NIH Public Access
Author Manuscript
Depress Anxiety. Author manuscript; available in PMC 2011 September 1.

Published in final edited form as:
Depress Anxiety. 2010 September ; 27(9): 859–863. doi:10.1002/da.20690.

Unipolar Depression Does Not Moderate Responses to the Sweet Taste Test

Gabriel S. Dichter[A,B,C,D,*], **Moria Smoski**[D], **Alexey B. Kampov-Polevoy**[A], **Robert Gallop**[E], and **James C. Garbutt**[A]

[A] Department of Psychiatry, University of North Carolina at Chapel Hill School of Medicine, CB# 7160, Chapel Hill, NC 27599-7160

[B] Carolina Institute for Developmental Disabilities, University of North Carolina at Chapel Hill School of Medicine, CB# 3366, 101 Manning Drive, Chapel Hill, NC 27599-7160

[C] Duke-UNC Brain Imaging and Analysis Center, Duke University Medical Center, Durham, NC, 27710

[D] Department of Psychiatry and Behavioral Sciences, Duke University Medical Center, Box 3026, Durham NC 27710

[E] Department of Mathematics, Applied Statistics Program, West Chester University, 25 University Avenue - Room 180, West Chester, PA, USA

Abstract

Background—The Sweet Taste Test (STT) measures hedonic responses to sweet tastes and has been linked to both alcoholism and to a family history of alcoholism. However, STT response profiles in unipolar major depressive disorder (MDD), a disorder characterized by anhedonia, have been minimally investigated.

Methods—Twelve adults with and 15 adults without MDD participated in two identical STT assessments separated by approximately 12 weeks. Between assessments, MDD outpatients received Behavioral Activation Therapy for Depression, a psychotherapy modality designed to increase engagement with rewarding stimuli and reduce avoidance behaviors. Primary dependent measures included sensitivity to sucrose, hedonic response to sucrose, and designation as a Sweet Liker or Sweet Disliker.

Results—75% of adults with MDD were treatment responders. There were no significant differences in STT response profiles between groups overall or at either timepoint. Furthermore, STT profiles of MDD participants did not differ after psychotherapy, relative to baseline.

Conclusions—Findings suggest that although anhedonia is a symptom of MDD, the disorder is not characterized by altered responses to sweet tastes. Implications and future directions are discussed.

Keywords

Unipolar Depression; Anhedonia; Sweet Taste Test; Treatment

[*]Address correspondence by: dichter@biac.duke.edu, or by mail to: Dr. Gabriel S. Dichter, Department of Psychiatry, University of North Carolina School of Medicine, CB# 3366, 101 Manning Drive, Chapel Hill, NC 27599-3366; phone: 919-681-3169; fax: 919-869-2990.

NIH-PA Author Manuscript
NIH-PA Author Manuscript
NIH-PA Author Manuscript

NIH-PA Author Manuscript

NIH-PA Author Manuscript

NIH-PA Author Manuscript

Introduction

Anhedonia, the diminished capacity to experience pleasurable events as such, is a defining feature of unipolar major depressive disorder (MDD) [1]. MDD is characterized by diminished pleasure in a number of contexts, including (a) attenuated subjective responses to pleasant images [2–5]; (b) aberrant psychophysiological responses to pleasurable images [6,7]; and (c) functional neural deficits in brain regions mediating reward processing [8–10]. However, there are relatively few studies that assess sensory responses to putatively pleasurable stimuli. Such studies are critical in order to understand the boundary conditions of pleasure deficits in MDD.

The scope of the word “anhedonia” implies a complete lack of pleasure, including sensory pleasures (e.g., touch, taste, smell). However, the total absence of pleasurable responses is a rare state [11]. Further, is not entirely clear whether individuals with MDD truly lack the capacity for sensory pleasures, or rather undervalue the cognitive impact of rewards while simultaneously preserving a capacity for sensory pleasure. In other words, despite the converging neuroimaging evidence that MDD is characterized by decreased activity in reward-related brain regions in response to pleasurable stimuli [12,13,9,14] and despite linkages between the neurobiological substrates of responses to sweet tastes [i.e., the nucleus accumbens; 15,16] and neurofunctional correlates of anhedonia in MDD [8,17], sensory responses to pleasurable stimuli have rarely been assessed in MDD. To partially address this unanswered question, in the present study, we examined responses to sweet tastes via the Sweet Taste test [STT; 18] in adult outpatients with MDD before and after psychotherapy and compared response profiles to those of nondepressed control participants also assessed at two points in time.

