
Social	70.58 (14.66)	650	73.22 (14.66)	2287	4.05** *	2935	-0.18 [-0.27, -0.09]							
Sexual	78.85 (16.45)	630	75.54 (17.65)	2156	4.20** *	2784	0.19 [0.10, 0.19]							
Perceptual	71.32 (12.07)	650	73.29 (11.98)	2287	3.71** *	2935	-0.16 [-0.25, -0.08]							
Personal achievements	73.65 (12.61)	650	70.69 (12.93)	2287	5.18** *	2935	0.23 [0.14, 0.32]							
Mean pleasure	73.47 (10.98)	650	73.07 (11.47)	2287	0.8	2935	0.04 [-0.05, 0.12]							
1-item pleasure	66.56 (22.41)	650	67.61 (20.90)	2287	1.08	999.20 <sub>a</sub>	-0.05 [-0.14, 0.04]							
Study 2														
Sample 1														
Social	68.68 (12.89)	164	71.47 (13.80)	798	2.39*	960	-0.20 [-0.37, -0.04]	68.73 (14.06)	59	68.61 (15.19)	90	0.05	147	0.01 [-0.32, 0.34]
Sexual	74.23 (16.51)	163	72.15 (18.67)	754	1.43	259.64 <sub>a</sub>	0.11 [-0.06, 0.28]	72.68 (15.13)	57	65.52 (23.31)	83	2.21*	137.63 <sub>a</sub>	0.35 [0.01, 0.69]
Perceptual	69.55 (11.76)	164	71.27 (11.74)	798	1.7	960	-0.15 [-0.31, 0.02]	70.75 (10.34)	59	70.76 (14.66)	90	0	146.17	0 [-0.33, 0.33]
Personal achievements	71.70 (12.61)	164	68.72 (12.82)	798	2.72**	960	0.23 [0.06, 0.40]	71.56 (12.26)	59	67.42 (14.55)	90	1.81	147	0.30 [-0.03, 0.63]
Mean pleasure	71.02 (10.60)	164	70.81 (11.57)	798	0.22	960	0.02 [-0.15, 0.19]	70.81 (10.61)	59	68.19 (14.66)	90	1.18	147	0.20 [-0.13, 0.53]
1-item pleasure	63.09 (23.54)	164	63.50 (22.13)	798	0.21	960	-0.02 [-0.19, 0.15]	65.32 (20.38)	59	61.30 (21.37)	90	1.14	147	0.19 [-0.14, 0.52]
Sample 2														
Social	74.53 (12.10)	65	70.37 (14.53)	160	2.04*	223	0.30 [0.01, 0.59]	73.02 (12.47)	53	69.08 (15.28)	141	1.68	192	0.27 [-0.05, 0.59]
Sexual	79.38 (16.20)	64	74.15 (17.56)	143	2.03*	205	0.30 [0.01, 0.60]	76.25 (17.00)	52	71.89 (17.76)	119	1.49	169	0.25 [-0.08, 0.57]
Perceptual	74.30 (11.83)	65	72.17 (13.32)	160	1.12	223	0.16 [-0.12, 0.45]	74.11 (9.73)	53	70.94 (13.51)	141	1.81	129.39 <sub>a</sub>	0.25 [-0.07, 0.57]



personal achievements	76.47 (13.67)	65	66.10 (13.41)	160	5.22** *	223	0.77 [0.41, 1.06]	74.30 (15.16)	$\frac{5}{3}$	65.73 (14.54)	$\frac{14}{1}$	3.62** *	192	0.58 [0.26, 0.90]
Mean pleasure	76.22 (10.75)	65	70.45 (11.98)	160	3.37**	223	0.49 [0.20, 0.79]	74.50 (11.20)	$\frac{5}{3}$	69.13 (13.14)	$\frac{14}{1}$	2.64**	192	0.42 [0.10, 0.74]
1-item pleasure	65.99 (20.69)	65	60.39 (25.44)	160	1.57	223	0.23 [-0.06, 0.52]	67.41 (18.14)	$\frac{5}{3}$	55.44 (25.64)	$\frac{14}{1}$	3.63** *	131.85 <sub>a</sub>	0.50 [0.18, 0.82]

*Note.* <sup>a</sup> adjusted degrees of freedom because homogeneity of variances could not be assumed. *g* = Hedges' *g*

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

Table 6. *Scores on the Pleasure Level Measures for the Three Educational Levels*

	IVE ( <i>n</i> = 332 <sup>a</sup> )	HVE ( <i>n</i> = 872 <sup>a</sup> )	U ( <i>n</i> = 1584 <sup>a</sup> )
	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )
Domains			
Social	<b>68.64 (16.37)<sup>1</sup></b>	73.20 (14.14)	73.32(14.44)
Sexual	77.62(18.12)	75.27 (18.08)	76.67 (16.48)
Perceptual	73.81 (13.42)	73.83 (11.70)	<b>72.21 (11.50)<sup>2</sup></b>
Personal achievements	70.07 (14.05)	71.17 (12.75)	71.81 (12.39)
Mean pleasure	72.29 (12.71)	73.25 (11.29)	73.39 (10.61)
1-item pleasure	67.86 (22.21)	67.12 (21.72)	67.74 (20.32)

IVE intermediate vocational education; HVE higher vocational education; U university

<sup>a</sup> For the sexual scale the number of cases were IVE = 309, HVE = 830, U = 1504

<sup>1</sup> Significantly different from both other groups

<sup>2</sup> Significantly different from the HVE group