Hedonic response to sweet taste is a stable trait in nonclinical contexts [19–21] and is resistant to different metabolic manipulations, including food intake, dieting, and overnight fasting [22]. Cravings for sweet foods and elevated hedonic responses to sweet tastes have been reported amongst patients with a range of psychiatric disorders, including seasonal affective disorder and binge eating disorder [see 18 for a review]. In particular, the STT has emerged as an indicator of risk for alcohol use disorders: “Sweet-likers” (i.e., those who prefer the highest STT sucrose concentration) are more likely to have alcoholism and/or a paternal history of alcoholism than “Sweet-dislikers” [19,23].

There have been three published studies to date of responses to sweet tastes in MDD. Berlin and colleagues [24] reported higher sweet taste perception thresholds but equivalent hedonic responses to sucrose in adults with and without MDD. Kazes and colleagues [25] reported a preference for sweet foods in MDD that did not change with antidepressant treatment, but did not formally assess responses to varying concentrations of sweet solutions. Finally, Amsterdam and colleagues [26] reported similar intensity and pleasantness ratings to lower sweet concentrations in MDD relative to a control group, but found that individuals with MDD gave relatively lower intensity and higher pleasantness ratings to higher sucrose concentrations. No study to date has examined responses to sweet tastes in individuals with MDD using the STT, a measure that yields three types of information about response to sweet solutions: sensitivity to sucrose, hedonic response to sucrose, and sweet liking/sweet-disliking.

Hypotheses were informed by the findings of Berlin and colleagues [24] and the pattern of findings of Amsterdam and colleagues [26] to lower sweet concentrations: we hypothesized that MDD would be characterized by blunted hedonic responses to sweet tastes across the three STT metrics examined. Based on findings described above that sweet taste preference

NIH-PA Author Manuscript

NIH-PA Author Manuscript

NIH-PA Author Manuscript

is a stable trait [19] and that sweet preference is maintained following treatment for MDD [25], we hypothesized that that psychotherapy would not impact STT profiles in MDD.

Materials and Method

Participants

Sample characteristics have been reported elsewhere [10]. All participants received a Structured Clinical Interview for DSM-IV [SCID; 27]. The MDD group met DSM-IV criteria for a current episode of MDD, no other current Axis I disorder other than dysthymia, and scored 15 or above on the Hamilton Rating Scale for Depression [HAM-D, 28]. The control group scored 6 or lower on the HAM-D and did not meet criteria for a current Axis I disorder or a current/lifetime mood disorder. Exclusion criteria included: 1) bipolar or psychotic disorder, 2) comorbid Axis I diagnosis, 3) active suicidal ideation, 4) evidence of organicity, 5) verbal IQ below 70, 6) history of neurological injury or disease, and 7) use of psychoactive medications including antidepressants. Written informed consent was obtained and participants were paid $10 for each STT session.

Sixteen MDD and 15 control participants enrolled. Four MDD participants did not return for the Time 2 STT session, resulting in 12 depressed (6 females, average age 39.0 ± 10.4 years) and 15 control (9 females, average age 30.8 ± 9.6 years) participants with data at both timepoints. Groups did not differ in age, estimated verbal IQ [29] (MDD=112.8, Control=117.7), or gender distribution, χ^2 (1) = .99 p >0.32.

Brief Behavioral Activation Treatment for Depression (BATD)

The MDD group received an average of 11.4 (SD=2.0) weekly sessions of Brief Behavioral Activation Treatment for Depression (BATD). BATD is a validated psychotherapy method designed to increase engagement with rewarding behaviors and reduce avoidance behaviors [30,31].

Sweet Taste Test (STT)

The STT has been described previously [18]. Briefly, each of five concentrations of sucrose solution (0.05, 0.10, 0.21, 0.42, and 0.83 M) was presented five times in random order, for a total of 25 samples per session (Coca-Cola Classic is a 0.33 M sugar solution). Participants were instructed to sip the solution, swish it around in their mouths, and spit it out. They then rated the solution, rinsed their mouth with distilled water, and proceeded to the next solution. Each participant was asked to rate *intensity* (“How sweet was the taste?”) and *pleasantness* (“How much do you like the taste?”) on 200-mm analog scales. Time 1 STT’s were administered on the same day as the SCID, and the two STT assessments were separated by 102.5 (SD=10.1) days for the nondepressed group and by 102.2 (SD=15.4) days for the MDD group.

Consistent with previous studies of STT profiles [18,19], three primary STT dependent measures were examined: (1) *Hedonic response* was the slope of pleasantness ratings: a natural logarithm transformation was applied to pleasantness scores, and then the slope of a linear regression line of pleasantness scores over the five concentrations was estimated. Higher slopes denote greater pleasantness ratings as sweet concentrations increased. (2) *Sensitivity to sucrose* was the slope of intensity ratings: a natural logarithm transformation was applied to sensitivity scores, and then the slope of a linear regression line of sensitivity scores over the five concentrations was estimated. Higher slopes denote greater intensity ratings as sweet concentrations increased. (3) *Sweet liking* (SL) was defined as preferring the highest concentration, 0.83 M, and *sweet disliking* (SDL) was defined as preferring one of

NIH-PA Author Manuscript

NIH-PA Author Manuscript

NIH-PA Author Manuscript

the lower concentrations (0.05, 0.10, 0.21 or 0.42 M). The designation as SL or SDL as been suggested as a putative probe of brain opioid function [32].

Statistical Analyses

To examine Group (MDD, Nondepressed) and Time (Time 1, Time 2) effects on *hedonic responses* and *sensitivity to sucrose*, slopes were analyzed by a mixed model via SAS Proc GLIMMIX [33] which accounts for the clustering attributable to these two repeated measures, followed by independent samples t-tests at both timepoints. To examine s*weet liking (SL)* status, chi-square tests were conducted, McNemar's test was used to assess the overall significance of the difference between two correlated proportions (i.e., early and late sucrose concentration tests) [35], whereas generalized linear mixed models [33] were used to assess if the difference in the correlated proportions was different between MDD and Nondepressed groups.

We also report Cohen's *d* effect sizes at each time point for pairwise contrast of the difference between diagnostic groups for continuous measures, where an effect size of 0.2 is small, 0.5 is medium, 0.8 is large, and 1.2 is very large [37]. For designation of SL status, effect size was measured using odds ratios, where 1.5 is a small effect, 2.5 is a medium effect, 4 is a large effect, and an 10 is a very large effect [36].

Results

Psychotherapy Outcomes

As reported in Dichter et al. (2009), within the MDD group HAM-D scores changed from 23.8 (SD=2.3) at Time 1 to 8.7 (SD=9.4) at Time 2 ($p<.003$). 75% of participants were responders (i.e., Time 2 HAM-D scores of ≤ 6), and 83% were partial responders (i.e., Time 2 HAM-D scores of ≤ 10). Analyses below include all MDD participants (n=12); results are nearly identical when including only psychotherapy responders (n=9).

Hedonic response

The mixed model Group X Time interaction test on hedonic responses was not significant, $F(1,25)=0.001$, $p=0.98$. Pleasantness slopes at Time 1 were 0.103 ± 0.592 and 0.133 ± 0.884 for the nondepressed and MDD groups, respectively, a nonsignificant difference, $t(25)=-0.11$, $p=0.92$, corresponding to a Cohen's *d*[37] effect size of d=0.04 (less than a small effect). Pleasantness liking slopes at Time 2 were 0.073 ± 0.673 and 0.106 ± 0.850 for the nondepressed and MDD groups, respectively, a nonsignificant difference, $t(25)=-0.11$, $p=0.91$, corresponding to a Cohen's *d*[37] effect size of d=0.05 (less than a small effect). Time 1 and 2 slopes were highly correlated, $r=0.90$ and 0.93 for nondepressed and MDD groups, respectively.

Sensitivity to sucrose

The mixed model Group X Time interaction test on sensitivity slopes was not significant, $F(1,25)=2.38$, $p=0.14$. Sensitivity slopes at Time 1 were −1.23 (SD= 0.31) and −1.40 (SD=0.35) for the nondepressed and MDD groups, respectively, a nonsignificant difference, $t(25)=1.31$, $p=0.20$, corresponding to a Cohen's *d*[37] effect size of d=0.51 (a medium effect). Sensitivity slopes at Time 2 were −1.40 (SD= 0.30) and −1.25 (SD=0.53) for the nondepressed and MDD groups, respectively, a nonsignificant difference, t[1](16)=−0.86, $p=0.40$, corresponding to a Cohen's *d*[37] effect size of d=0. 37 (a small-to-medium effect).

[1]Degrees of freedom determined through Satterthwaite approximation.

NIH-PA Author Manuscript

NIH-PA Author Manuscript

NIH-PA Author Manuscript

Sweet liking

The Time effect on the designation as SL or SDL was not significant, as assessed through McNemar's test, $\chi^2(1) = 0.33$, $p=0.56$, with 12.5% as SL at Time 1 (4/32) versus 6.3% (2/32) as SL at Time 2, corresponding to effect size odds ratios of 1.14 at Time 1 and 1.26 at Time 2, both corresponding to lower than small effect sizes. The Group X Time interaction on the designation as SL or SDL was not significant, as assessed through generalized linear mixed model test, $F(1, 25)=0.03$, p=0.86. At Time 1, 11.8% and 13.3% of nondepressed and MDD participants, respectively, were categorized as SL, a nonsignificant difference, $\chi^2(1)=0.02$, $p=0.89$. At Time 2, 6.7% and 8.3% of nondepressed and MDD participants, respectively, were categorized as SL, a nonsignificant difference, χ^2 (1)=0.03, $p=0.87$).

Discussion

The goal of the present study was to assess whether MDD, a disorder characterized by anhedonia, [1] is associated with altered responses to sweet tastes measured via three SST metrics: sensitivity to sucrose, hedonic response, and designation as sweet-liking or sweet-disliking. The STT is a validated assay of sweet reactivity that predicts alcohol abuse disorder, seasonal affective disorder, and binge eating disorder [see 18 for a review]. Contrary to predictions, groups did not differ on the three measures of STT responsivity. Further, despite robust response to psychotherapy, there was no evidence of differential STT change in the MDD group after psychotherapy, relative to repeated STT assessment in the control group. These results suggest that MDD may not impact responses to sweet tastes.

The present findings confirm and extend the finds of Berlin and colleagues [24] who reported equivalent hedonic responses to a range of sucrose solutions in MDD and stand in contrast to the portions of findings of Amsterdam and colleagues [26] who found evidence of blunted intensity ratings and higher pleasure ratings to higher concentrations of sweet solutions in MDD. The present data also indicate that adults with MDD have similar hedonic sensitivity slopes and similar sweet liking/disliking status profiles. Though the precise reasons for differences between the present findings and the results of Amsterdam and colleagues [26] is unclear, the present study is the first to report simultaneously of hedonic response to sucrose, sensitivity to sucrose, and sweet liking/disliking status profiles in individuals with MDD in a treatment context.

The STT has emerged as an indicator of risk for alcohol use disorders: "Sweet-likers" (i.e., those who prefer the highest STT sucrose concentration) are more likely to have alcoholism and/or a paternal history of alcoholism than "Sweet-dislikers" [19,23]. Amsterdam and colleagues [26] reported similar intensity and pleasantness ratings to lower sweet concentrations in MDD relative to a control group, but found that individuals with MDD gave relatively lower intensity and higher pleasantness ratings to higher sucrose concentrations. Kazes end colleagues [25] reported a preference for sweets in MDD that did not change with antidepressant treatment (despite increased appetite). Finally, Berlin and colleagues [24] reported equivalent hedonic responses to sucrose in adults with and without MDD. However, no study to date has examined hedonic sensitivity slopes nor the categorical characterization as a "sweet-liker" or "sweet-disliker" [18].

A number of studies have indicated that MDD is characterized by disruptions of brain activation patterns in orbitofrontal, insular, and other limbic regions in response to images and monetary incentives [12,13,9,14]. The present findings raise the possibility that MDD may impair cognitive evaluations of putatively pleasurable stimuli, yet leave intact more basic capacity for pleasure reactions. This pattern of findings raises the possibility that cognitive interventions may not need to focus on the sensory feeling of a pleasurable stimulus, but rather on the downstream cognitive mediation of response to such stimuli.

NIH-PA Author Manuscript

NIH-PA Author Manuscript

NIH-PA Author Manuscript

Response to sweet tastes are mediated by the nucleus accumbens [15,16], the same region that is hypoactive to rewards in MDD [8,17]. Additionally, orbital frontal networks both respond to gustatory information and regulate mood [38]. However, brain imaging studies of reward processing in MDD have assessed responses to monetary incentives or responses to pleasant pictures [13,12], and future neuroimaging studies that assess accumbens response to sweet tastes are needed. Nevertheless, the present findings suggest that anhedonia in MDD may not in fact extend to subjective responses to sweet tastes. This conceptualization is consistent with theories of anhedonia in MDD that suggest that this symptom domain may not reflect a global insensitivity to pleasure but rather reflect a tendency to undervalue rewards [39].

We note that caution is warranted in interpreting our findings that groups did not differ statistically on all STT measures, which in this context is essentially confirmation of the null hypotheses that groups would not differ. Formal validation of the null hypothesis would require a bioequivalence analysis, a method to determine whether groups are sufficiently near each other to be considered equivalent [40]. However, the sample sizes used here are far too small for such an approach, and thus we instead reported Cohen's *d* effect sizes [37] in the pairwise contrast of the difference between the two groups for the continuous measures and odds ratios for tests of designation as Sweet-dislikers. All effect sizes were small or less-than-small, with the exception of sensitivity to sucrose, which yielded small-to-medium effects, suggesting that the findings of non-significant differences should be validated in larger samples.

Despite the limitation of small sample sizes, the patterns of data reported here reveal that response profiles of both groups were highly similar. These preliminary findings suggest that STT response profiles do not predict MDD status. This is in contrast to the utility of the STT to predict alcoholism and genetic vulnerability to alcoholism [19,23]. These findings constrain the diagnostic utility of the STT in unipolar MDD, and suggest that anhedonia in MDD may not extend to sensory responses.

Acknowledgments

This research was supported by MH078145 to G. Dichter. M. Smoski was supported by NIMH T32-MH070448, a NARSAD Young Investigator award, and a career development award from Duke University Medical Center, NICHD K12 HD043446. G. Dichter was supported by Postdoctoral Research in Neurodevelopmental Disorders, NICHD T32-HD40127, NARSAD Young Investigator awards, a career development award from UNC-Chapel Hill, NIH/NCRR K12 RR023248, and NIMH K23 MH081285. We thank two anonymous reviewers for helpful comments on a previous version of this manuscript.

References

1. American Psychiatric Association. Diagnostic and statistical manual of mental disorders: DSM-IV. 4. Washington, DC: 1994.
2. Sloan DM, Strauss ME, Quirk SW, Sajatovic M. Subjective and expressive emotional responses in depression. Journal of Affective Disorders. 1997; 46:135–141. [PubMed: 9479617]
3. Sloan DM, Strauss ME, Wisner KL. Diminished response to pleasant stimuli by depressed women. Journal of Abnormal Psychology. 2001; 110(3):488–493. [PubMed: 11502092]
4. Allen NB, Trinder J, Brennan C. Affective startle modulation in clinical depression: Preliminary findings. Biological Psychiatry. 1999; 46(4):542–550. [PubMed: 10459405]
5. Rottenberg J, Gross JJ, Gotlib IH. Emotion context insensitivity in major depressive disorder. Journal of Abnormal Psychology. 2005; 114(4):627–639. [PubMed: 16351385]
6. Dichter GS, Tomarken AJ, Shelton RC, Sutton SK. Early- and Late-Onset Startle Modulation in Unipolar Depression. Psychophysiology. 2004; 41(3):433–440. [PubMed: 15102129]

NIH-PA Author Manuscript

NIH-PA Author Manuscript

NIH-PA Author Manuscript

7. Dichter GS, Tomarken AJ. The chronometry of affective startle modulation in unipolar depression. J Abnorm Psychol. 2008; 117(1):1–15. [PubMed: 18266482]
8. Forbes EE, Hariri AR, Martin SL, Silk JS, Moyles DL, Fisher PM, et al. Altered Striatal Activation Predicting Real-World Positive Affect in Adolescent Major Depressive Disorder. Am J Psychiatry. 2008
9. Knutson B, Bhanji JP, Cooney RE, Atlas LY, Gotlib IH. Neural responses to monetary incentives in major depression. Biol Psychiatry. 2008; 63(7):686–692. [PubMed: 17916330]
10. Dichter GS, Felder JN, Petty C, Bizzell J, Ernst M, Smoski MJ. The Effects of Psychotherapy on Neural Responses to Rewards in Major Depression. Biol Psychiatry. 2009
11. Lemke MR, Puhl P, Koethe N, Winkler T. Psychomotor retardation and anhedonia in depression. Acta Psychiatr Scand. 1999; 99(4):252–256. [PubMed: 10223426]
12. Keedwell PA, Andrew C, Williams SC, Brammer MJ, Phillips ML. The neural correlates of anhedonia in major depressive disorder. Biol Psychiatry. 2005; 58(11):843–853. [PubMed: 16043128]
13. Mitterschiffthaler MT, Kumari V, Malhi GS, Brown RG, Giampietro VP, Brammer MJ, et al. Neural response to pleasant stimuli in anhedonia: an fMRI study. Neuroreport. 2003; 14(2):177–182. [PubMed: 12598724]
14. Dichter GS, Felder JN, Petty C, Bizzell J, Ernst M, Smoski MJ. The effects of psychotherapy on neural responses to rewards in major depression. Biol Psychiatry. 2009; 66(9):886–897. [PubMed: 19726030]
15. Pecina S, Smith KS, Berridge KC. Hedonic hot spots in the brain. Neuroscientist. 2006; 12(6):500–511. [PubMed: 17079516]
16. Pecina S, Berridge KC. Hedonic hot spot in nucleus accumbens shell: where do mu-opioids cause increased hedonic impact of sweetness? J Neurosci. 2005; 25(50):11777–11786. [PubMed: 16354936]
17. Smoski MJ, Felder J, Bizzell J, Green SR, Ernst M, Lynch TR, et al. fMRI of alterations in reward selection, anticipation, and feedback in major depressive disorder. J Affect Disord. 2009
18. Kampov-Polevoy AB, Alterman A, Khalitov E, Garbutt JC. Sweet preference predicts mood altering effect of and impaired control over eating sweet foods. Eat Behav. 2006; 7(3):181–187. [PubMed: 16843219]
19. Kampov-Polevoy AB, Ziedonis D, Steinberg ML, Pinsky I, Krejci J, Eick C, et al. Association between sweet preference and paternal history of alcoholism in psychiatric and substance abuse patients. Alcohol Clin Exp Res. 2003; 27(12):1929–1936. [PubMed: 14691380]
20. Looy H, Weingarten HP. Effects of metabolic state on sweet taste reactivity in humans depend on underlying hedonic response. Chemical Senses. 1991; 16:123–130.
21. Thompson DA, Moskowitz HR, Campbell RG. Effects of body weight and food intake on pleasantness ratings for a sweet stimulus. J Appl Physiol. 1976; 41(1):77–83. [PubMed: 972136]
22. Drewnowski A, Greenwood MR. Cream and sugar: human preferences for high-fat foods. Physiol Behav. 1983; 30(4):629–633. [PubMed: 6878464]
23. Kampov-Polevoy AB, Eick C, Boland G, Khalitov E, Crews FT. Sweet liking, novelty seeking, and gender predict alcoholic status. Alcohol Clin Exp Res. 2004; 28(9):1291–1298. [PubMed: 15365298]
24. Berlin I, Givry-Steiner L, Lecrubier Y, Puech AJ. Measures of anhedonia and hedonic responses to sucrose in depressive and schizophrenic patients in comparison with healthy subjects. Eur Psychiatry. 1998; 13(6):303–309. [PubMed: 19698645]
25. Kazes M, Danion JM, Grange D, Pradignac A, Simon C, Burrus-Mehl F. Eating behaviour and depression before and after antidepressant treatment: a prospective, naturalistic study. Journal of Affective Disorders. 1994; 30:193–207. [PubMed: 8006246]
26. Amsterdam JD, Settle RG, Doty RL, Abelman E, Winokur A. Taste and smell perception in depression. Biol Psychiatry. 1987; 22(12):1481–1485. [PubMed: 3676376]
27. First, MB.; Spitzer, RL.; Gibbon, M.; Williams, JBW. Structured Clinical Interview for DSM-IV Axis I Disorders (SCID), Clinician Version; Administration Booklet. American Psychiatric Press; Washington, D.C: 1996.

NIH-PA Author Manuscript

NIH-PA Author Manuscript

NIH-PA Author Manuscript

28. Hamilton MA. A rating scale for depression. Journal of Neurology and Neurosurgery in Psychiatry. 1960; 23:56–62.
29. Blair JR, Spreen O. Predicting premorbid IQ: A revision of the national adult reading test. The Clinical Neuropsychologist. 1989; 3:129–136.
30. Hopko DR, Lejuez CW, Ruggiero KJ, Eifert GH. Contemporary behavioral activation treatments for depression: Procedures, principles, and progress. Clinical Psychology Review. 2003; 23:699–717. [PubMed: 12971906]
31. Jacobson NS, Dobson KS, Truax PA, Addis ME, Koerner K, Gollan JK, et al. A component analysis of cognitive-behavioral treatment for depression. J Consult Clin Psychol. 1996; 64(2): 295–304. [PubMed: 8871414]
32. Garbutt JC, Osborne M, Gallop R, Barkenbus J, Grace K, Cody M, et al. Sweet liking phenotype, alcohol craving and response to naltrexone treatment in alcohol dependence. Alcohol Alcohol. 2009; 44(3):293–300. [PubMed: 19189996]
33. Wolfinger RD, O'Connell N. Generalized linear mixed models: a pseudolikelihood approach. Journal of Statistical Computation and Simulation. 1993; 43:233–243.
34. Littell, RC.; Milliken, GA.; Stroup, WW.; Wolfinger, RD. SAS System for Mixed Models. Cary, NC: SAS Institute Inc; 1995.
35. Durkalski VL, Palesch YY, Lipsitz SR, Rust PF. Analysis of clustered matched-pair data. Stat Med. 2003; 22(15):2417–2428. [PubMed: 12872299]
36. Rosenthal JA. Qualitative descriptors of strength of association and effect size. J Soc Serv Res. 1996; 21:37–59.
37. Cohen, J. Statistical power analysis for the behavioral sciences. 2. Hillsdale, N.J: L. Erlbaum Associates; 1988.
38. Price JL. Prefrontal cortical networks related to visceral function and mood. Ann N Y Acad Sci. 1999; 877:383–396. [PubMed: 10415660]
39. Berridge KC, Kringelbach ML. Affective neuroscience of pleasure: reward in humans and animals. Psychopharmacology (Berl). 2008; 199(3):457–480. [PubMed: 18311558]
40. Schuirmann DJ. A comparison of the two one-sided tests procedure and the power approach for assessing the equivalence of average bioavailability. J Pharmacokinet Biopharm. 1987; 15(6):657–680. [PubMed: 3450848]